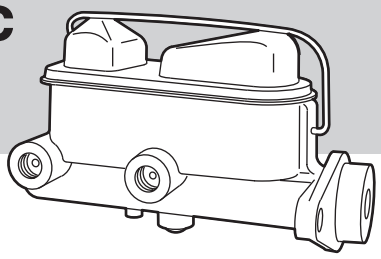
PEP Program No. 12
March, 2002

Dayton Parts™

www.daytonparts.com

Hydraulic Brake



PRODUCT EMPHASIS PROGRAM

The Hydraulic Brake System

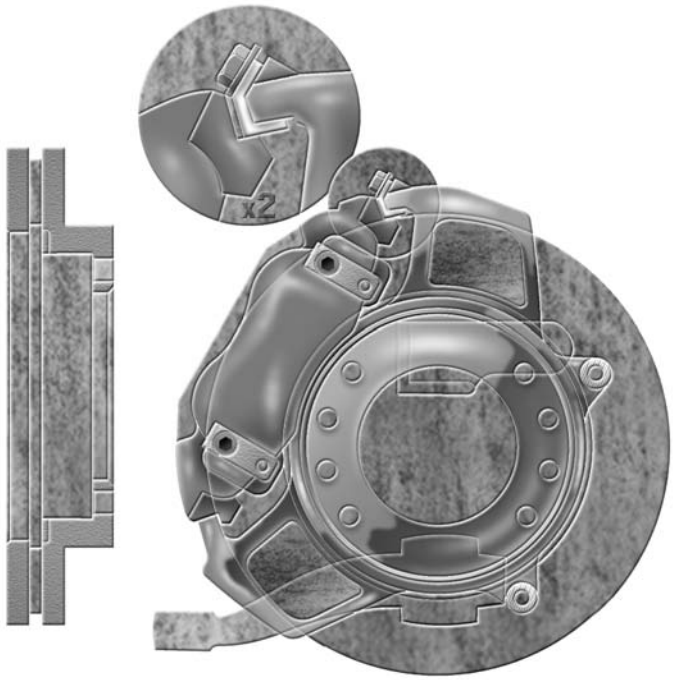
In the medium duty truck market, the preferred brake system is a four wheel hydraulic disc. Dayton Parts carries a complete line of components from the master cylinder (the beginning) to the rotor (the end). Some applications still use hydraulic drum brakes but since that is such a small percentage of today's market, we'll focus on the hydraulic disc.

The main function of a brake system is to slow the vehicle down to a safe and progressive stop. This is accomplished with a delivery agent, in this case hydraulic fluid, and a way to create work or pressure, the master cylinder. When the operator applies the brake pedal, the pressure created in the master cylinder is transferred through the brake hoses/steel lines to a component, in this case the caliper, that will apply this pressure to the wheel assembly.

The pressure from the master cylinder causes the piston(s) in the caliper to push out the inner pad of friction material and at the same time the caliper slides so as to center both the inner and outer pads on the rotor. The pads of friction material squeeze both sides of the rotor, which is machined with a slight waver in it, and causes the rotor to slow down rotation. The friction material accomplishes this by changing the kinetic energy of the rotating wheel assembly into heat and releasing it into the atmosphere.

The rotor is attached to the hub/wheel assembly on the end of the axle. The hub/wheel assembly has the tires mounted to it to transfer the slowing down of the assembly to the ground (pavement) and thereby slowing the vehicle itself.

Now that we have done a brief overview of how the hydraulic brake system works let's take a look at the individual components inside the system.



Typical Hydraulic Disc Brake & Rotor

The Master Cylinder

The master cylinder contains at least one reservoir, usually two, that holds the hydraulic fluid until it is needed to make a brake application. The fluid should be clear enough to see the bottom of the reservoir. Over time hydraulic fluid will absorb some moisture, this is what causes cloudiness, and heat from the caliper can cause the fluid to discolor. When the fluid gets in this condition, it can cause deposits to develop on components in the brake system and keep them from functioning properly. If the fluid is in this condition, the system should be flushed and replaced with fresh hydraulic fluid. Only use fluid approved by the original equipment manufacture and fill the master cylinder to the proper level. Be sure to "bleed" any air out of the hydraulic system.

The brake pedal the operator uses is attached to a push rod in the master cylinder. This push rod has a series of cups attached to the end of it that expand and seal against the bore of the master cylinder when a brake application is made. If the bore of the master cylinder is scored or the cup has a tear in it, the cup may not seal and will not create any pressure to stop the vehicle. When inspecting a master cylinder that might be suspected of needing replacement, look to see if there is any hydraulic fluid dripping down the firewall from underneath the master cylinder. This is a good indication that the cup is not sealing properly and that the master cylinder might need replaced.

The Brake Hoses and Steel Lines

Brake hoses should be in good repair and free from external cracks in the casing. Brake hoses can also swell internally and keep the pressure from a brake application from being released. This will cause the caliper to continue to apply pressure to the rotor through the disc pads and make the brakes "drag". This generates excessive heat in the brake system and can cause premature failure of components like the rotor, pads or caliper. Steel lines should be free of excessive external rust. If a steel line is disconnected at any time and the flare nut is "frozen" on the end of the steel line (the nut cannot swivel on the line) it should be replaced.

Calipers

The caliper takes the pressure from the master cylinder and applies it to the rotor through the disc pads. Most calipers have the ability to slide on their mounting bracket to center themselves and apply equal pressure on both sides of the rotor. If the caliper cannot slide then pressure is applied to only one side of the rotor. This will cause the inner pad to wear out prematurely and generate excessive heat. Sometimes enough heat is generated to the point the bonding agent cannot keep the friction material attached to the backing plate and they separate. Excessive heat can also form deposits on the pistons inside the caliper and cause them to stick thereby putting uneven pressure on the disc pads (when there is more than one piston). A stuck piston can also make the inner pad keep in contact with rotor and "drag" thereby creating more excessive heat. It is a good rule of thumb to always replace the caliper when ever installing a new set of disc pads.

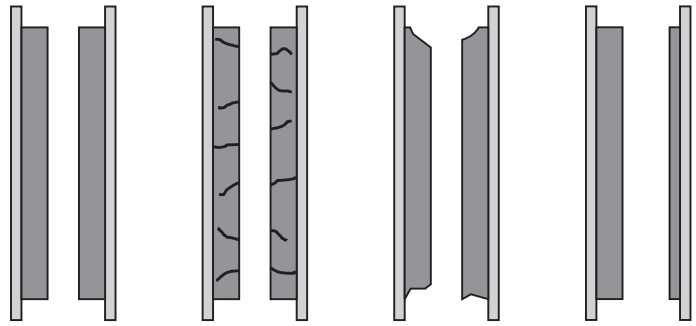
Typical Disc Brake Pads &Calipers

Friction Material

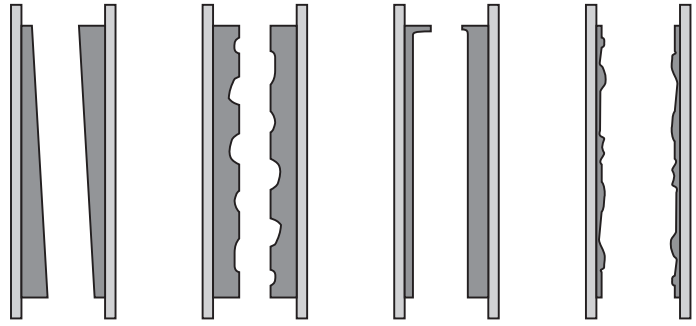
The friction material takes the kinetic energy of the rotating wheel assembly and slows it down by turning it into heat. The main thing to remember about friction material is to make sure you pick the right type for the application. Carbon based materials like Dayton Parts CT pads are good for most applications. Semi-metallic friction is generally more aggressive because of the brass filings mixed in with the rest of the friction formula. The hotter a semi-met pad gets the more the brass chips want to stick to something, like the rotor. Semi-met pads usually wear rotors out faster than a carbon based material. The latest material on the market is a ceramic formula which works at even higher temperatures than a carbon based pad with out losing its progressiveness.

The disc pads can also tell you about what is going on in the brake system at the wheel assembly. Below are some disc pad wear patterns to help you identify what is going on in your brake system.

Disc Brake Pad Wear Patterns



Normal Wear | Cracked or Heat Checked | Chipped Edges | One Side Worn



Tapered Wear | Grooves Worn Into Surface | Stepped Wear | Worn Beyond Safe Usage

Normal Disc Brake Pad Wear

Normal Wear

Wear Pattern: Even wear between the inner and outer pads - smooth, even wear on friction material surfaces. (end to end, top to bottom - no taper wear)

Abnormal Disc Brake Pad Wear Symptoms / Causes

Cracked / Heat Checked / Chipped Edges

Wear Pattern: Cracked/heat checked lining or chipped corners/edges on friction material.

Symptom/Cause: Excessive heat build up in brake system - caliper or caliper piston hanging up creating constant friction - rear brakes not functioning effectively, causing disproportionate braking energy on the front disc pads.

One Side Worn *(Inner or Outer Pad)*

Wear Pattern: One side of the pad set pair worn down.

Symptom/Cause: Caliper or caliper piston hanging up - caliper slide not functioning properly.

Tapered Wear

Wear Pattern: Tapered wear - horizontally or vertically.

Symptom/Cause: Worn out caliper bushings and/or worn out caliper hardware.

Grooved Surface

Wear Pattern: Grooves worn into the surface of the friction material.

Symptom/Cause: Rotors need to be turned (refaced) or replaced with new units.

Stepped Wear

Wear Pattern: Stepped wear on lining

Symptom/Cause: Pads not installed correctly - pads not in full contact with the rotor. Replace the guide pins, mounting bolts, bushing and caliper hardware.

Wear Beyond Safe Limits

Wear Pattern: Lining friction surface worn away completely, rotor destroyed beyond refacing and must be replaced.

Symptom/Cause: Disc pads allowed to remain in service beyond normal safe limits of usage.

Rotors

The rotor is the component in the brake system that takes the pressure of a brake application through the disc pads and transfers the slowing down of wheel rotation to the wheel assembly. Most rotors today are vented in the center for cooling and can be turned at least once before being replaced. Sometimes a rotor can be scored or grooved enough that it cannot be turned even once. Always know the minimum thickness of the rotor you are turning as set by the original equipment manufacturer. If the rotor cannot be cleaned up above the minimum thickness, it should be replaced. Failure to do so can leave insufficient rotor material to dissipate heat or could allow the pistons to push out of the caliper. If a rotor is not wearing evenly, this is a good indication that the caliper is stuck and all the braking is being done by the inner pad. Always have the rotor turned or replaced when installing a new set of disc pads.

Hydraulic Brake System Check List

Master Cylinder

- ✔ Is the fluid in good condition?
- ✔ Is the fluid at the proper level?
- ✔ Any signs of fluid leaking out of the master cylinder around the push rod?

Brake Hoses / Steel Lines

- ✔ Any brake hoses with external cracks?
- ✔ Any steel lines with excessive external rust?

Calipers

- ✔ Are the disc pads wearing evenly?
- ✔ If more than one piston, are they even with each other?

Disc Pads

- ✔ Do both disc pads have a sufficient amount of friction material left?
- ✔ Are the disc pads wearing evenly?

Rotors

- ✔ Is the rotor wearing evenly?
- ✔ Is the rotor blue from heat on the brake surface?
- ✔ Is the rotor scored or grooved anywhere on the brake surface?

Typical Medium Duty Rotors

Dayton Parts' medium duty rotors have the ABS drilling included (where applicable) at no extra cost.

Always use quality Dayton Parts hydraulic replacement parts and disc pads when doing your next brake repairs.

Catalogs and Support Materials

Hydraulic Brake Parts
Catalog 203
Hydraulic Brake Parts for years 1990-1997

Hydraulic Brake Parts
Catalog 204
Hydraulic Brake Parts for years 1989 and Earlier
"Library Edition"