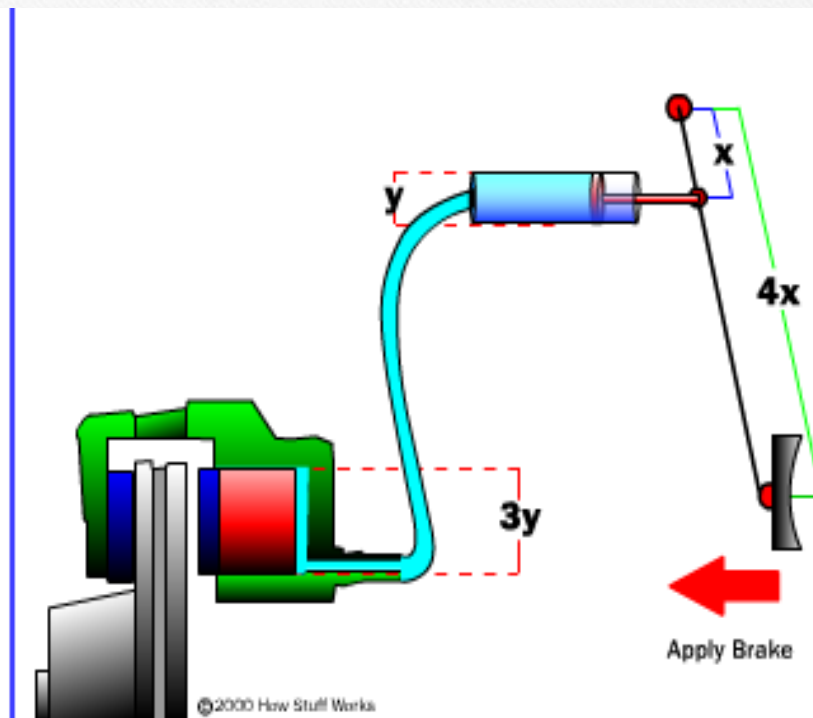


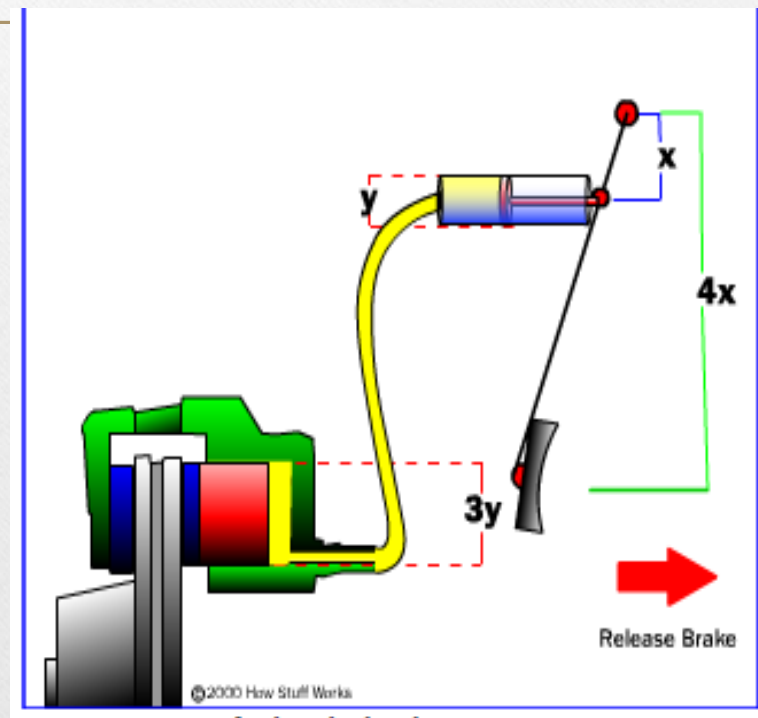
# Brake Fundamentals

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# Brake System



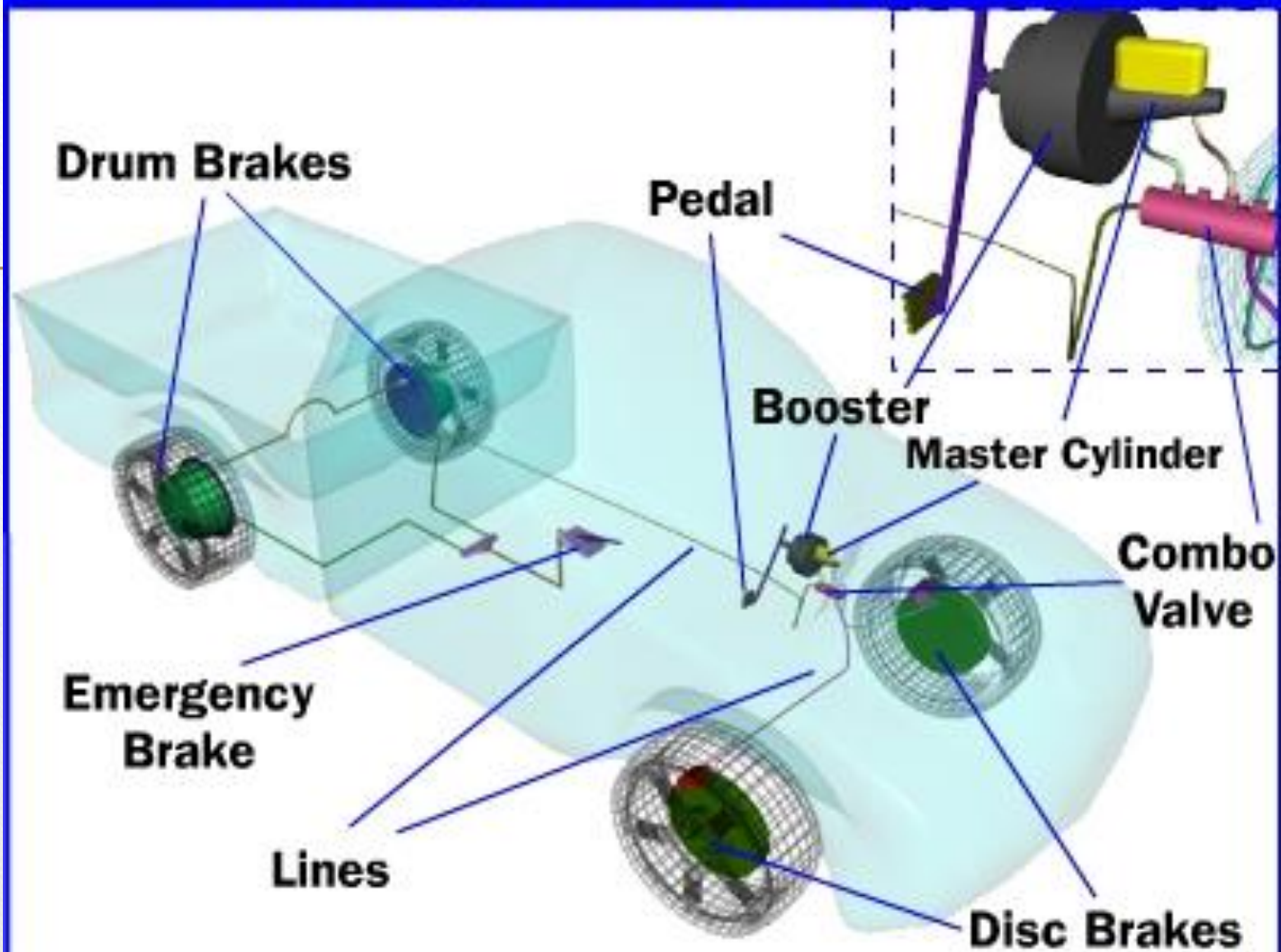
A simple brake system



A simple brake system

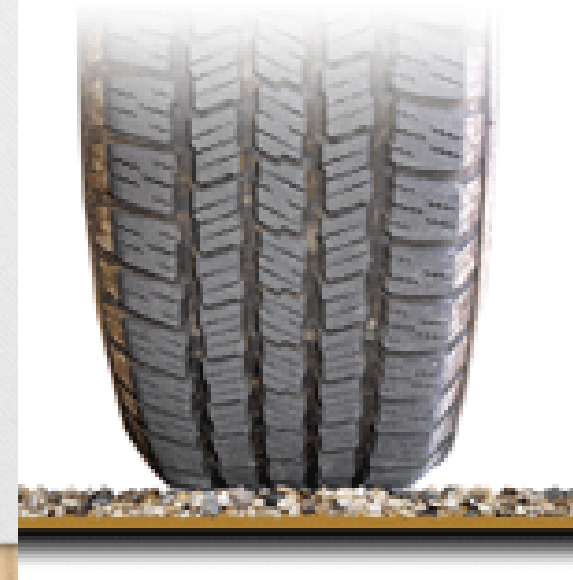
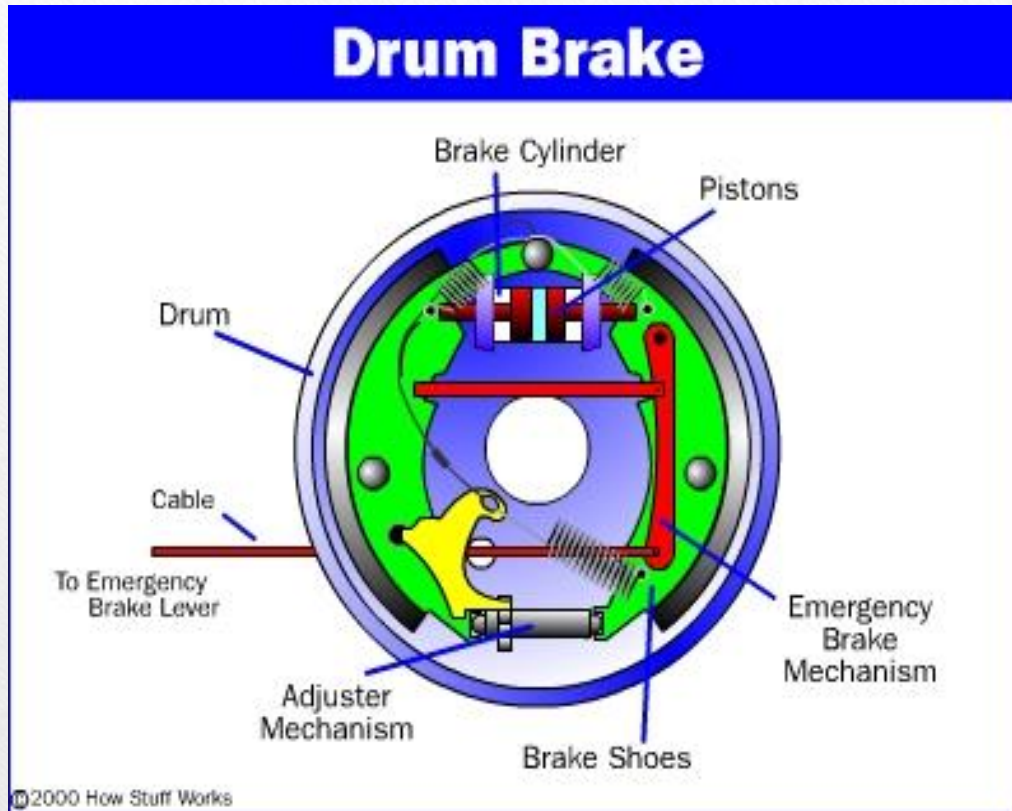


# Brake System Components



# BRAKES

Friction between *Drums & Shoes* or *Pads & Rotors* slows the car.



Friction between TIRES and ROAD stops the car.



# BRAKES

## Brake Action

- Brake *Pedal* is connected to the *Master Cylinder*.



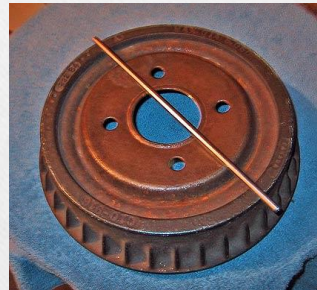
- Each wheel has a *Wheel cylinder*  
(Rear)



- Or *Caliper*  
(Front)



- Each wheel has a brake *Drum*  
(Rear)



- Or *Disk*  
(Front)

- Each wheel has *Shoes*  
(Rear)

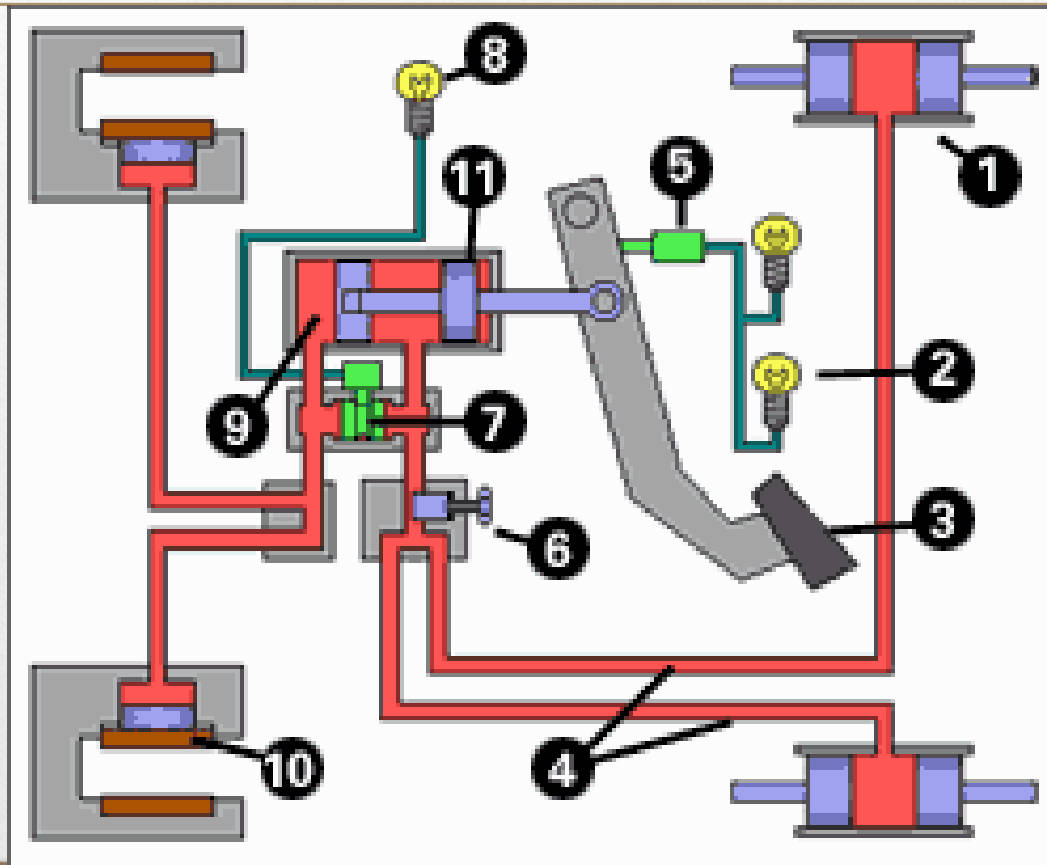


- Or *Pads*  
(Front)



# Brake Action

When the Brake pedal is pressed, brake fluid travels from Master cylinder to the Caliper or Wheel cylinder, pushing the pistons out. In turn this action pushes the shoes against the drum or the pads against the rotor.





# BRAKES

When the vehicle comes to a stop, most of the weight is shifted to the front

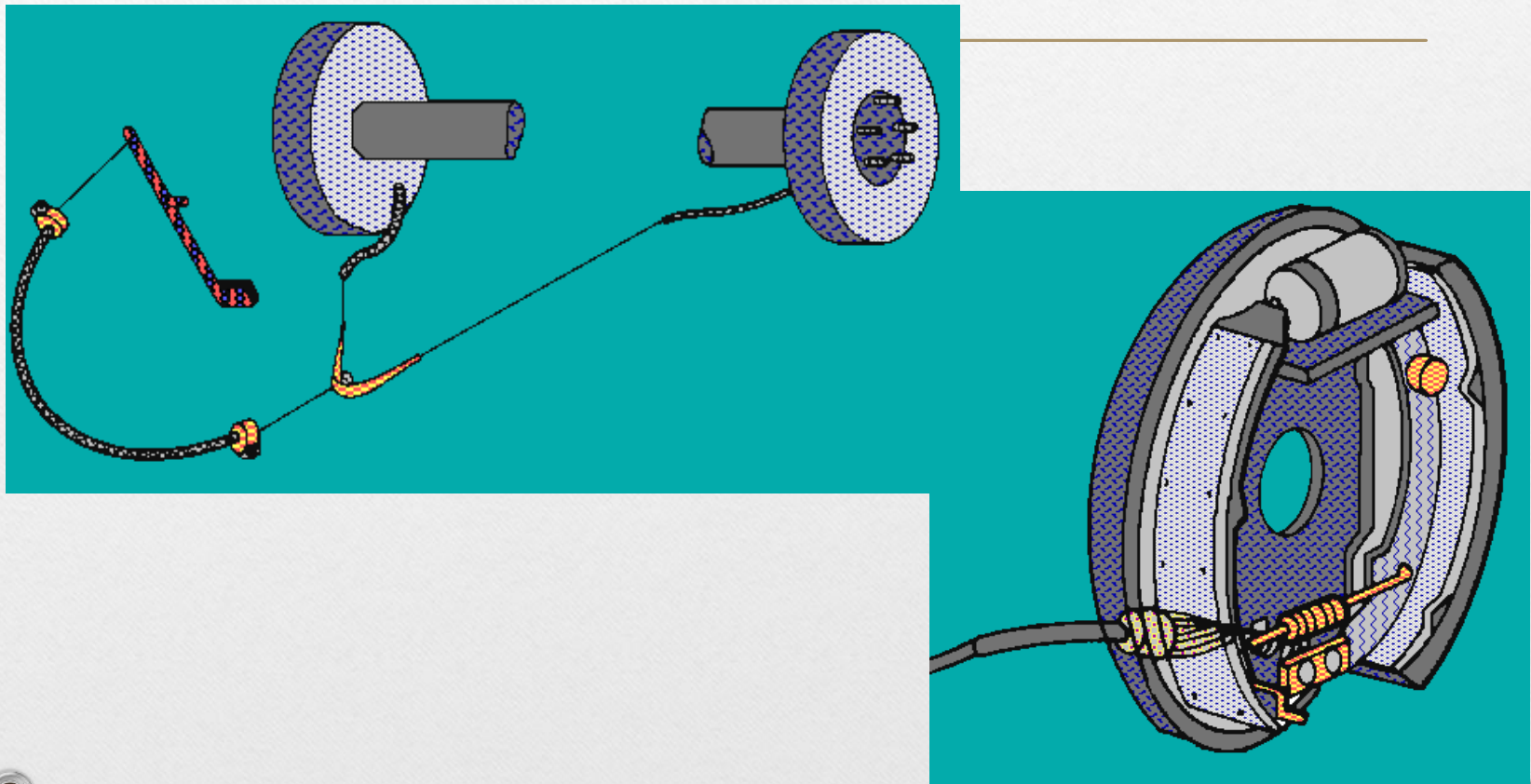
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70% - 80% of the work is done by the front brakes

# BRAKES

**Parking brakes** are part of the rear brakes and are operated mechanically with the help of a lever and cables.





# The Science of Brakes

- Knowing what happens when vehicles goes down the road and what happens when the brakes are needed- is the first steps you need to understand brakes.
- Terms we need to know:
  - Kinetic Energy— energy that wants to stay in motion.
  - Coefficient of Friction --- A ratio that tells how much power it take to move an object across a surface.
  - Friction- a force that resists movement between any two contacting surfaces.

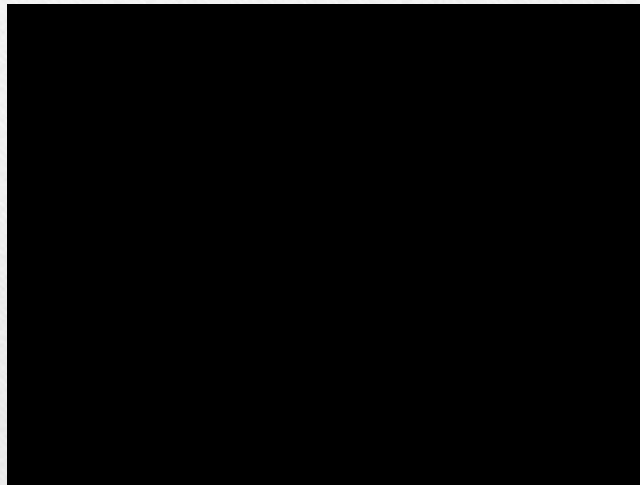
## More Science

- Centrifugal Force- The expression centrifugal **force** is used to express that if an object is being swung around on a string the object seems to be pulling on the string.
- Weight Transfer- When the weight shifts to the front, this is the reason the front wheel drive vehicle's brake system provides 80% of its power to the front brakes and 20% to the rear (60% front-40% rear for rear wheel drive vehicles).



# Centrifugal Force

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# Friction

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# Brake Linings

- These are the friction materials that a vehicle uses.
- They can be bonded (glued), riveted, and injection molded to the backing pad or shoes.



## Types of Linings

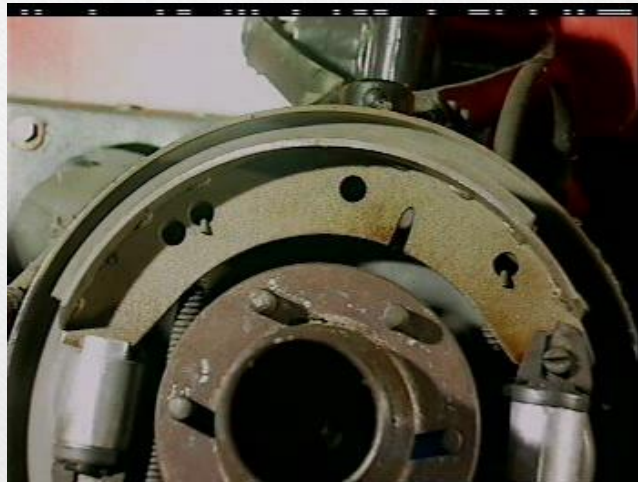
- **Asbestos**- these have phased out, very hazardous to breath the dust.
- **Organic**- mixture of asbestos and organic materials with a resin binder
- **Semi-metallic**- organic mixed with metal shavings, last longer and very good at dissipating heat.
- **Ceramic** – low dust output, provide exceptional braking performance
- **Carbon/Kevlar**- Motor sports application, not used on road vehicles because of cost and they take time to warm up.

- *This is why we don't use a bow gun to clean brakes or brake parts (asbestos is hazardous in the airborne form)*



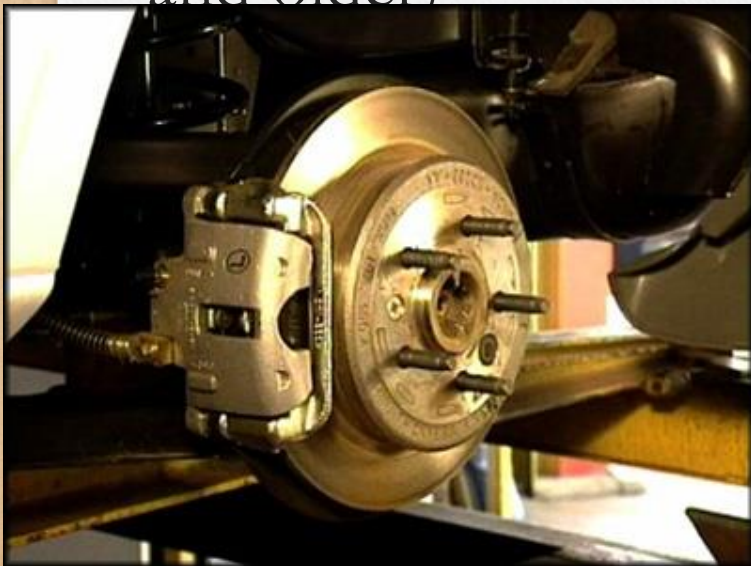
# Linings

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# Disc and Drum Brakes

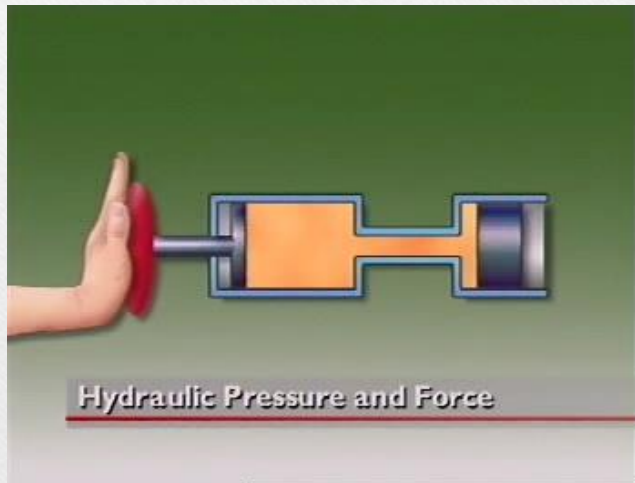
- Disc brakes are found on almost all vehicles now.
- Older cars and trucks had a combination of disc and drum brakes.
- At one time vehicles came with drum brakes only (1970 and older)

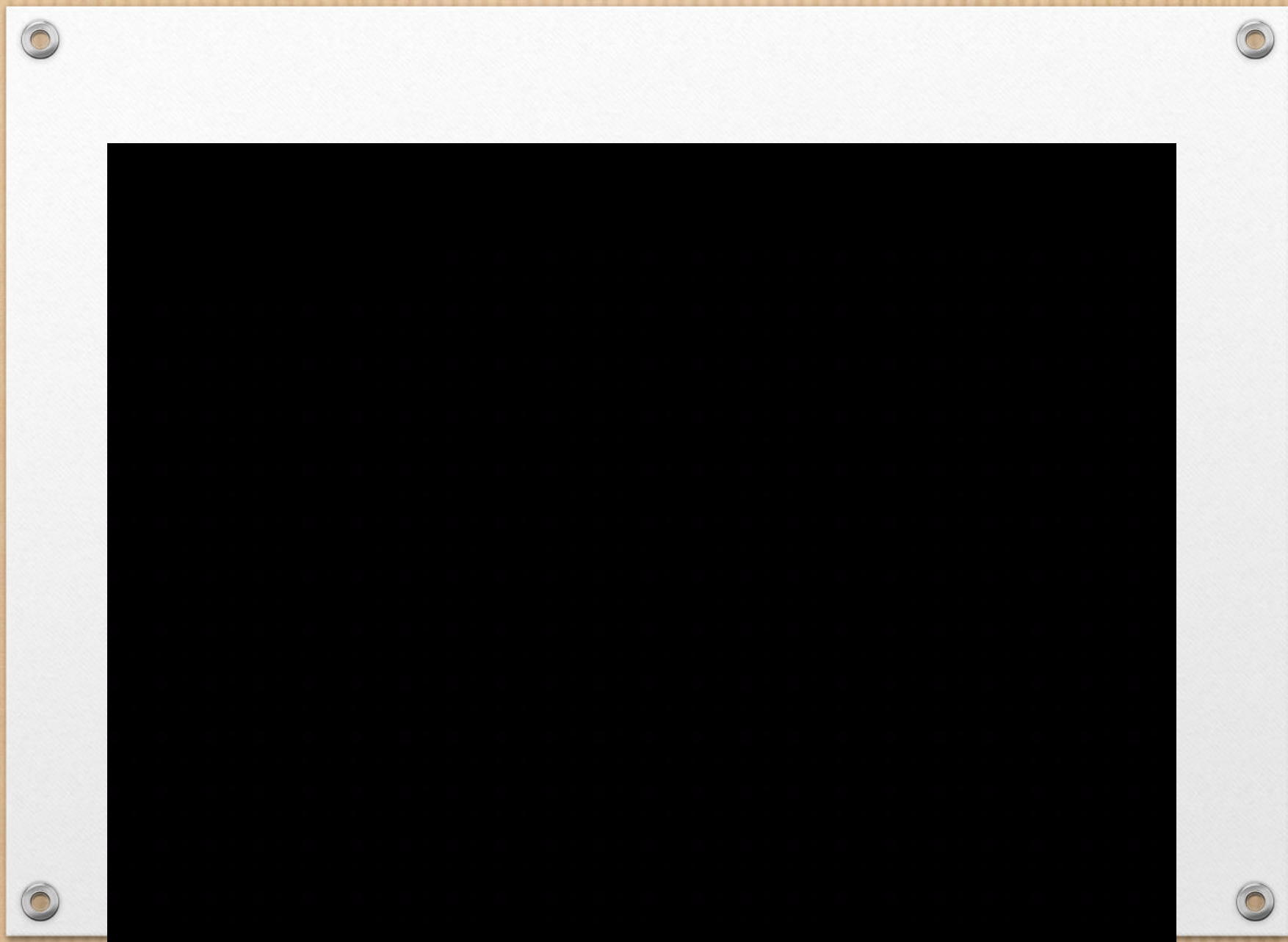




# Hydraulics

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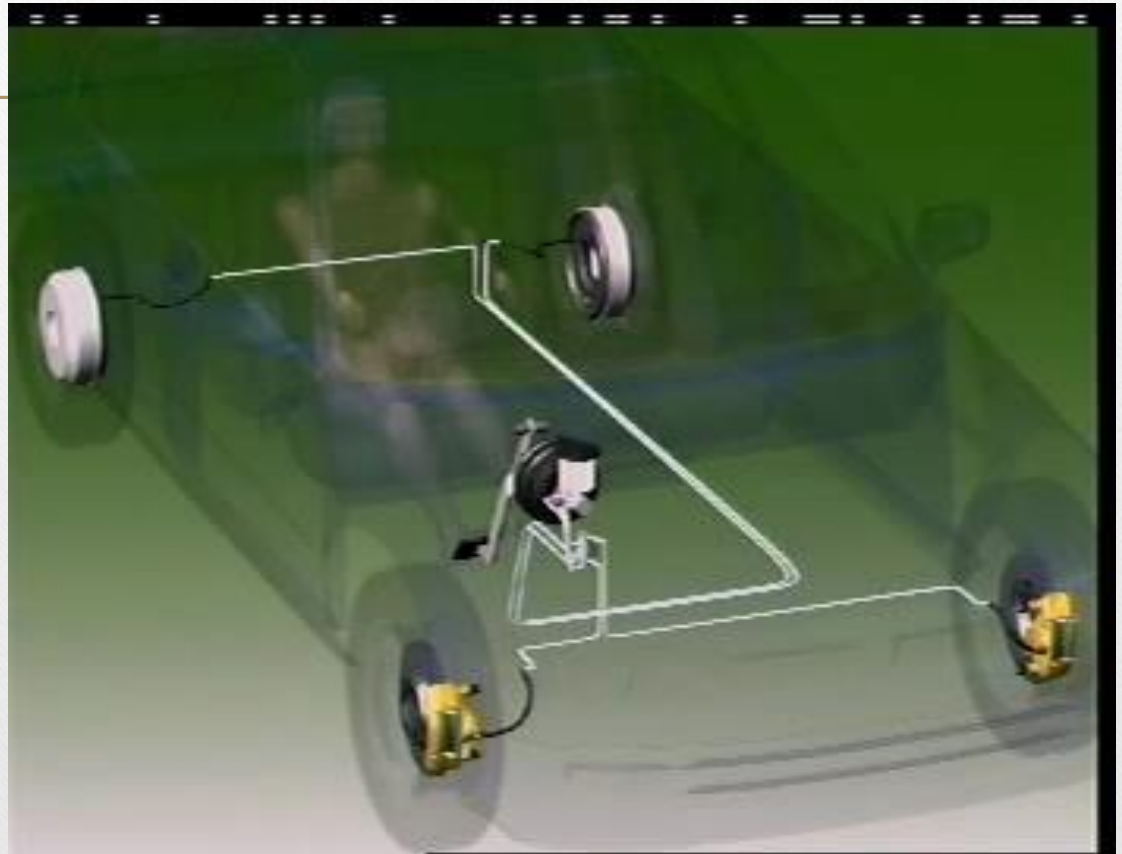
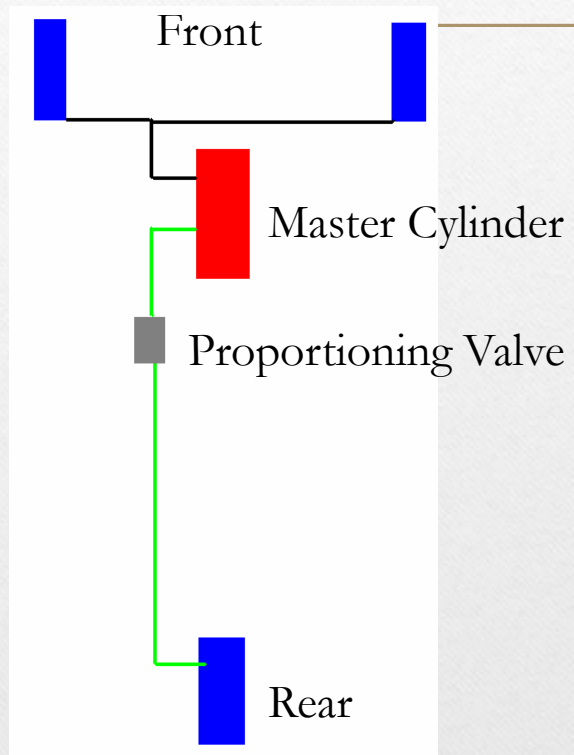


# Brake Fluid

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- DOT (Department of Transportation)
  - Type 3 boils at 401 degrees
  - Type 4 boils at 446 degrees
  - Type 5 synthetic boils at 500 + degrees
- Can mix 3+4 but not 5 with the other two. Read what the brake system cap says to use.

# Brake Hoses and Lines





# Master Cylinder



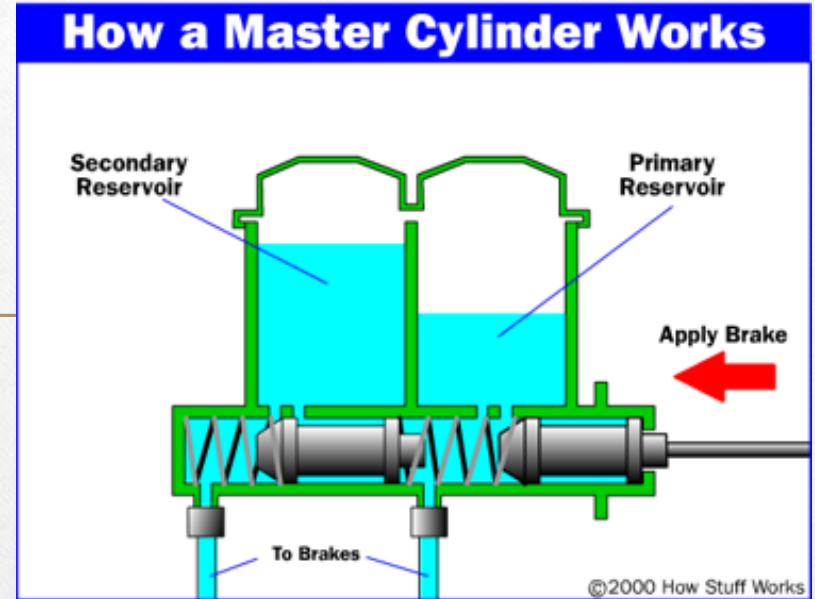
# BRAKES

## Master Cylinder

- Reservoir for brake fluid.
- Connected to the brake pedal.
- Pressurizes the system when brakes are applied.
- Cheaper to replace.
- Bench bleed when installing new.

### PROBLEMS

- Internal leak – Pedal slowly goes down to the floor when stopped at a red light. (No visible leak)
- External leak – Between Master cylinder and power booster.





# Master Cylinder



**TM1 Tandem Master Cylinder**

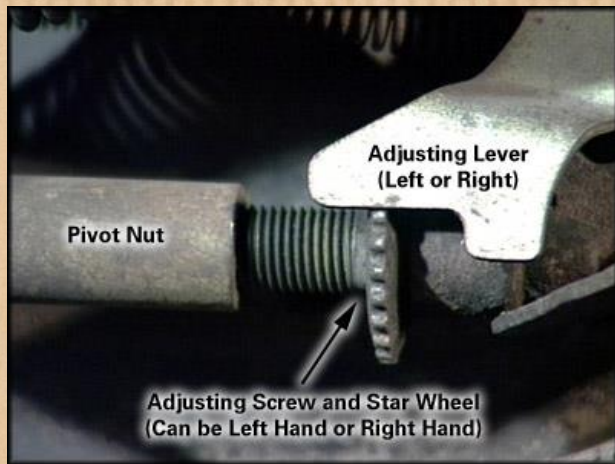
# Proportioning Valve



- Weight transfer to front during braking
- Lower pressure to rear caliper
- 62% Front 38% Rear
- Adjustable







Adjusting Screw

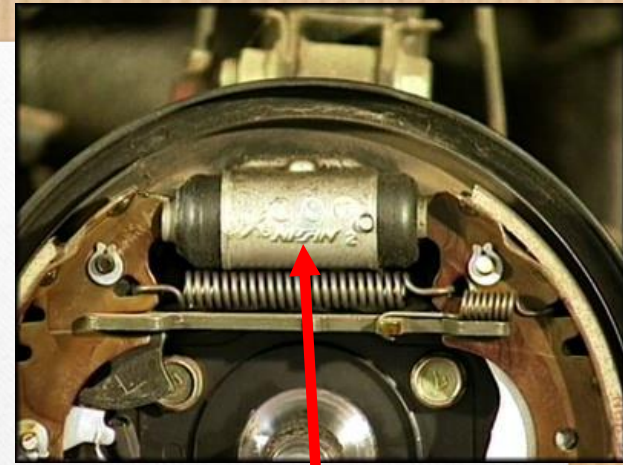
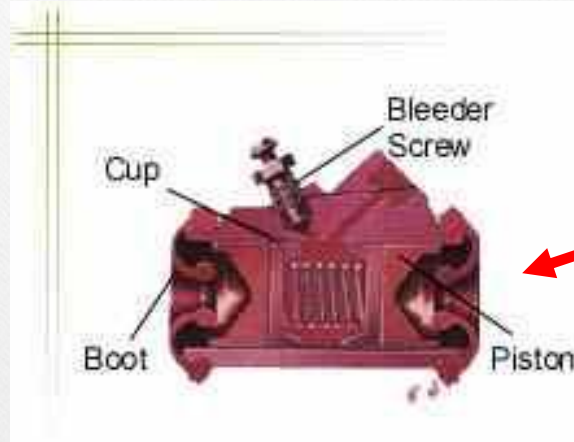


Brake Pads

Hardware



# Drum Parts



Wheel  
Cylinder

Backing plate



Drum



# Wheel Cylinders

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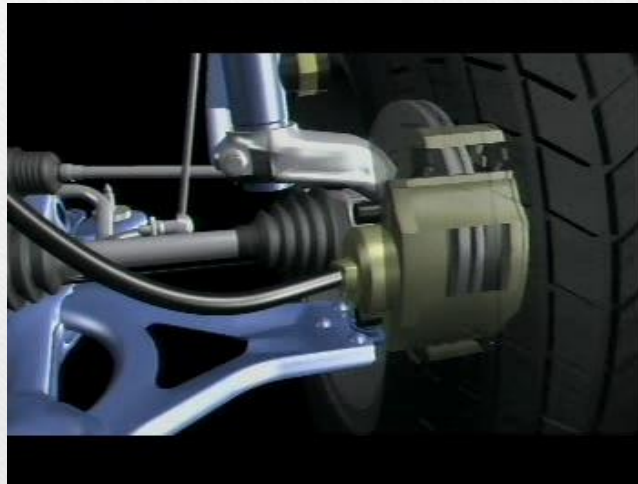
# Backing Plate





# Disc Brakes

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**Cross-Drilled Rotors**



**Bearings**



**Caliper**

**Rubber Hoses**



**Backing Plate and Spindle**



**Pads**





# Metering and Proportioning Valves

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- Metering Valve lets the rear brakes build 125 psi before the front brakes apply--- keeps from wearing out as soon and keeps the front brakes from doing as much light braking (prevents nose diving).
- Proportioning Valve prevents the rear wheels from locking up when the weight shifts forward on stopping.
- Combination Valve incorporates both of the above with a safety switch. (tells if a tandem system fails to keep equalized.) (front to back or diagonal systems)

# Power Brakes (Boosters)

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# Parking Brake (Emergency) **Lever and Foot Types**

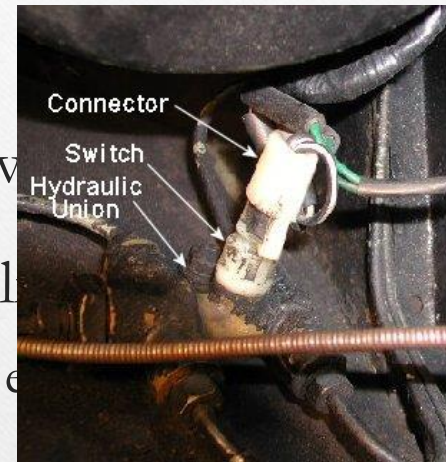
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# Brake Switch

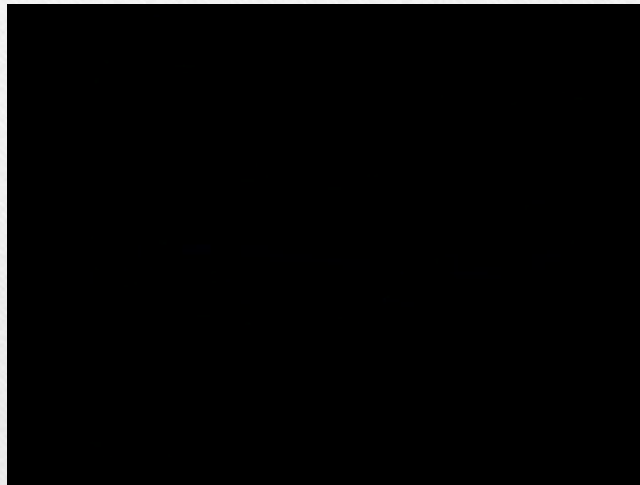
- Mounted at the top of the brake pedal
- Activates the brake lights in the rear of vehicle
- Is not incorporated with brake warning light (That is for the tandem brake safety switch and e...h)





# Antilock Brakes

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# Control Unit

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# Wheel Sensors

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