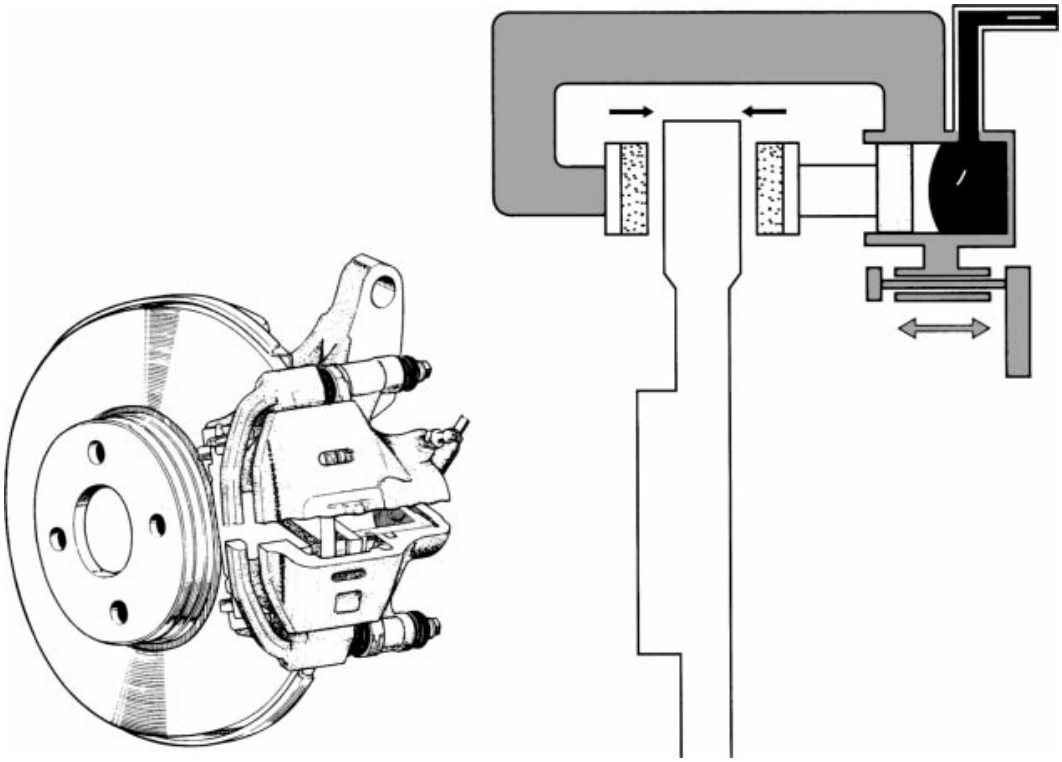
Section 4

DISC BRAKES



Lesson Objectives

1. Identify the components of the disc brake system.
2. List the advantages of a disc brake system over a drum brake system.
3. Describe the self-adjustment of the brake caliper piston.
4. Explain the function of anti-squeal shims and support plates for brake noise reduction.
5. List the advantages of multiple pistons on a fixed caliper design.

Components and Operation of Disc Brakes

A disc brake assembly consists of a:

- cast-iron disc (disc rotor) that rotates with the wheel.
- caliper assembly attached to the steering knuckle.
- friction materials (disc pads) that are mounted to the caliper assembly.

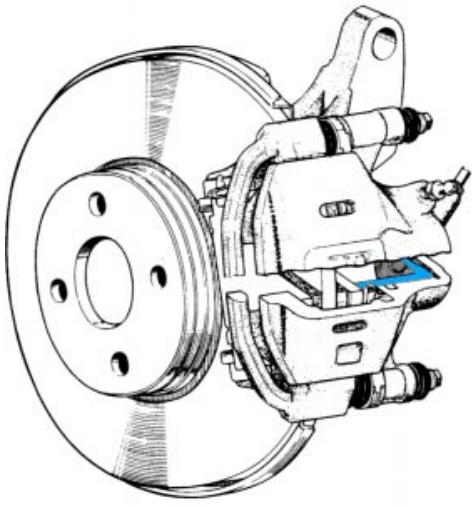
When hydraulic pressure is applied to the caliper piston, it forces the inside pad to contact the disc. As pressure increases the caliper moves to the right and causes the outside pad to contact the disc. Braking force is generated by friction between the disc pads as they are squeezed against the disc rotor. Since disc brakes do not use friction between the lining and rotor to increase braking power as drum brakes do, they are less likely to cause a pull.

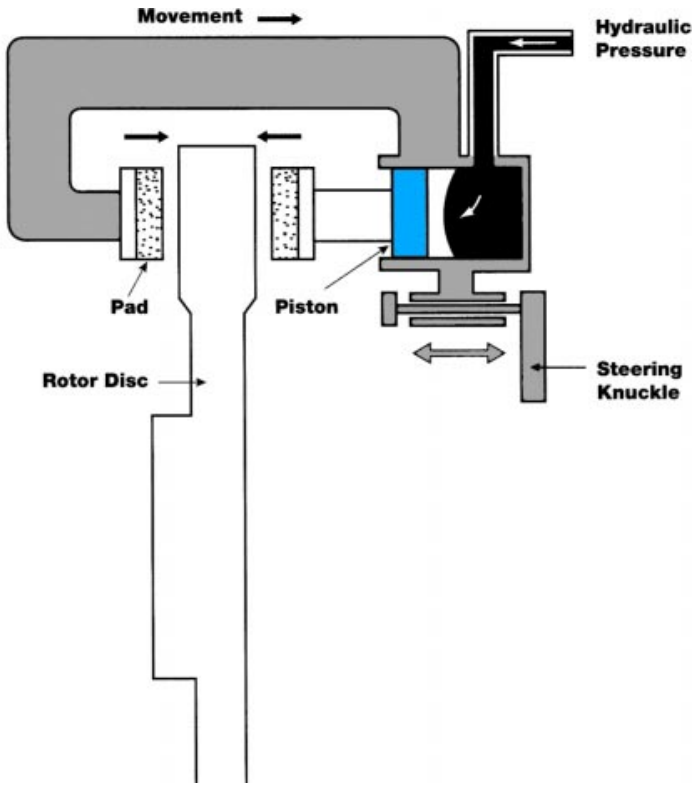
The friction surface is constantly exposed to the air, ensuring good heat dissipation, minimizing brake fade. It also allows for self-cleaning as dust and water are thrown off, reducing friction differences.

Unlike drum brakes, disc brakes have limited self-energizing action making it necessary to apply greater hydraulic pressure to obtain sufficient braking force. This is accomplished by increasing the size of the caliper piston. The simple design facilitates easy maintenance and pad replacement.

Disc Brake Assembly

Disc rotor, caliper and disc pads are the major components.





Disc Rotor

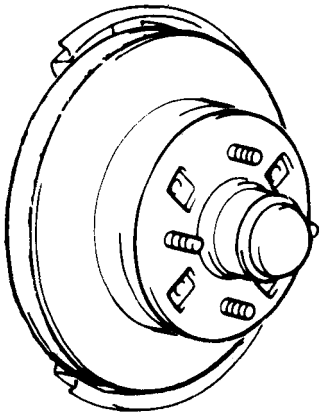
Generally, the disc rotor is made of gray cast iron, and is either solid or ventilated. The ventilated type disc rotor consists of a wider disc with cooling fins cast through the middle to ensure good cooling. Proper cooling prevents fading and ensures longer pad life. Some Ventilated rotors have spiral fins which creates more air flow and better cooling. Spiral finned rotors are directional and are mounted on a specific side of the vehicle. Ventilated rotors are used on the front of all late model Toyotas.

The solid type disc rotor is found on the rear of four wheel disc brake systems and on the front of earlier model vehicles.

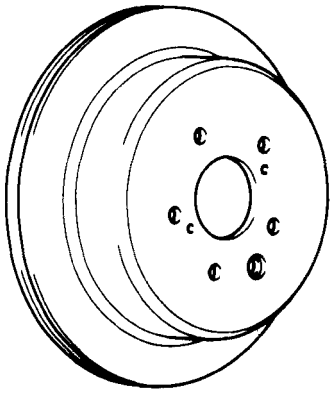
A third style rotor can be either the ventilated or solid type which incorporates a brake drum for an internal parking brake assembly.

Disc Rotor Types

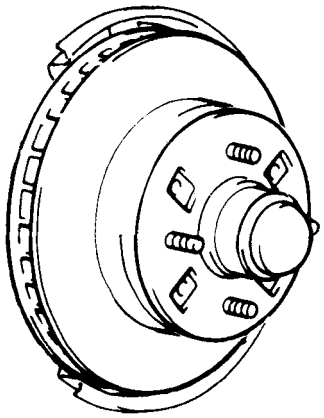
The type of rotor is determined by the vehicles intended use.



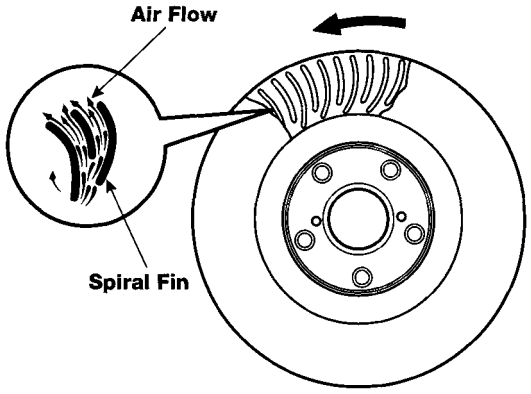
Solid Type



Solid Type With Drum



Ventilated Type



Caliper (Cylinder Body)

The caliper, also called the cylinder body, houses one to four pistons, and is mounted to the torque plate and steering knuckle or wheel carrier. It is found in floating caliper designs or fixed caliper designs on Toyotas.

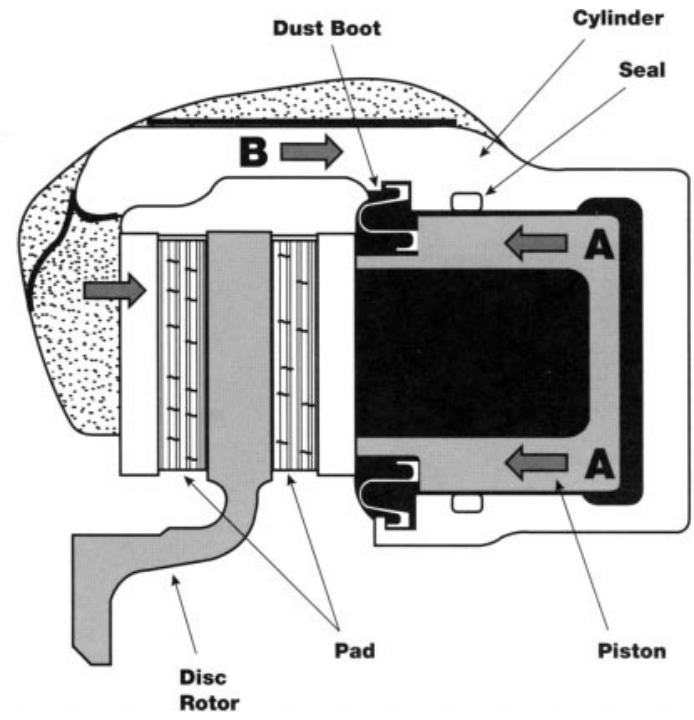
Floating Caliper Type

The floating caliper design is not only more economical and lighter weight but also requires fewer parts than it's fixed caliper counterpart. Depending on the application, the floating caliper has either one or two pistons.

The piston is located in one side of the caliper only. Hydraulic pressure from the master cylinder is applied to piston (A) and thus presses the inner pad against the disc rotor. At the same time, an equal hydraulic pressure (reaction force B) acts on the bottom of the cylinder. This causes the caliper to move to the right, and presses the outer pad located opposite the piston against the disc rotor.

Floating Caliper

The piston exerts pressure on the inside pad as well as moving the caliper body to engage the outside pad.



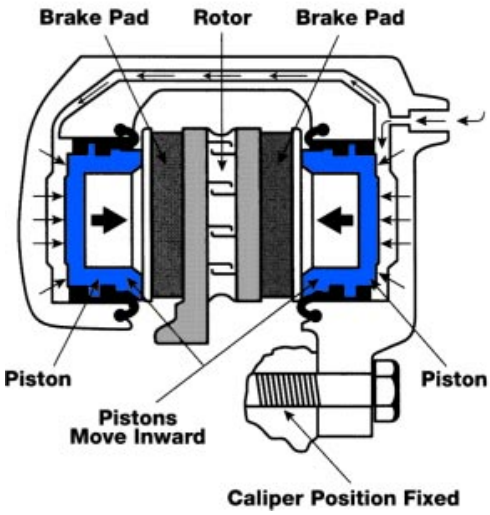
Fixed Caliper Type

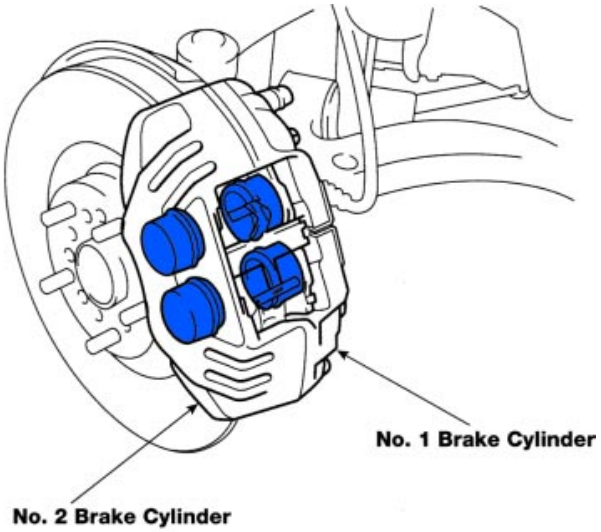
The fixed caliper design has pistons located on both sides of the caliper providing equal force to each pad. The caliper configuration can incorporate one or two pistons on each side. The ability to include multiple pistons provides for greater braking force and a compact design. Because these assemblies are larger and heavier than the floating caliper, they absorb and dissipate more heat. This design is able to withstand a greater number of repeated hard stops without brake fade.

This design is found on models which include larger engine displacement such as the V-6 Camry and Avalon as well as the Supra and four-wheel-drive Truck, T100 and Tacoma.

Fixed Caliper

The ability to include multiple pistons provides for greater braking force and a compact design.





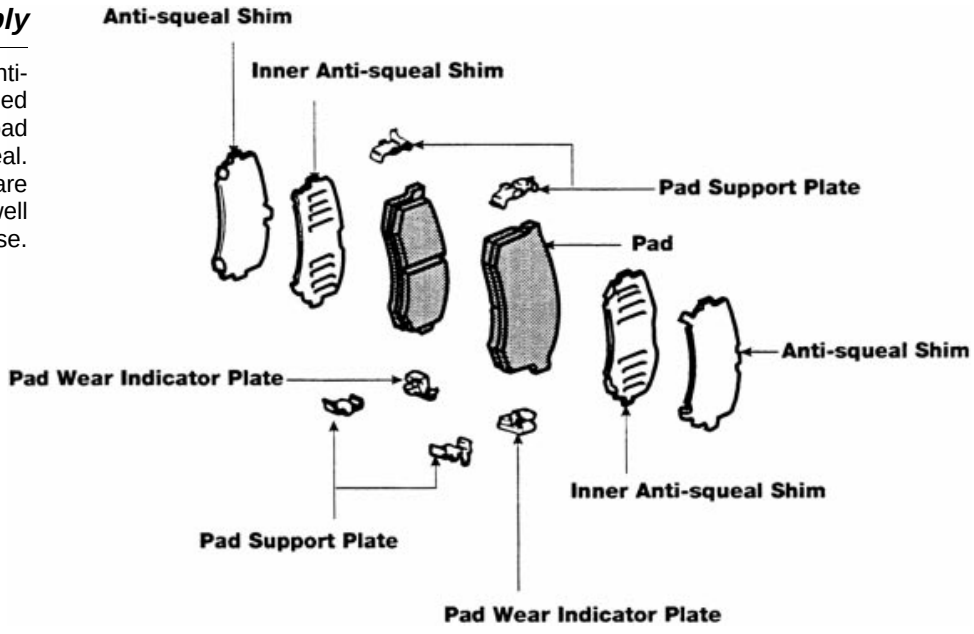
Brake Pad

Different brake design applications require different kinds of friction materials. Several considerations are weighed in development of brake pads; the coefficient of friction must remain constant over a wide range of temperatures, the brake pads must not wear out rapidly nor should they wear the disc rotors, should withstand the highest temperatures without fading and it should be able to do all this without any noise. Therefore, the material should maximize the good points and minimize the negative points.

Materials which make up the brake pad include friction modifiers, powdered metal, binders, fillers and curing agents. **Friction modifiers** such as graphite and cashew nut shells, alter the friction coefficient. **Powdered metals** such as lead, zinc, brass, aluminum and other metals increase a material's resistance to heat fade. **Binders** are the glues that hold the friction material together. Phenolic resin is the most common binder in current use. **Fillers** are added to friction materials in small quantities to accomplish specific purposes such as rubber chips to reduce brake noise.

Brake Pad Assembly

Multiple plates called anti-squeal shims, are provided on the piston side of the pad to minimize brake squeal. Various springs and clips are used to reduce rattle as well as reduce brake noise.



The brake pad material is bonded to a stamped steel backing plate with a high temperature adhesive to which heat and pressure are applied to cure the assembly. A slit is provided on the face of the pad to indicate the allowable limit of pad wear and provide a path for brake dust and gas to escape.

A metal plate, or in some applications multiple plates called anti-squeal shims, are provided on the piston side of the pad to minimize brake squeal. Various springs and clips are used to reduce rattle as well as reduce brake noise. Shims and plates should be inspected for wear and rust and can be re-used when replacing pads. Fresh approved grease should be applied to the shims prior to installation.

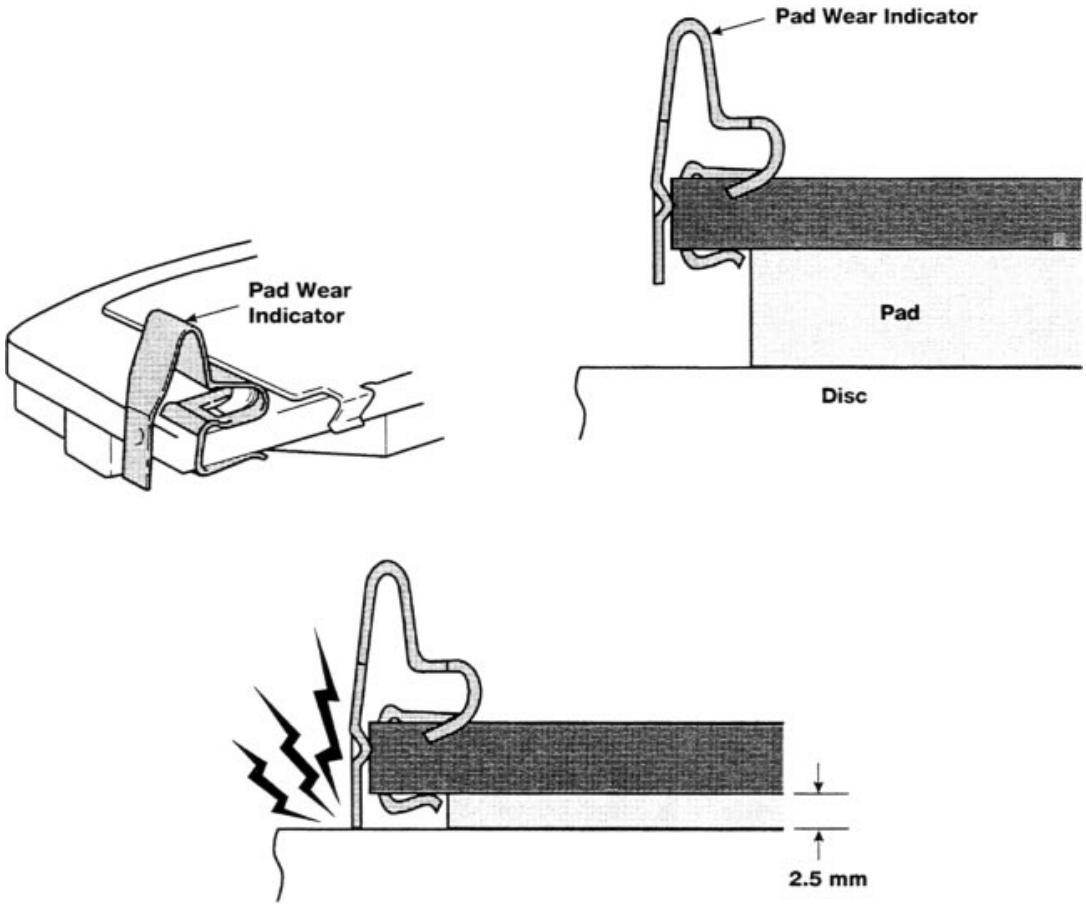
Pad Wear Indicator

A pad wear indicator has been adopted on some models that produces a high screeching noise when the pad is worn down to a predetermined thickness. The purpose of the indicator is to warn the driver and prevent damage to the rotor should the brake pad wear further. The indicator contacts the rotor while the wheel turns and the brakes are not applied. A customer may comment that the noise stops when the brakes are applied.

Be sure to install the wear indicators when new pads are installed.

Pad Wear Indicator

Produces a high screeching noise when the pad is worn down to a predetermined thickness.



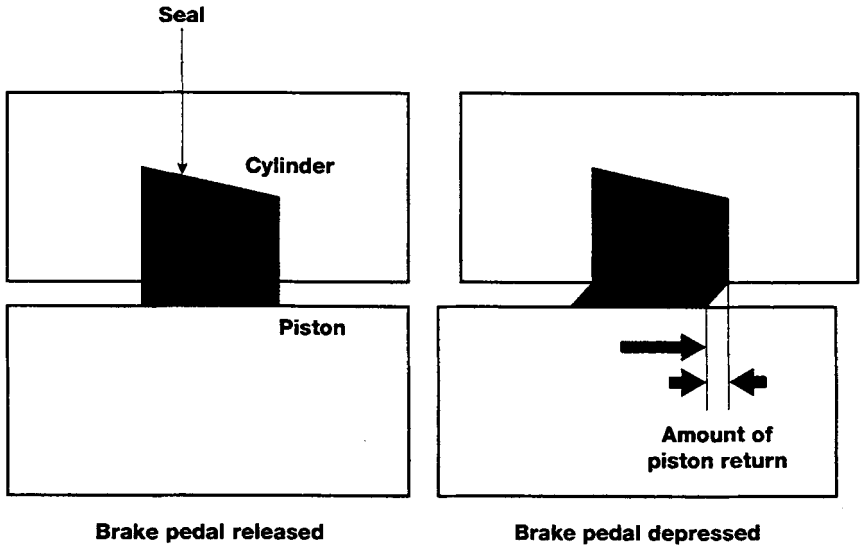
Automatic Adjustment of Rotor-to-Pad Clearance

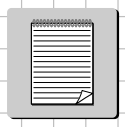
Disc brakes also have the advantage of being self adjusting. The pads are always right next to the spinning rotor. This adjustment is maintained in all models by a square cut piston seal which is seated in a machined groove in the cylinder bore. Any wear of the lining is automatically compensated for by the action of the brake caliper.

When the brakes are applied, the caliper piston moves out toward the rotor until the brake pad contacts it. The piston seal twists or deforms elastically as shown below. When the brake pedal is released and hydraulic pressure is reduced, the piston seal returns to its original shape, pulling the piston back. As the brake pads wear, the piston continually moves outward through the seal to maintain proper pad to rotor clearance.

Self Adjusting Mechanism of the Disc Caliper

Piston seal deforms as the piston moves outward. It returns to its original shape, pulling the piston back when the brakes are released.





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