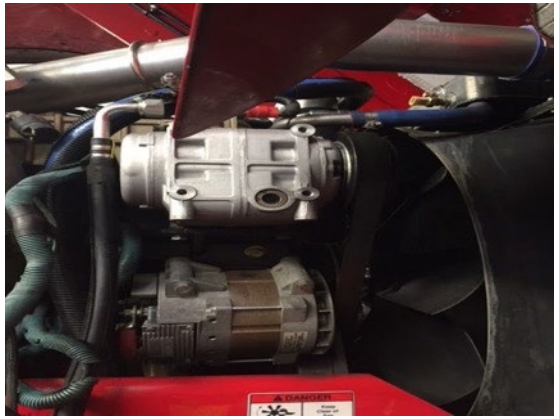
Session II
Apparatus Components

12 Volt System



Components

Batteries

Alternator

Voltmeter

Ammeter

Load manager

Any other item in or on the vehicle that uses or produces electricity will influence these components

Battery Types Maintainable & Maintenance Free

Maintenance-free type:

Have no caps

Electrolyte is in gel form

Caps

No Caps

A bank of Gel batteries Maintenance Free (No Caps)

Battery Maintenance

This corrosion is common to Lead-Acid or traditional batteries but not to Gel batteries. Nearly all of our large vehicles have been upgraded to Gel batteries.

These can still be found on the small fleet such as staff vehicles and utilities.

It is not recommended that we disconnect the batteries on our vehicles as the programming for our electronics can be lost.

Contact the shop for maintenance

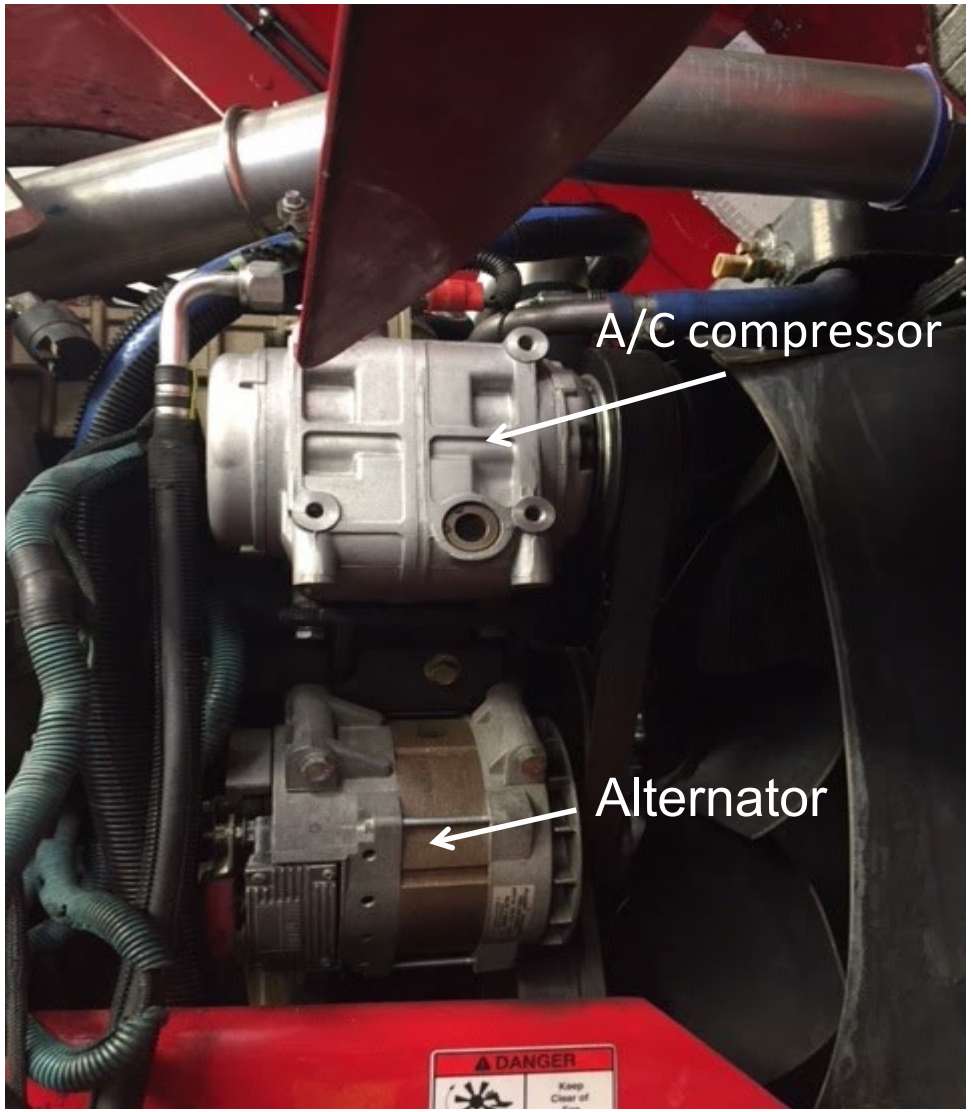
Alternator

Uses power from the running engine to generate electricity

Provides electricity to the 12-volt systems:

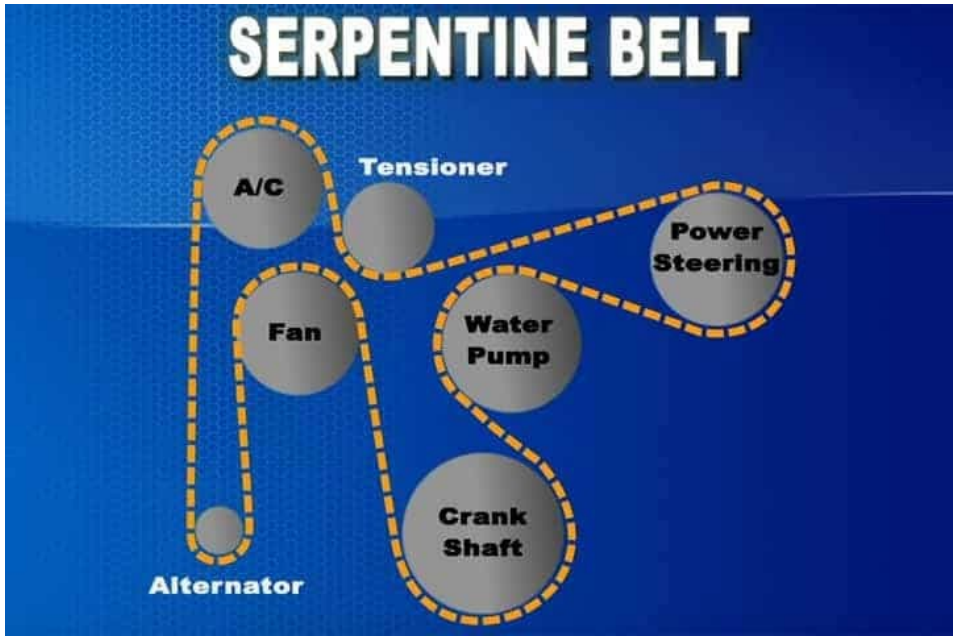
- Batteries
- Engine Starter
- Fuel Injection
- Lighting
- Warning Devices
- Secondary Braking Devices;
  - Telma and Jacobs “Jake Brake”
- Portable device Battery chargers and electronics

AC Compressor and Alternator



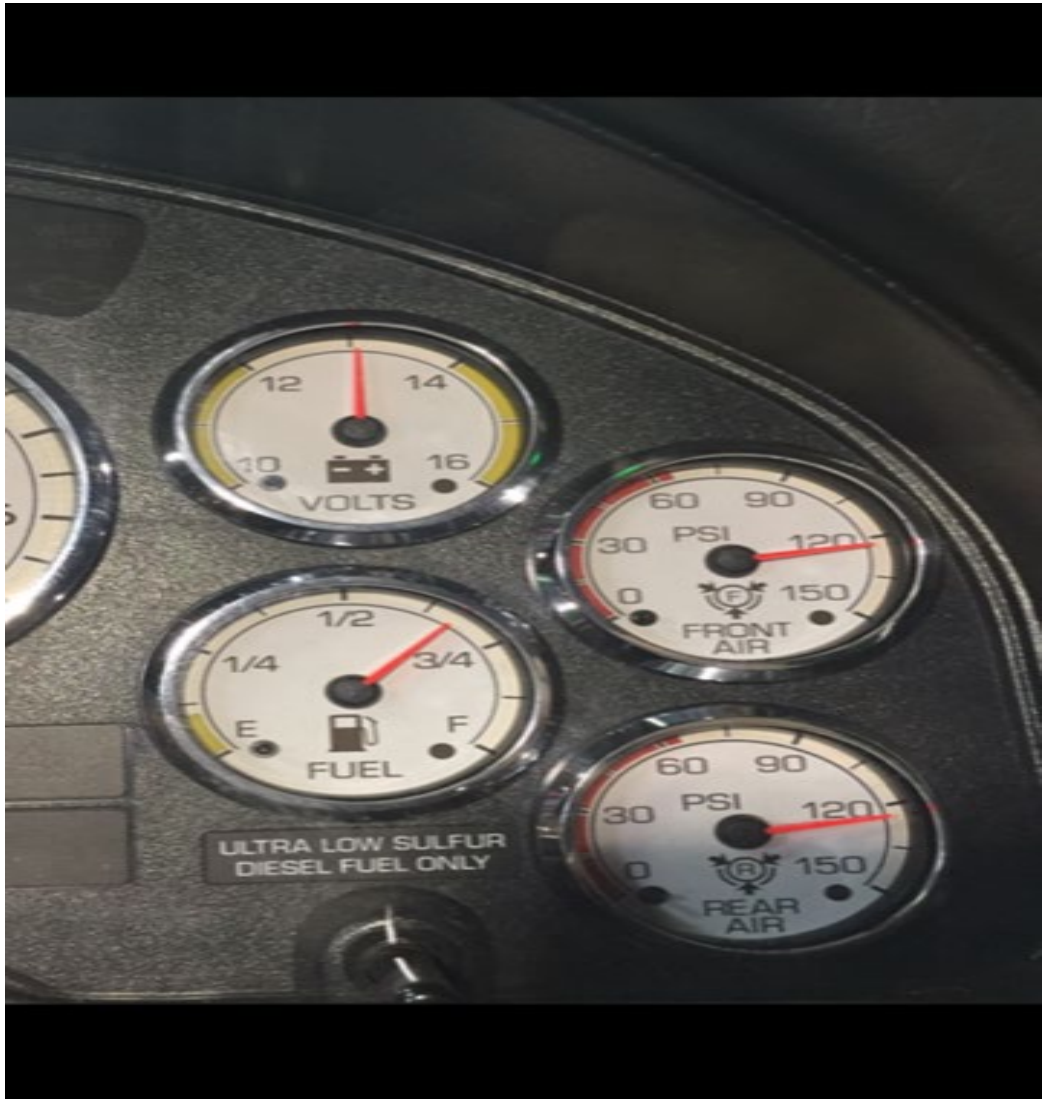
Alternator Maintenance

With the engine off, check the alternator belts for proper tension. Belt snugness ½” to ¾” play at center of the belt. Modern vehicles with serpentine belts have auto-tensioners



Check all electrical connections are secure.

Voltmeter


12
14
10
16
VOLTS
60
90
30
PSI
120
0
150
FRONT
AIR
1/2
1/4
3/4
E
F
FUEL
ULTRA LOW SULFUR
DIESEL FUEL ONLY
60
90
30
PSI
120
0
150
REAR
AIR

Voltmeter

A voltmeter shows the amount of voltage the system currently has with the engine on or off

A fully charged battery will read approximately **12.6** volts on the voltmeter, with the engine off and no loads on

A reading below **12.6** volts indicates that one or more batteries are low and need charging, or that there are abnormal loads on the system (headlights, interior lights, etc.)

Low and needs charging

Leave apparatus running at scenes, especially if lights/loads are on.

Ensure all battery and alternator connections are tight and corrosion free

Alternator belt properly tensioned

Load manager turned on

While in the station, keep the charging cord plugged in and turned on !!!

With the engine running

The voltmeter should read 13.0 - 14.8 volts

This indicates that the alternator is charging normally and the batteries are charged

If after a few minutes of running your voltmeter reads less than 13 volts, notify the repair facility.

Ammeter

Ammeter

The ammeter shows how much electricity (DC Amps) is going to and from the batteries.

A positive reading shows that the amount of current being produced by the alternator is greater than the amount used by the vehicle. The excess is used to charge the batteries.

The ammeter will read high just after starting because the alternator is replacing the battery charge used to start the engine.

Ammeter

As the batteries become charged, the ammeter will work its way toward “0” and the alternator produces less current

If the meter continues to read high the alternator is producing large amounts of current to feed the electrical system, i.e., warning devices and braking devices as well as charging the batteries.

If the ammeter remains high over a long period of time one or more batteries may need replacement

Ammeter

A negative reading on the ammeter indicates that the alternator is not keeping up with the amount of current leaving the batteries.

This reading is normal while the vehicle is being started as the alternator cannot charge until the engine is running.

If the ammeter remains negative with the engine running this is an indication of battery or alternator damage. Notify the repair facility.

Load Manager

The function of the load manager is to prevent the batteries from being excessively discharged

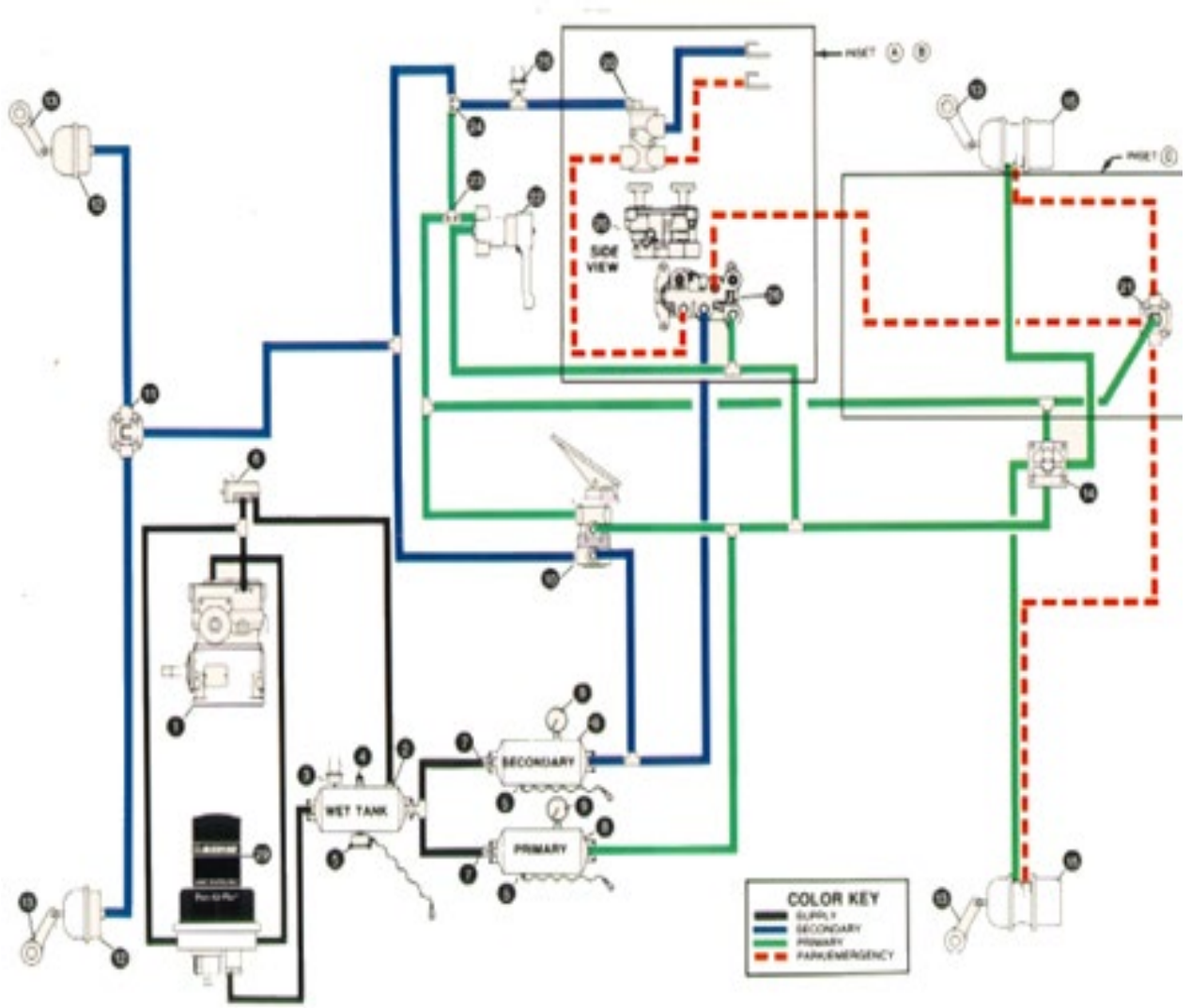
When battery voltage drops to a certain level the load manager will automatically turn off pre-programmed loads until the batteries are recharged

Load Manager

Load Manager is integrated into the Command Zone information system

If the Load Manager begins to shed electrical loads, status will be displayed on Command Zone screen

Air Brake Systems



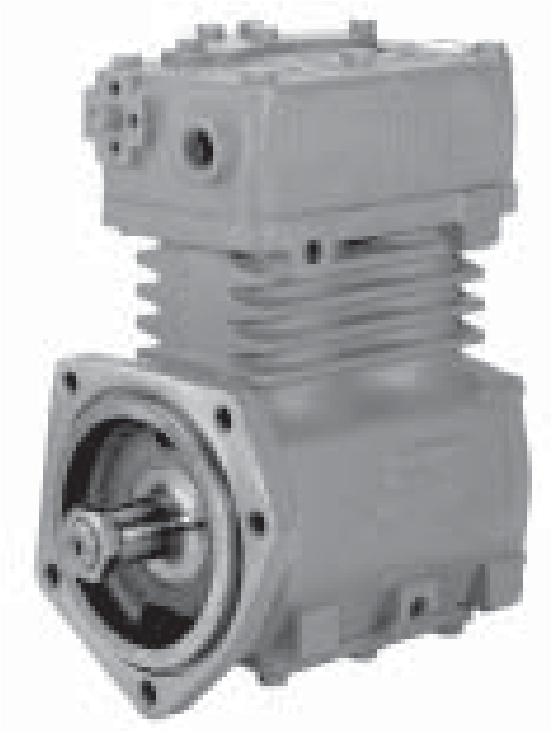
Common Components

- Air Compressor
- Air Tanks
- Air Dryer
- Treadle Valve
- Brake Chambers
- Slack Adjusters
- Rotors/Discs

Air compressor

Air Compressor

- Belt driven
- Gear driven



Belt Driven
Air Compressor

AIR TANK

- Multiple tanks
- Weekly drain (Monday)

Air Dryer

Remove water and oil from the air supply before entering the tanks

Brake Actuator (Chamber or Can)

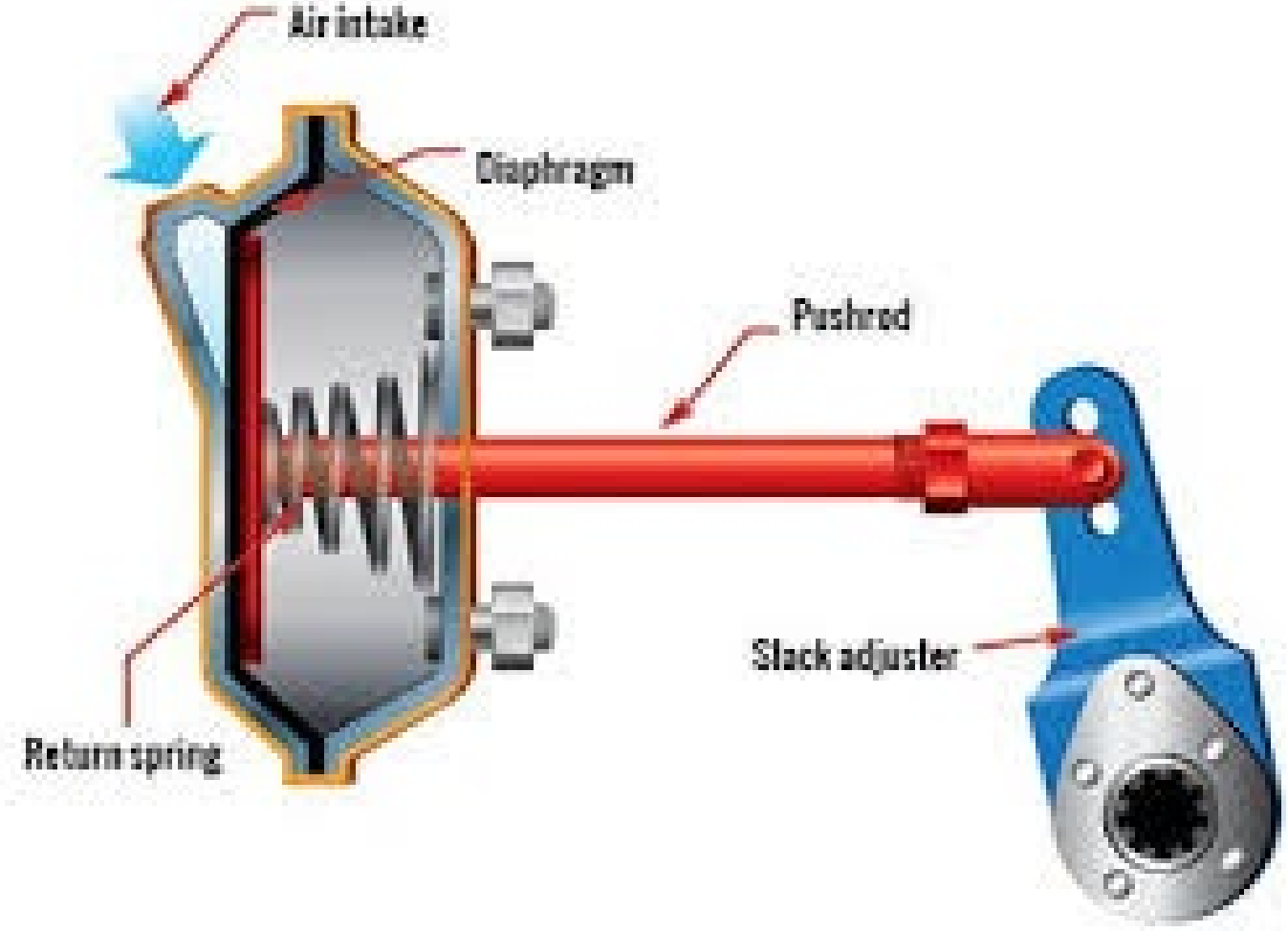
Diaphragm pushes the rod

Size based on need

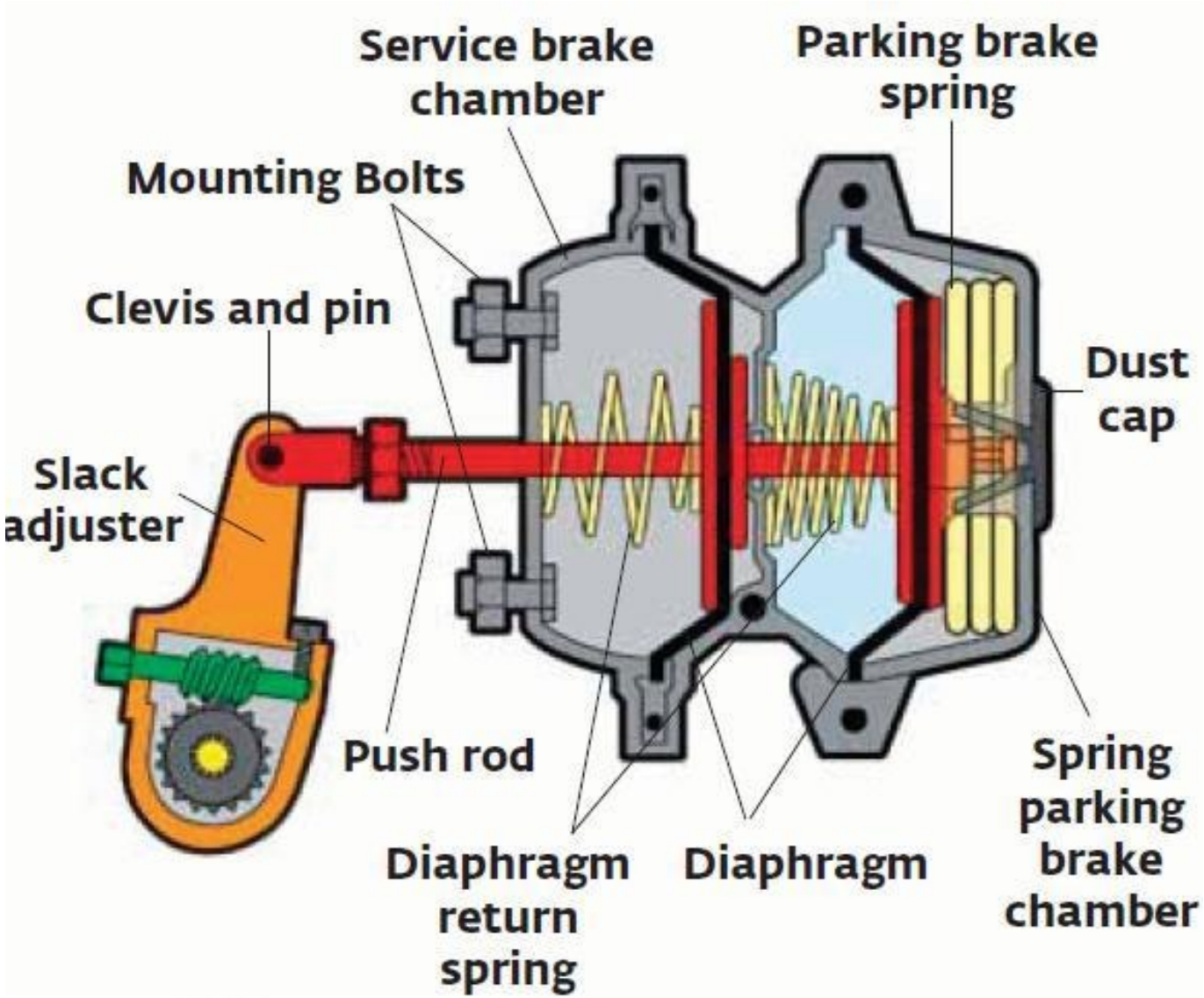
Type 24 = 24 square inches of diaphragm

Converts air pressure to mechanical force

Single Brake Chamber (Front Brake)

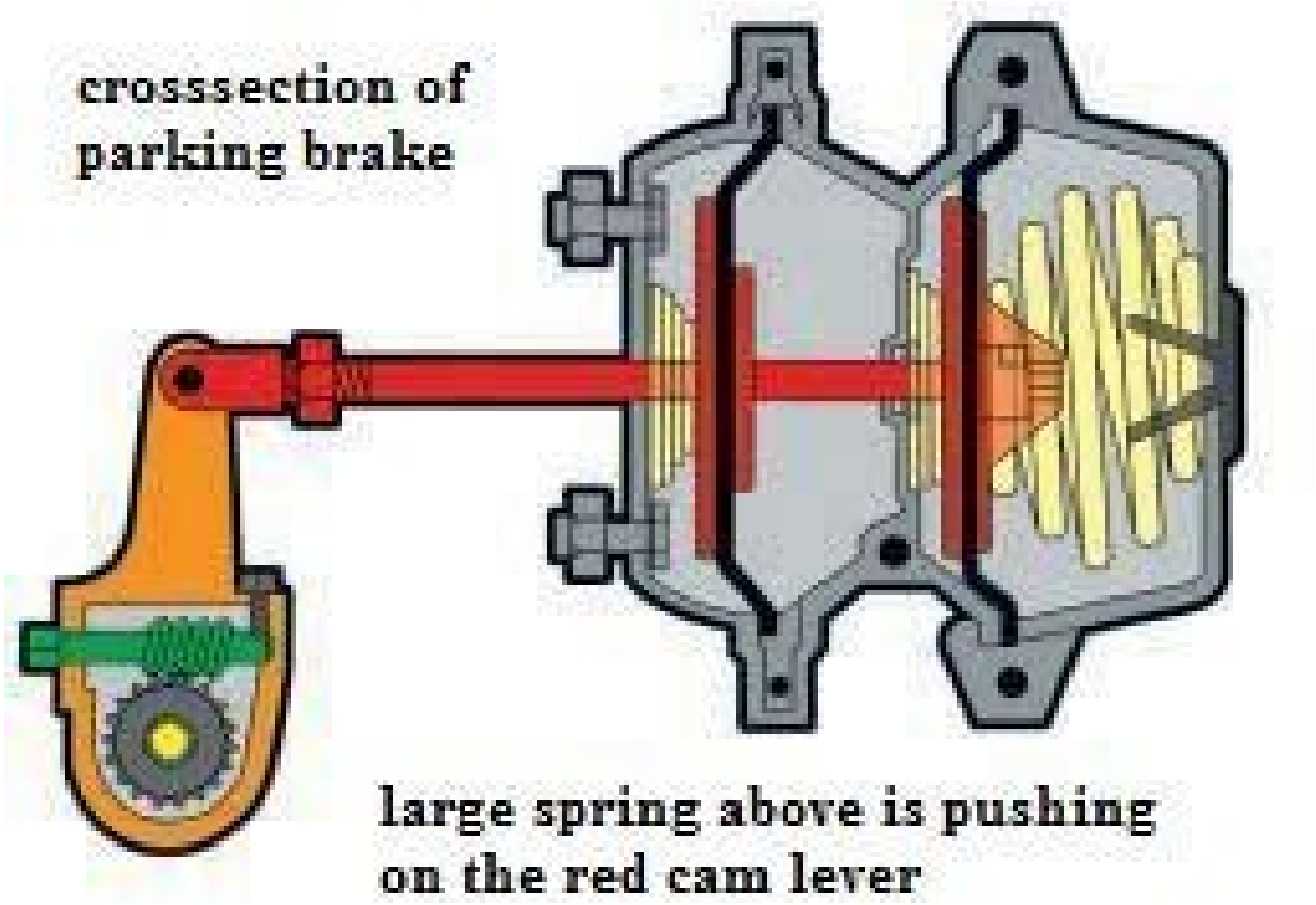


Dual Brake Chamber (Rear Brakes)
Service Chamber



Dual Brake Chamber (Rear Brakes)

Spring Chamber

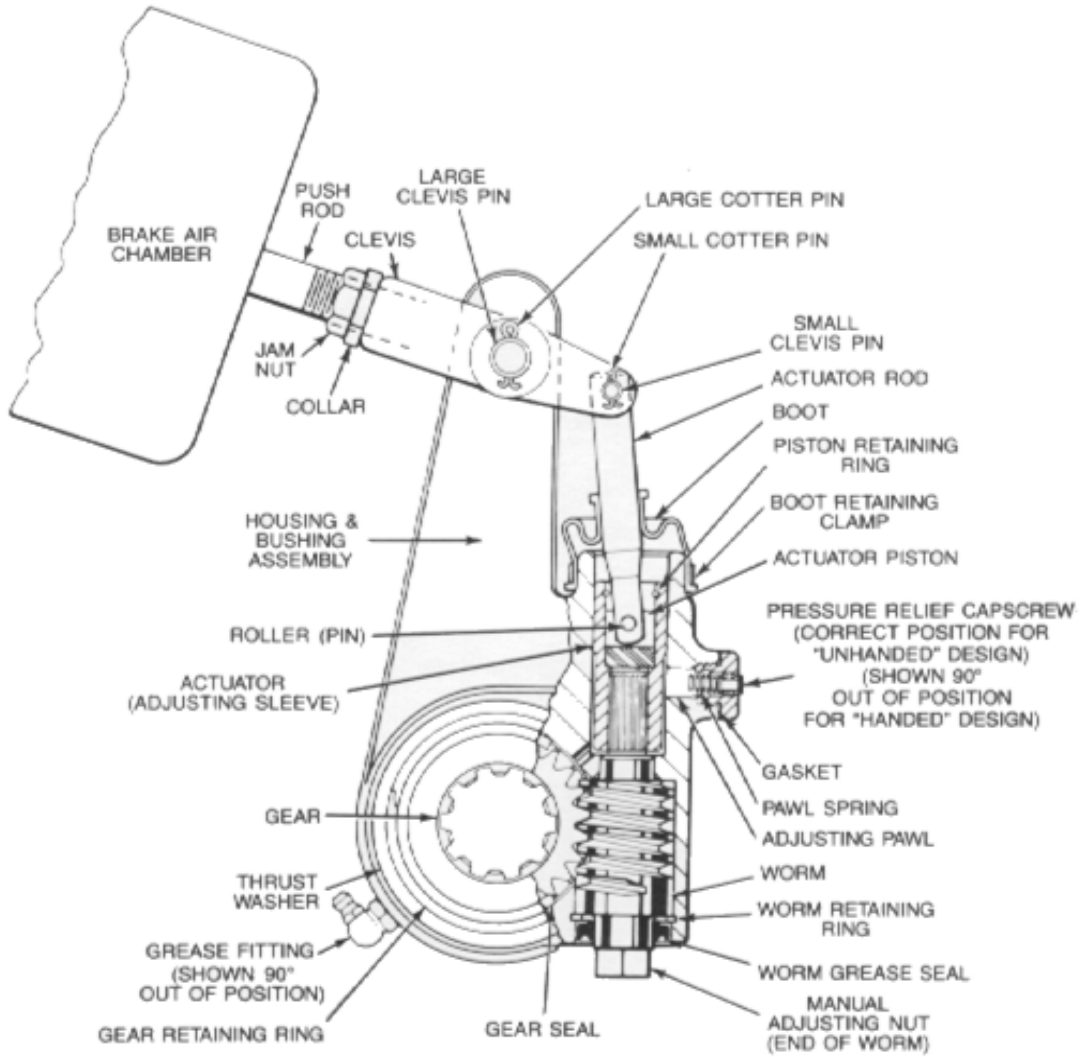


Slack Adjuster

- Link between brake chamber and brake camshaft
- Acts as a lever, multiplies torque
- Most efficient at 90°
- Manual or automatic (takes up slack caused by wear)

Slack Adjuster

Slack Adjuster

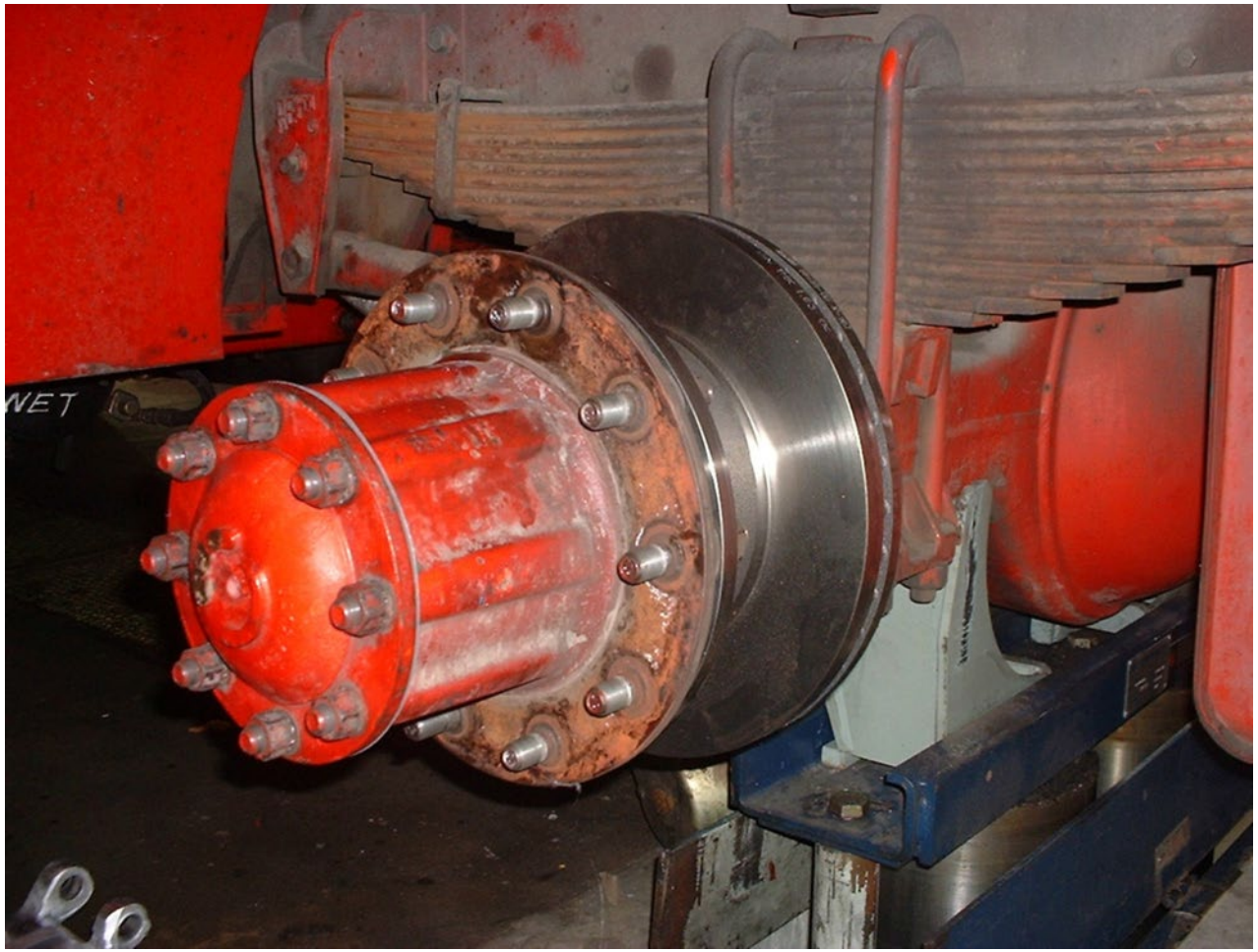


Disc Brakes

- Bendix
- Meritor
- Rockwell
- May or may not have slack adjusters
- Brake pads
- Calipers
- Rotors

Pierce

Rotor

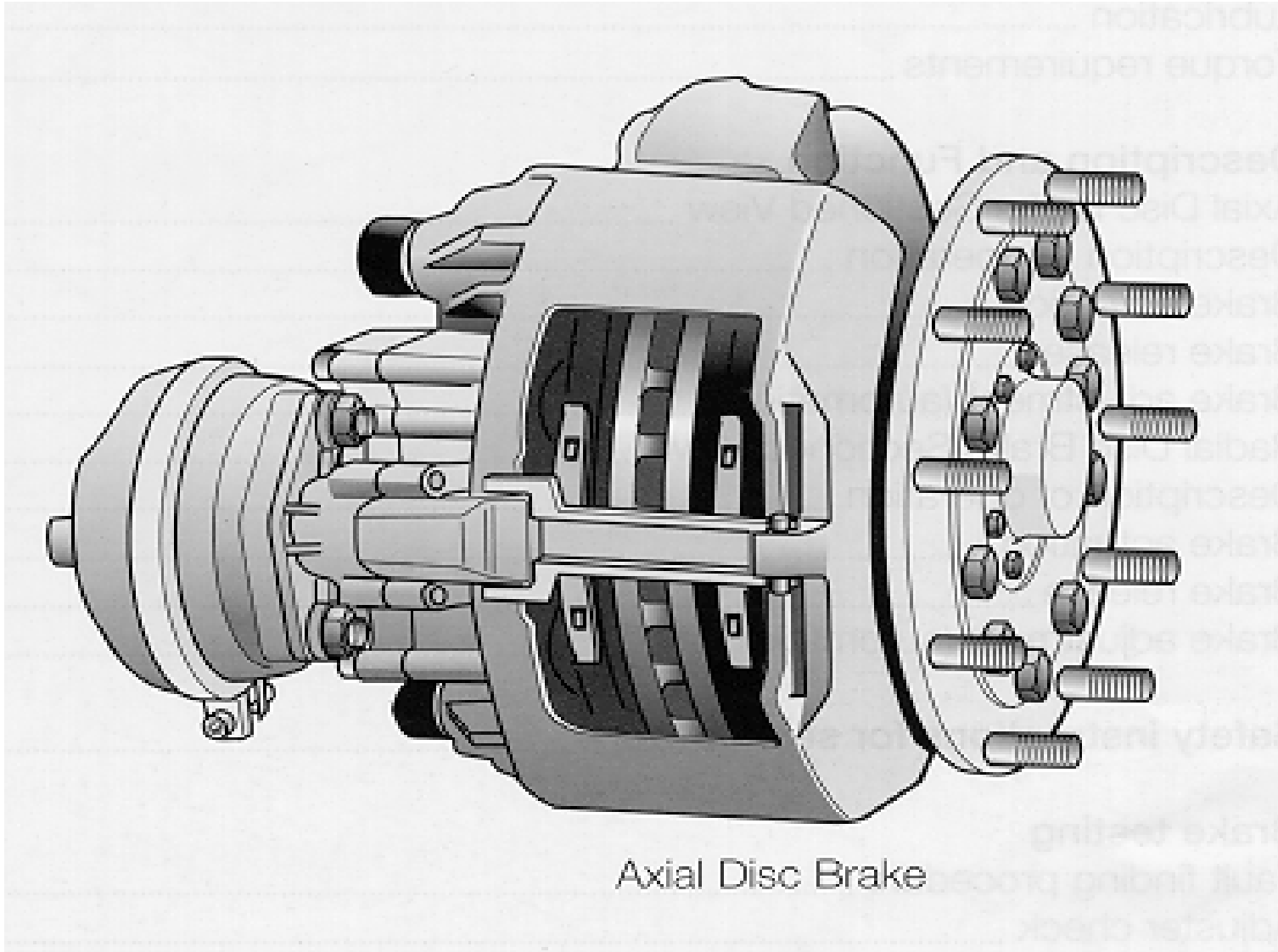


Caliper

Brake Pads

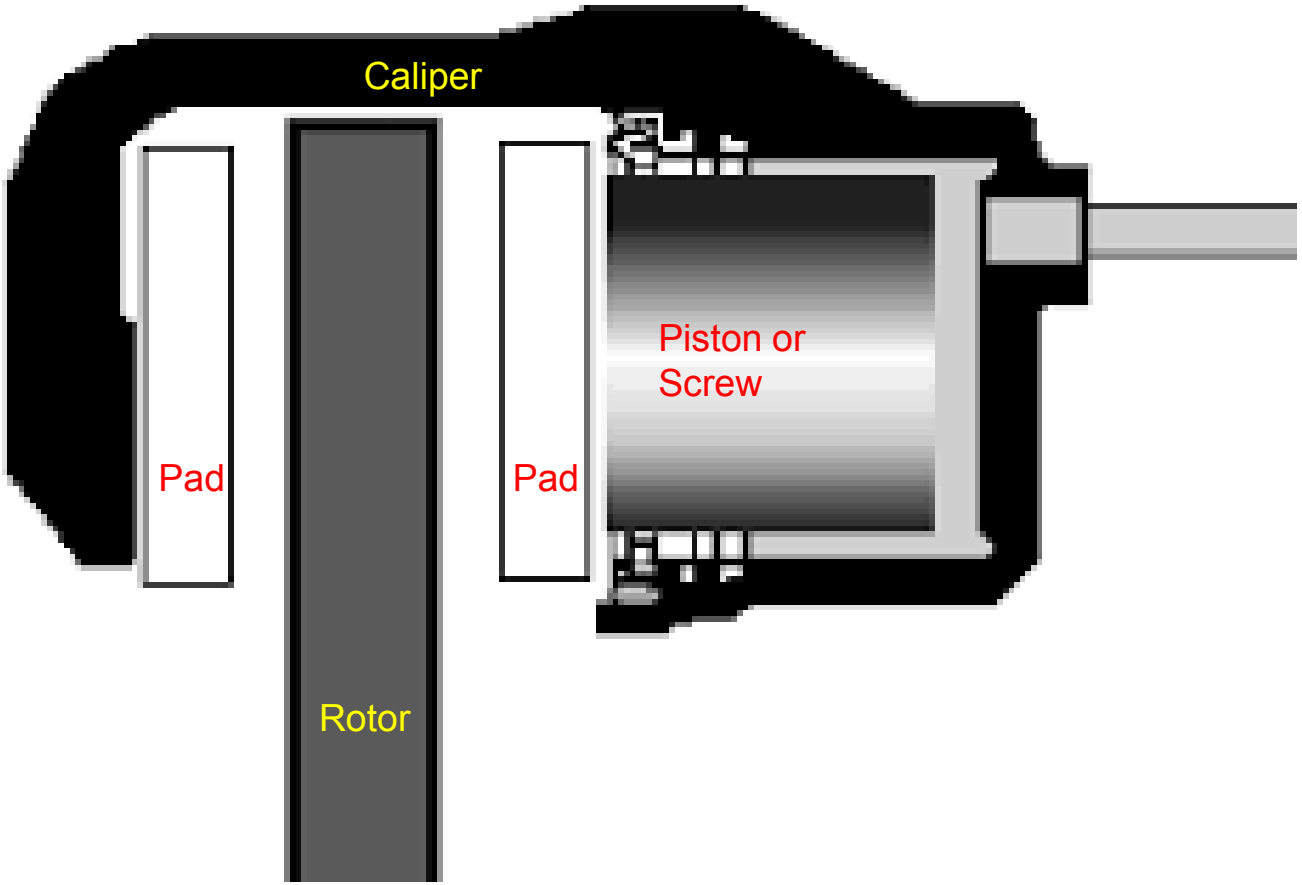
- Notify shop at ¼”
- Pad with a thickness less than 1/16” or to wear indicator is OOS.

Front Disc Brakes

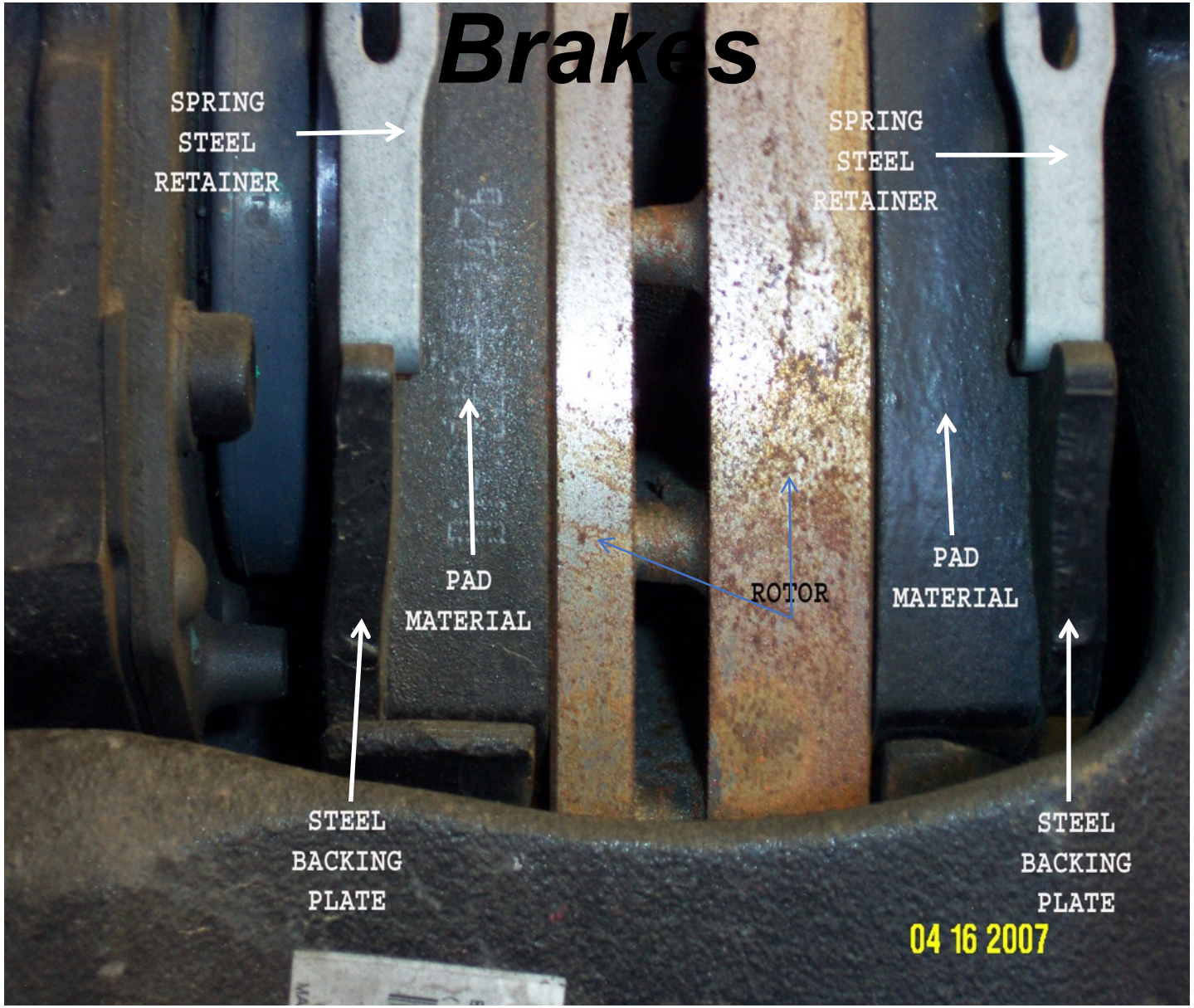


Axial Disc Brake

Disc Brake Theory

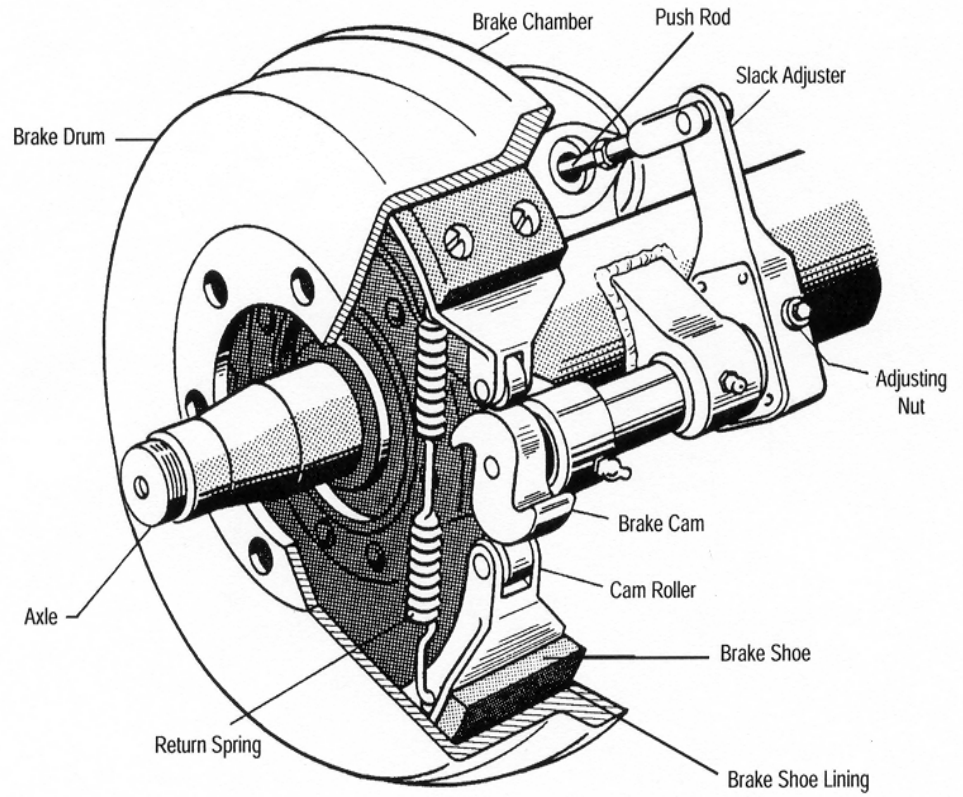


Top View of Disc Brakes



Drum Brakes (S-cam)

- Brake shoes Minimum thickness less than 1/4” or worn into the wear indicator if lining is marked
- Measured at the shoe center



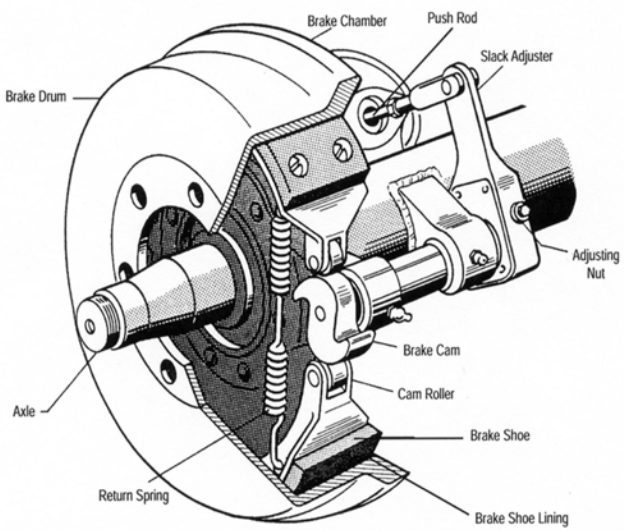
S-cam Air Brake

Drum Brake Components

Drums

Shoes

S-Cam



S-cam Air Brake

Drum Brake Theory

Inspecting And Testing The Brake Systems

Physical Brake Inspection

Turn vehicle batteries and ignition switch on.

Check the air pressure if both front and rear air tanks

If the air pressure is below 100 psi in either tank, start the engine and build air pressure to 100 psi.

Turn the engine off.

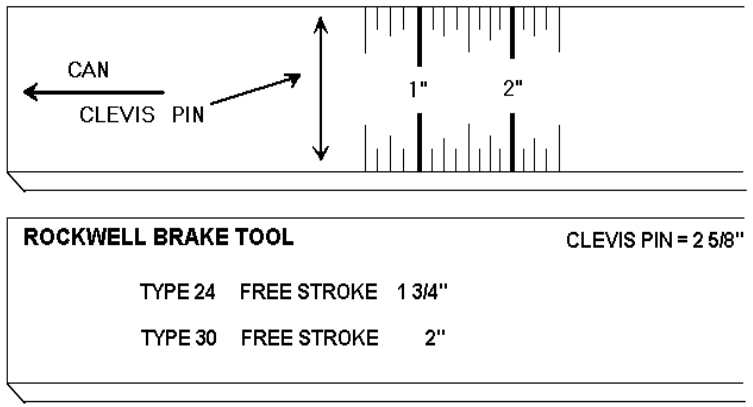
Chock the rear tire.

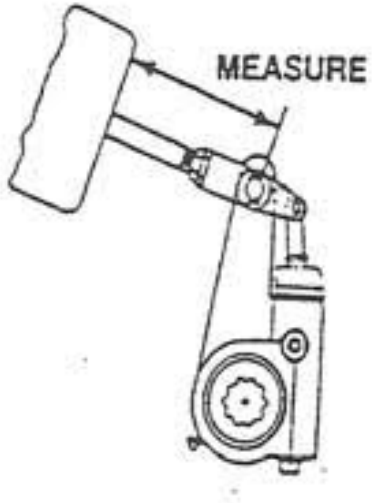
If the vehicle is equipped with slack adjusters, release the spring brakes.

Inspecting And Testing The Brake Systems

Using the Rockwell Brake tool, check the slack adjuster position. If the slack adjuster is not in the correct position the measurements will not be correct.

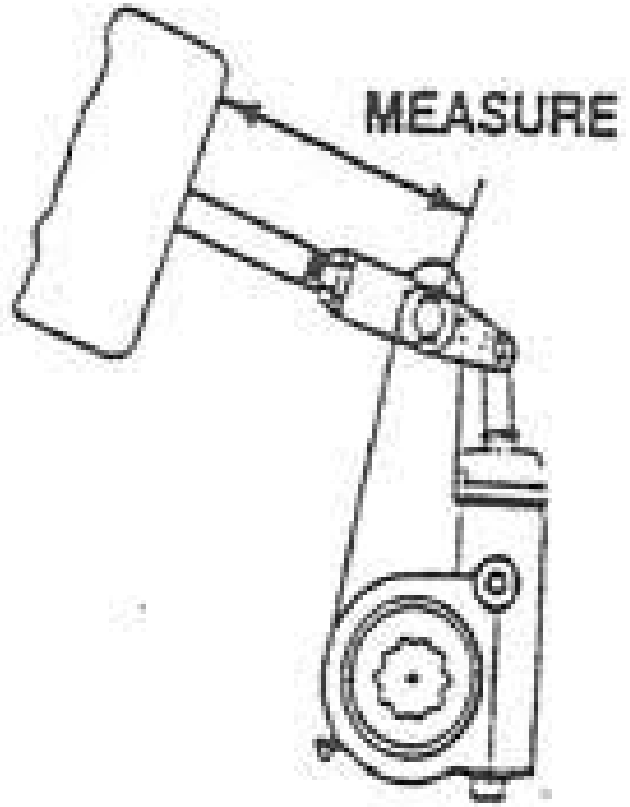
If the vehicle has an unusual clevis pin position as with the Pierce Dash (2 1/8”) and Crimson Truck 1 tractor (2 3/8”), the Brake tool must be modified to match that measurement.





Inspecting And Testing The Brake Systems

- Measure the initial clevis pin measurement with the brakes released.



Inspecting And Testing The Brake Systems

Clevis Pin Measurement

From the back of the brake can to the middle of the clevis pin with all brakes released at 100 psi.

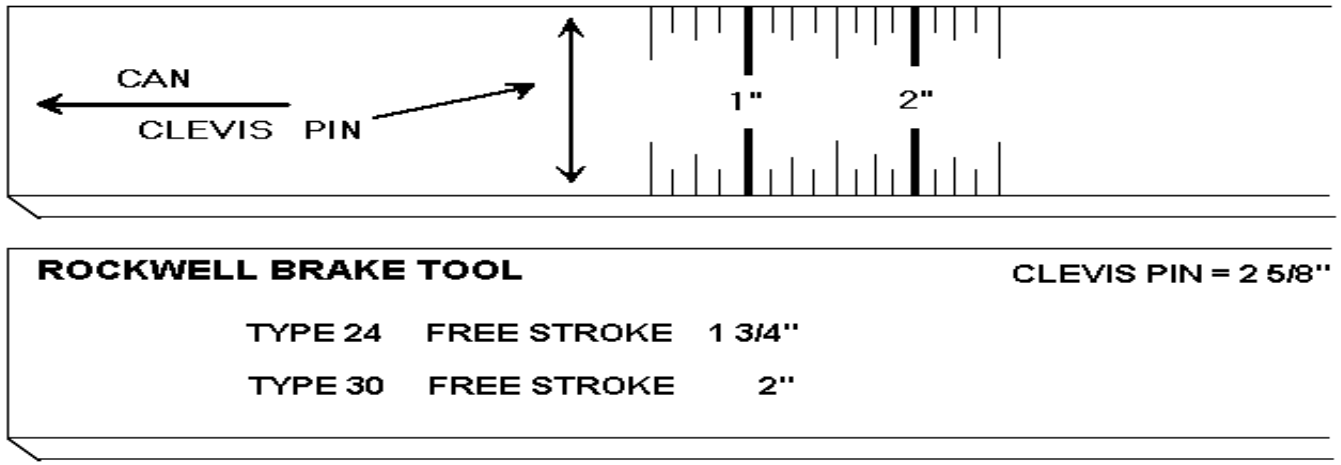
Any variation plus or minus of 1/8” should be reported to the repair facility.

Inspecting And Testing The Brake Systems

Clevis Pin Measurement

Measure daily. Record the measurement on the 29th of the month on the FDM-8.

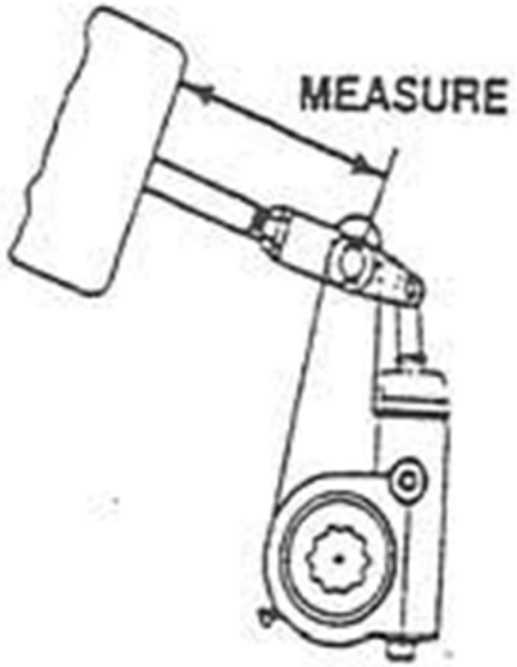
Use the Rockwell Brake tool on all apparatus with 2-5/8” initial clevis measurement.



Inspecting And Testing The Brake Systems

Brake Free Stroke

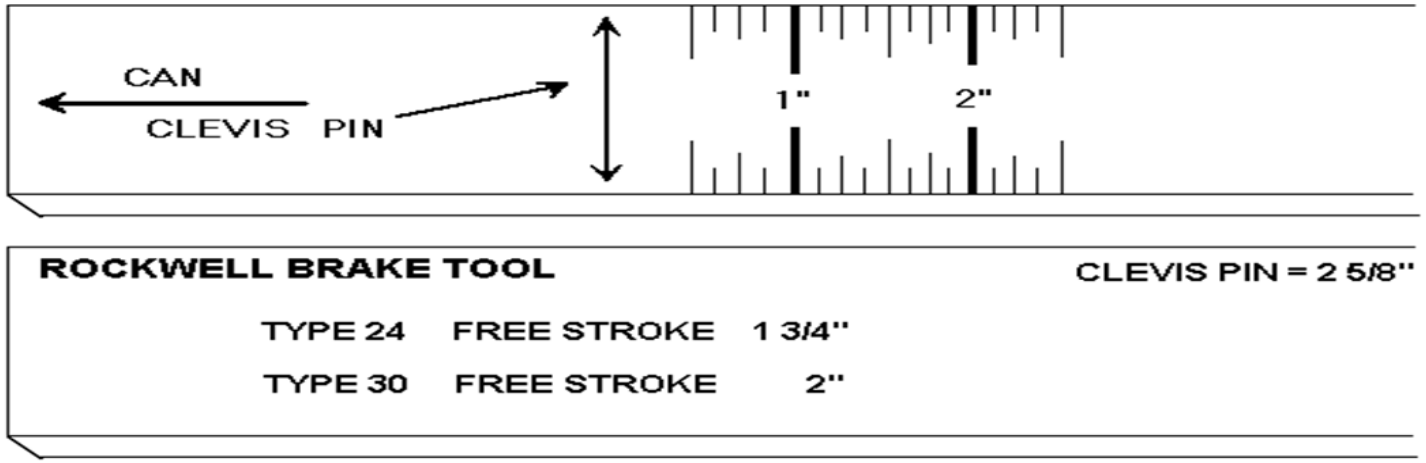
- With the spring brakes released and approx. 100 psi air pressure available.
- Have another person fully apply and hold the brake pedal while you measure the stroke of the pushrod to the clevis pin.



Inspecting And Testing The Brake Systems

Brake Free Stroke

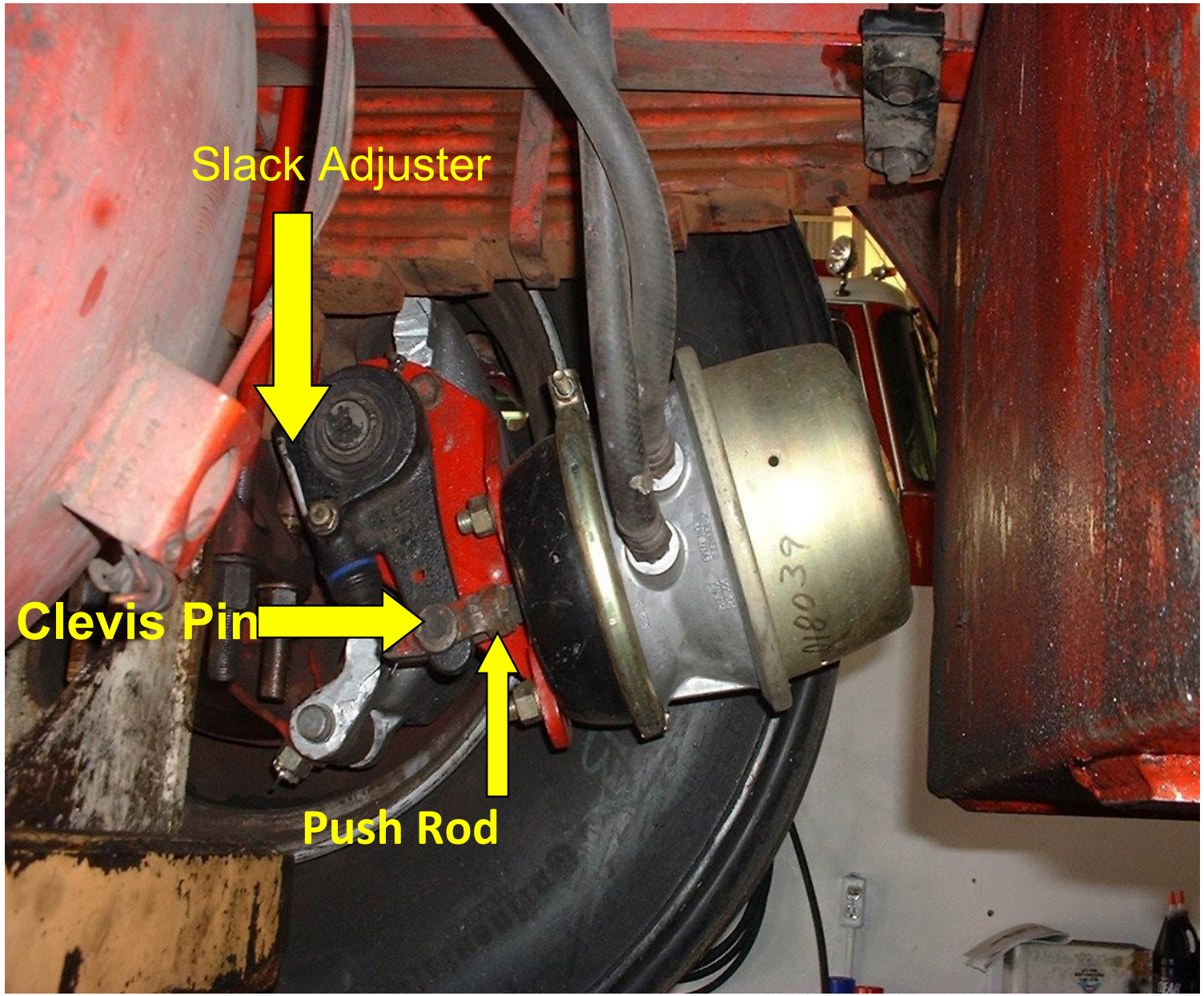
The pushrod free stroke should not be more than the measurements stated on the back of the Rockwell brake tool.



A type 24 air chamber should not more than 1 ¾” (common on Brush vehicles).

A type 30 air chamber should not measure more than 2”. Notify the Repair Facility if greater

DD-3 Rear Brake Chamber



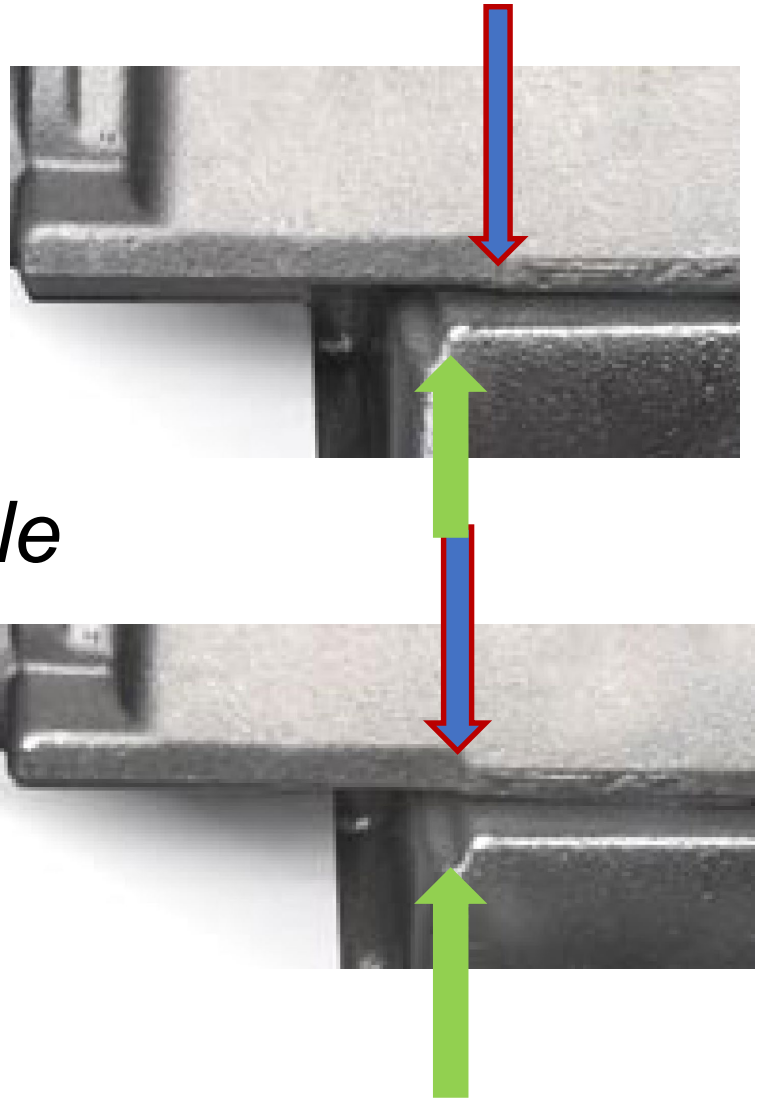
Inspecting And Testing The Brake Systems

Inspect the brake shoe or pad thickness:

Notify shop when pads are at ¼” or same thickness as backing plate. A brake repair will be scheduled.

- Minimum shoe thickness less than ¼”is OOS.
- Minimum pad thickness less than **1/16**” (out of service).

Wear Indicators



Notch Style

Compare notches

Wear Indicator Notch

Zoomed in

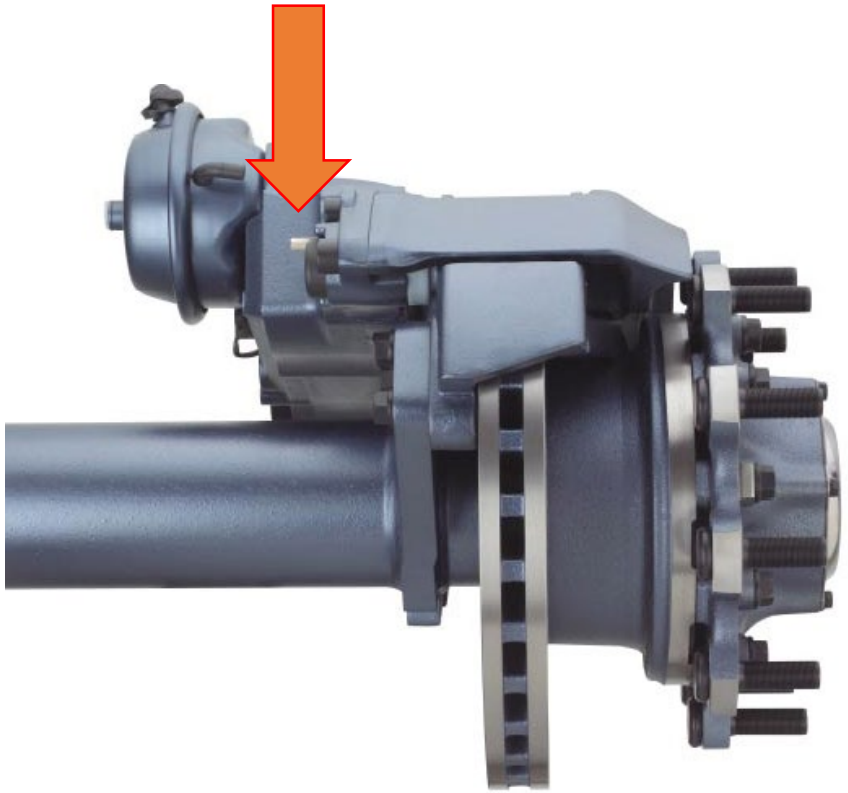
Pierce Arrow XT (rear) Brakes

Meritor EX-225

Direct mount

Visual wear indicator

- When pin tip is exposed 1/8”notify the shop. If the tip is flush, Out of Service.



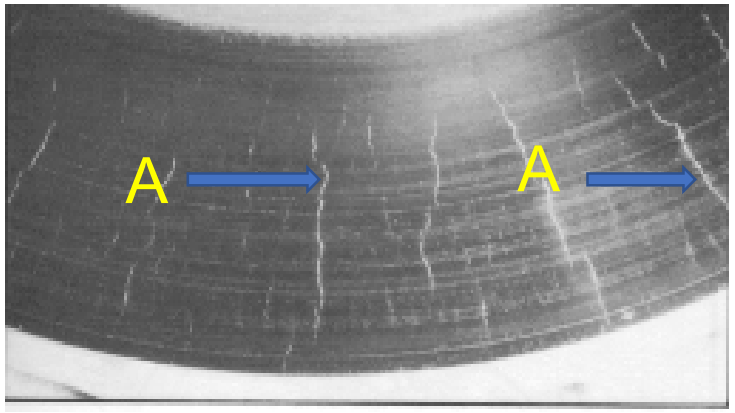
Viewing pads and rotor through access window

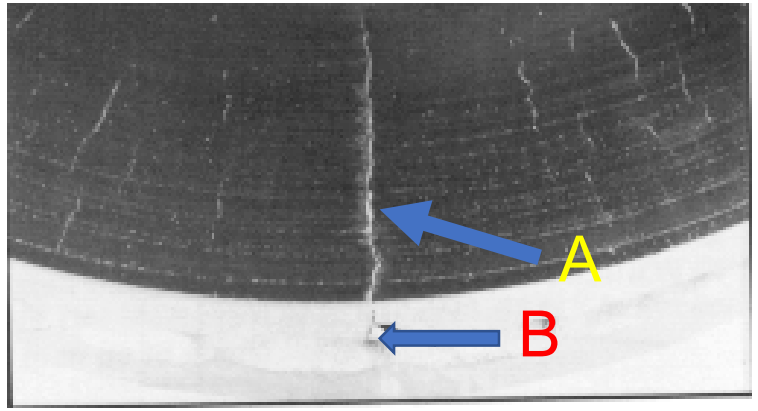
Inspecting And Testing The Brake Systems

Inspect the Drums and Rotors for cracks. Any crack greater than 1 1/8” long or continuing past the edge of the rotor is out of service.

A = over length

B = past edge





Tire and Wheel inspections

If you do not look, you will not see.

Do Not Overlook The Obvious!

Tire and Wheel inspections

Do Not Hurry Your Pretrip!

Tire and Wheel inspections

Look for under inflated tires

Tire and Wheel inspections

Look for foreign objects

Tire and Wheel inspections

More foreign objects

Before

After

Tire and Wheel inspections

Look for worn tread

Tire and Wheel inspections

Look for front tire outer edge wear.
Common on our newer apparatus.

Tire and Wheel inspections

Even if the worn through portion is slight, it is still “out of service”.

Tire and Wheel inspections

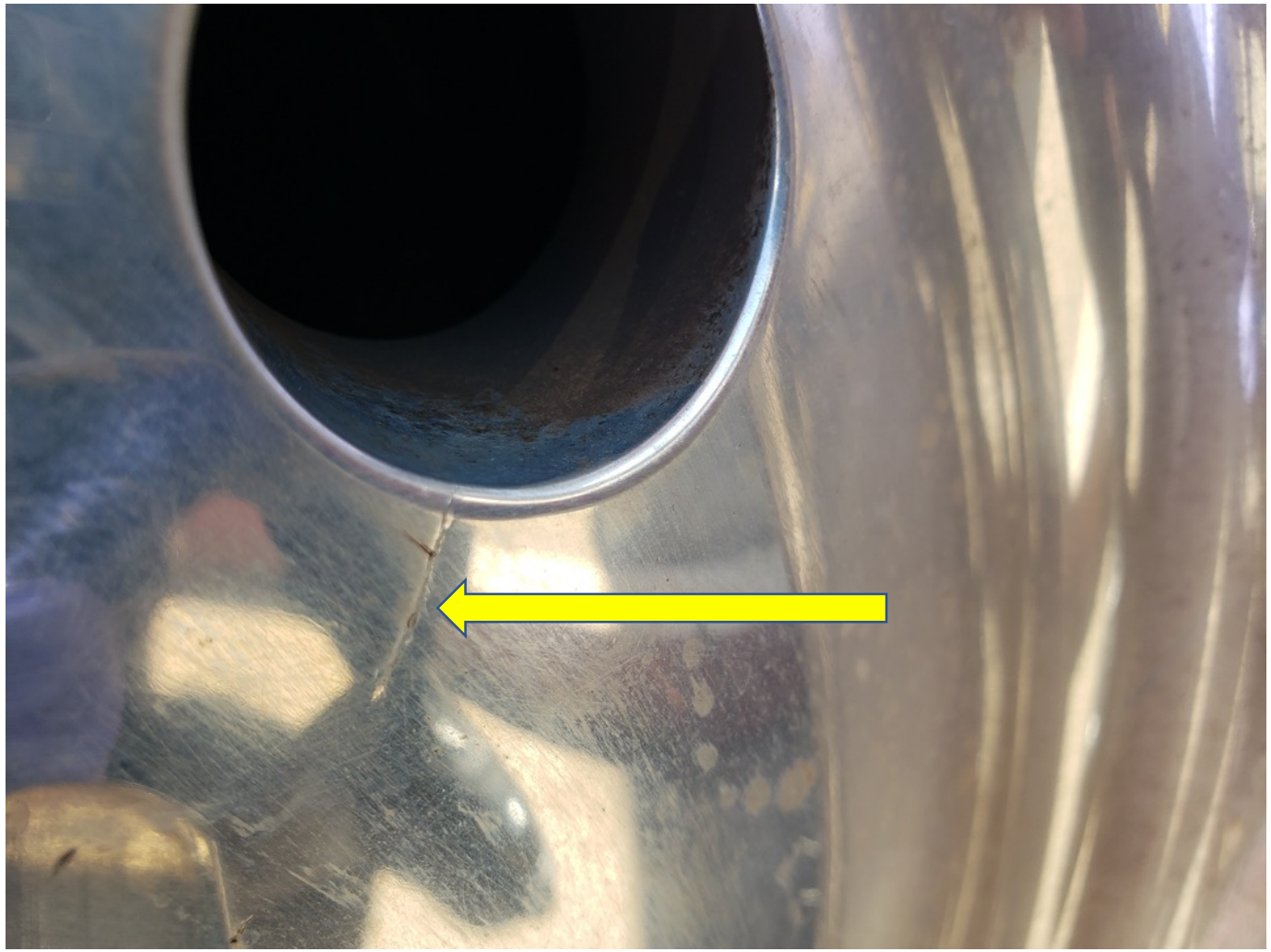
Tread depth may be fine but the outer edge has exposed sub-layers

Tire and Wheel inspections

Inspect the wheel for damage

Tire and Wheel inspections

Cracks don’t heal or go away if ignored.



Tire and Wheel inspections

If there are cracks on the outside, there are nearly always cracks on the inside as well. Look next to the red line.

These cracks ran the whole way around the inside of the wheel.

Secondary Braking Devices

Function: prevent fading of the chassis (foundation) brakes that result from overheating due to frequent or hard stopping.

The cooler the brakes are the more effective they will be in a panic stop

Secondary Braking Devices

- Requirements

California Vehicle Code 35002(b)(2)states: “Any fire apparatus exceeding 31,000 lbs. gross vehicle weight rating (GVWR) shall be equipped with a retarder.”

Vehicle is out of service if the secondary braking device is not operating as per Repair Facility personnel

If the vehicle is equipped with two or more 2° devices, they all shall work per SDFRD policy.

Secondary Braking Devices

Types of Secondary Braking Devices

Jacobs engine compression brake, “Jake brake” = engine decompression

Telma Retarder = magnetic resistance

Transmission Output Retarders (TOR) = back pressure of trans fluid to create resistance

Exhaust Brakes = restricts the engine exhaust

Secondary Braking Devices

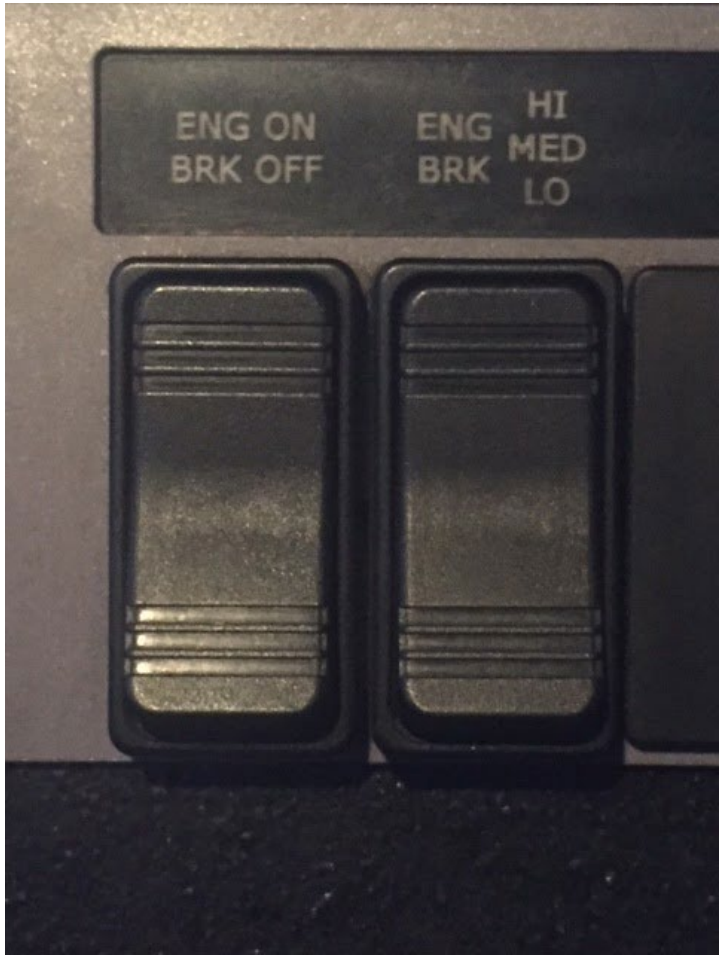
Jacobs Engine Compression Brake (Jake Brake)

- The compression brake is an electronically actuated mechanical system added to the engine valve train. When activated, the compression brake alters the operation of the engine's exhaust valves so that the engine works as a power-absorbing air compressor.

- Used on Pierce Dash, Pierce Arrow
- International Water Tender
- Brush Apparatus
- Various others

Jacobs Engine Brake

a.k.a. Jake Brake



Secondary Braking Devices

The Jake Brake is connected to the throttle/accelerator circuit

It is not controlled by the Anti-lock Brake System because you are not braking. ABS in not traction control.

Automatically turns off during critical wheel slip conditions (ABS Event), only after the skid has been initiated.

Some Jake Brake have only high/low settings, some high/medium/low settings , others have a 1,2,3 and off settings.

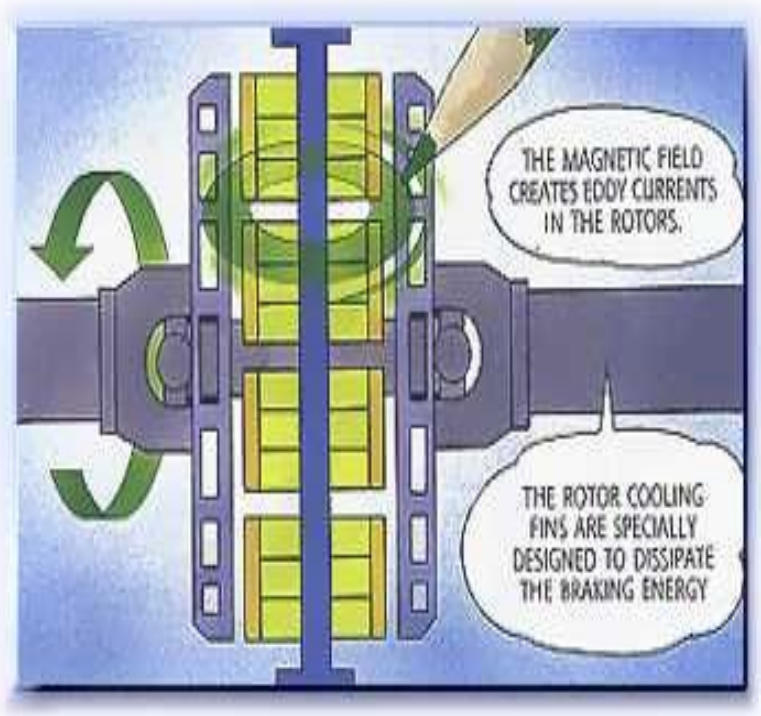
Secondary Braking Devices

Wet weather Operation

- The Jake Brake should be turned off during slippery conditions.

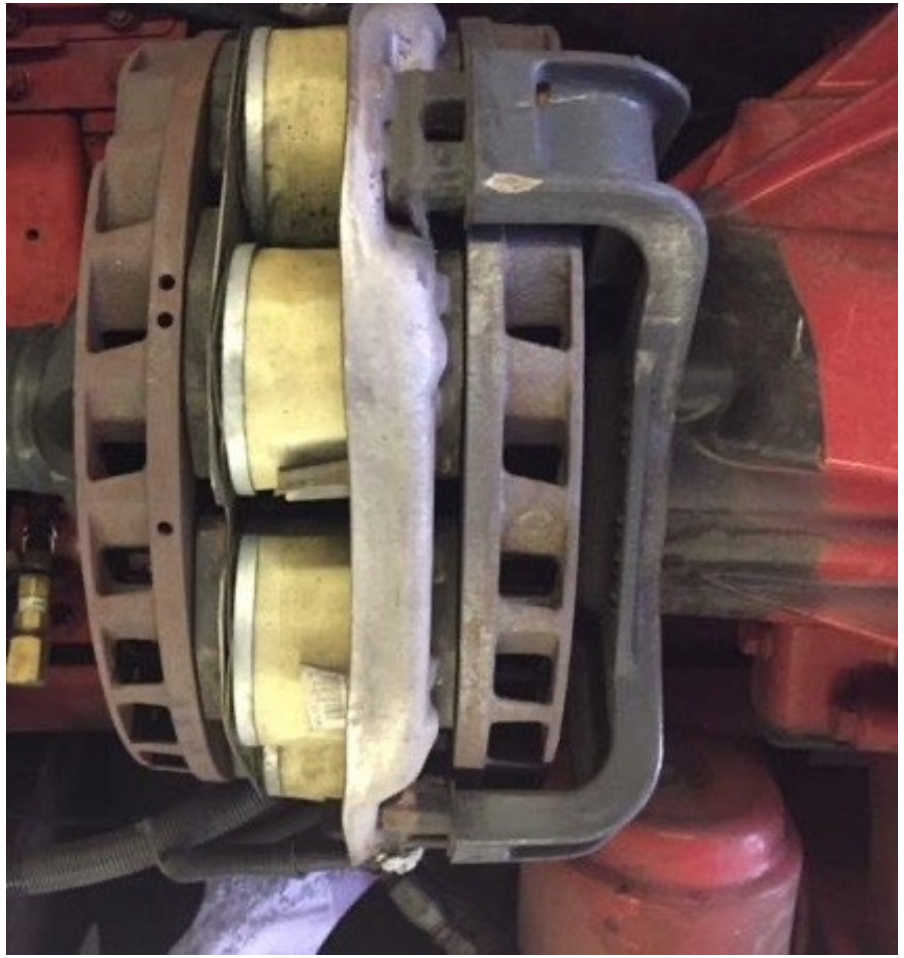
Telma Retarders

Electromagnetic driveline retarder



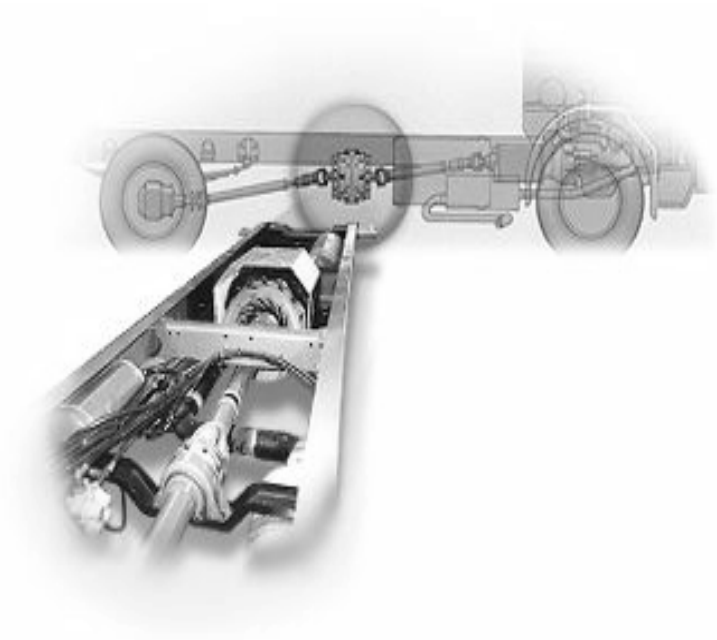
Telma Retarders

Telma Retarders



Telma Retarders

Can be mounted on the drive shaft (axial mount) or on the differential (focal mount)



Axial

Focal

Telma Retarders

Activation

Older style floor pedal; stepping on the pedal energizes the Telma. The harder pushed the more slowing energy.

Dash joystick; if equipped ensure that the dash switch is on. Select the level of slowing desired. All the way up is off or 0 slowing. Each lever position down is 25% more and one additional light on the indicator. The joystick controls the Telma when you lift your foot off of the throttle/accelerator pedal only.

Brake Applied; As you step on the brakes the Telma is also applied automatically proportionate to how hard you apply the brake pedal. This aspect of the Telma cannot be turned off.

Telma Retarders

Telma will disengage at speeds 3 and 14 mph depending on programming

The ABS will disable Telma if wheel lock up occurs

The Telma ***does not*** need to be turned down or off during inclement weather.

Telma Dashboard Lights (Pierce Dash)

Telma Dashboard Lights (Pierce Arrow XT)

Telma Joystick Lever

All the way up is ***off*** for throttle lift only. 25% more braking for each position down the handle is moved.

Exhaust Brake

Operation: switch must be “ON”.

Activates on throttle/accelerator pedal lift

Works by restricting the exhaust creating engine back pressure. This makes it difficult to breath and robs the engine of power.

This back pressure can also cause the transmission to downshift, slowing the apparatus and creating more back pressure

The exhaust brake is disabled when mobile pumping

Inclement Weather Operation

Jake Brake – “Turned off in Slippery Conditions”

Telma Retarder – Leave in any position desired.

Transmission Output Retarder (TOR) – Leave on but do not use the foot pedal

Exhaust Brake leave “ON” adjust road speed accordingly

NORTH AMERICAN UNIFORM OUT OF SERVICE CRITERIA

How to find it . . . . .

Target Solutions> Quick links> Training> Driver Training> Out of Service Criteria> North American Standard Out of Service Criteria.

Please read this for yourself. It is important!

NORTH AMERICAN UNIFORM OUT OF SERVICE CRITERIA

Defective Brakes

Includes any brake that meets one of the following criteria:

–Absence of effective brake action upon application.

– Broken/missing mechanical components.

–Loose brake components.

NORTH AMERICAN UNIFORM OUT OF SERVICE CRITERIA

Defective Brakes

- Includes any brake that meets one of the following criteria:
  - Audible air leak at brake chamber (air can).
  - Does not meet re-adjustment limits.
  - Has cracked, loose, or missing lining.
  - Has oil on brake linings / drum surface.

NORTH AMERICAN UNIFORM OUT OF SERVICE CRITERIA

Steering Axle Brakes

- **Defective Brakes**

Includes any brake that meets one of the following criteria:

-Absence of effective braking action.

-Mismatch of air chamber sizes, slack adjuster length.

-Has cracked, loose, or missing lining.

-Has oil seeping onto linings or drum surfaces.

-Linings/pads are less than ¼” for drums or 1/16” for disc pads.

NORTH AMERICAN UNIFORM OUT OF SERVICE CRITERIA

Parking Brakes

- **Defective Brake**

Includes any brake that meets one of the following criteria:

- Any non-manufactured holes or cracks in the spring brake housing.
- Brake Drums / Rotors; External cracks that open upon brake application, are over 1 1/8” long or pass the outer edge
- Any portion is missing or in danger of falling away.

NORTH AMERICAN UNIFORM OUT OF SERVICE CRITERIA

Air Loss Rate

If there is an air leak and pressure is not maintained with compressor on and service brake applied.

NORTH AMERICAN UNIFORM OUT OF SERVICE CRITERIA

- **Brake Hoses and Brake Tubing**

Check for damage, bulging, audible leaks, improper splicing, or any cracked, broken, or crimped hoses, or tubing.

NORTH AMERICAN UNIFORM OUT OF SERVICE CRITERIA

Low Pressure Warning Device

- Audible and visual are both missing or do not operate at approximately 55 PSI or below.

- If one works, the vehicle should not be taken out of service, but do notify the Repair Facility.

Ten Steps to Good Braking "COALS" plus 4

1. Check air system **C**ut In, must engage at 100 psi or higher.
2. Check cut-**O**ut pressure must occur by the MAX 140 PSI
3. **A**pplied Air leakage, with parking brakes off, Apply the service brake, after initial air loss:
   - Straight truck-3 PSI or less in one minute- OK
   - Combination tractor/trailer 4 PSI or less in one minute- OK Check air system Loss
4. **L**ow Pressure lights and alarm must occur between 75-55 PSI
5. Spring Brake Test must engage between 45-20 PSI

Ten Steps to Good Braking COALS" plus 4

6. Parking Brake- with parking brake engaged, transmission in drive, must not move.
7. Service Brake Test-put vehicle in drive and accelerate to 5mph. Apply the service brake. If the vehicle does not stop or pulls to one side or the other, turn in for repair.
8. Anti Lock (ABS) Check- Turn on vehicle ignition to ensure the ABS lighting indicator illuminates and promptly turns off.
9. Air Pressure Build up Test- Engine running compressor must build air from 85-100 PSI within 45 seconds.
10. Check brake system components, brake hardware, cans, drums, discs, linings, hoses, etc…

Anti-lock Brake System (ABS)

Monitors each wheel during the braking process.

- **It enables shorter stopping distances on a variety of road surfaces while maintaining vehicle stability**
- **If wheel lock-up is sensed the brake pressure to that wheel will automatically be decreased to allow it to remain in motion.**
- **The brake pedal will pulsate when ABS is operating.**
- **ABS amber warning light stays on while the system is active.**
- **If the light stays on after the brakes are released, this is a warning of an irregularity in the system. Notify repair facility.**

Anti-lock Brake System ABS

ABS amber warning light-Stays on while the system is active.

If the light stays on after the brakes are released, this is a warning of an irregularity in the system. Notify repair facility

How do we use ABS?

STOMP – on the brake pedal and apply steady pressure.

STAY – on the brake pedal and do not pump the brakes. Releasing brake pressure resets the system. The brake pedal will pulsate as the ABS operates.

STEER – to avoid obstacles.

THE END