

ABSTRACT

These day technologies go beyond us and for automotive field, the technology of engine develops very fast even the system of the car, luxury etc. which comforts everything that develops by the innovation of engineer. Although the engineer gives priority for comfort or safety measure, but most consumers still have inadequate knowledge in safety system. During turning movement or sudden braking of any vehicle, disc rotor subjects to heat dissipation and uneven stresses which causes problem like Scarring, Cracking, Rusting, Poor stopping, noise, Vibration etc. which increases chances of accidents due to poor efficiency of disc rotor. Thus safety is the first important thing we must focus. This paper "Failure of Disc Rotor in Two Wheeler" studies about different forces acting on disc brake by analysis as well as by designing five different profiles of disc rotors with possible optimization of material and finally selection of desirable performance profile of disc rotor for greater efficiency. Therefore, we can estimate the efficiency of the disc brake. Hopefully this project will help everyone to understand how disc brake works more efficiently, which can help to reduce the accident that may happen in each day.

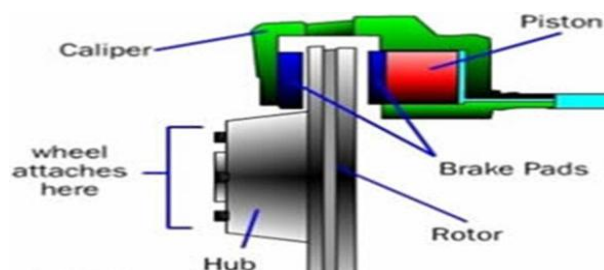
KEYWORDS: Disc rotor, Material, Safety, Efficiency, Design.

INTRODUCTION

The decisive safety aspects of the disk brake design are shorter braking distances Safety is the first important thing we must focus on any human related things. Here in case of automobiles the brake is one of the major devices which contribute in safety system. So the performance of the same should be as good as possible, and if we are generating the brakes with optimum parameters that is added advantage. Considering this fact on mind this paper deals with, Performance improvement of the disc brake, better heat dissipation and Material used improvement.^[2]

In the process of performing function of brake system, the brakes absorb either kinetic energy of the moving member or the potential energy given up by objects being lowered by hoists, elevators etc. The energy absorbed by brakes is dissipated in the form of heat which is dissipated in the surrounding atmosphere to stop the vehicle, so brakes must be strong enough to stop the vehicle within a minimum distance. The driver must have proper control over the vehicle during braking and vehicle must not skid, The brakes must have well antifade characteristics i.e. their effectiveness should not decrease with constant prolonged application and they should have well anti wear properties.^[1]

The disc brake is a device used for slowing or stopping the rotation of a wheel within least possible distance and to stop the wheel, friction material in the form of brake pads is forced against both sides of the disc.



Single-piston Floating Caliper Disc Brakes [1]

The most important part of a vehicle is the Brake system. Brakes are required to stop the vehicle within the possible distance and it is done by converting kinetic energy of the vehicle into heat energy by friction which is then dissipated into atmosphere. The brakes are strong enough to stop the vehicle within the least possible distance. Hence Brakes are applied on the wheels to stop or to slow down the vehicle. Brakes should also be consistent with safety. The driver should have good control over the vehicle during panic braking. During panic braking, the vehicle should not skid. The brakes should have proper antifade characteristics and their effectiveness should not decrease. A disc brake assembly consists of Disc rotor that rotates with the wheel, Caliper assembly attached to the steering knuckle, disc pads that are mounted to the caliper assembly. ^[3]

CAUSES OF FAILURE OF DISC ROTOR

Scarring

Scarring can occur if brake pads are not changed promptly when they reach the end of their service life and are considered worn out. If the scarring is deeper but not excessive, it can be repaired by machining off a layer of the disc's surface. This can only be done a limited number of times as the disc has a minimum rated safe thickness. The minimum thickness value is typically cast into the disc during manufacturing on the hub or the edge of the disc. One of the most rigorous auto safety inspection programs in North America, an automotive disc cannot pass safety inspection if any scoring is deeper than .015 inches (0.38 mm), and must be replaced if machining will reduce the disc below its minimum safe thickness.



Scarring of Disc Rotor [4]

In the Fig above, the scarring of disc rotor is shown. To prevent scarring, it is prudent to periodically inspect the brake pads for wear. A tire rotation is a logical time for inspection, since rotation must be performed regularly based on vehicle operation time and all wheels must be removed, allowing ready visual access to the brake pads. Some types of alloy wheels and brake arrangements will provide enough open space to view the pads without removing the wheel. When practical, pads that are near the wear-out point should be replaced immediately, as complete wear out leads to scarring damage and unsafe braking. Many disc brake pads will include some sort of soft steel spring or drag tab as part of the pad assembly, which is designed to start dragging on the disc when the pad is nearly worn out. The result is a moderately loud metallic squealing noise, alerting the vehicle user that service is required, and this will not normally scar the disc if the brakes are serviced promptly. A set of pads can be considered for replacement if the thickness of the pad material is the same or less than the thickness of the backing steel.

Cracking

Cracking is limited mostly to drilled discs, which may develop small cracks around edges of holes drilled near the edge of the disc due to the disc's uneven rate of expansion in severe duty environments. A brake disc is a heat sink that is it absorbs unwanted heat, but the loss of heat sink mass may be balanced by increased surface area to radiate away heat. Small hairline cracks may appear in any cross drilled metal disc as a normal wear mechanism, but in the severe case the disc will fail catastrophically.



Fig. Cracking of Disc Rotor [4]

No repair is possible for the cracks, and if cracking becomes severe, the disc must be replaced. These cracks occur due to the phenomenon of low cycle fatigue as a result of repeated hard braking.

Rusting

The discs are commonly made from cast iron and a certain amount of surface rust is normal. The disc contact area for the brake pads will be kept clean by regular use, but a vehicle that is stored for an extended period can develop significant rust in the contact area that may reduce braking power for a time until the rusted layer is worn off again.

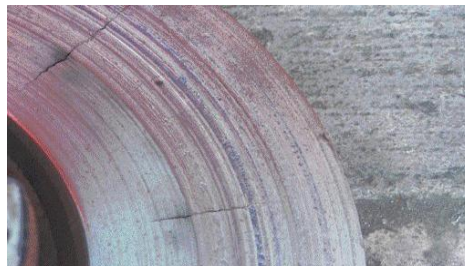


Fig. Rusting of Disc Rotor [5]

Rusting can also lead to disc warping when brakes are re-activated after storage because of differential heating between unrusted areas left covered by pads and rust around the majority of the disc area surface. Over time, vented brake discs may develop severe rust corrosion inside the ventilation slots, compromising the strength of the structure and needing replacement. ^[5]

Noise

Getting rid of an annoying brake squeal and other disc brake noise is like trying to cure a bad case of herpes. You can treat the symptoms and improve the patient's condition. But it is virtually impossible to eliminate the underlying cause. Fortunately, brake noise is not caused by a virus. It is caused by a combination of factors that sometimes adds up to create noise.

Brake squeal is really a high frequency vibration. In disc brakes, it can be caused by vibrations between the pads and rotors, the pads and calipers, or the calipers and their mounts.

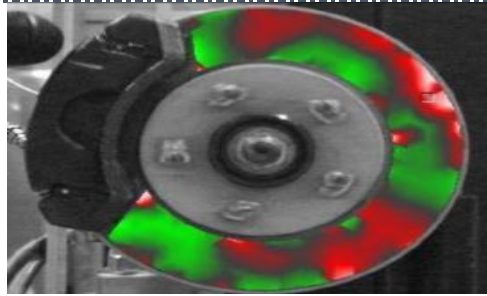


Fig. Noise in Disc Rotor [5]

In the Fig. above, the noise produced by a brake rotor in a test lab has been captured electronically and converted into a color graphic. The red areas are producing the loudest noise while the green areas are producing the least noise

Vibration

Brake vibration is where a shaking motion occurs when the brakes in a car or other vehicle are deployed. This can vary from a slight shaking to a quite severe shuddering, depending on the severity of the condition. It can also be known as rotor shimmying or brake pulsation. ^[5]

Pulsation

Loose wheel bearings will cause the rotor to tilt in the caliper when a load or side thrust is placed on the bearings. Disc brake pistons require lots of fluid volume and pressure to push the pad against the rotor. If loosely adjusted wheel bearings force the pistons into the caliper, the result will be a low or spongy brake pedal. ^[6]

DISCUSSION

Scarring can occur if brake pads are not changed promptly when they reach the end of their service life and are considered worn out. Small hairline cracks may appear in any cross drilled metal disc due to the disc's uneven rate of expansion in severe duty environments. No repair is possible for the cracks, and if cracking becomes severe, the disc must be replaced. The disc contact area for the brake pads will be kept clean by regular use, but a vehicle that is stored for an extended period can develop significant rust in the contact area that may reduce braking power for a time until the rusted layer is worn off again. Brake squeal is really a high frequency vibration. In disc brakes, it can be caused by vibrations between the pads and rotors. Brake vibration is where a shaking motion occurs when the brakes in a car or other vehicle are deployed

CONCLUSION

Hence this paper studies various causes of failure of disc rotor like scarring, cracking, rusting, noise, vibration, pulsation which leads to failure of disc rotor. Which can be avoided by designing the disc rotor of various materials which may give long life to disc rotor and hence disc rotor will have maximum efficiency.

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