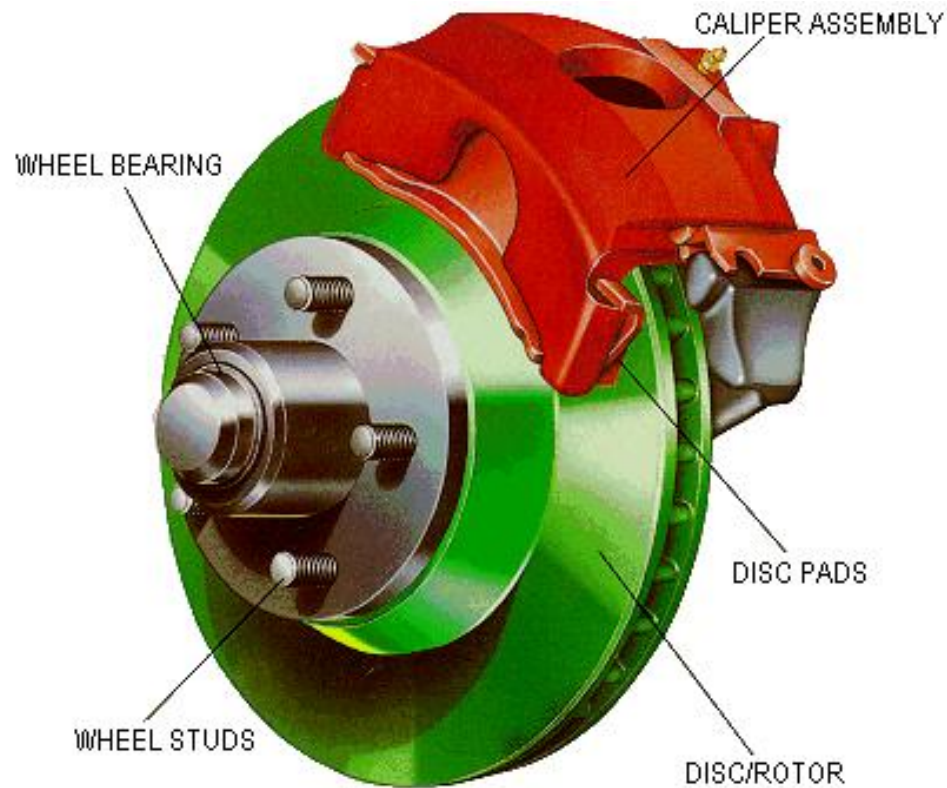


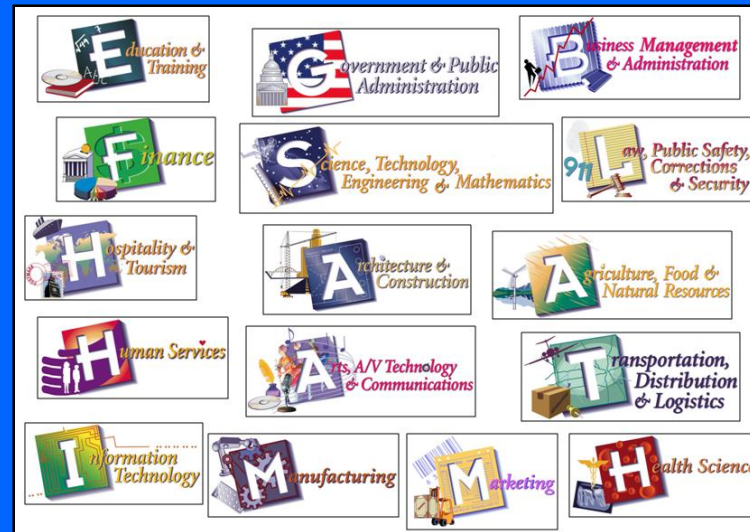
ATASA 5th Disc Brake Systems

Please Read The Summary

ATASA 5TH Study Guide
Chapter 50 Pages: 1481 - 1505
Disc Brakes
67 Points



Before We Begin...



Keeping in mind the **Career Cluster** of Transportation, Distribution & Logistics

Ask yourself:

What careers might be present in this slide series?

What careers might interest me?

How do these careers relate to my other high school classes?

What career cluster is my 4-year plan preparing me for?

ATASA 5th Disc Brake Systems

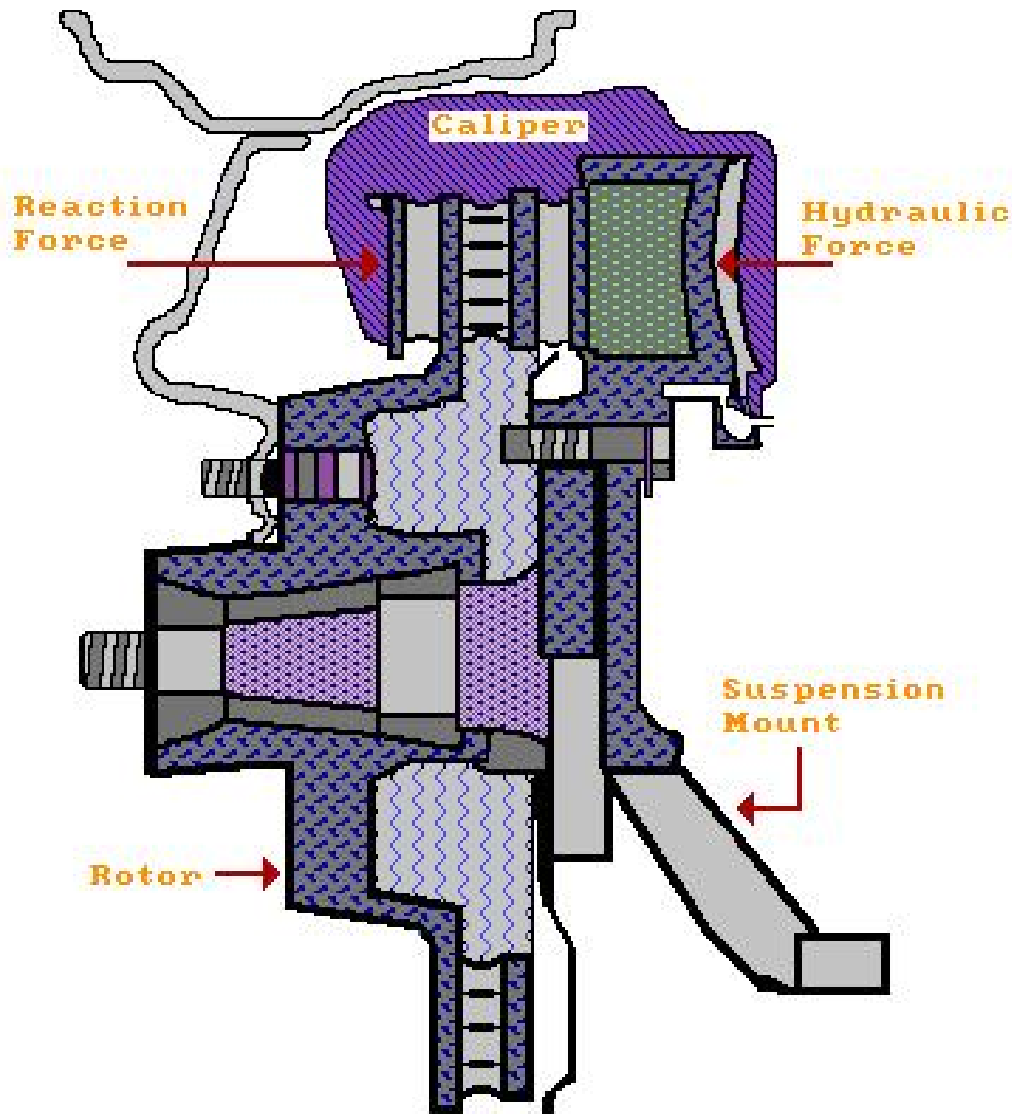
1. Disc brakes use a _____ to squeeze pads against the edges of a spinning _____.



Caliper, Rotor
Caliper, Hub
Coroner, Rotor

ATASA 5th Disc Brake Systems

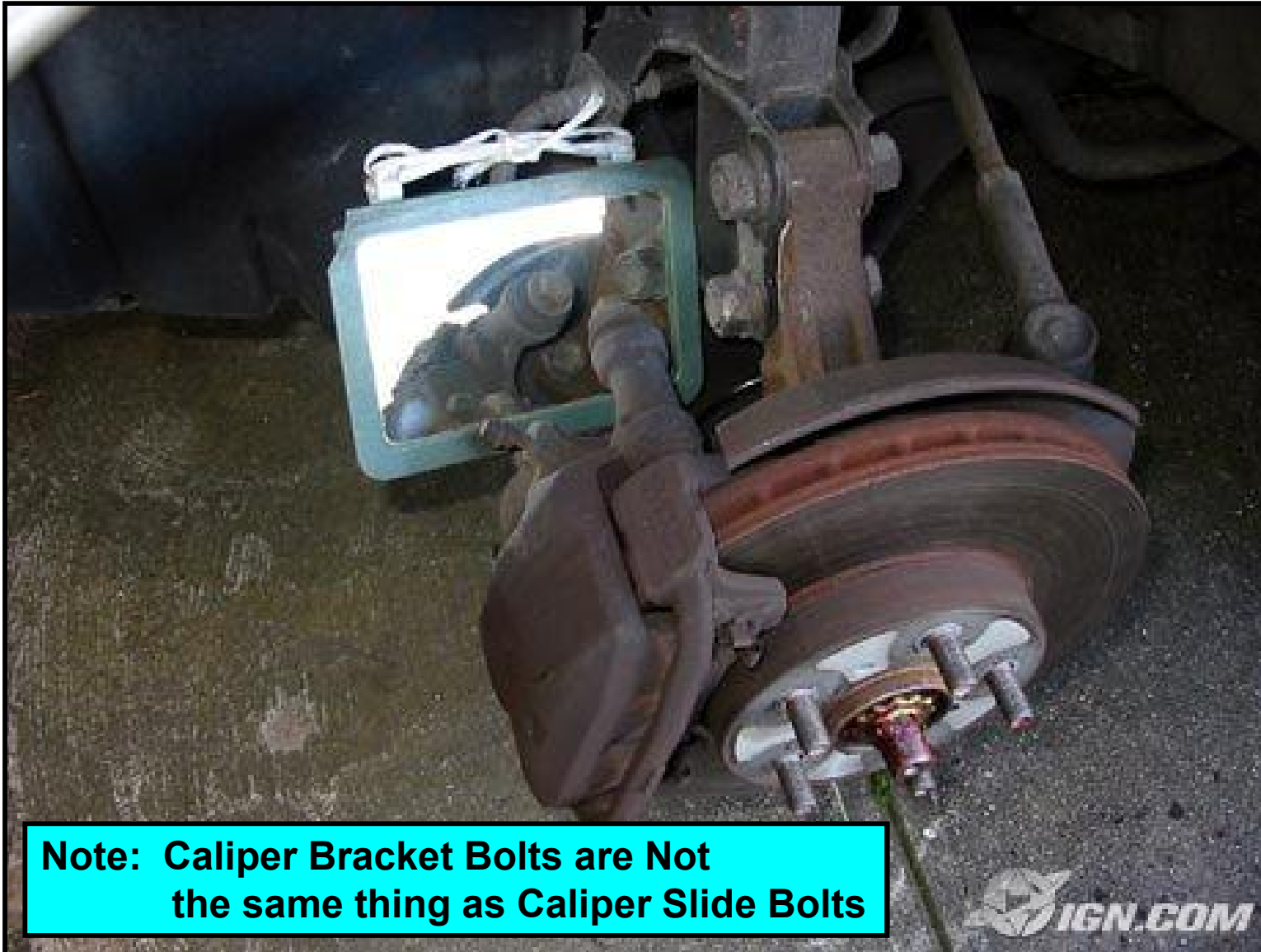
2. The rotor or disc is typically made of _____ and may be ventilated for better cooling.



Aluminum
Lead
Cast Iron

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3. The caliper is mounted to the steering _____ to stop it from rotating or moving fore & aft.



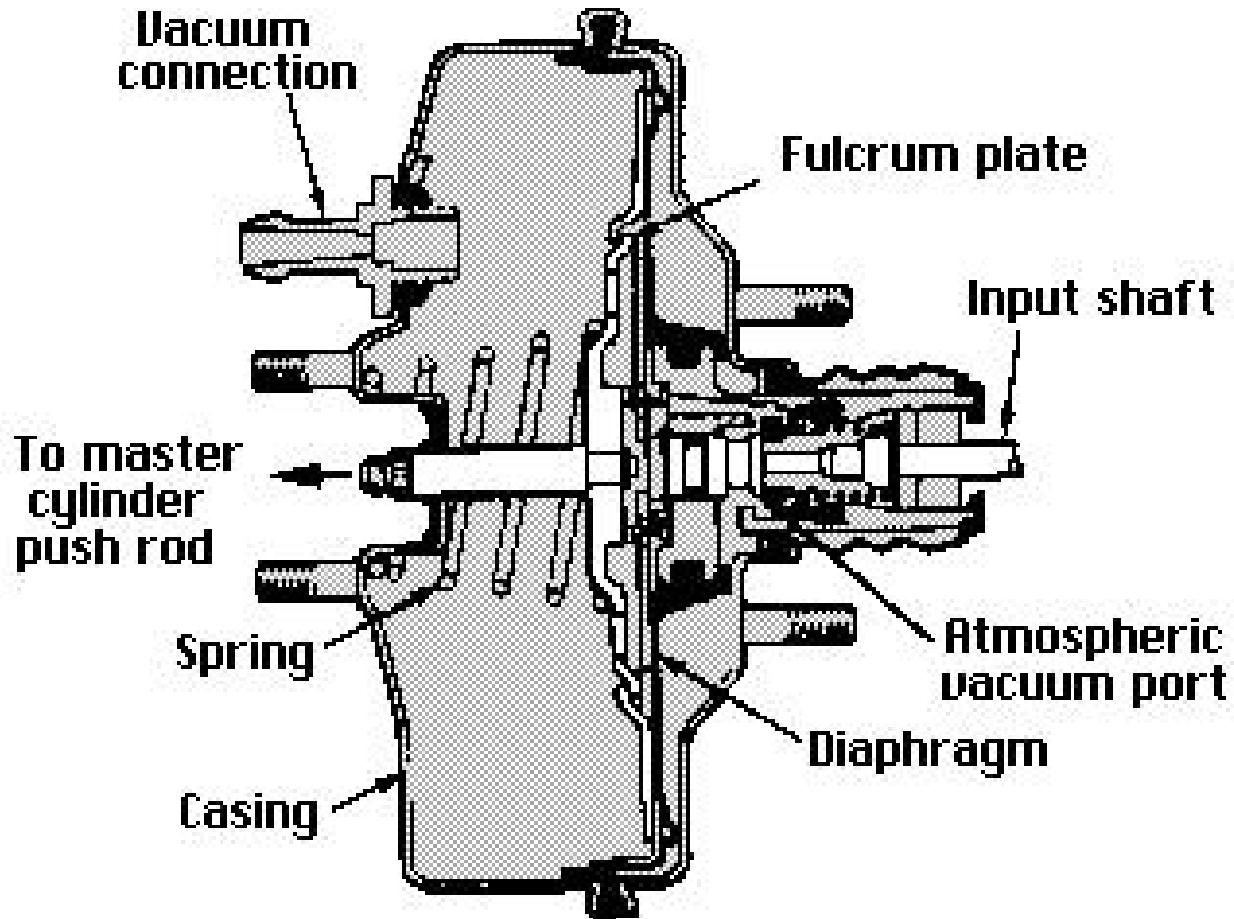
Note: Caliper Bracket Bolts are Not the same thing as Caliper Slide Bolts

Knuckle Spindle Arm

ATASA 5th Disc Brake Systems

4. Disc brakes are usually _____-assisted since they are not self-energizing like drum brakes.

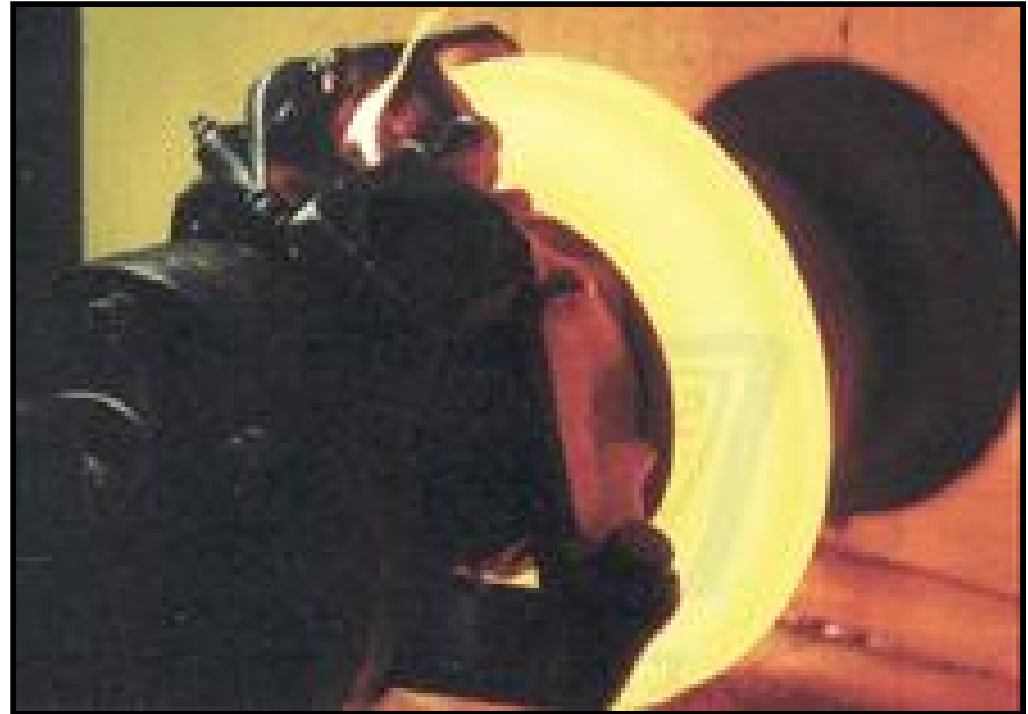
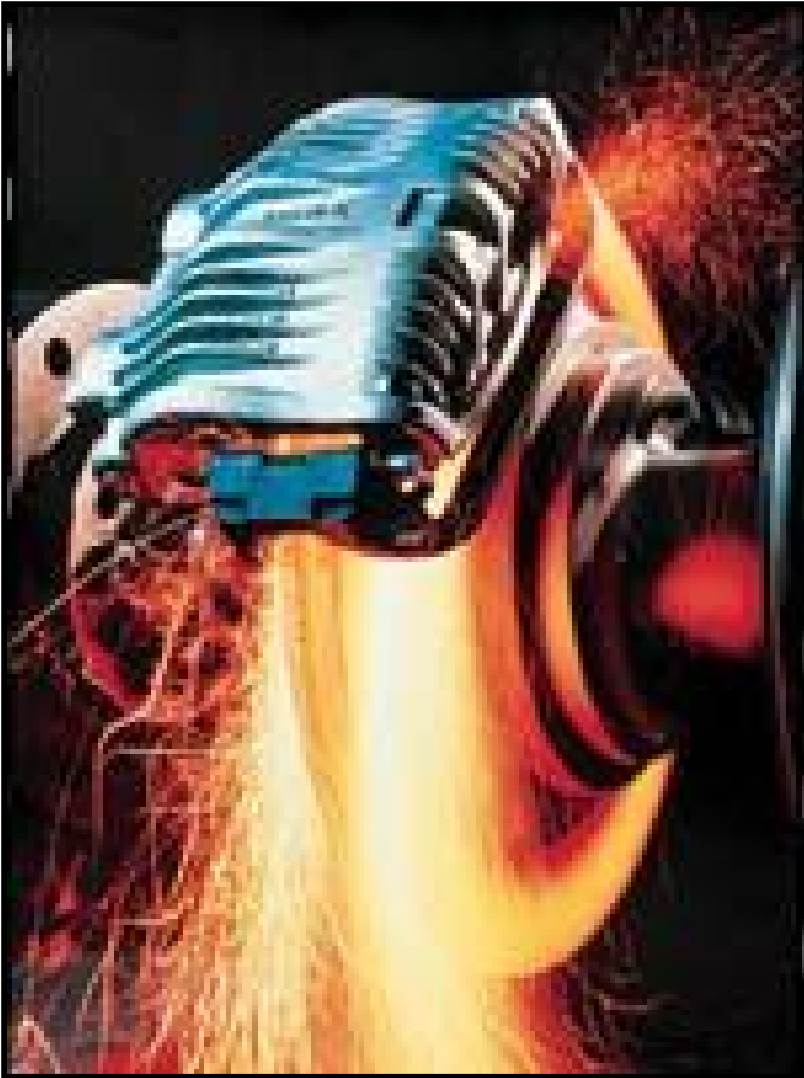
Vacuum Power Brake Booster



Power
ABS
Electric

ATASA 5th Disc Brake Systems

5. Disc brakes are more resistant to heat _____, water fade, and are less apt to pull. *Disc brakes will automatically adjust for pad wear through the action of the square-cut o-ring piston seal.*



Facet
Fade
Melt

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6. Calipers may be either fixed, sliding, or _____ designs that move on special pins or bolts.



Fixed Caliper

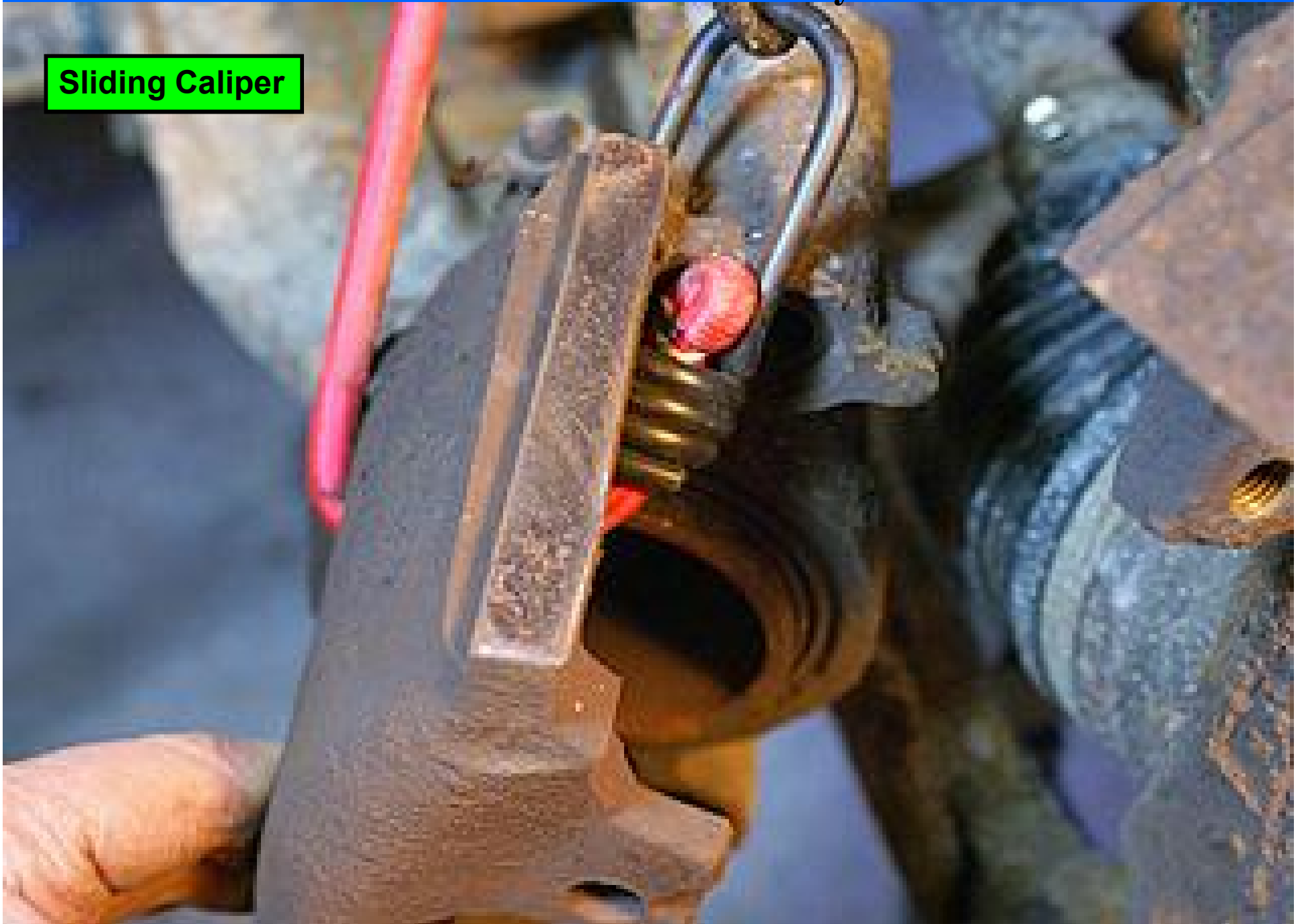


Floating Caliper

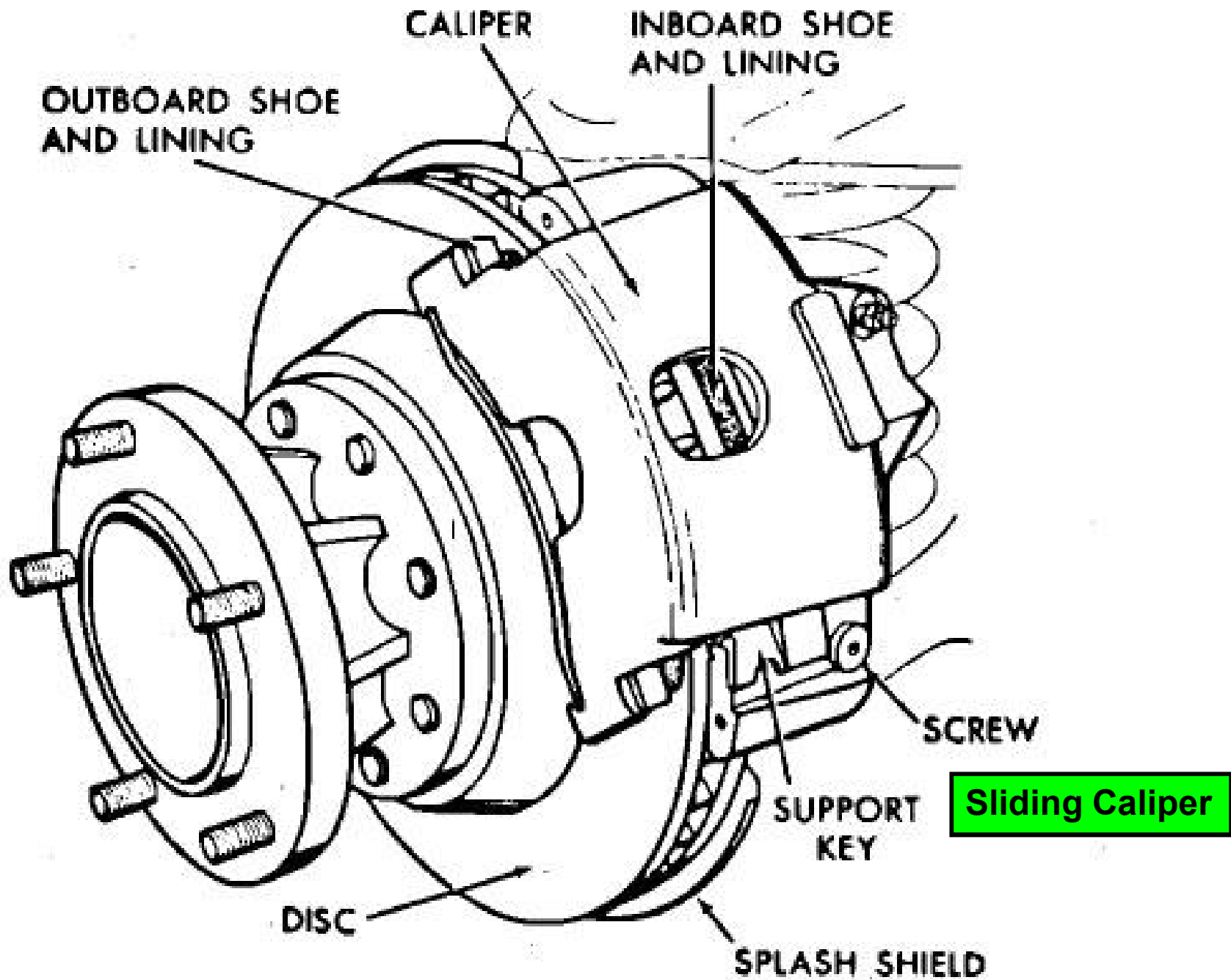
Floating
Gloating
Boating

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Sliding Caliper



ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems

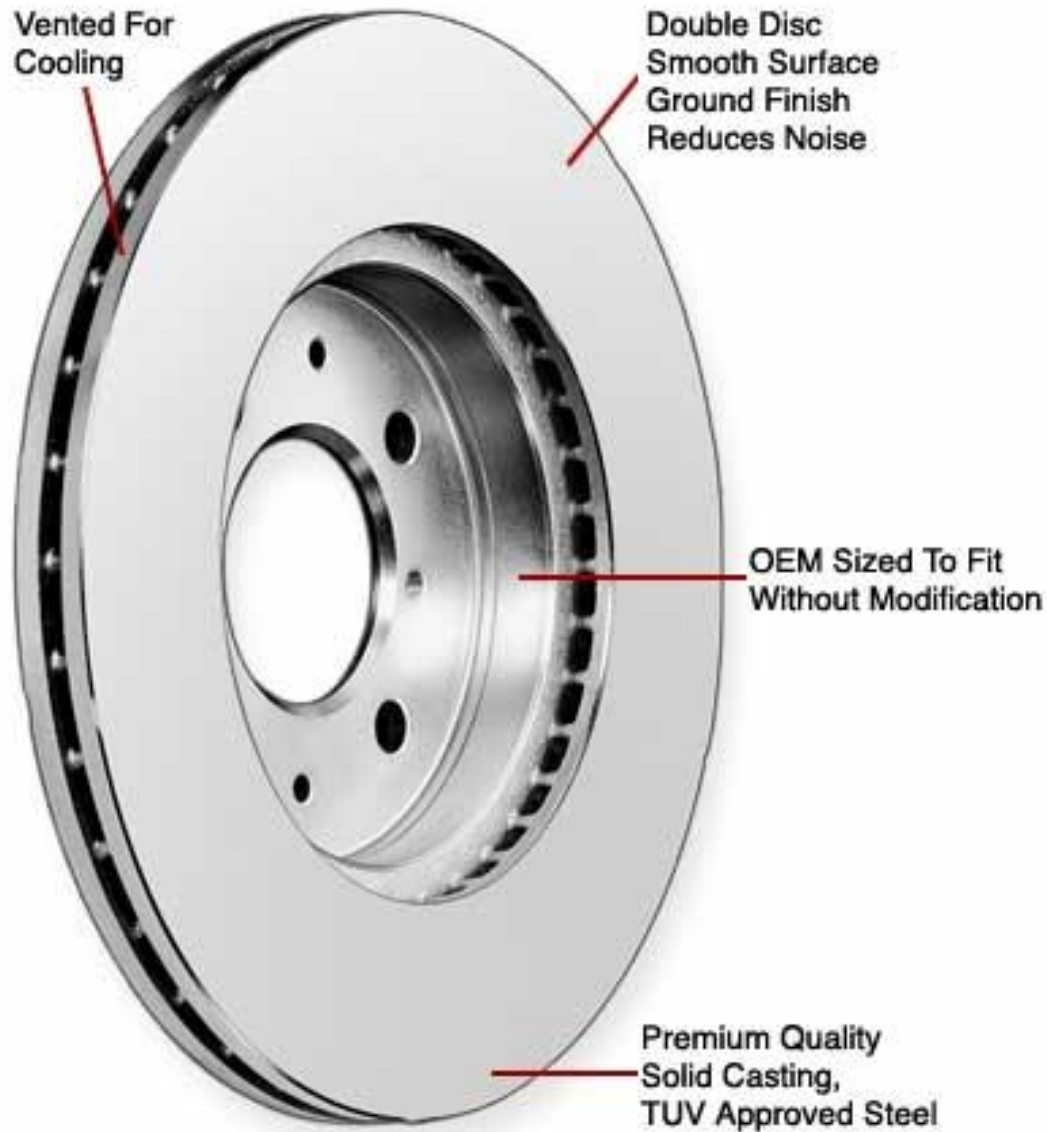


**Anti-Seize
Lubricant**

Caliper Slide Lubricant

ATASA 5th Disc Brake Systems

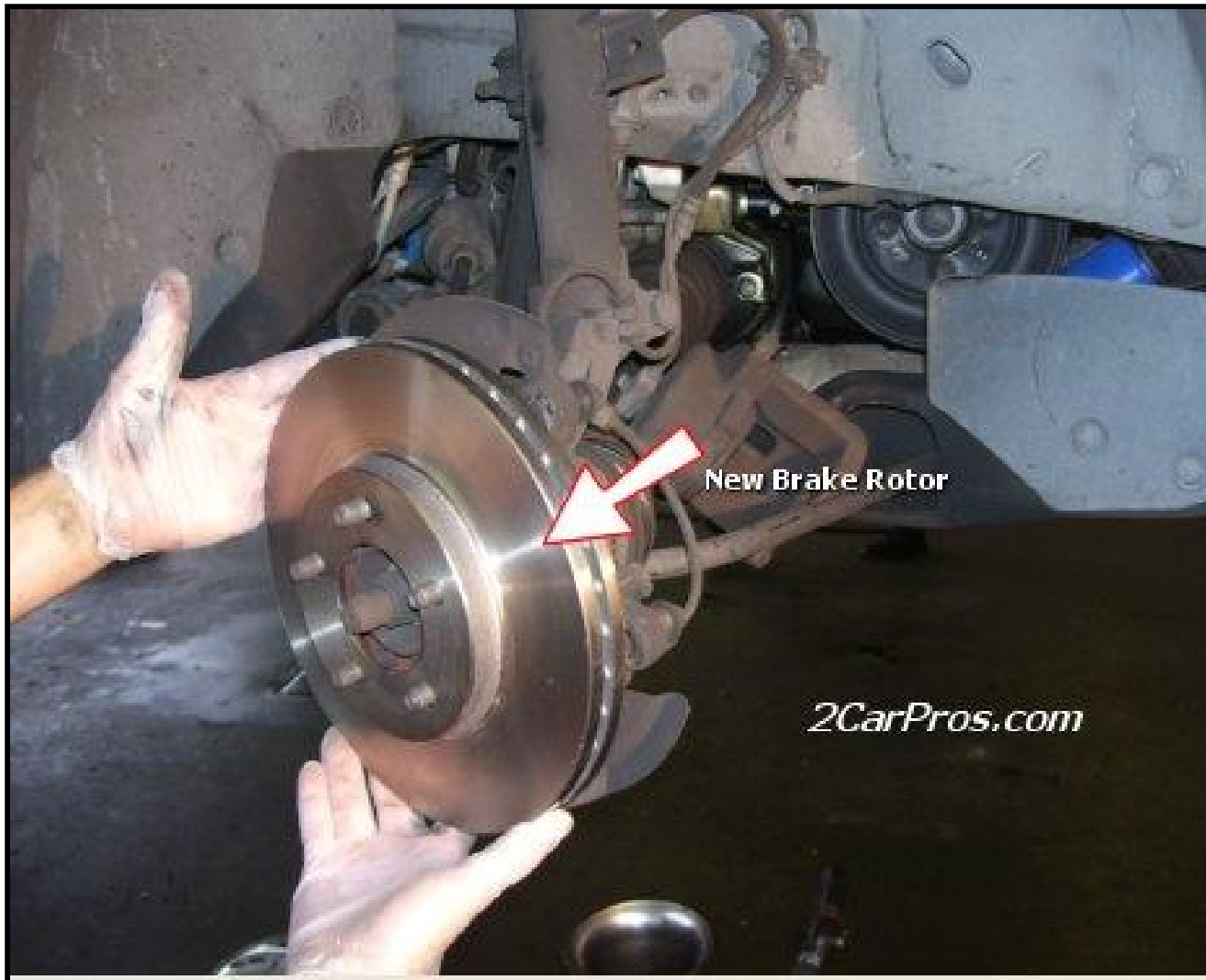
7. Cast iron rotors are cooled by _____ being drawn in at the center & discharged along the outer edge.



Center
Outside
Inside

ATASA 5th Disc Brake Systems

8. A sheet metal _____ shield protects rotors & pads from road splashes and dirt in addition to channeling air flow into the center of the rotor for cooling. *Note: There are also Dust Shields in use.*



Splash
Crash
Trash

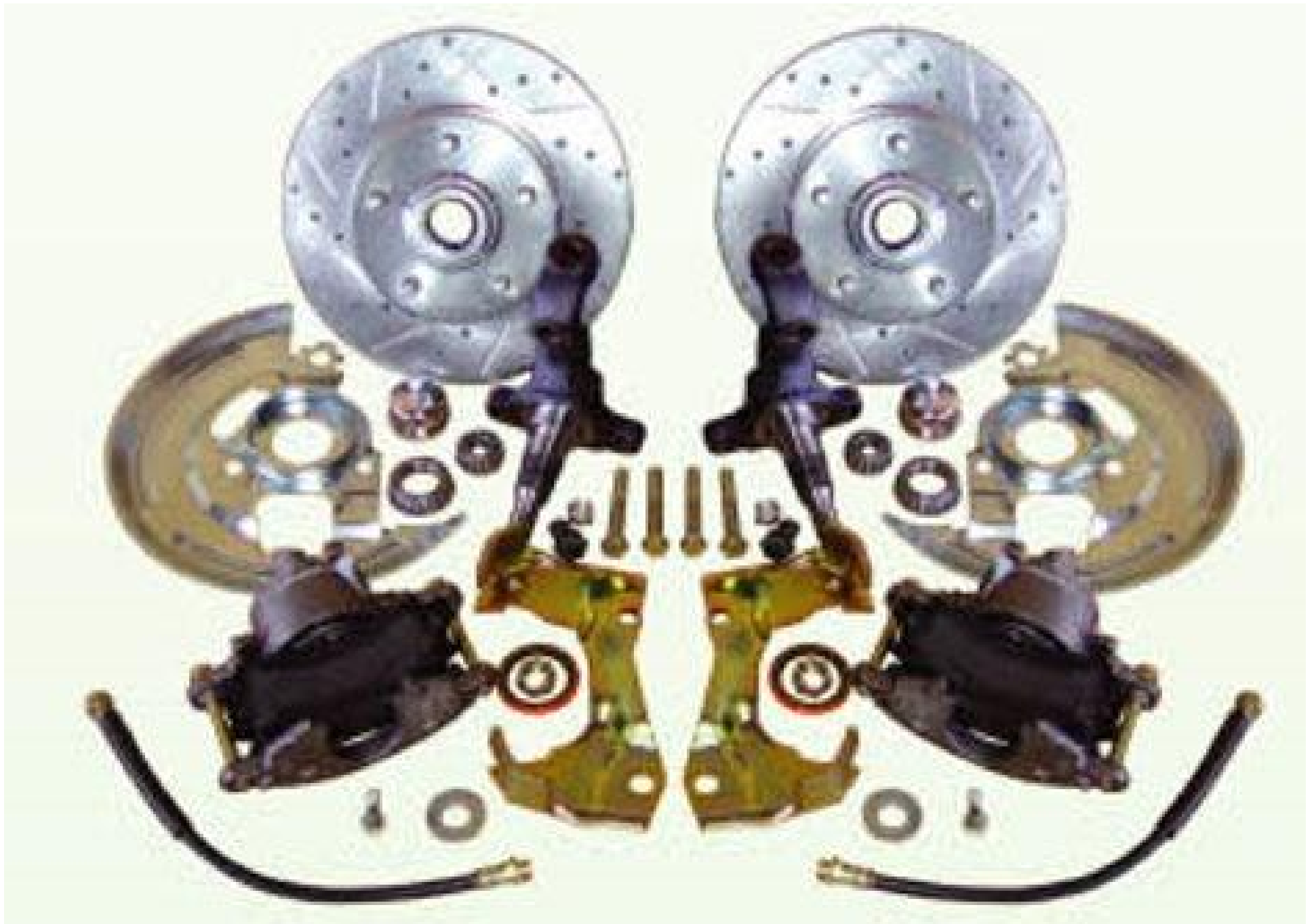
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**FITS IN THE WHEEL
JUST LIKE
AN INSIDE
HUBCAP !!**



ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems

9. Lightweight _____ rotors have stamped steel hubs and cast iron friction surfaces.



Aluminum
Plastic
Composite

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A new exhibit is opening this week at Albrechtsburg Castle in Meissen, Germany to celebrate the 300th anniversary of the discovery of porcelain. As part of the show, Porsche will be displaying one of several ceramic applications that they have pioneered in cars. The 2001 911 GT2 was the first series production car to use carbon ceramic brake rotors, one of which will be on display at the castle. *The carbon ceramic brakes are lighter than their metal equivalents, don't corrode, have better stopping power and withstand heat much better than conventional units.* The 2003-2006 Carrera GT was the first model to use ceramic clutch plates.



ATASA 5th Disc Brake Systems

10. Carbon fiber & _____ rotors with steel hubs may be found on extremely high-end cars. (*Motorcycles*)



Aluminum
Plastic
Ceramic

ATASA 5th Disc Brake Systems

11. Rotors can be either _____ or can be ventilated. *They may be directional with curved fins.*



Solid
Heated
Striped

ATASA 5th Disc Brake Systems

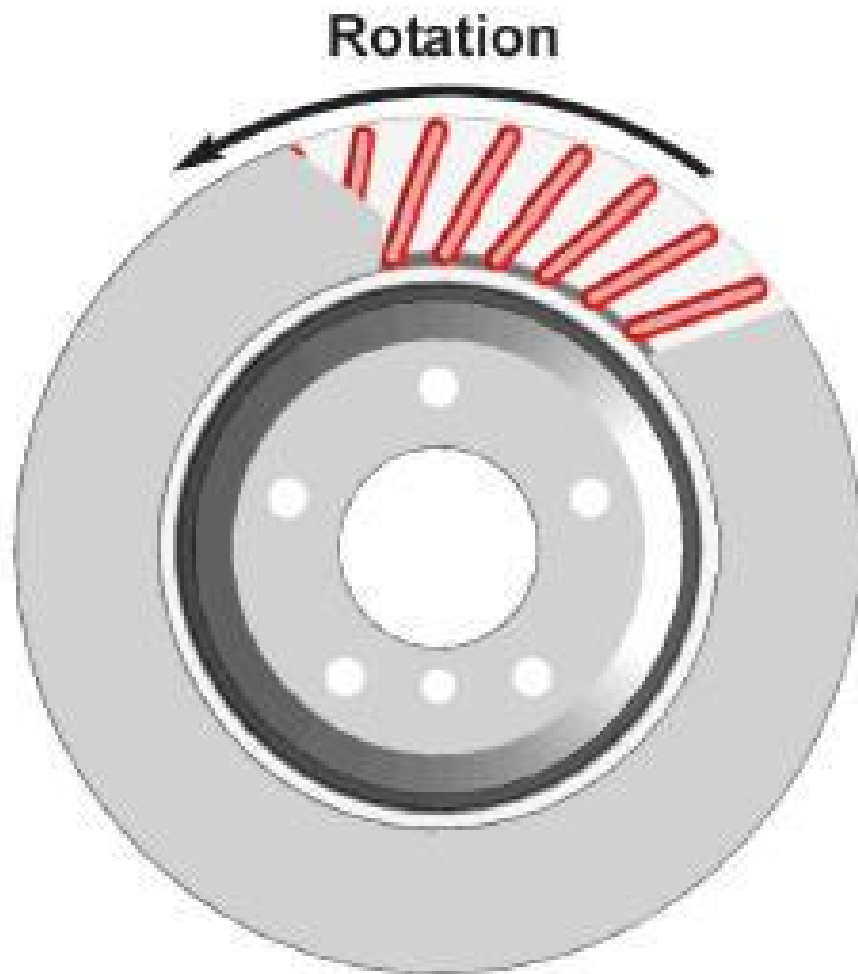
Curved Vane



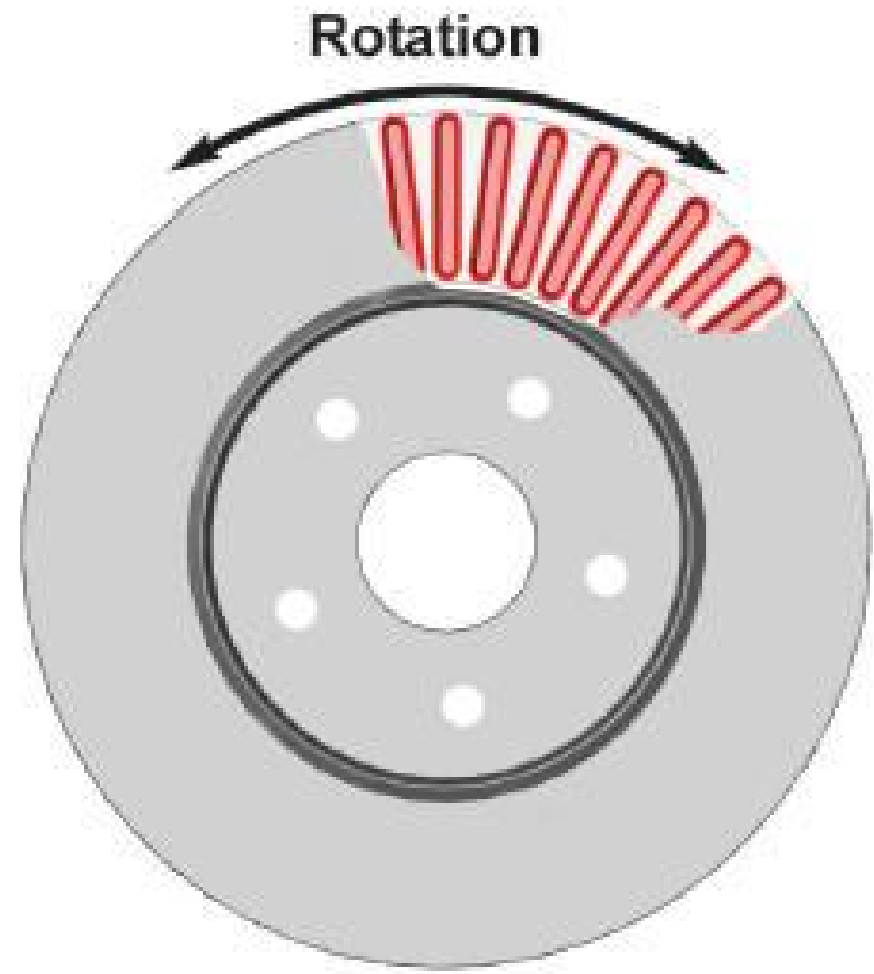
Pillar Vane



ATASA 5th Disc Brake Systems



Directional Vanes



Radial or "Straight" Vanes

ATASA 5th Disc Brake Systems

12. The idea behind *drilled & slotted rotors* is to allow _____, _____, and dirt to escape.

Brake Rotor Tech

The rotors need to dissipate a lot of heat: Use a thick vented rotor.

Thick so it can hold a lot of heat and vented to dissipate the heat to the air.

Brake pads will generate gasses: Use a cross drilled rotor or grooved rotor so gasses can escape from between the pad and disk.

Brake pads will generate dust: Use a rotor with directional angled dust grooves which will shed the dust radially to the outer rim of the rotor as the rotor turns.

Note: If gasses generated by the heated pads and brake dust are allowed to collect between the pad and rotor, the braking effectiveness is diminished.

Heat, Gases
Peat, Classes
Water, Dust

ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems

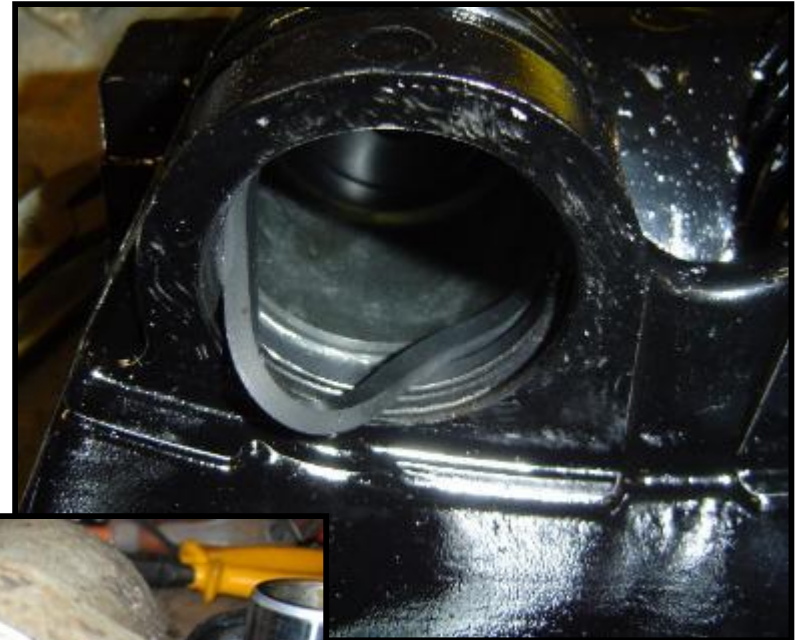
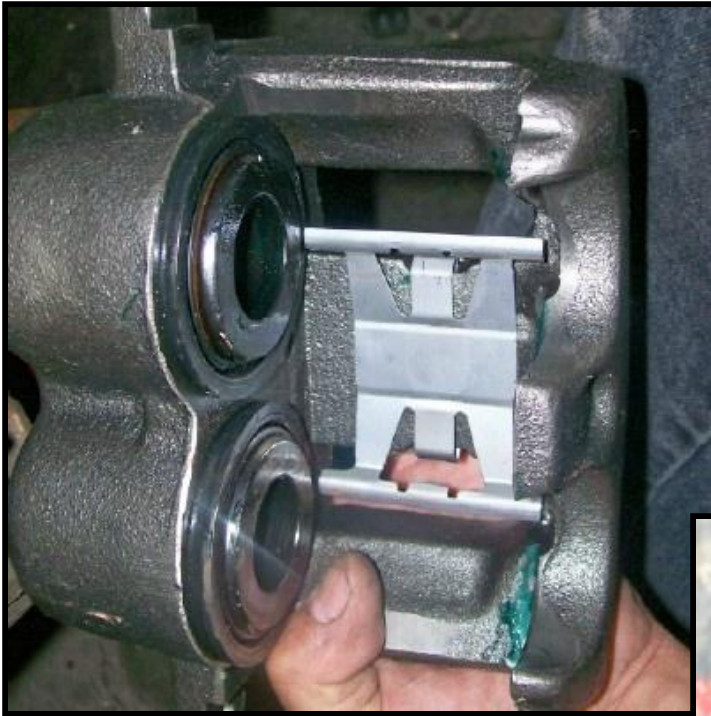
13. Some rotors on non-drive wheels will have _____ roller bearings & races to mount the hub.



Straight
Tapered
Dis-jointed

ATASA 5th Disc Brake Systems

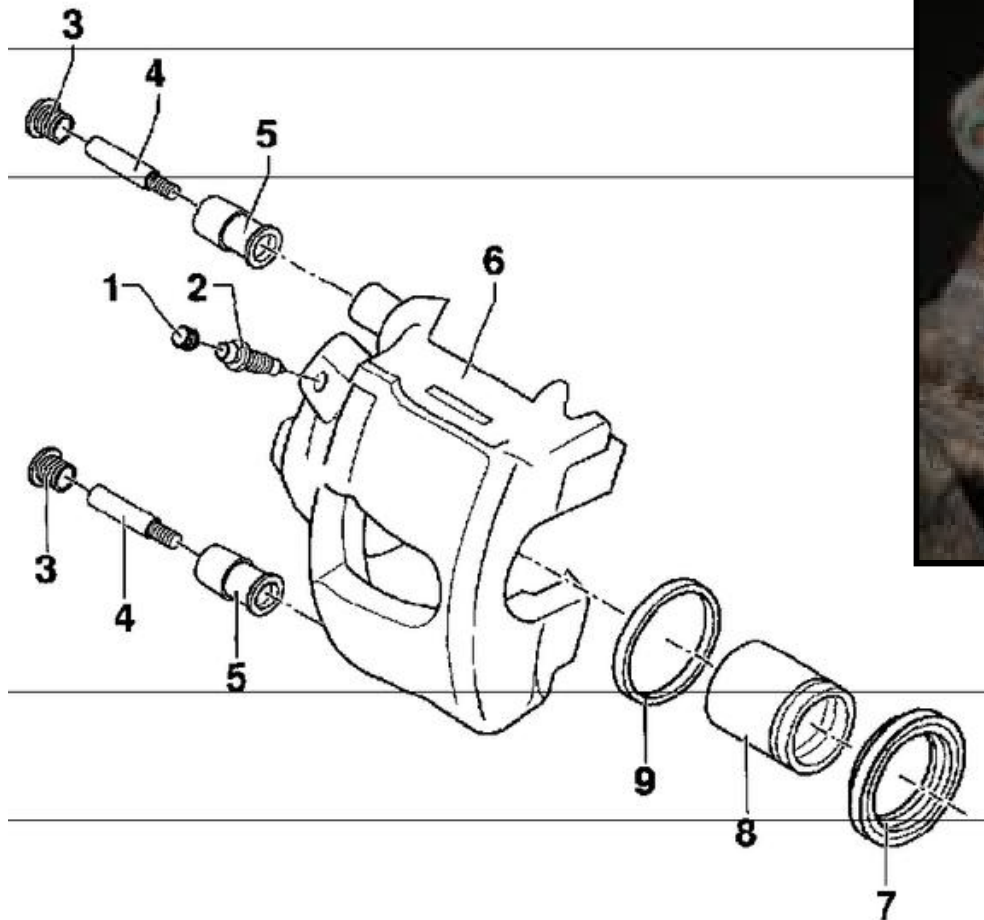
14. Calipers are cast of either _____ or _____. They have a finely honed inside finish.



Iron, Aluminum
Silver, Bronze
Plastic, Wax

ATASA 5th Disc Brake Systems

15. The top groove in the caliper is for the _____ . The *other* groove with a tapered bottom, machined *midway* through the caliper bore seats the _____ - _____ o-ring piston seal.



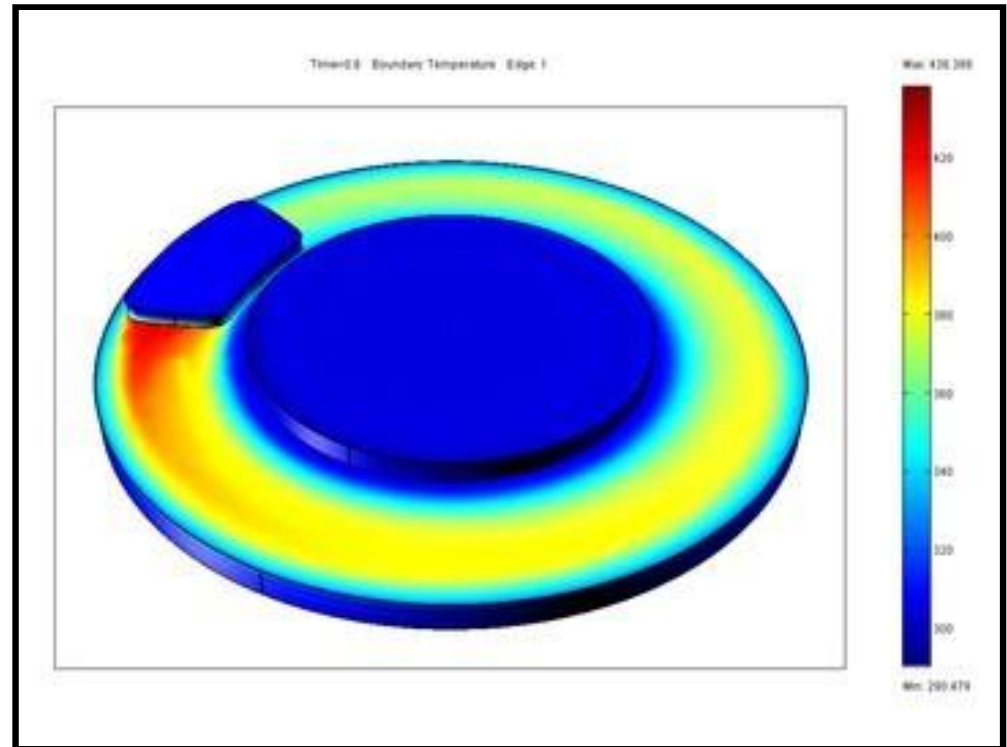
Dust Boot, Square-cut
Splash Shield, Round-cut
Vapor Barrier, Neoprene

ATASA 5th Disc Brake Systems



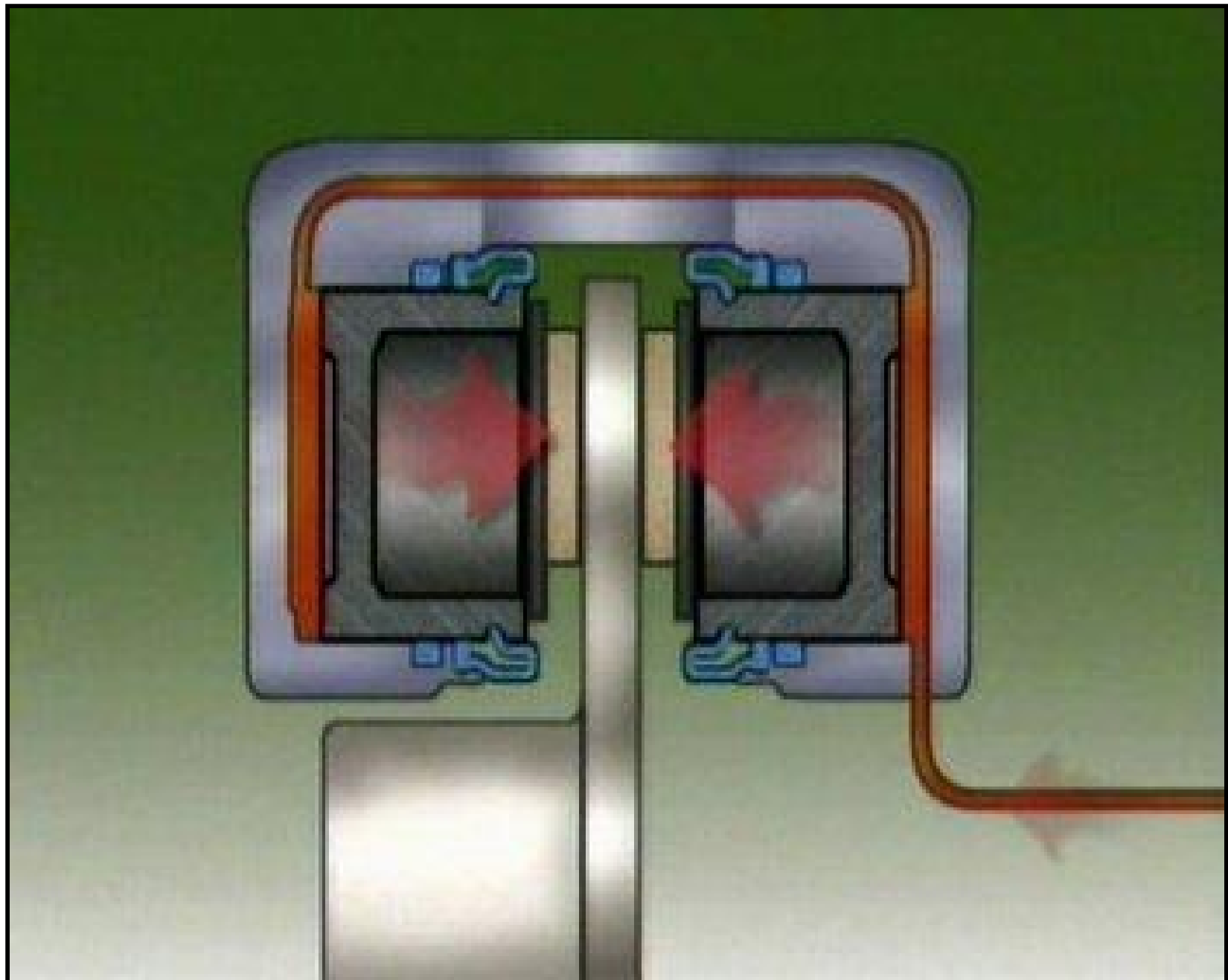
ATASA 5th Disc Brake Systems

16. Caliper pistons are large to provide high force on the pads w/a minimum of _____ transfer.



Sound
Heat
Fluid

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ATASA 5th Disc Brake Systems

17. Caliper pistons can be made of steel, aluminum or fiberglass-reinforced _____ resin.



Phenolic
Iron
Semiconductor

ATASA 5th Disc Brake Systems

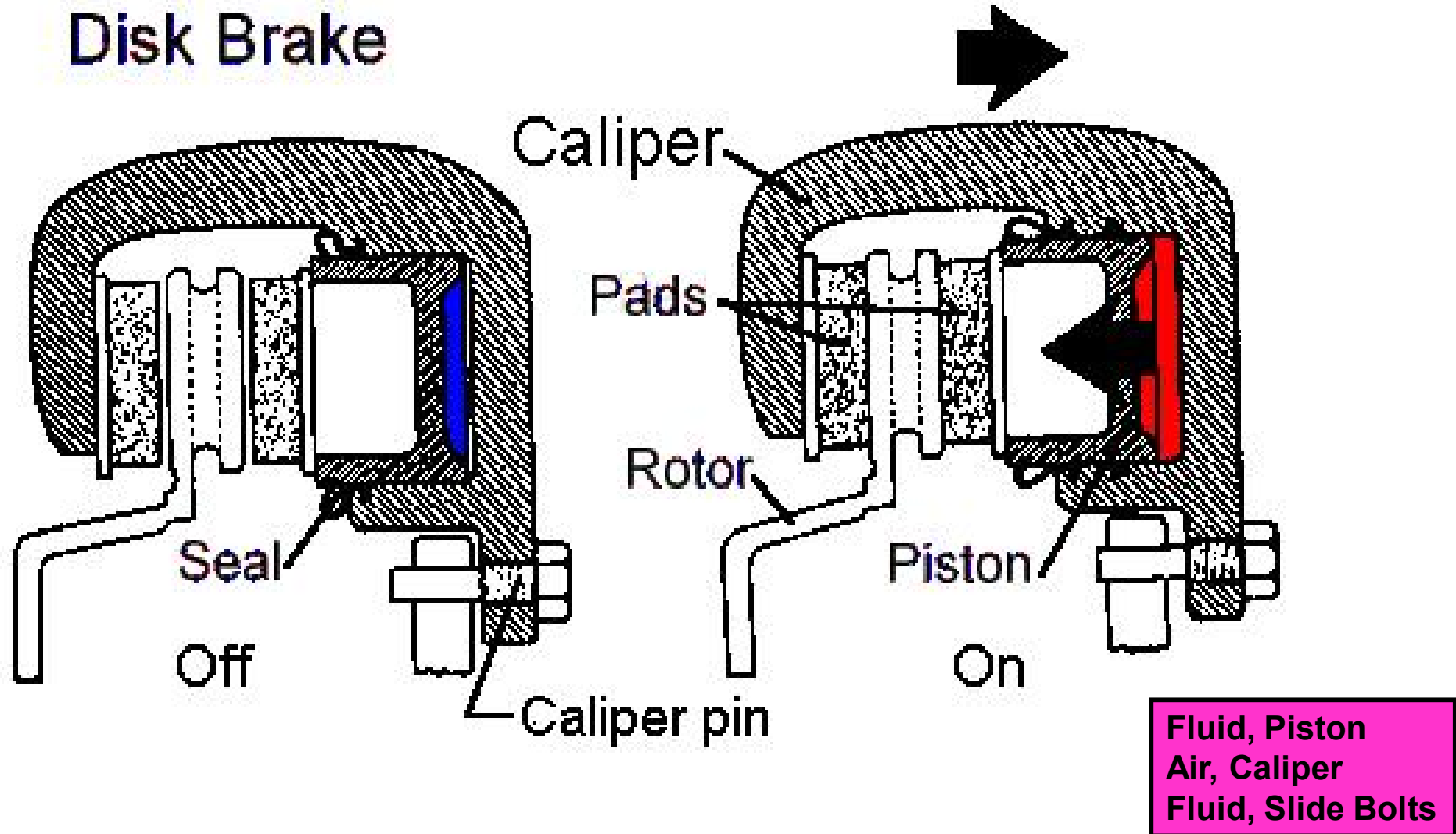
18. The top of the piston is grooved to accept the inside diameter of the _____, which prevents moisture and road contamination from entering the caliper bore.



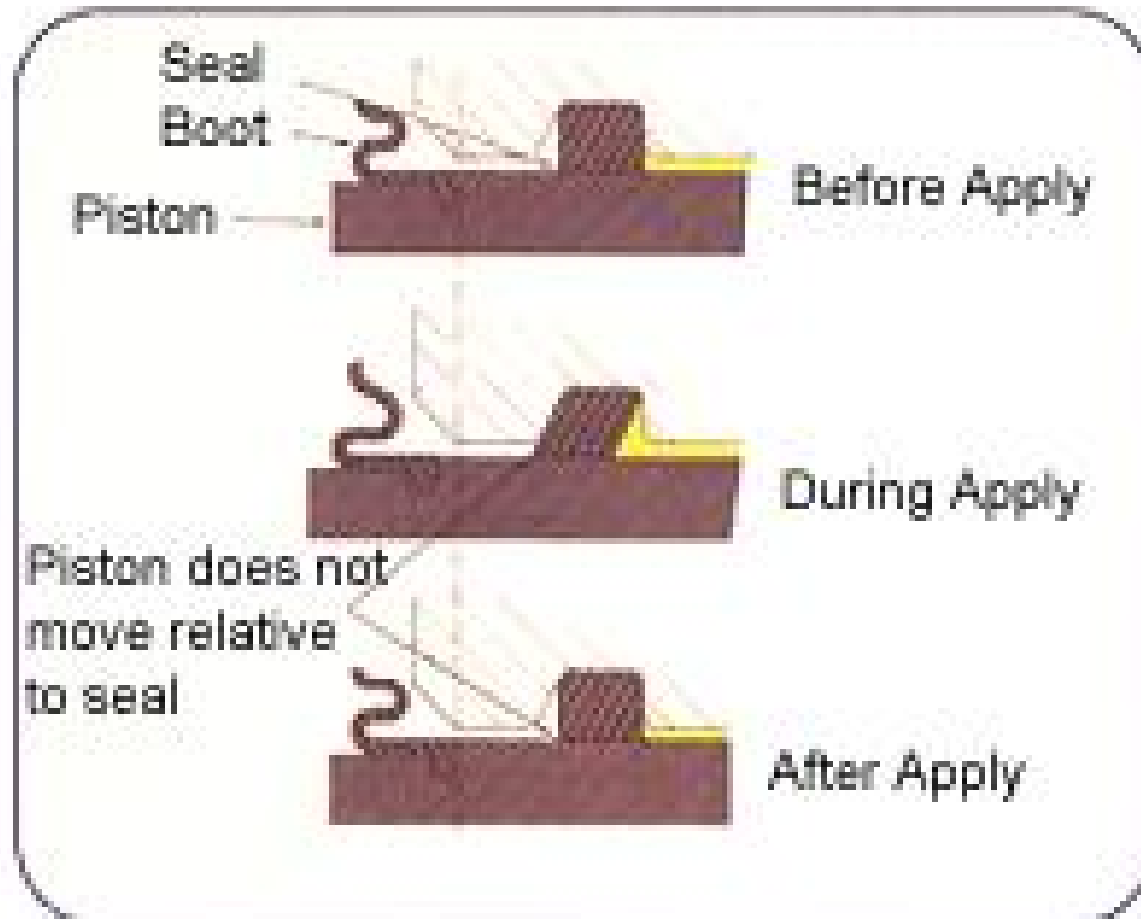
Dust Boot
Fluid Seal
O-ring

ATASA 5th Disc Brake Systems

19. *Square-cut o-ring piston seals prevent _____ leakage, retract the _____ like a return spring when brakes are unapplied, and allow for the self-adjusting action as the pads wear.*



ATASA 5th Disc Brake Systems

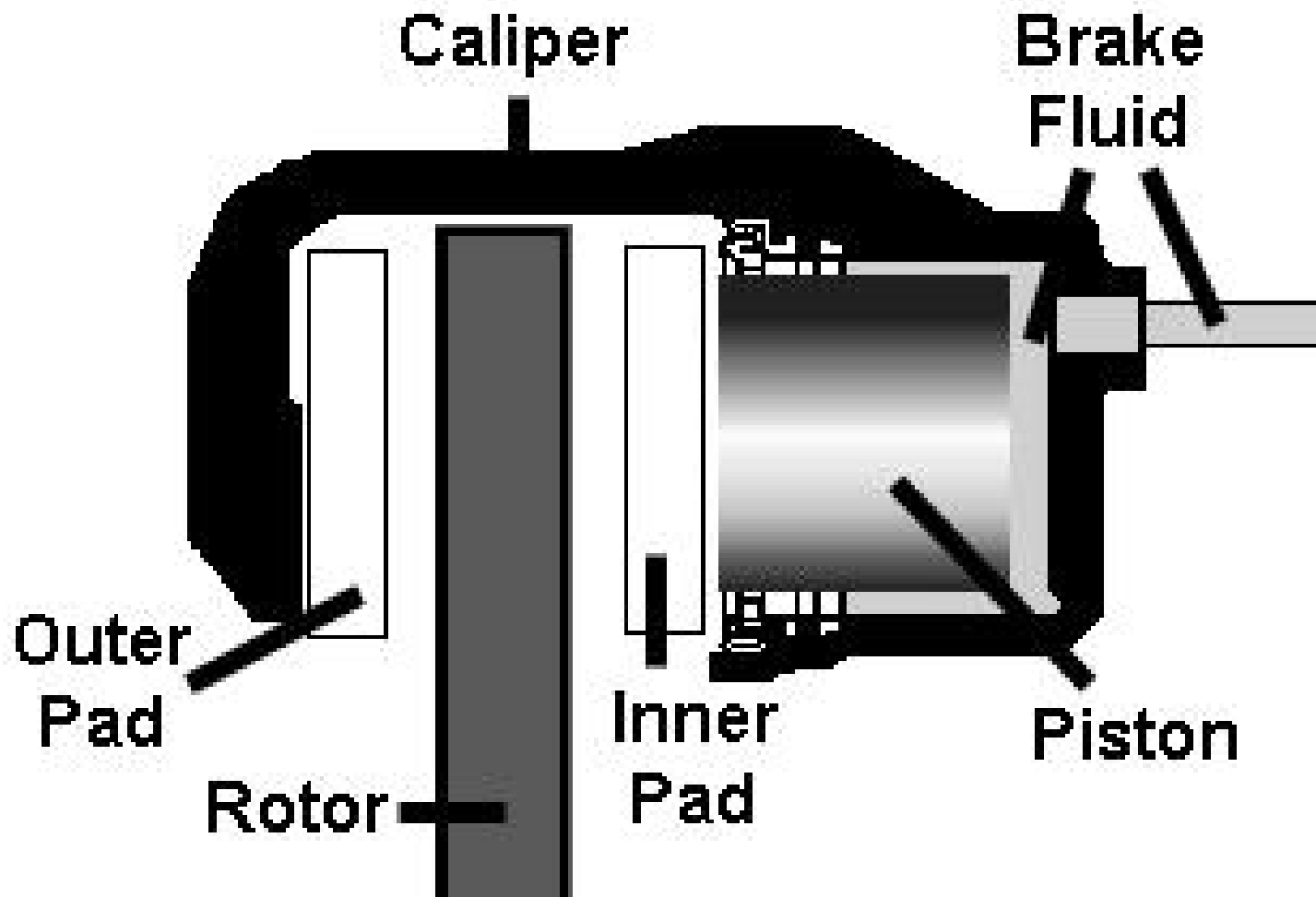


Caliper piston seals don't last forever, and once they start to leak, it's the end of the road for the caliper and the pads. Their ability to retract the piston and adjust for wear is compromised.

ATASA 5th Disc Brake Systems

20. On both sliding and floating, single piston calipers, the _____ pad is pressed against the rotor first. This pushes the caliper away from the piston forcing the outboard pad against the rotor.

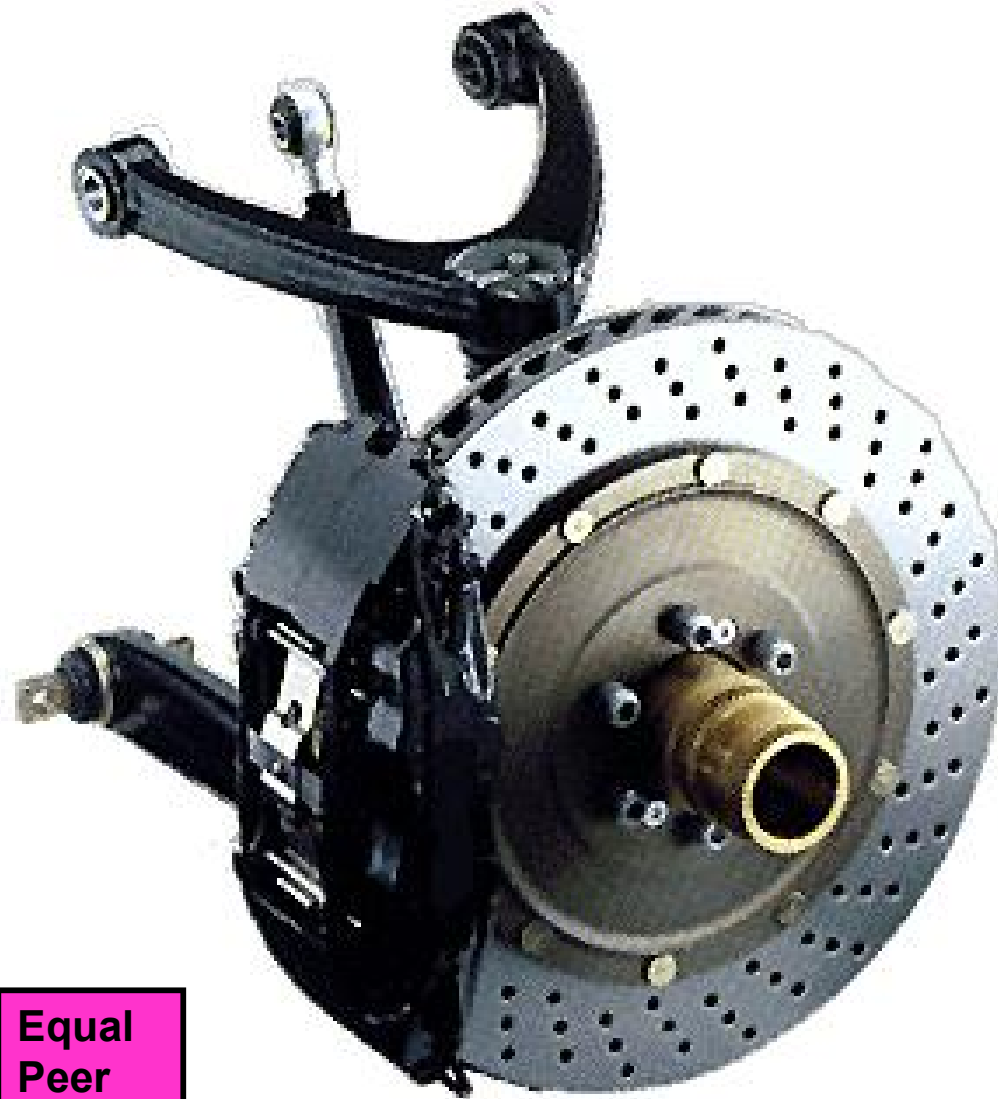
<http://www.acuravigorclub.com/Timely-Topics/TTGraphics/1204/CaliperAnimation.gif>



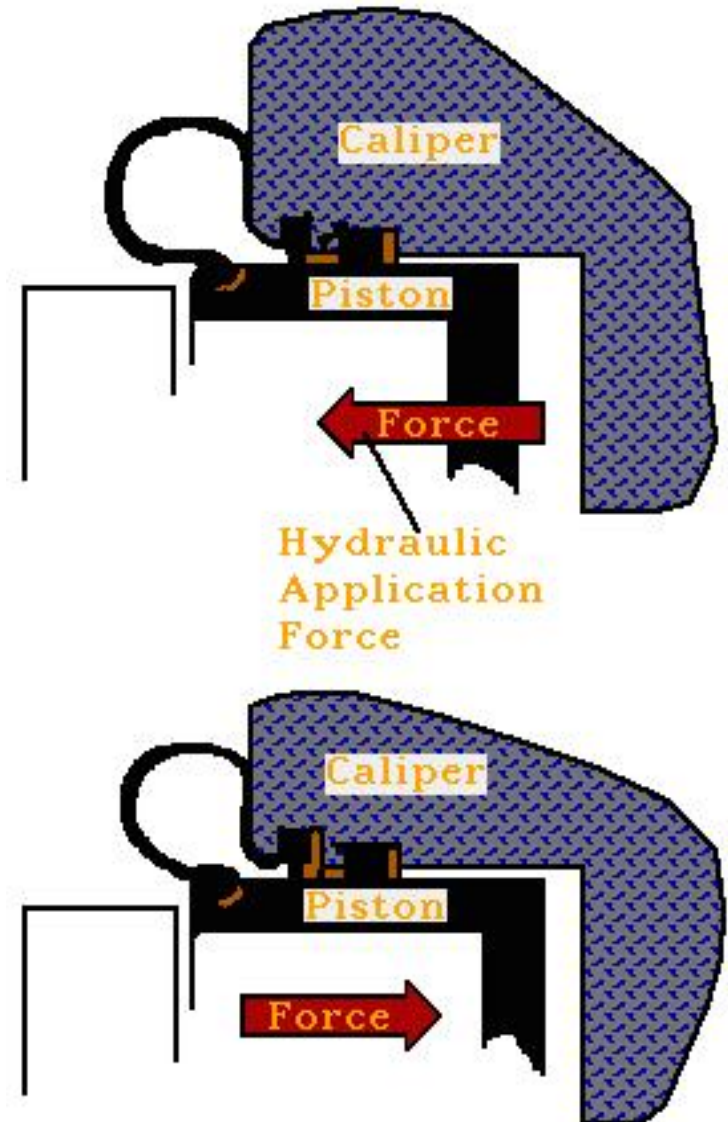
Inboard
Outboard
Trailing

ATASA 5th Disc Brake Systems

21. After both pads have contacted the rotor surfaces, they apply _____ pressure to the rotor.

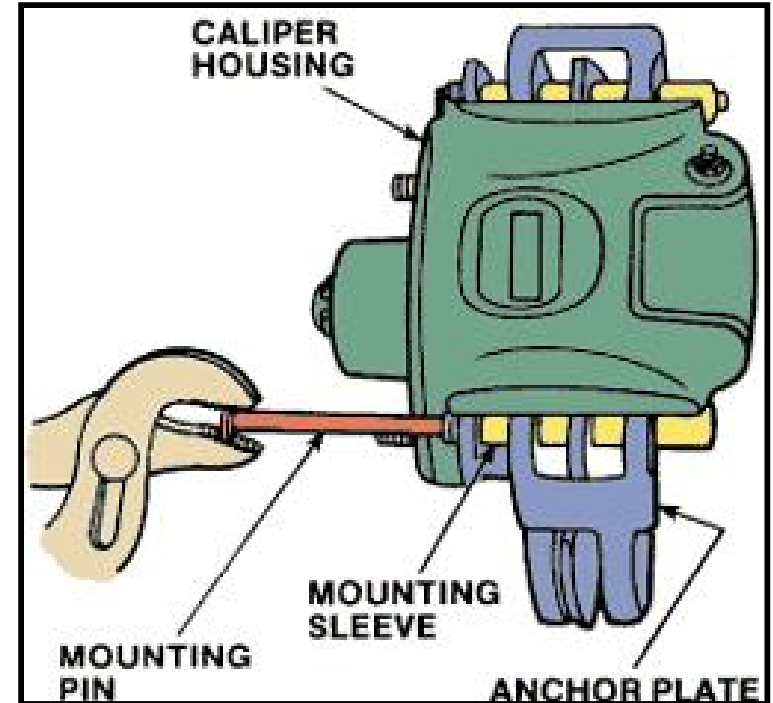
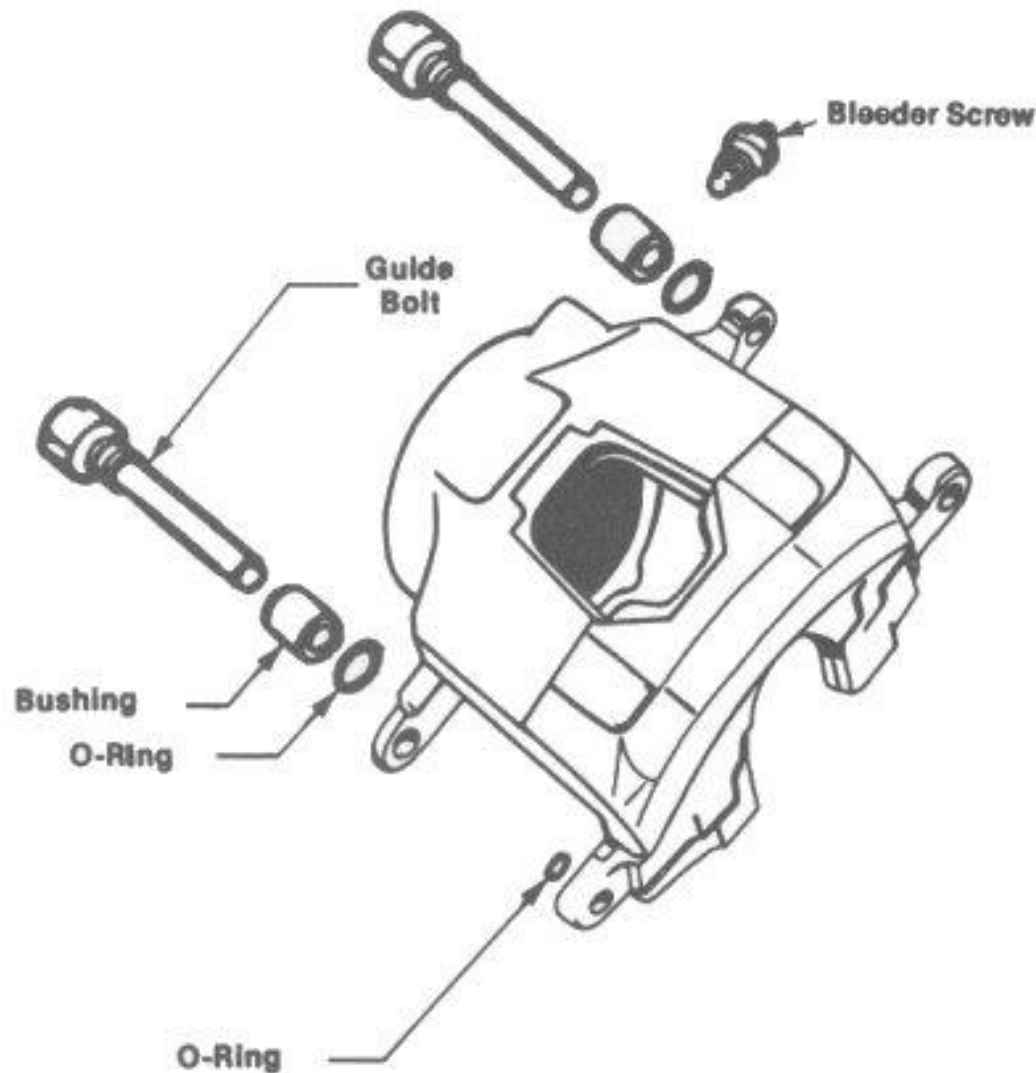


Equal
Peer
Atomic



ATASA 5th Disc Brake Systems

22. Both floating caliper locating pins & sliding caliper support keys must be _____.



Lubricated
Dry
Waxed

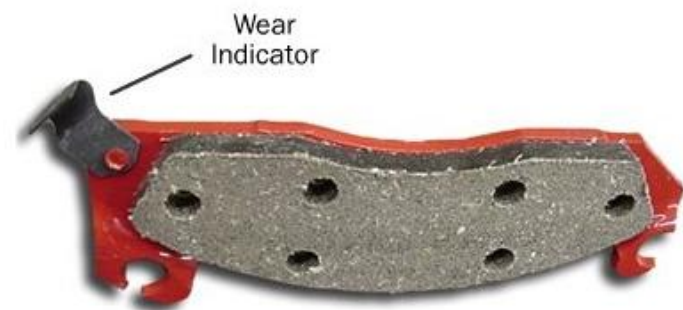


ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems

23. Brake pads, just like brake shoes may have their linings either _____ or _____ to the steel backings that can be organic nonasbestos, metallic, semi-metallic, synthetic or ceramic.



Riveted or Bonded
Screwed or Cemented
Welded or Soldered

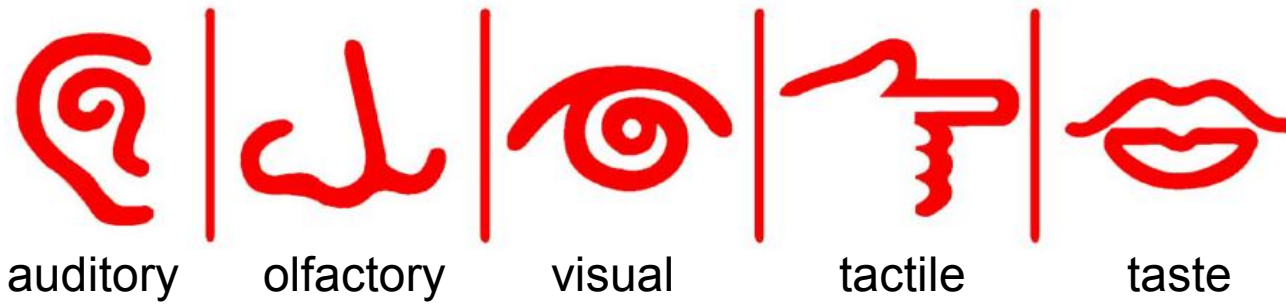
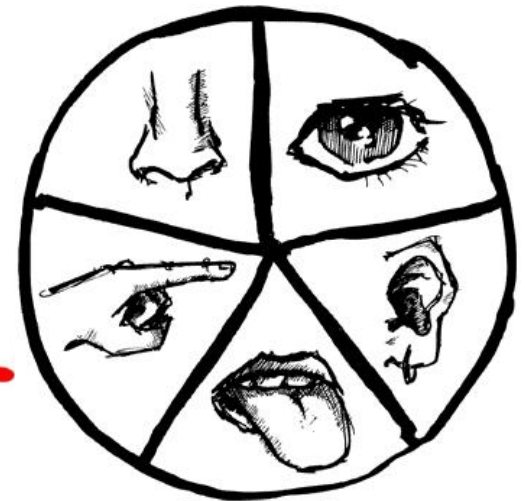
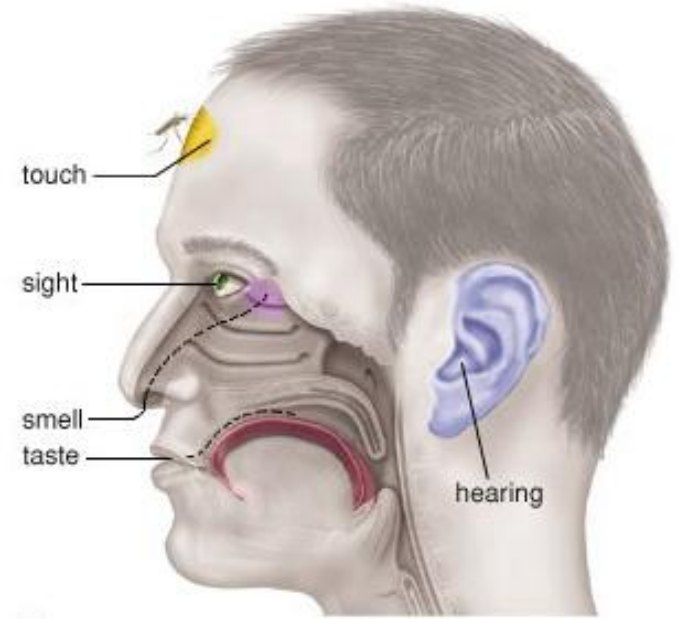
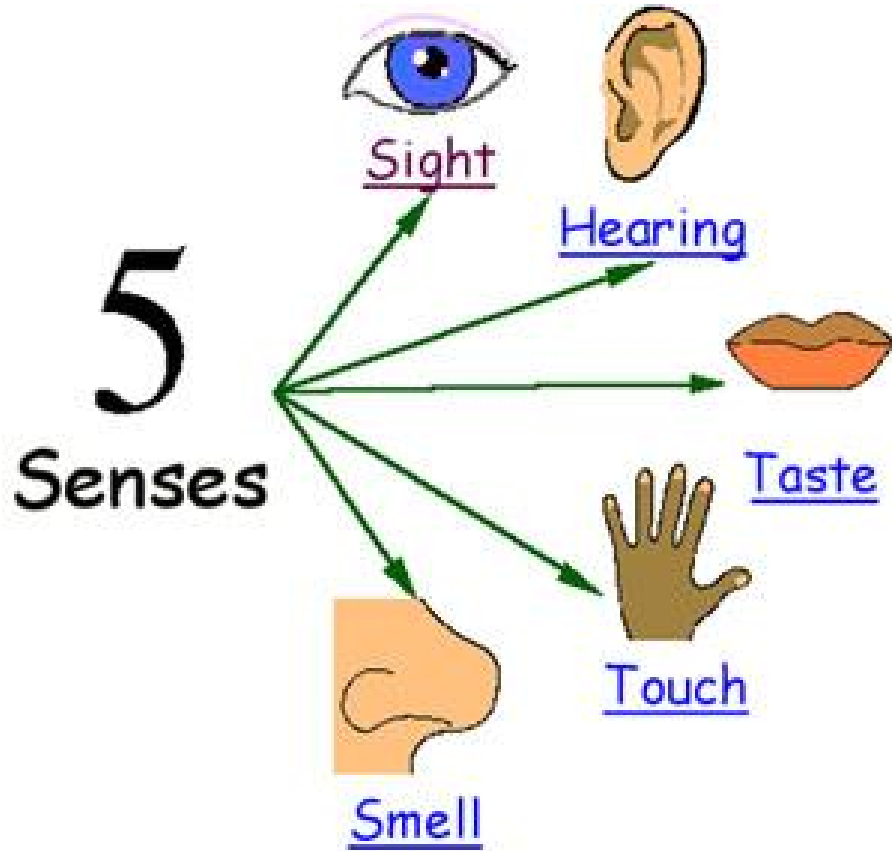
ATASA 5th Disc Brake Systems

24. Worn brake pads equipped with steel tab _____ sensors or wear indicators create a high-pitched squeal whenever the wheel is turning.
When the brakes are applied, the noise goes away.



Audible
Tactile
Visual

ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems

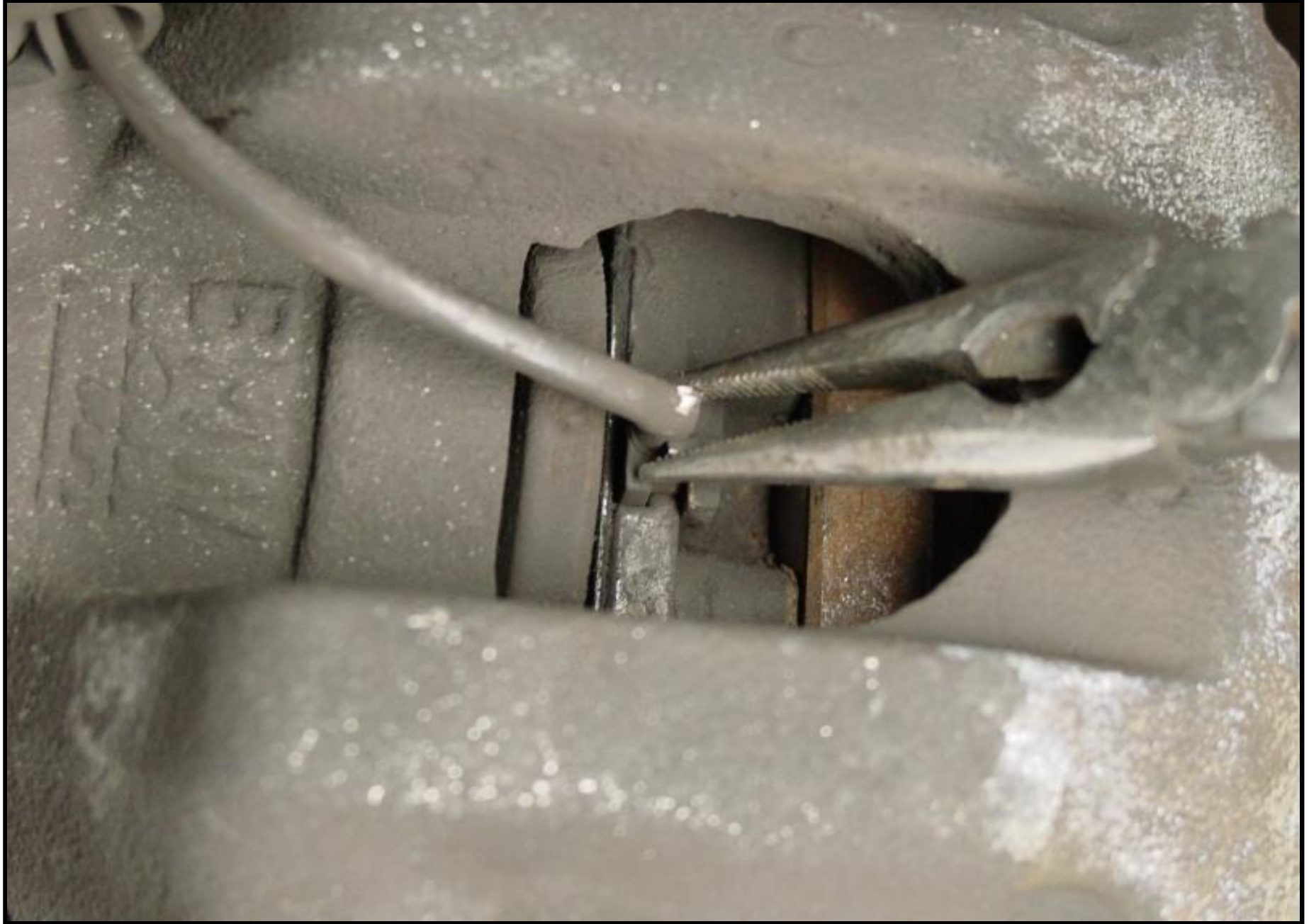
25. _____ wear indicators use sensors on the pads to illuminate a dashboard warning light.



Audible
Tactile
Visual



ATASA 5th Disc Brake Systems



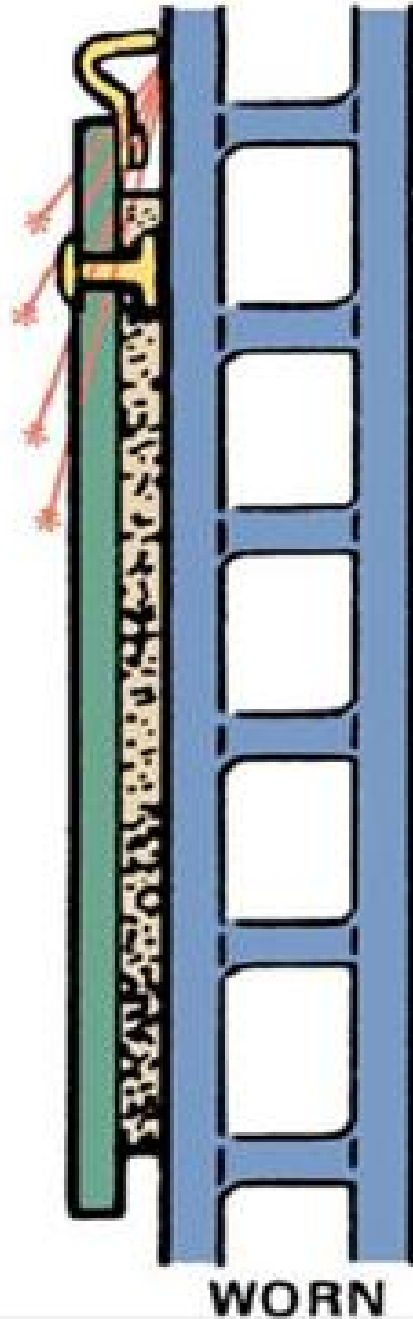
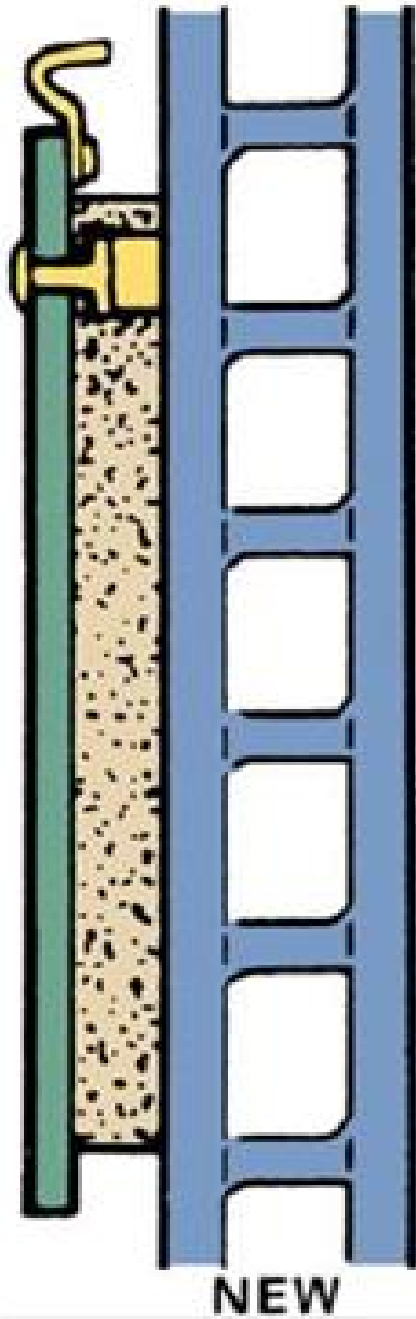
ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems

26. Proper break-in - break-out of the new friction materials (*linings*) on any brake system will prevent the resin binder from overheating and forming a squealing & fade-prone glaze over the pads.



Break-out
Break-in
Break-up

ATASA 5th Disc Brake Systems

27. Parking brake systems on rear disc brakes can be an auxiliary _____ brake inside of the rotor that use a small set of parking brake shoes & no self-adjusters. *Known as a "drum-in-hat system.*



Drum
Bum
Chum

ATASA 5th Disc Brake Systems

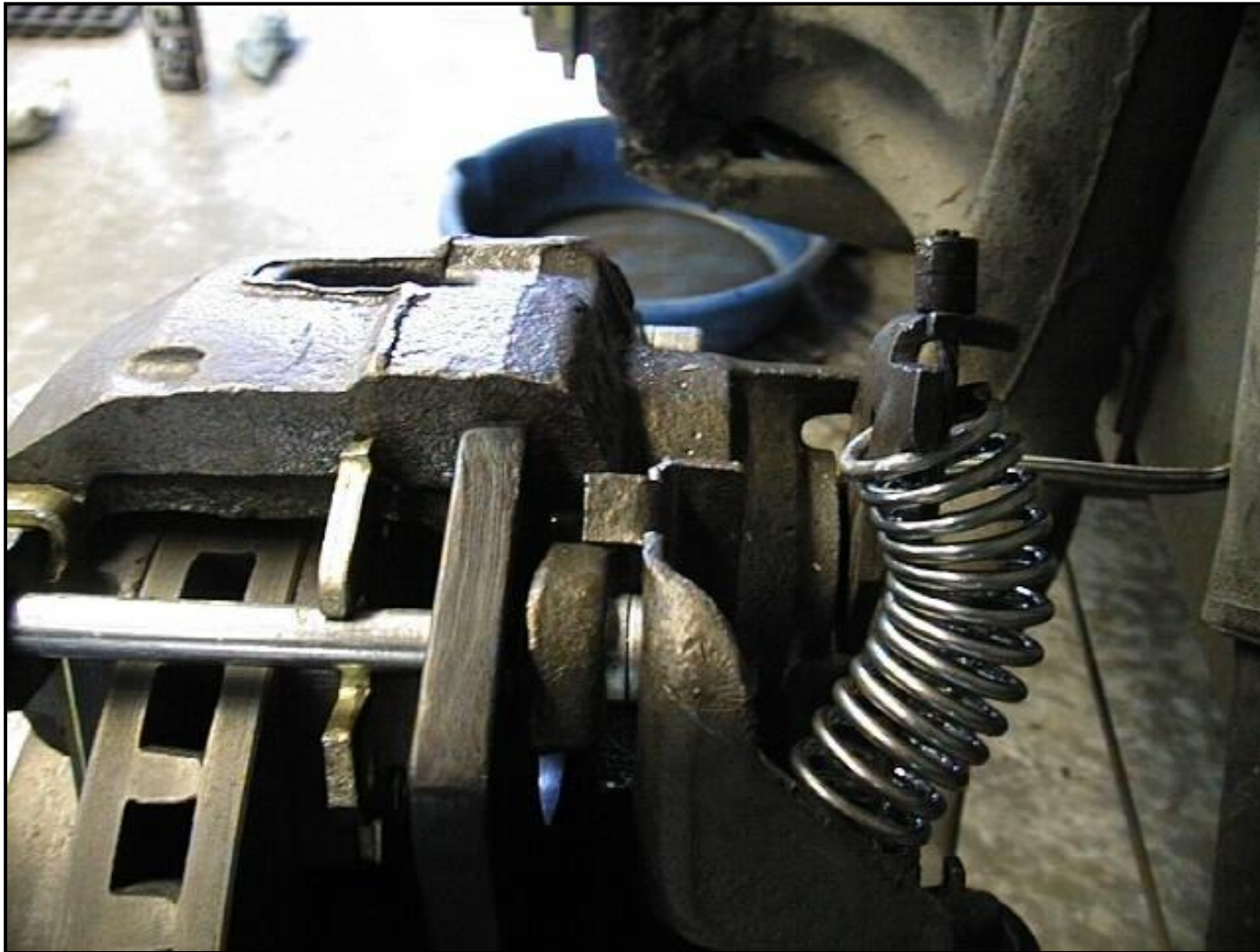


ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems

28. Parking brakes in/on the caliper can use either a screw-and-nut or a _____-and-_____ or an eccentric shaft and rod arrangement to mechanically apply & retract. (*rotate R or L to retract*)



Ball & Ramp

ATASA 5th Disc Brake Systems



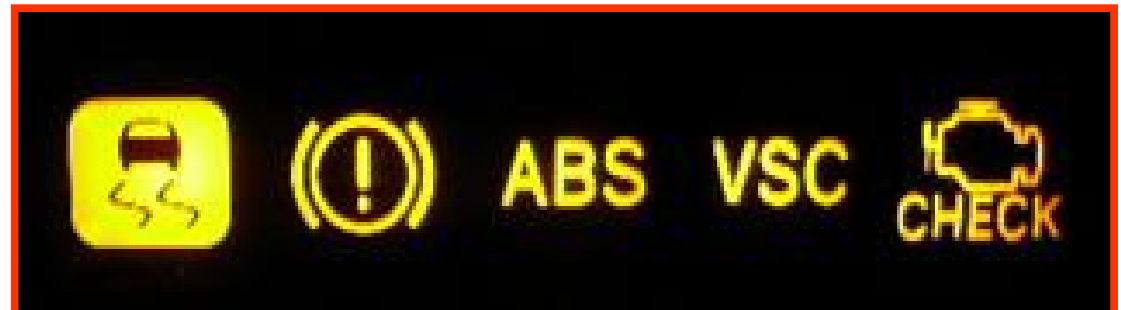
ATASA 5th Disc Brake Systems

29. Vehicles may have *more than 1 brake warning light* in the instrument cluster: the _____ warning light indicates a problem in the regular brake system, low fluid, or parking brake applied the _____ or _____ warning light is tied into the antilock system (self-test or fault) a _____ warning light lets the drive know the wheels are slipping because of poor road conditions

These lights should illuminate either during cranking or in the KOEO position for bulb check !!

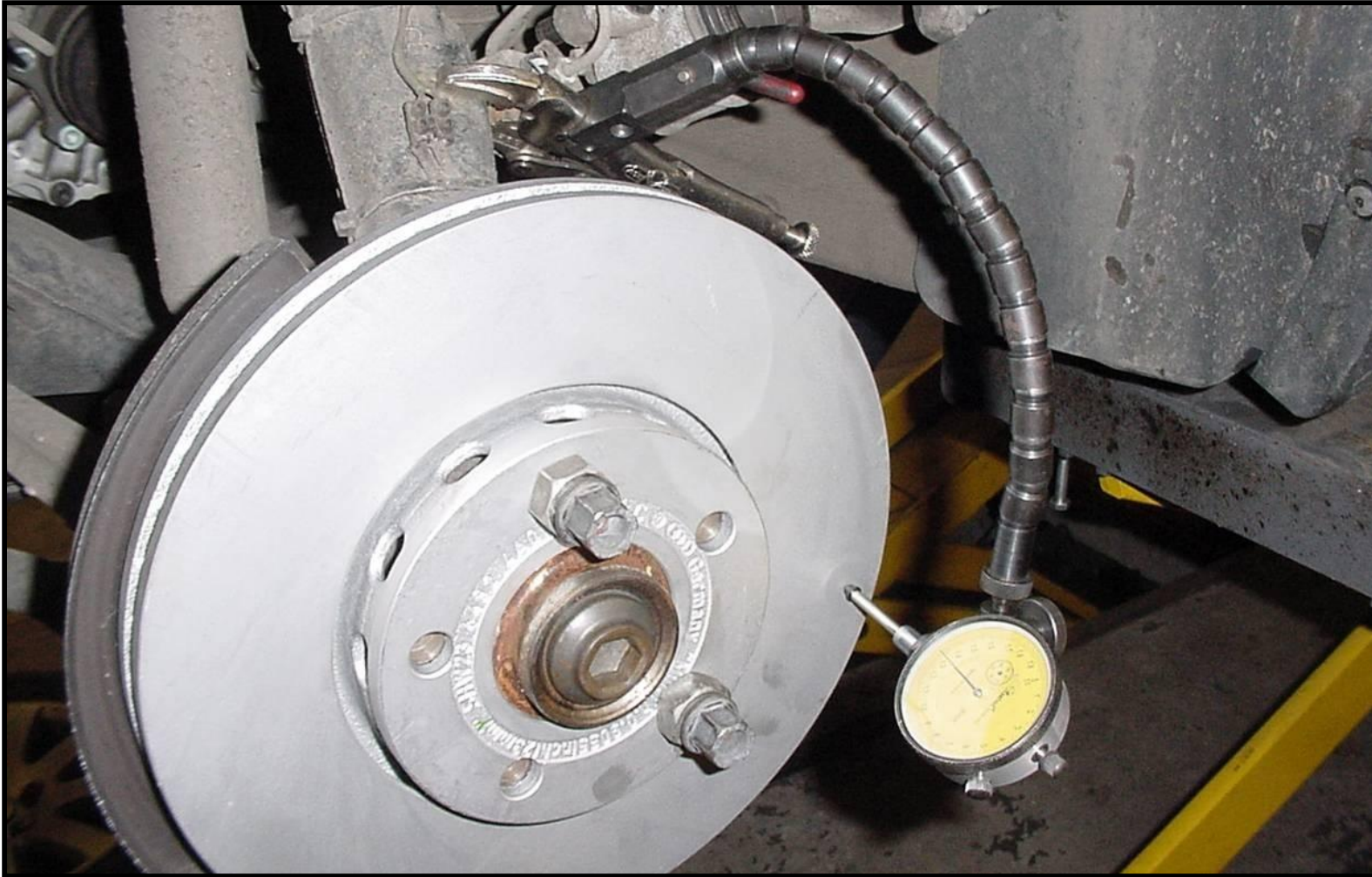


Red, orange or amber, yellow



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30. Pedal _____ during normal braking indicates rotors with runout or parallelism problems.



Pulsation
Shimmy
Sinking

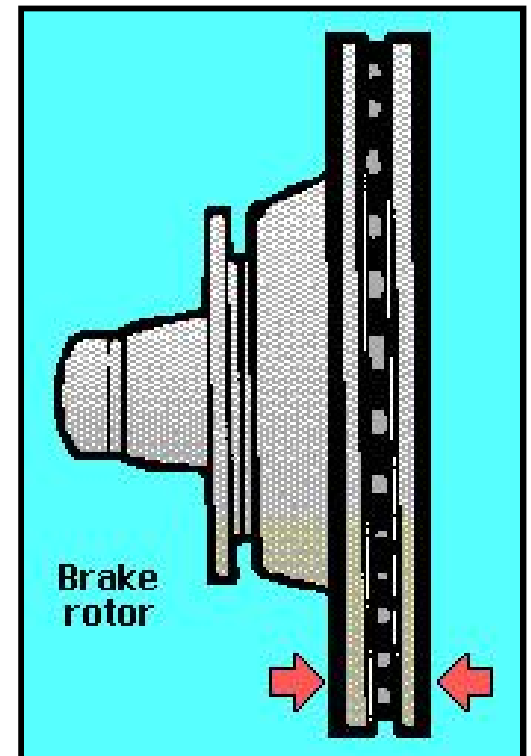
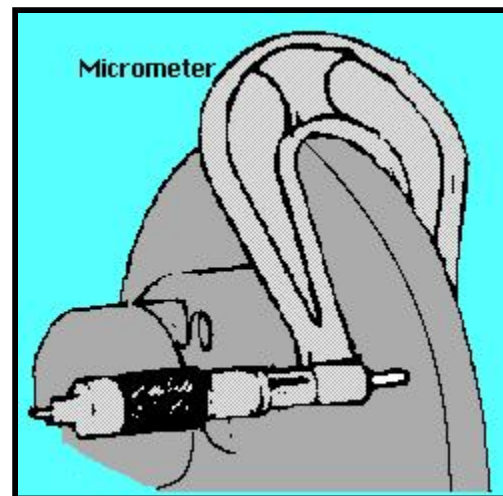
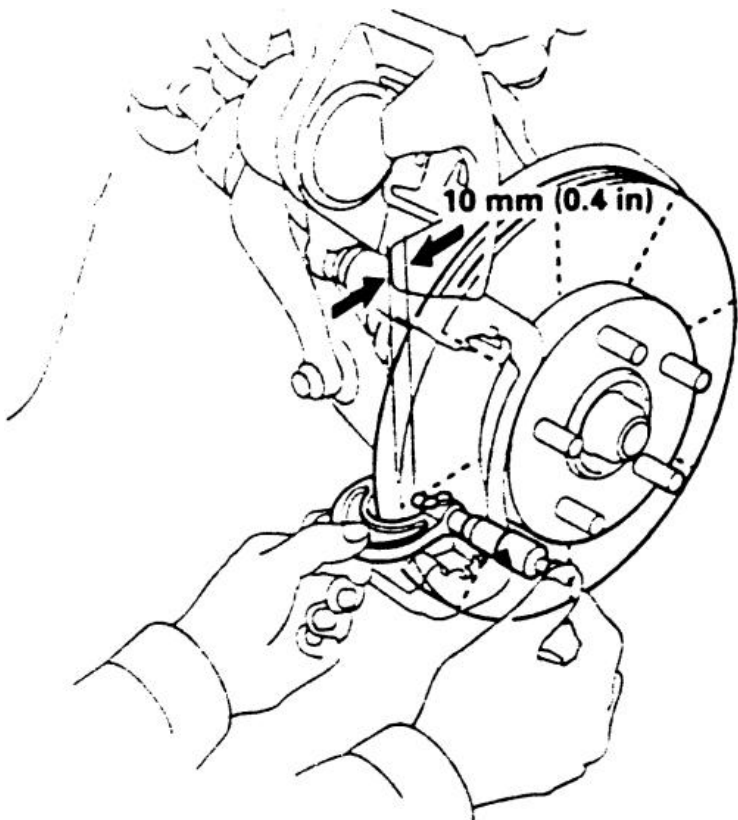
ATASA 5th Disc Brake Systems

Parallelism refers to variations in thickness of the rotor .

If the rotor is out of parallel, it can cause excessive pedal travel, front-end vibration, pedal pulsation, chatter, and on occasion, grabbing of the brakes.

The rotor must be resurfaced or replaced.

To check parallelism, measure thickness of the rotor at eight different spots.



ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems

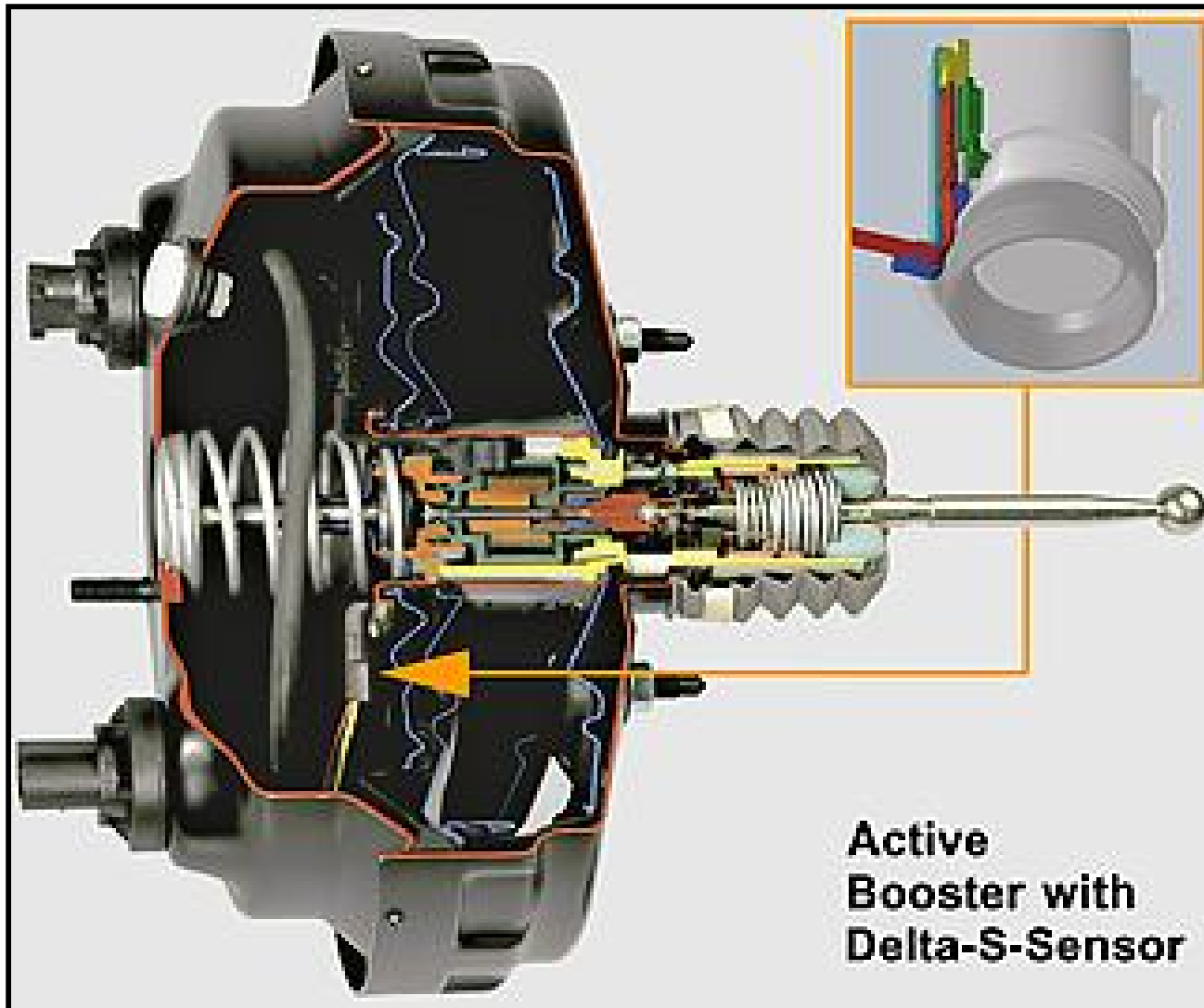
31. _____ or soft pedal feel indicates air has entered the hydraulic system & it needs bleeding.



Hard
Spongy
Pulsating

ATASA 5th Disc Brake Systems

32. _____ pedal indicates a problem w/ power brake booster operation, a restricted hose or valve.



Hard
Spongy
Pulsating

ATASA 5th Disc Brake Systems

33. _____ parking brakes & seized caliper pistons generate destructive amounts of heat.



Dragging
Slipping
Slacking

ATASA 5th Disc Brake Systems

34. _____ or overly sensitive brakes can be contaminated with oil, grease, or brake fluid.



Grabbing
Dragging
Slacking

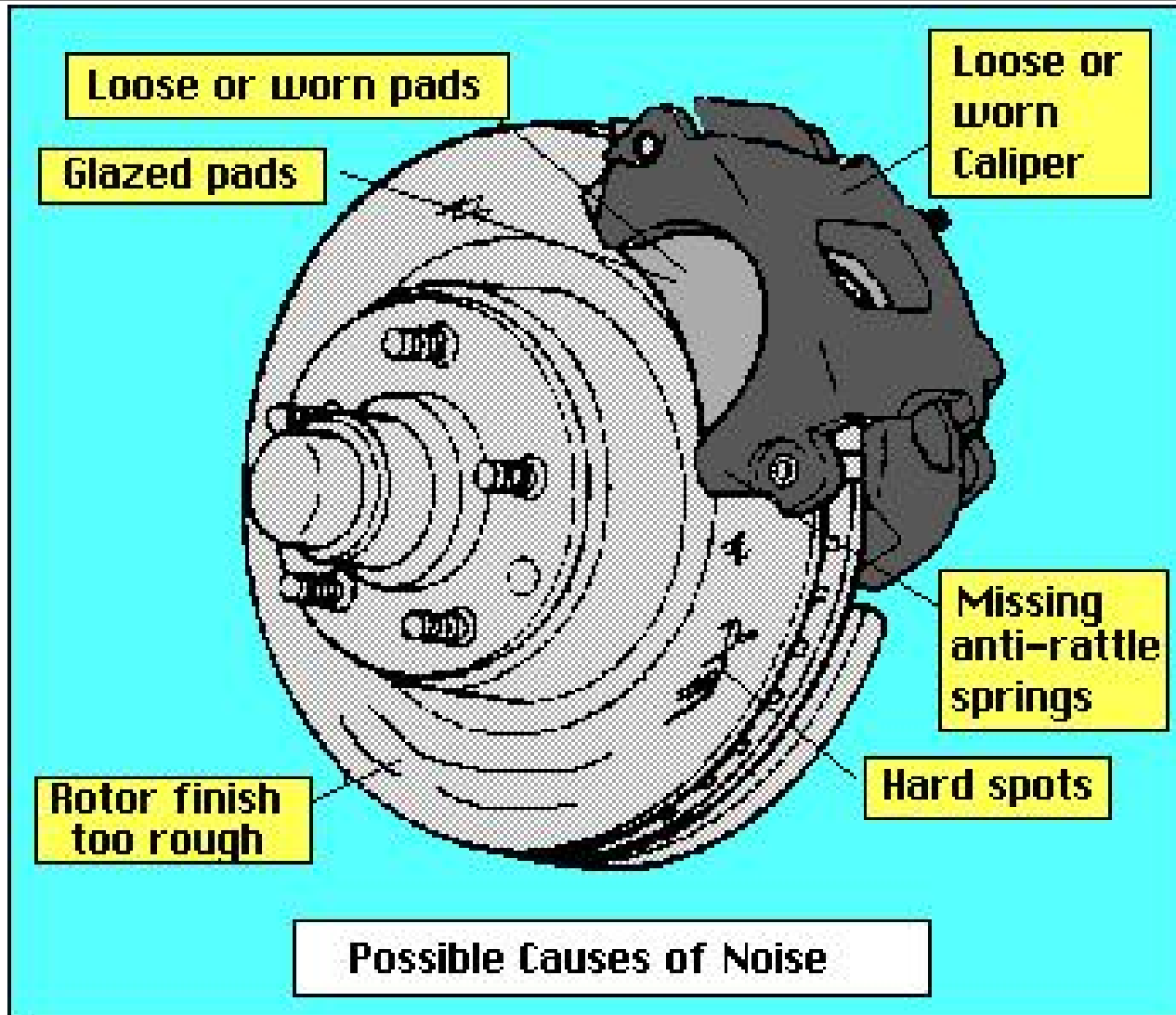
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ATASA 5th Disc Brake Systems

35. Noting the _____ of noise, frequency of noise, and time that brake noise occurs can help lead to finding the source of a brake problem.

Noise following brake service can be hardware-oriented.



Type
Skype
Yipe

Frequency =
How Often it Repeats

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36. A vehicle pulling or drifting to one side, can be caused by either tires, _____ or by steering and suspension problems.

Note the speed at which the drift occurs.

Often, pull=brakes & drift = alignment

Brakes

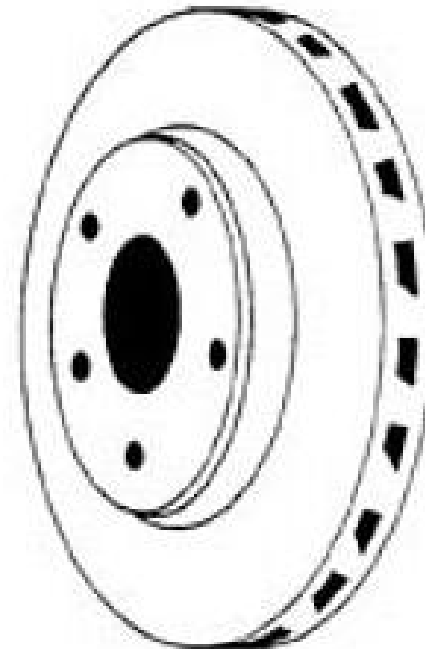
STEERING LEAD OR BRAKE PULL?

Troubleshoot the Condition Before You Install the Friction

By Larry Hammer

Troubleshooting a steering lead or brake pull symptom can be a challenge, considering that one can complement the other. Often the customer will request a brake job for a pull or lead symptom, only to encounter the same after the service has been performed. Then they are certain it must have been something we failed to do in our repair procedures. We know different, but we are still faced with having to diagnose the condition. Unfortunately, in the haste of our daily battle, too many recommend a service prior to diagnosing and isolating the problem. Take the time to perform the diagnostics, or else you may have to eat some of that brake job, especially when it turns out to be a steering related problem.

We see friction materials returned claiming that a brake pull was encountered following a brake service and a second set of friction was the cure. It is possible, but very unlikely. When all the facts are on the table, the ultimate fix involved much more. A steering lead can become a pull when aggravated during a brake application, just like a residual pressure problem may be misdiagnosed as a steering or alignment condition.



**Note: For safe & successful brake work, always follow the
SERVICE GUIDELINES on page 1490**

ATASA 5th Disc Brake Systems

37. Removing some fluid from the reservoir prior to pad replacement prevents _____.

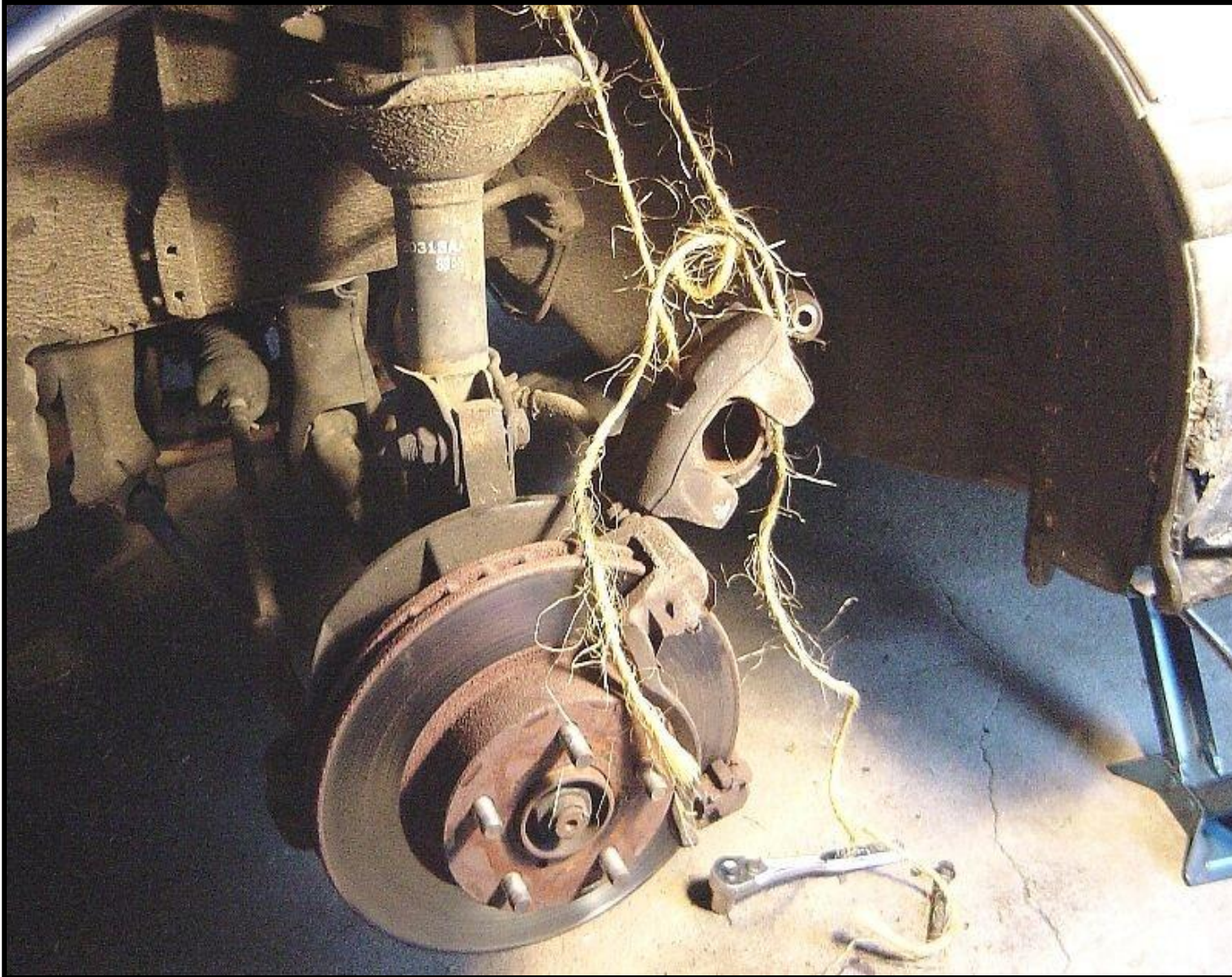


Over flowing
Over reacting
Over emphasizing



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38. Never let the caliper hang with its weight on the brake _____
& don't pinch-off hoses!



Hose
Cylinder
Booster

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ATASA 5th Disc Brake Systems

39. Brake noise suppressor (*spray or plastisol*) is applied to the back of the pads to prevent _____.



Squeal
Chatter
Twitter

ATASA 5th Disc Brake Systems

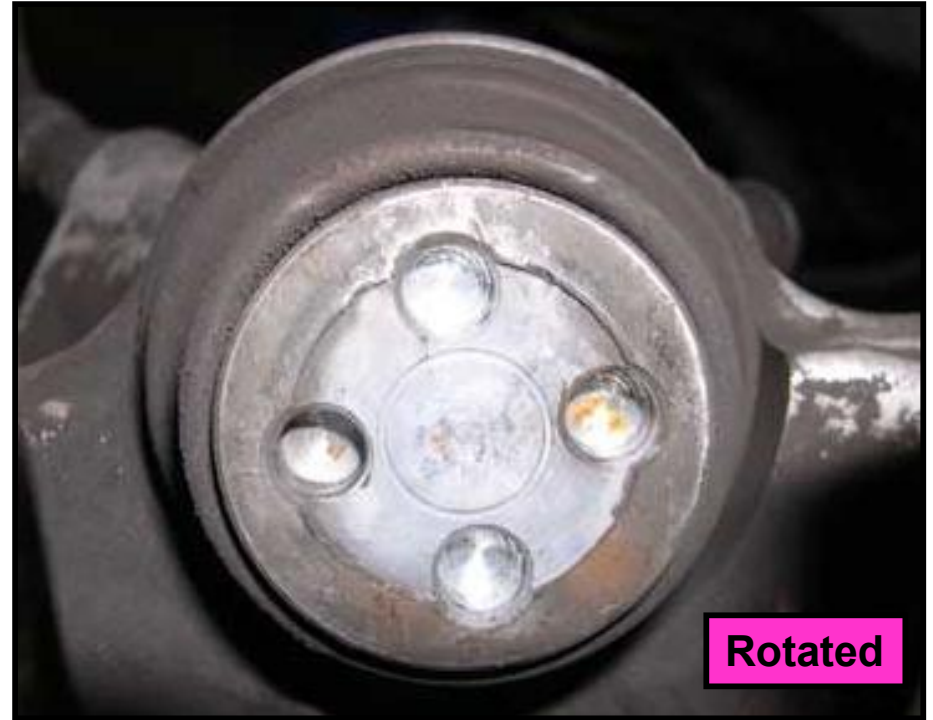
40. Best practice for fluid removal before pad replacement is to open the _____ screw and run a hose down to a container to catch the fluid as the caliper piston is bottomed in its bore.



Bleeder
ABS
Caliper

ATASA 5th Disc Brake Systems

41. On threaded-type (*parking brake*) rear calipers, pistons must be _____ back into their bores.

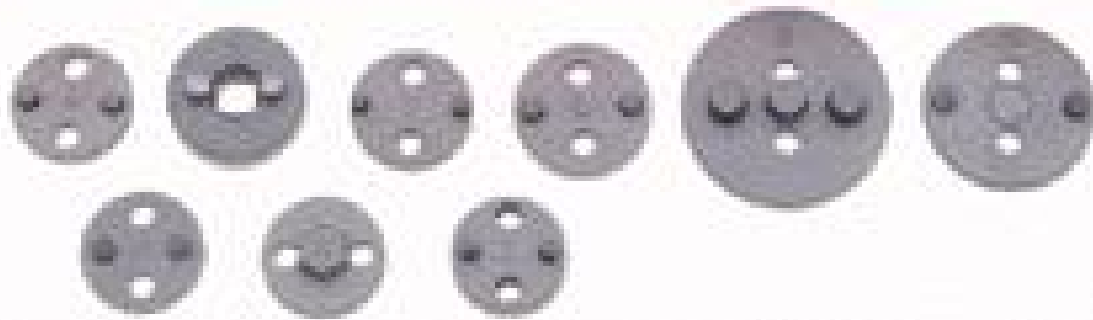


ATASA 5th Disc Brake Systems



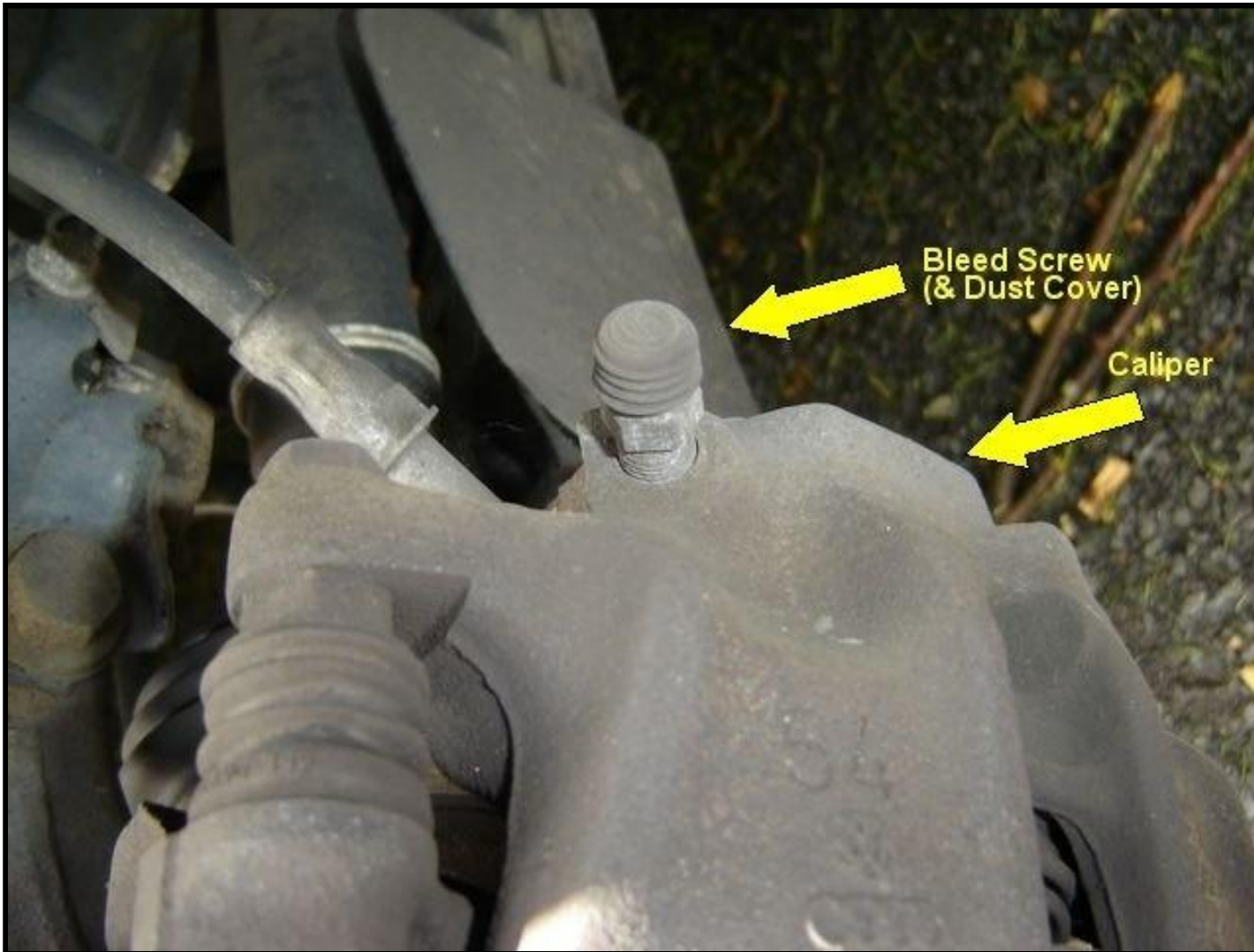
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Right-handed & Left-handed
caliper piston
bottoming tools



ATASA 5th Disc Brake Systems

42. There is no reason to disconnect brake _____ if just the pads are being replaced. But bleeders should be loosened while pistons are being bottomed to prevent ABS valve body concerns.



Hoses
Cylinder
Booster

ATASA 5th Disc Brake Systems



ATASA 5th Disc Brake Systems

Note: It's recommended to either replace or true-up (*machine*) the rotors anytime pads are replaced.



On-the-car Lathe



Brake Fluid



ATASA 5th Disc Brake Systems

Non-directional finish required!!



ATASA 5th Disc Brake Systems

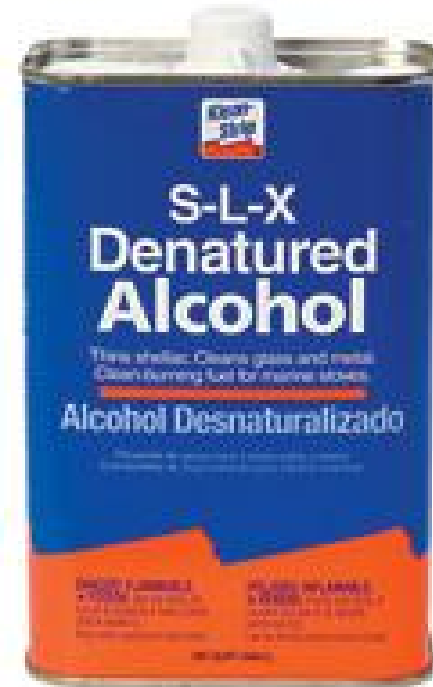
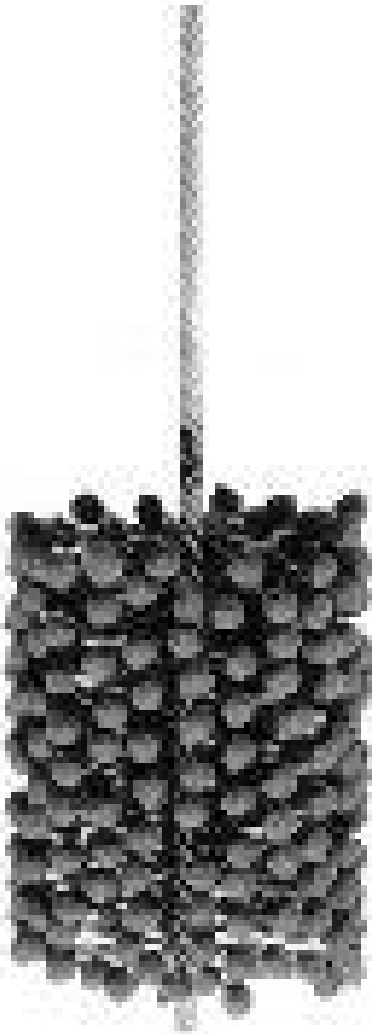
43. During caliper overhaul, pistons can be removed with ____ pressure compressed air. (*under 30 psi*).



High (>300 psi)
Low (< 30 psi)

ATASA 5th Disc Brake Systems

44. After light honing or *polishing with crocus cloth*, clean the caliper with denatured _____.



Polish
Alcohol
Baking Soda

ATASA 5th Disc Brake Systems

45. A _____ caliper is purchased completely remanufactured with pads & mounting hardware. *(Return the caliper & bracket for the core refund)*



Premium quality, application specific brake pads with shims



Totaled
Basic
Loaded

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46. Some calipers have a _____ cut in the face of the piston that must align with an *anti-squeal shim*.



Slot
Hole
Notch

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47. Brake pads have hardware or _____ clips & pins to restrict the squeal-causing free play.

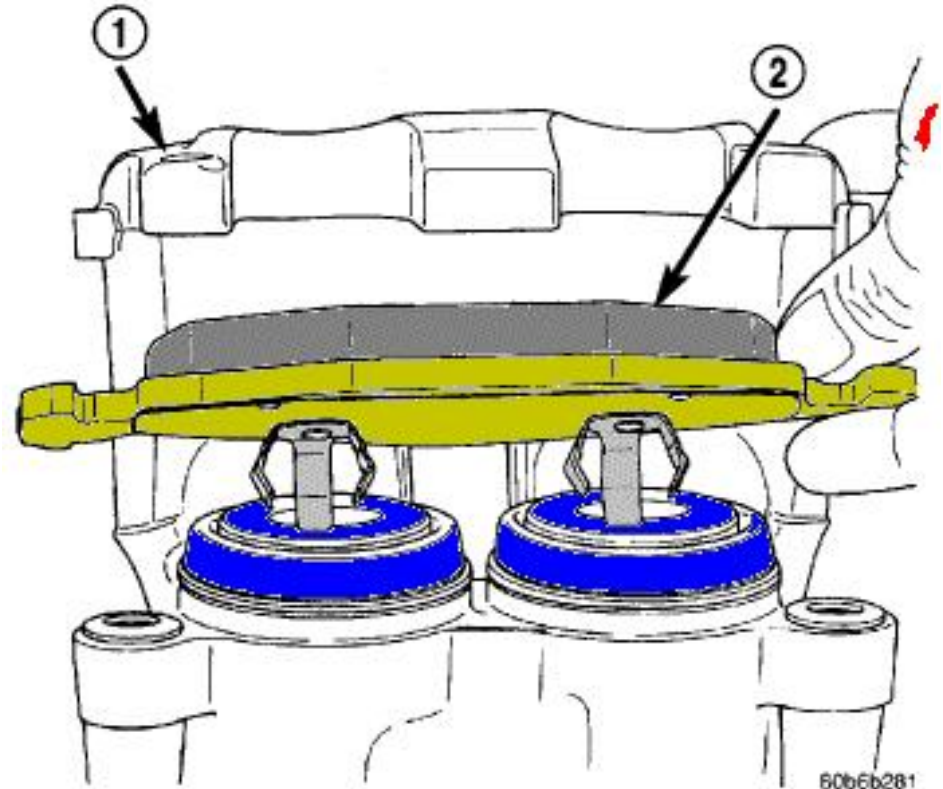
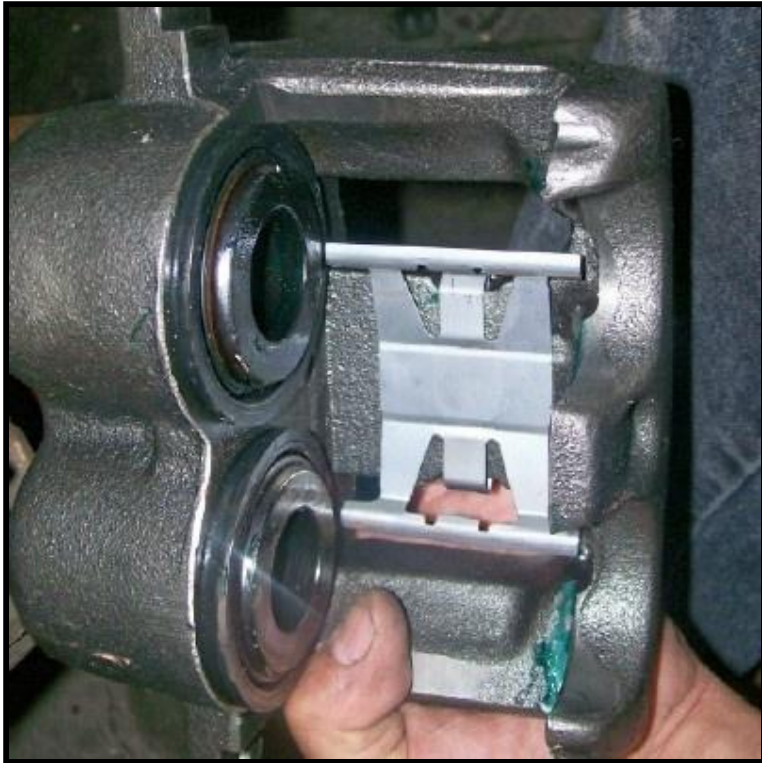
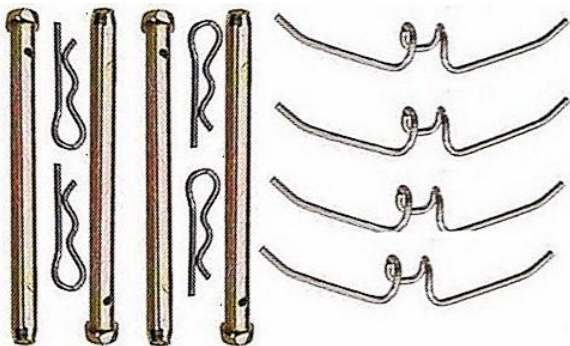


Fig. 31 Inboard Brake Shoe

- 1 - CALIPER
- 2 - INBOARD SHOE



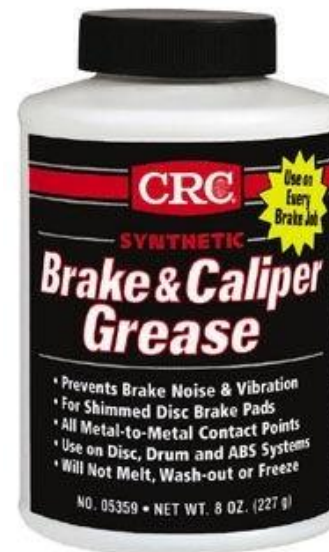
Clips
Notches
Slots

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48. Rubber insulators on *caliper slides* should be lubricated with _____ dielectric compound...or caliper slide lubricant.

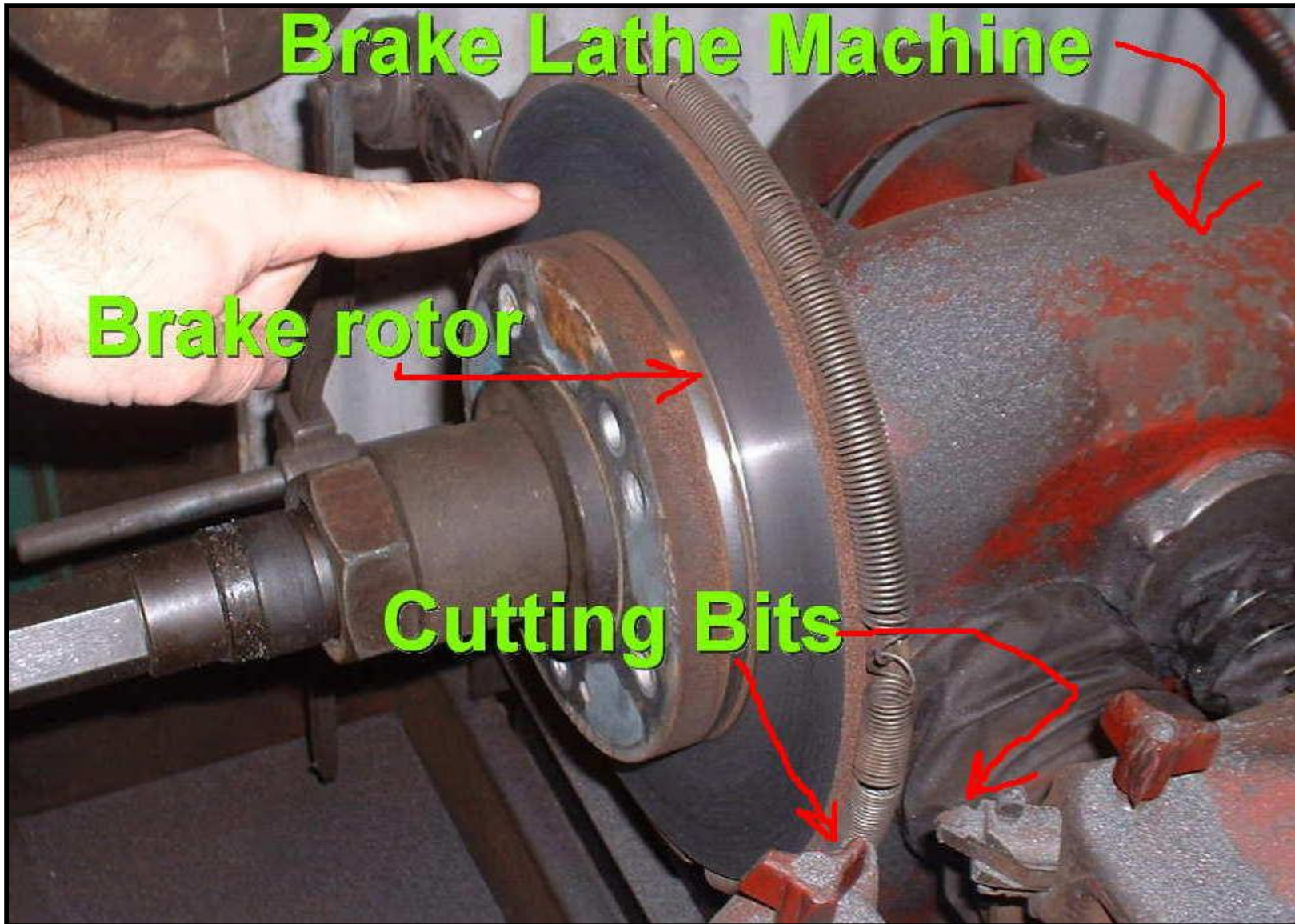


Silicone
Petroleum
Anti-Seize



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49. Closely inspect & then either replace or true-up (machine) the _____ anytime pads are replaced.

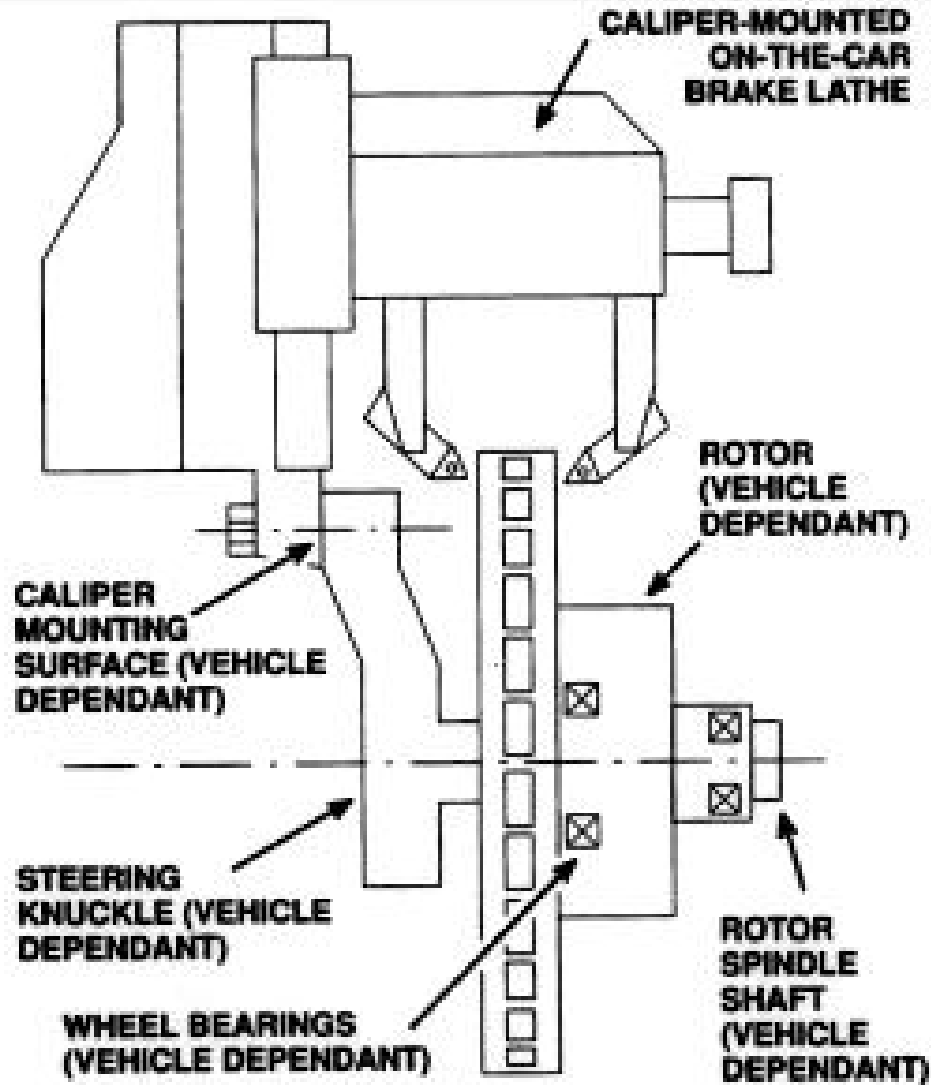


Drums
Cables
Rotors

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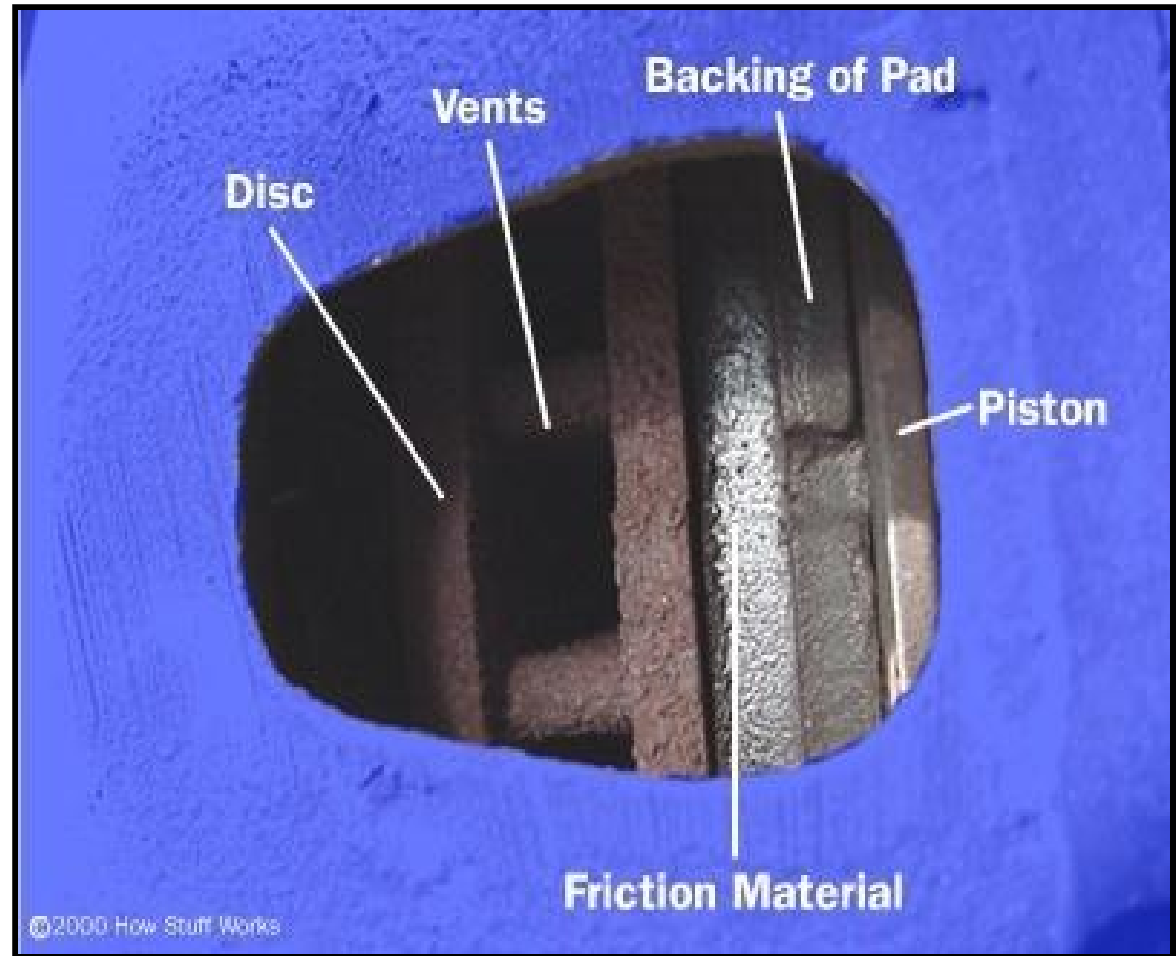
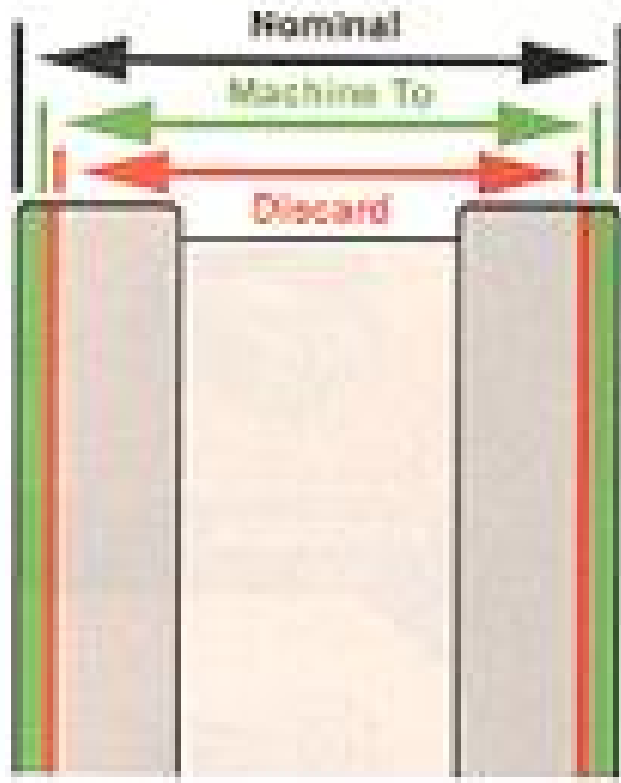
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**FIG. 6 CALIPER-MOUNTED ON-THE-CAR
BRAKE LATHE ATTACHED TO STEERING
KNUCKLE AND ROTOR**

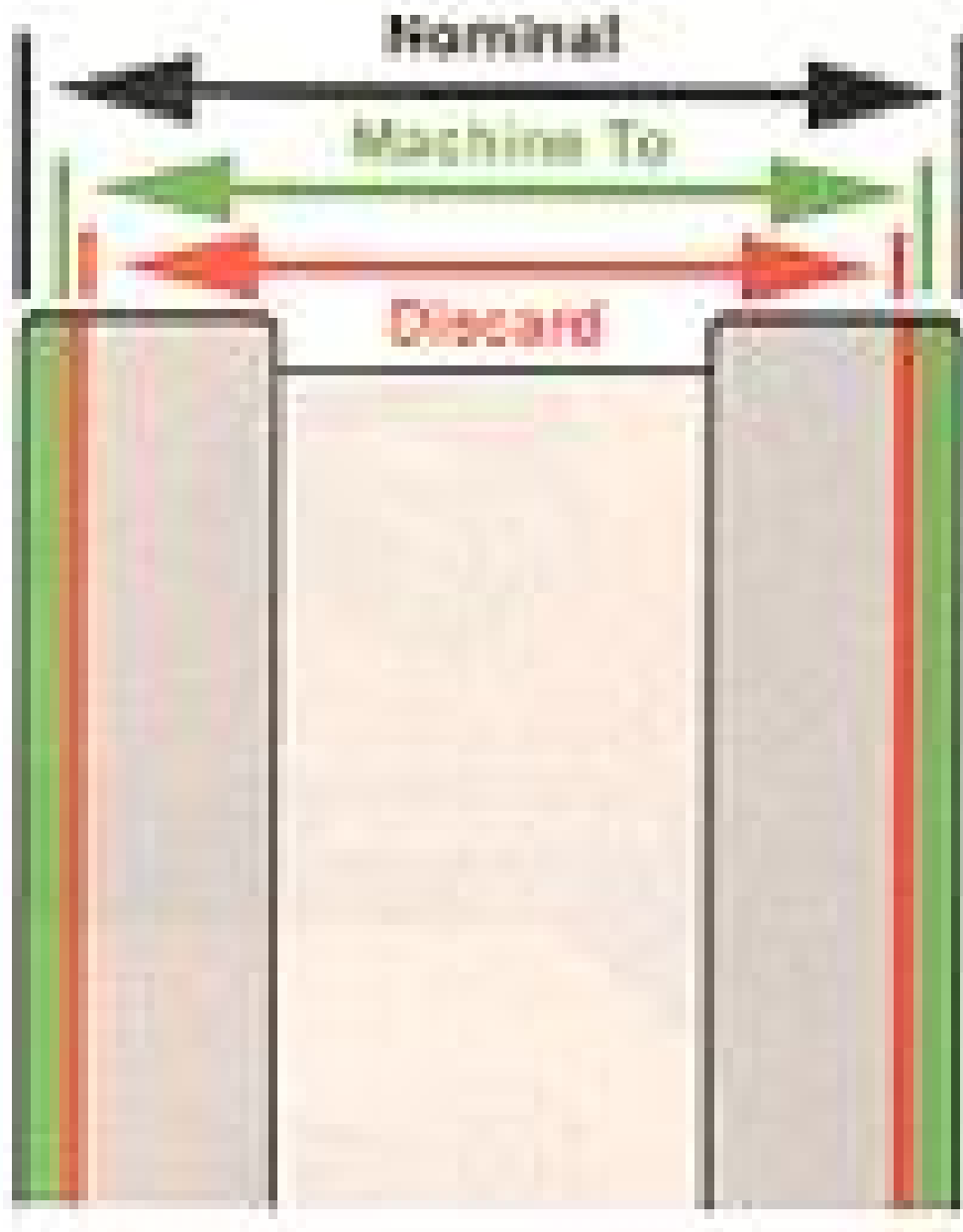
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50. Brake rotors have a nominal, discard, or minimum _____ specification cast into them.



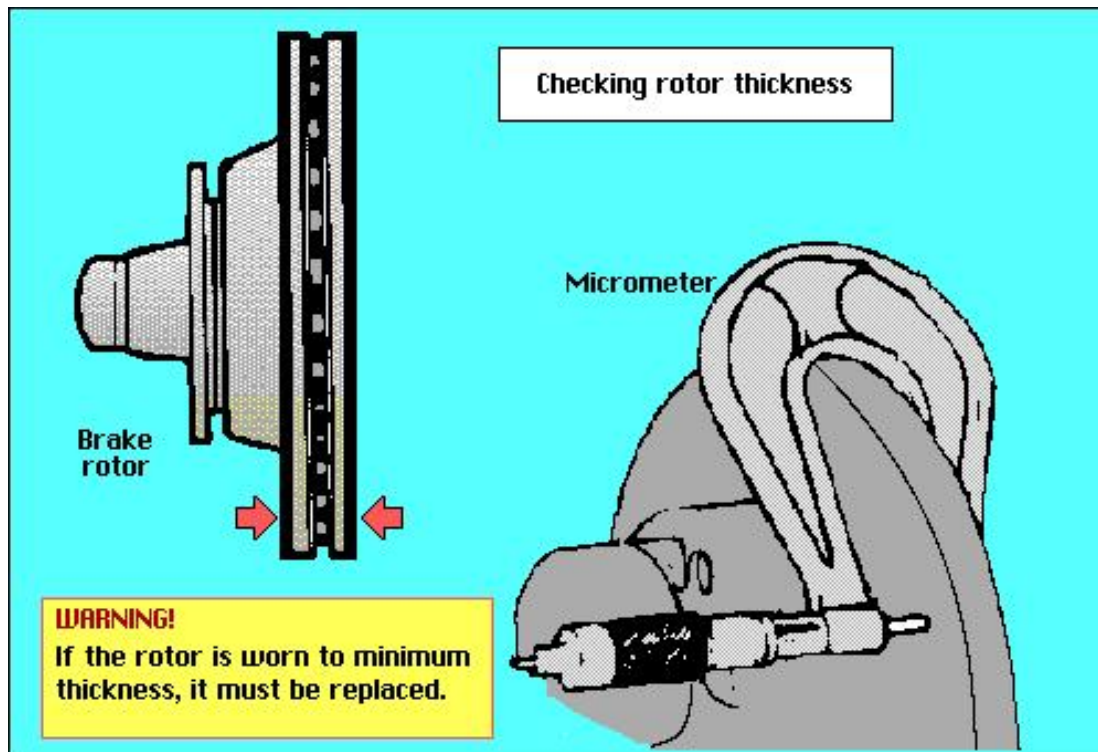
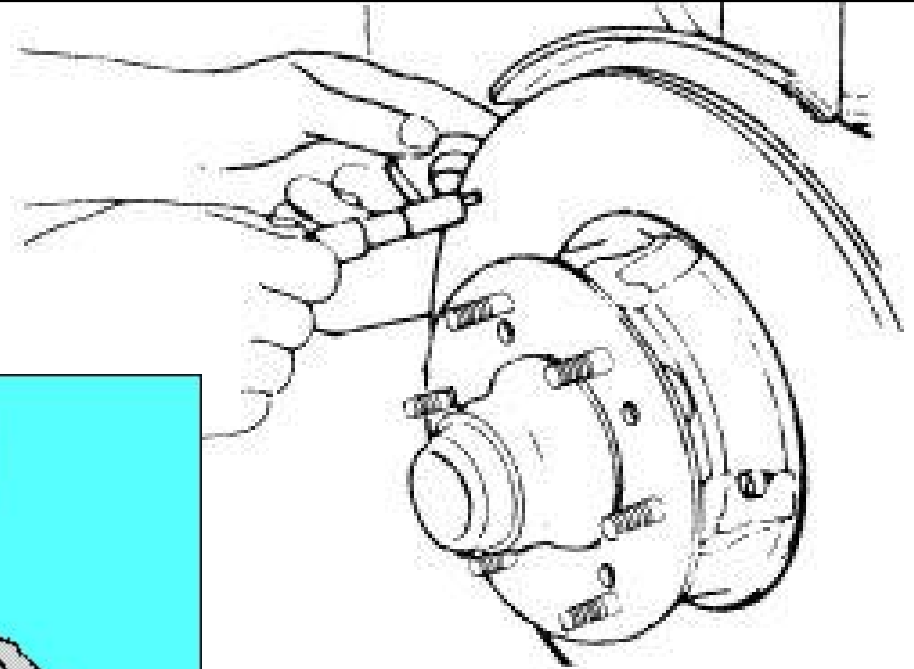
Width
Height
Thickness

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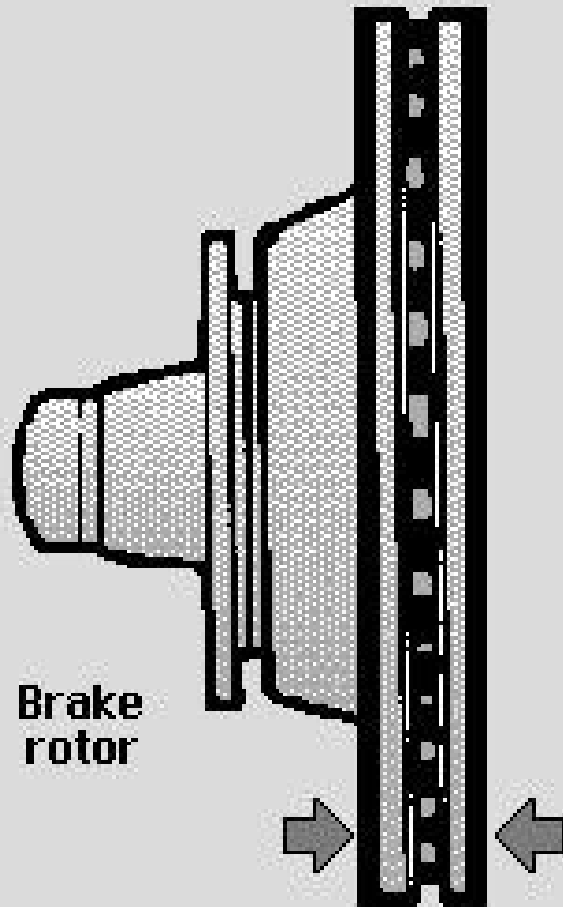
51. _____ refers to variations in rotor surface thickness. (.0005" maximum!)
Excess parallelism leads to runout & pedal pulsation, chatter, grabbing, & excessive pedal travel.



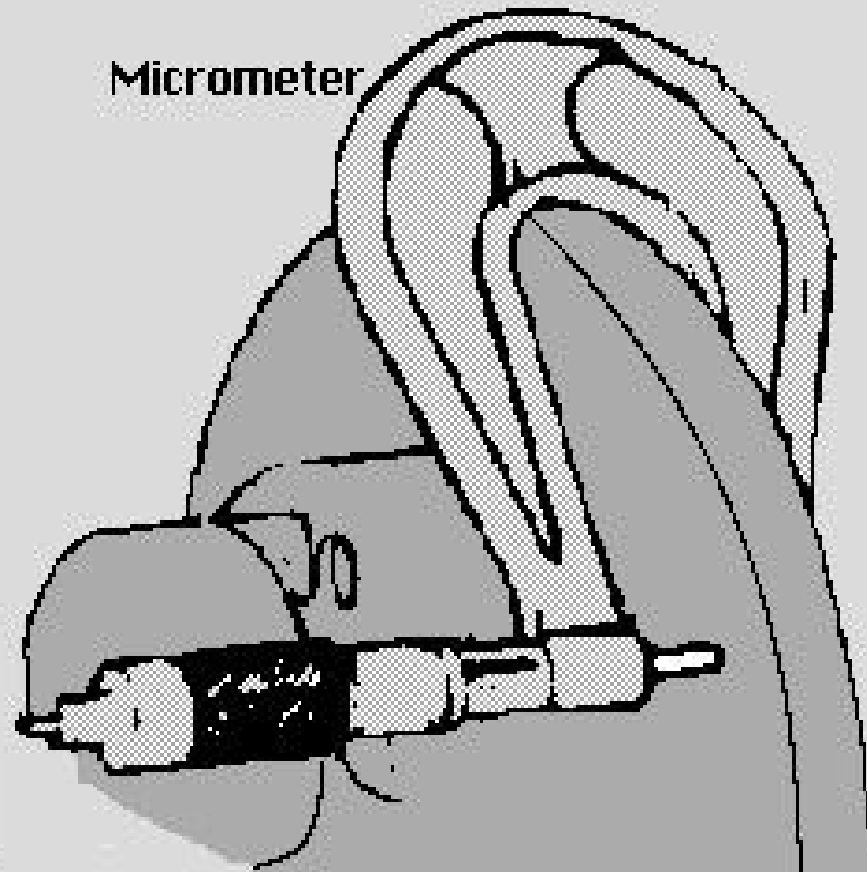
Runout
Parallelism
Lateral Play

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Checking rotor thickness



Micrometer



WARNING!

If the rotor is worn to minimum thickness, it must be replaced.

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52. Axial or _____ rotor runout (*wobble*) of more than .005" can cause pedal pulsation & piston knock-back. *Knock-back then demands more fluid movement & pedal travel on brake application.*

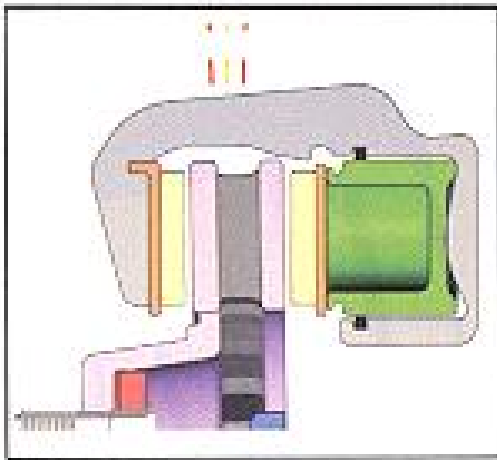


Figure 5

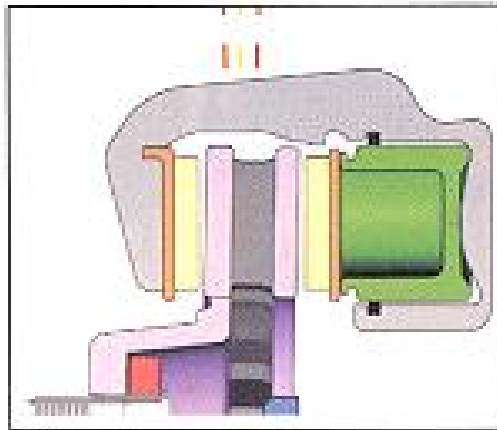
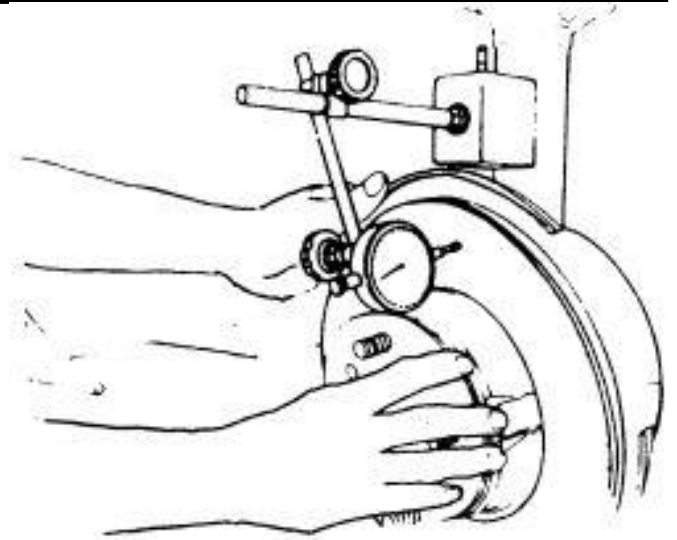


Figure 6



Lateral
Radial
Parallelism

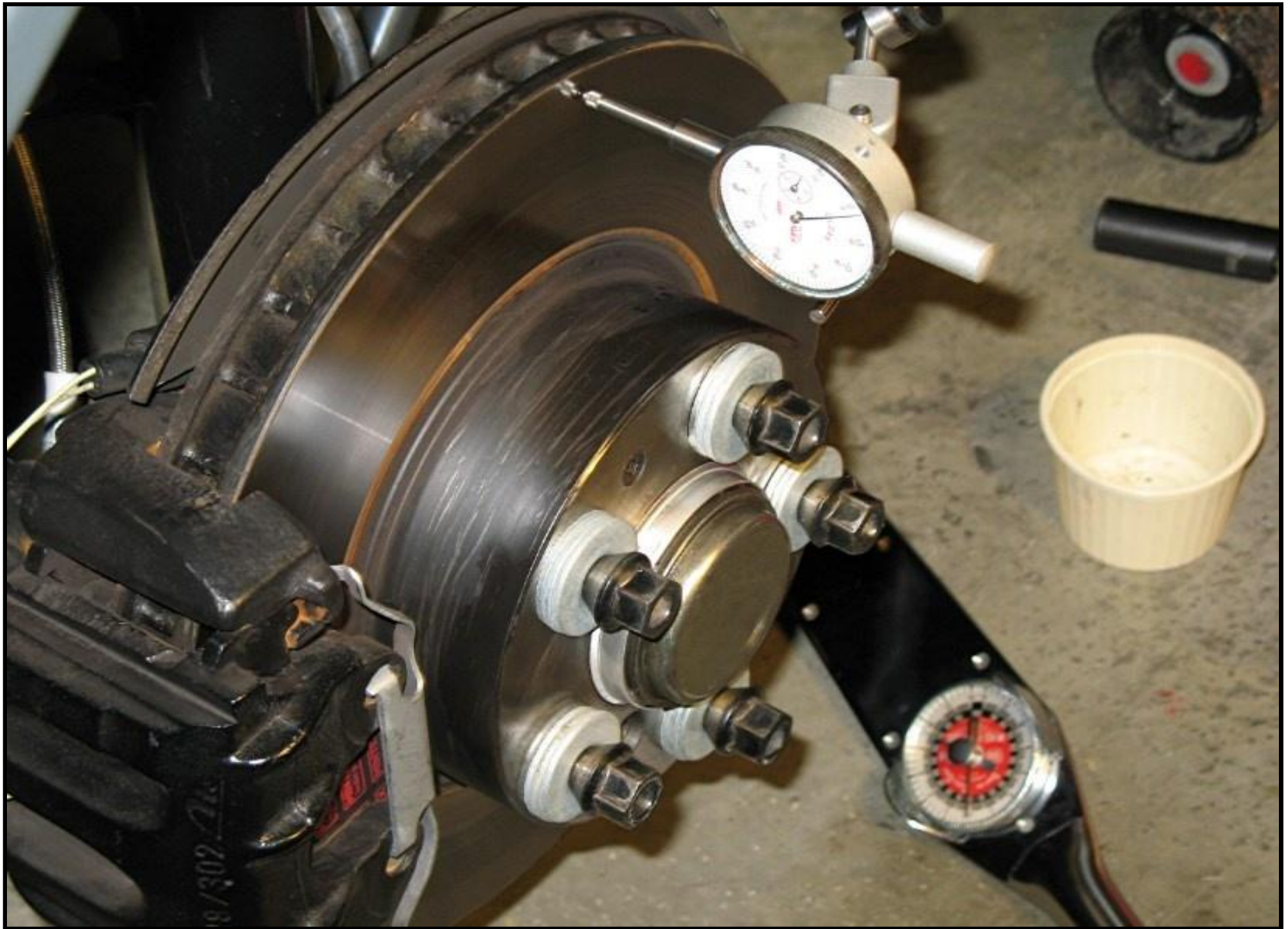
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53. _____ bearings on rotors with hubs and lug nuts on floating rotors will have to be tightened to get an accurate runout reading when using a dial indicator.



Wheel
Keel
Ball

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54. Rotors with blue areas, heat _____ and hard spots have been so overheated that a change in their metallurgy has taken place.
They should be replaced as should excessively rusted rotors.



Checking
Stressing
Treating

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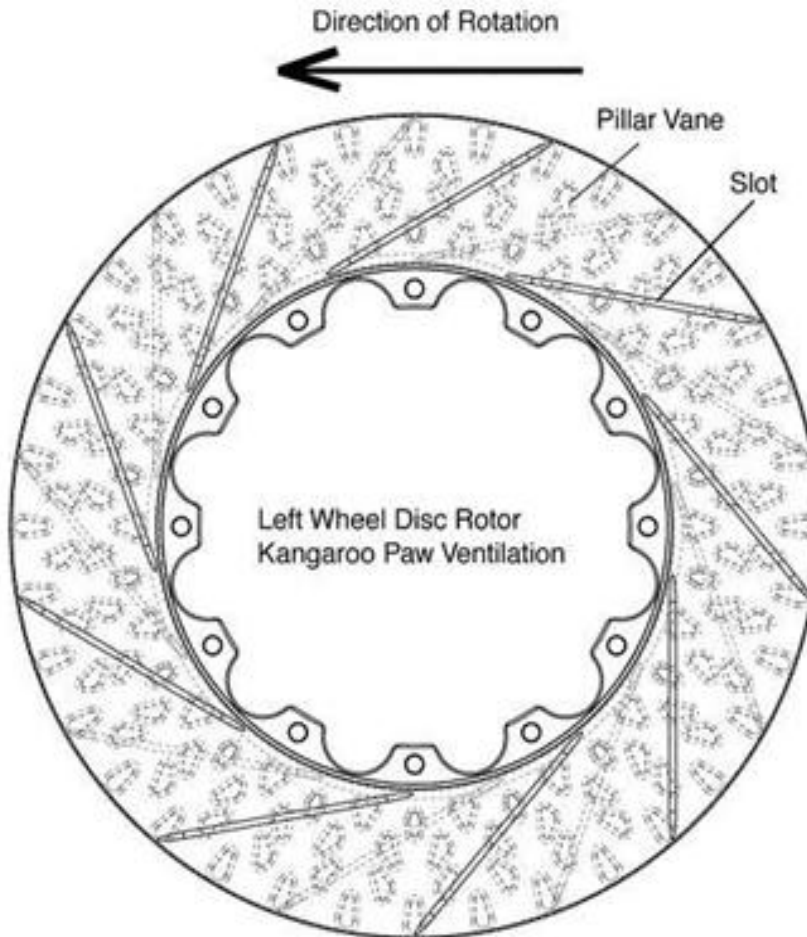
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ATASA 5th Disc Brake Systems

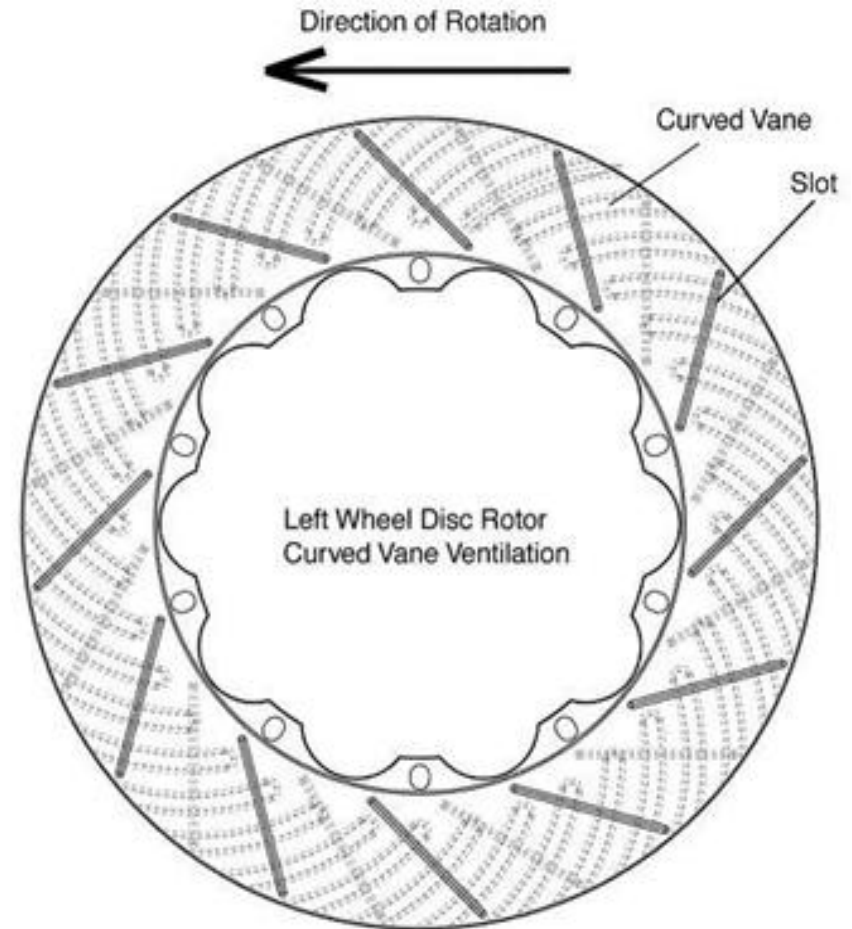


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A pillar style rotor is non directional therefore we machine the slots cutting upwards to push the pad/rotor dust away from the rotor. This maximises the cleaning efficiency of the slots and expels water in wet conditions.

You will also notice that the slots are supported by 3 or more pillars for maximum strength. Our research has found that having the slots cutting upwards is a better method.

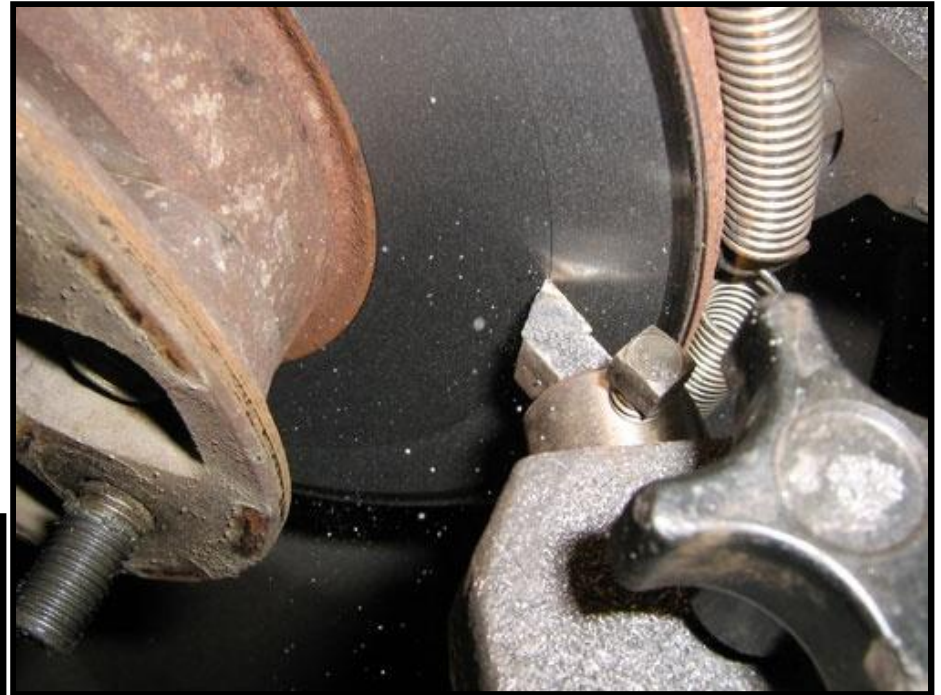


Direction of rotation for a curved vane rotor is governed by the internal cooling vanes which must face backwards for proper air flow.

To maximise strength the slots cut downwards which enables the slot to be supported by about 3 vanes. If slotted the opposite way the curved vane rotor will crack through the unsupported slot.

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55. A brake _____ (either on-car or bench) is used to true-up the surfaces of rotors correcting parallelism, surface runout and minor imperfections such as scratches, score marks, rust, etc.

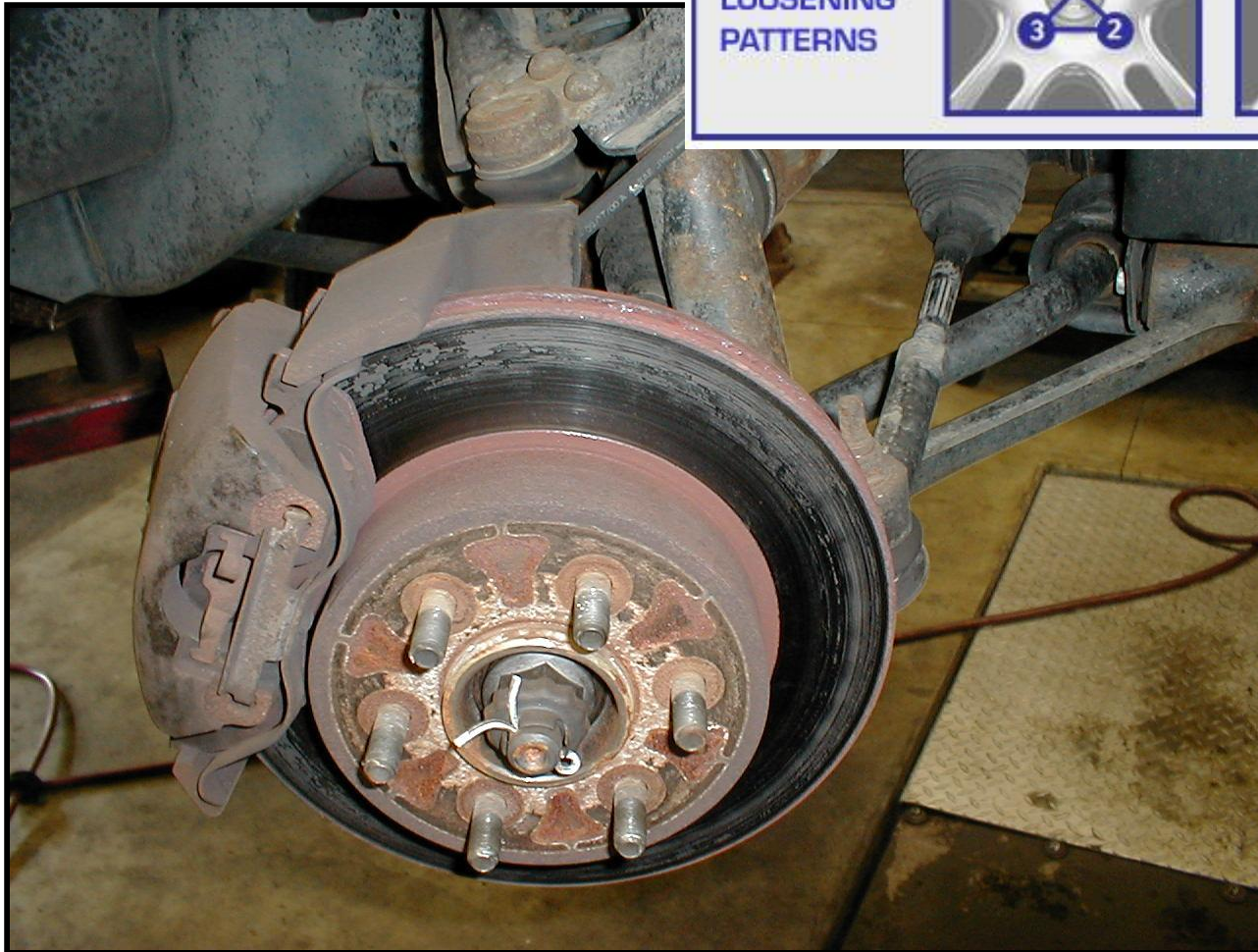
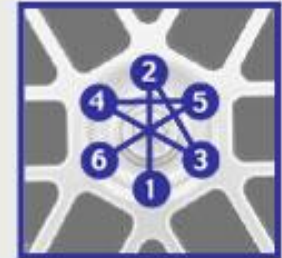
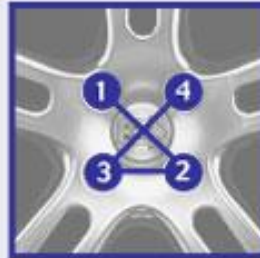


Lathe
Mill
Surface Grinder

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56. Improper torque & sequence when installing tires & wheels can cause _____ to warp.

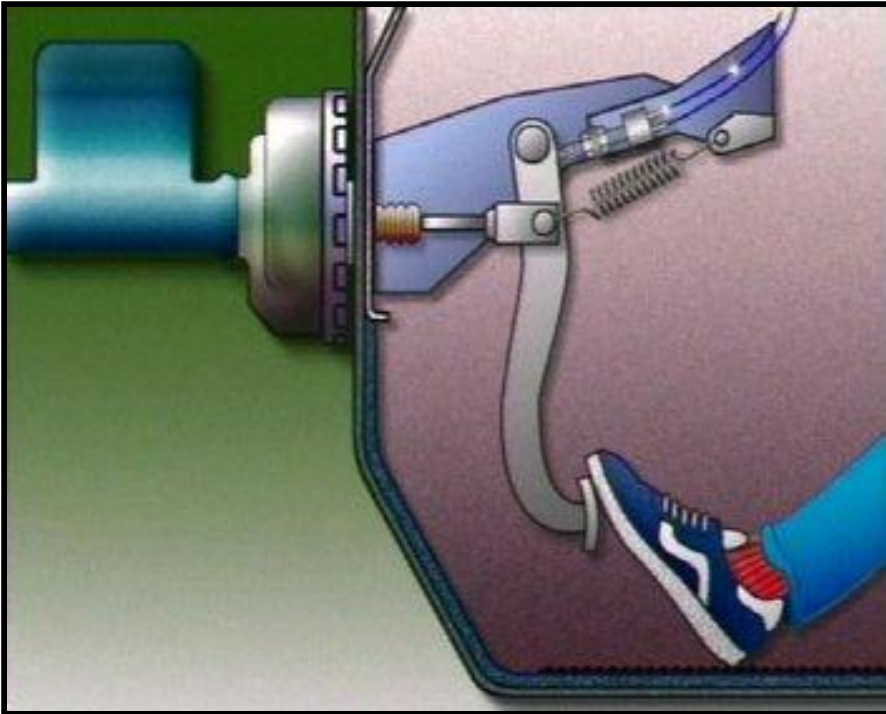
LUG OR BOLT
TIGHTENING/
LOOSENING
PATTERNS



**Rotors
Pads
Calipers**

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57. _____ the brake pedal several times before moving a vehicle on which pads were replaced. *This positions the brake linings against the rotor & verifies the vehicle “has pedal”.*



Pump
Bump
Sump

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How to properly install plain, slotted or drilled brake rotors

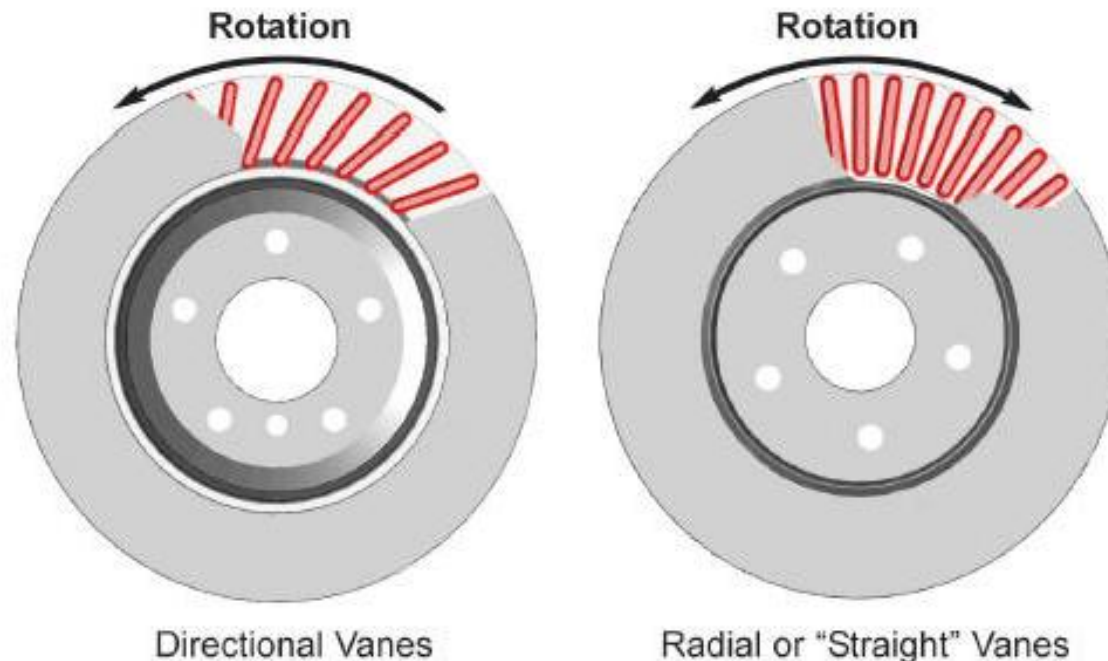
by Dave Zeckhausen

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Directional vs. Straight Vane Rotors

Most "normal" cars come with straight vane rotors, with internal cooling vanes that extend straight from the center of the rotor outward, like spokes on a wagon wheel. (See drawing on lower right) These rotors are not as efficient at cooling, but they are less expensive to manufacture and car dealers only have to stock a single part for both sides of the car.

Some higher performance cars come with "directional rotors", which have curved or tilted internal cooling vanes. These curved vanes pump more air through the rotors, resulting in improved cooling efficiency. Thus, there is a left and a right rotor. When the directional rotors are properly installed, these internal vanes should lean toward the back of the car - as shown in the diagram on the lower left.

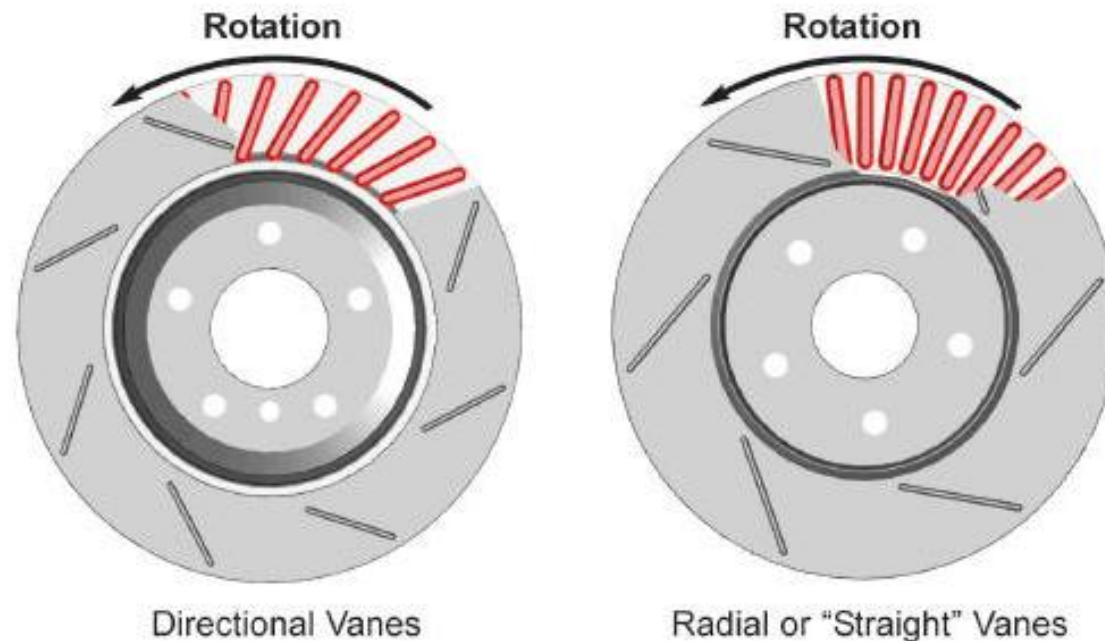


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Slotted rotors

As with the plain rotors discussed above, the internal vanes should lean toward the back of the car. The direction of the slots on the outside of the rotor do not dictate whether the rotor is a left or a right. For rotors with slots machined in the same direction as the internal cooling vanes, the slots should lean toward the back of the car. For rotors with slots machined in the opposite direction as the internal cooling vanes, the slots should lean toward the front of the car. Bottom line - don't use the slots to decide which side to mount the rotor. Pay attention to the internal cooling vanes.

For slotted rotors with straight internal cooling vanes, the direction of the slots is totally up to you and what you think looks best. In this case, there is no wrong answer.



Drilled rotors

It is not possible to tell if a drilled rotor is installed properly, simply by observing the drill pattern. Different manufacturers use different patterns with spiral "arms" that appear to lean in either direction, regardless of the internal cooling fin orientation. For example, StopTech AeroRotors, used on their big brake kits, have a drill pattern that appears to lean to the front of the car. Porsche OEM rotors have a drill pattern that appears to lean to the back of the car. In both cases, the internal cooling fins are properly oriented, leaning backwards. But the drill pattern is opposite. This is why Porsche mechanics often install StopTech big brake kit rotors backwards, despite the big "L" and "R" stickers on the rotors! They're relying on the drill pattern, rather than the direction of the internal cooling vanes.

As with slotted rotors, one **must** check the direction of the internal cooling vanes in order to determine the proper orientation of drilled rotors.

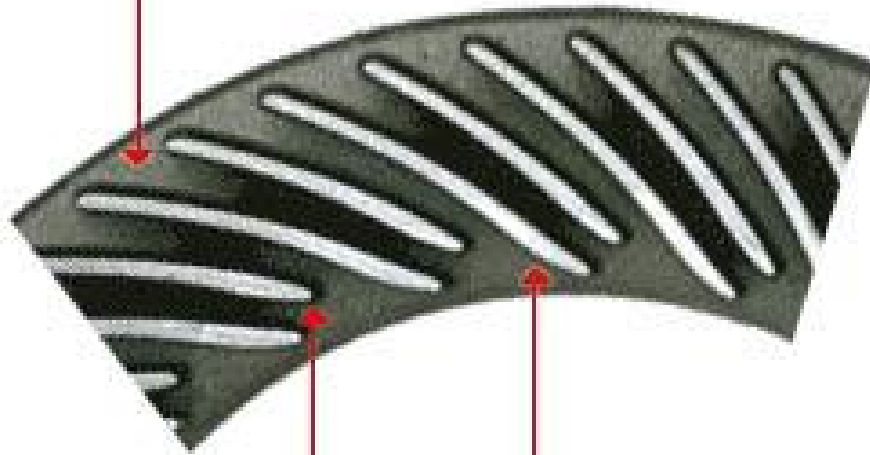


StopTech AeroRotors

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AeroRotor vane design improves airflow and cooling to resist fade

Air channels widen at trailing edge of vanes.
This allows more space for heated air to expand without obstructing flow.



Curve on leading edge of vane facilitates airflow to air channels

"Airfoil" shape increases speed of airflow and keeps air attached to vane walls to draw off more heat and reduce turbulence

On this competitor's rotor, turbulence created by the delamination of flow from the preceding vane partially blocks airflow into the next vane



Flat edge on leading edge of vane creates turbulence

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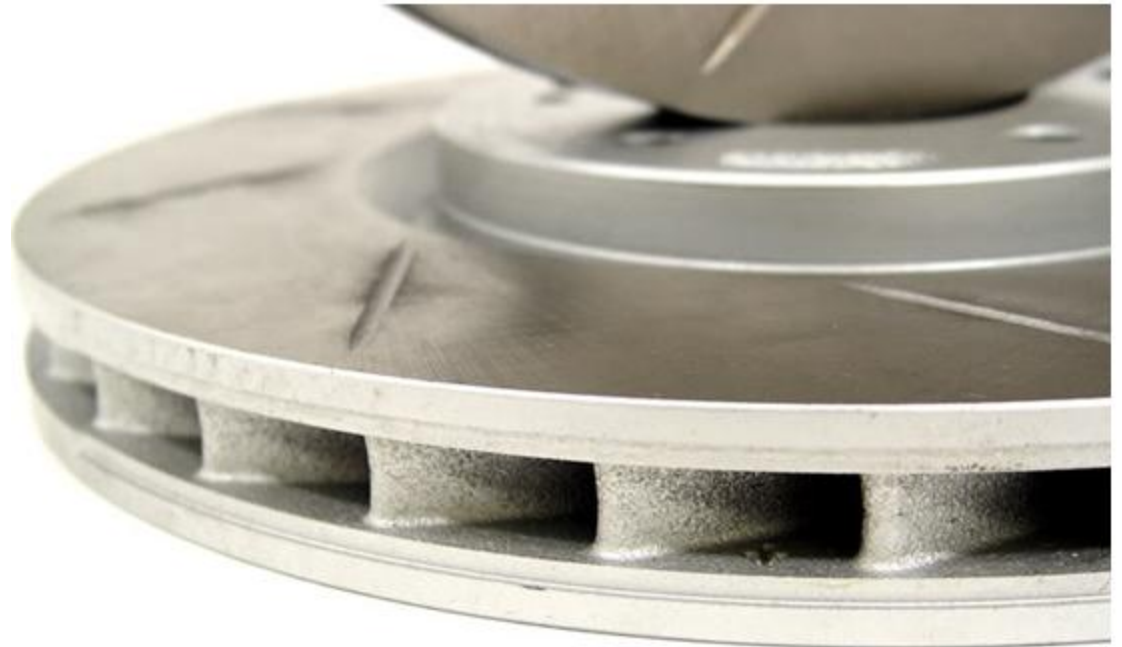
Side view of vented rotor.



Cutaway view of uni-directional (straight vane) rotor.



Cutaway view of directional (curved vane) rotor.

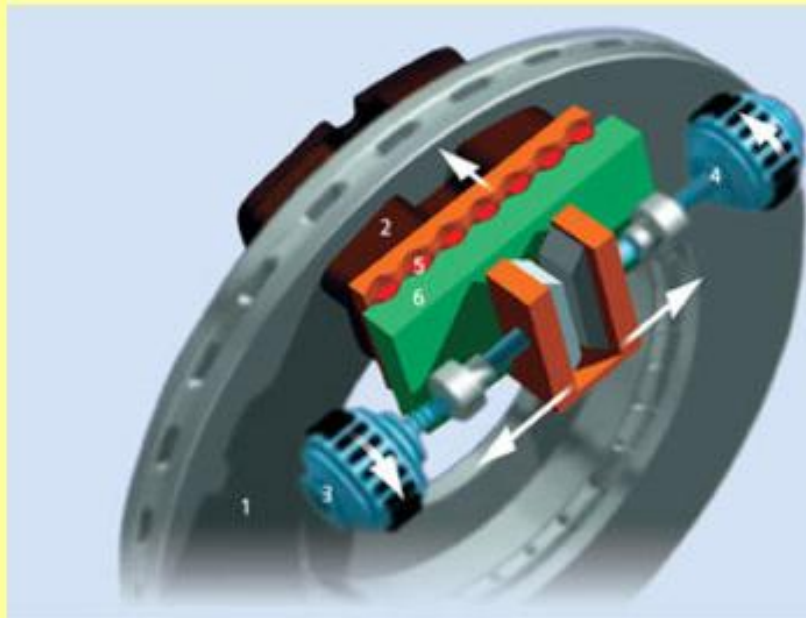


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Electric Brakes fo Future Cars

It is a little stretch to put this item on The Energy Blog, but the Electric Wedge Brake (EWB) would save weight and energy in future automobiles in addition to revolutionizing braking systems. **Siemans VDO's** EWB braking system makes possible a 12V brake-by-wire system.

The electric motors for the brakes obtain their energy from the turning wheels. The intelligently controlled wedge converts the kinetic energy of the vehicle directly into braking energy. As a result of its self-reinforcing action, the EWB is faster than today's hydraulic brake and requires only one-tenth the energy to operate.



As shown in the illustration, the brake rotor (1) and the pad (2) are brought into contact with each other by electric motors (3, 4) using several roller screws (5) along wedge-shaped angled surfaces (6). The wedge effect is

automatically amplified as the result of the wheel's rotation allowing varying degrees of braking force to be generated with little effort. This operation of the brake can be seen in this [video of EWB operation](#).