"Walking The Walk"
Is easy on flat ground!!

FIVE MAJOR COMPONENTS OF FIRE APPARATUS

Apparatus Division

Montgomery County Fire Rescue Service

OVERVIEW

Five Major Components

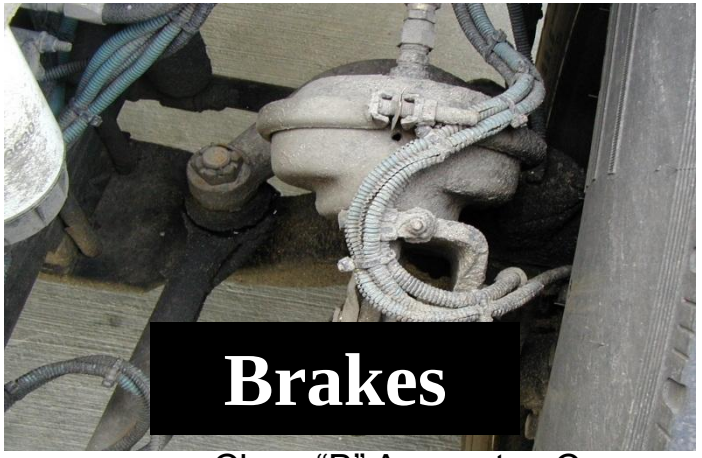
- Tires
- Wheels
- Steering
- Suspension
- Brakes
- Associated OOS Criteria

Five Major Components

Tires and Wheels

Steering

Suspension



Brakes

Why do we have to know the Five Major Components?

- Knowing the five major components of the apparatus we can identify and correctly write defect reports.
- Knowing the five major components and there working components helps determine normal and out of service conditions.
- Knowing all of the components by name help the mechanic understand what we are reporting.

TIRES

TIRES

C=Condition

**** CID ****

- No cuts that expose cord
- No bulges on sidewall which indicates cord separation
- Front tires are not re-grooved or recapped
- Front tires are not mismatched

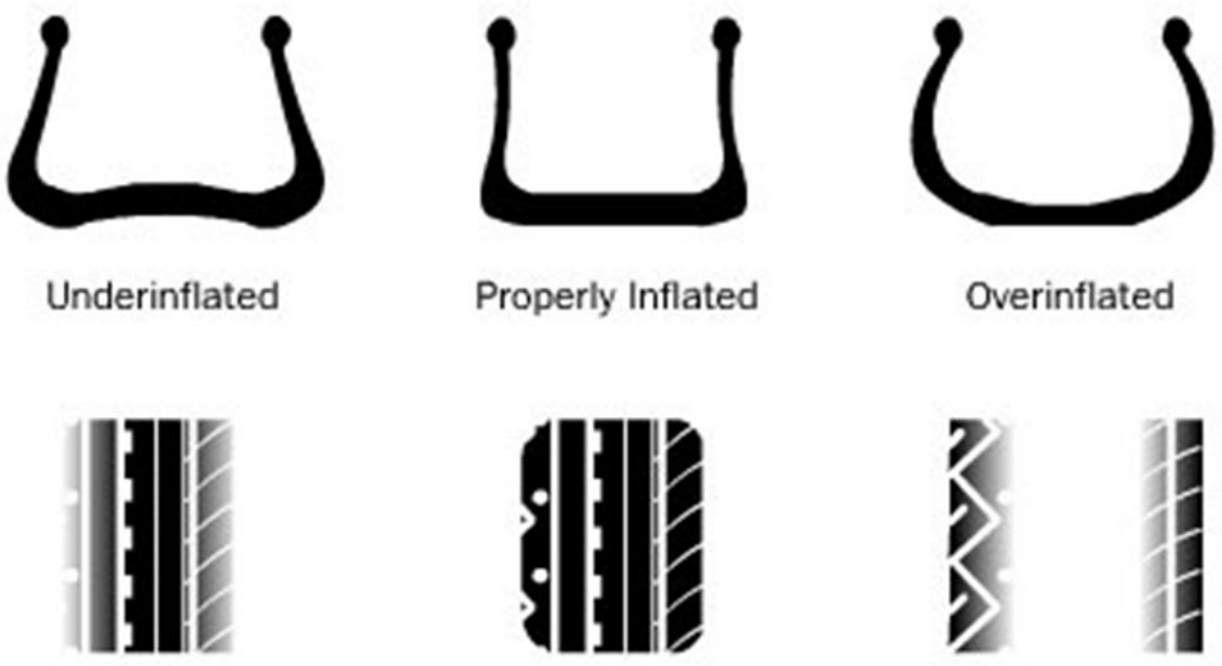
TIRES

I=Inflation

**** CID ****

- Not leaking or flat
  - Tire pressure will match posted pressure on the wheel well
  - Tire pressure will not exceed manufacture's recommended pressure.
  - Valve stem will be capped and not touching the wheel

TIRES



TIRES

I=Inflation

Under-inflation

20% under-inflation can cause a minimum 30% loss in tire life expectancy.

With just a glance from as far away as 20 feet, the Crossfire pressure equalization valve indicates an under-inflation problem.

Over-inflation

20% over-inflation can cause a minimum 10% loss in tire life expectancy.

The Crossfire pressure equalization valve signals can over-inflation problem which can dramatically shorten tire life.

Proper Inflation

Mounted correctly, Crossfire's yellow indicator verifies that air is flowing freely from one tire to the other, equalizing the load.

TIRES

D=Depth

**** CID ****

- Tread Depth no less than 4/32 inch
- No tread missing exposing cord
- Tread should be worn evenly
- Tread depth will be obtained from any major groove

TIRES

D=Depth

**** CID ****

TIRES

- Do the front tires match from side to side?
- Are they the same type?
- Do they have the same tread pattern?
- Do the rear tires match from side to side?
- Are they the same type and do they have the same tread pattern and wear?

MCFRS Driver Training Program

MCFRS Driver Training Program

TIRES

- Does the tire capacity match the axle weight ?
- Does the tire's maximum air pressure match the wheels maximum air pressure ?
- Does the wheels maximum weight match the axle weight ?
- Are they certificate tire's
- Are they certificate wheels

TIRES

- Does the tire have sufficient tread ? At least 4/32” inch of tread on steering axle’s and 2/32” tread on non steering axles
- Are there cuts in the tread or sidewall that expose the cord of the tire ? If so the tire is out of service.
- Does the tire have a bulge in the sidewall ? If so the tire has a cord, sidewall separation and the tire is out of service
- Is the Tire properly inflated ? A under inflated tire is a overloaded tire and is out of service

TIRES

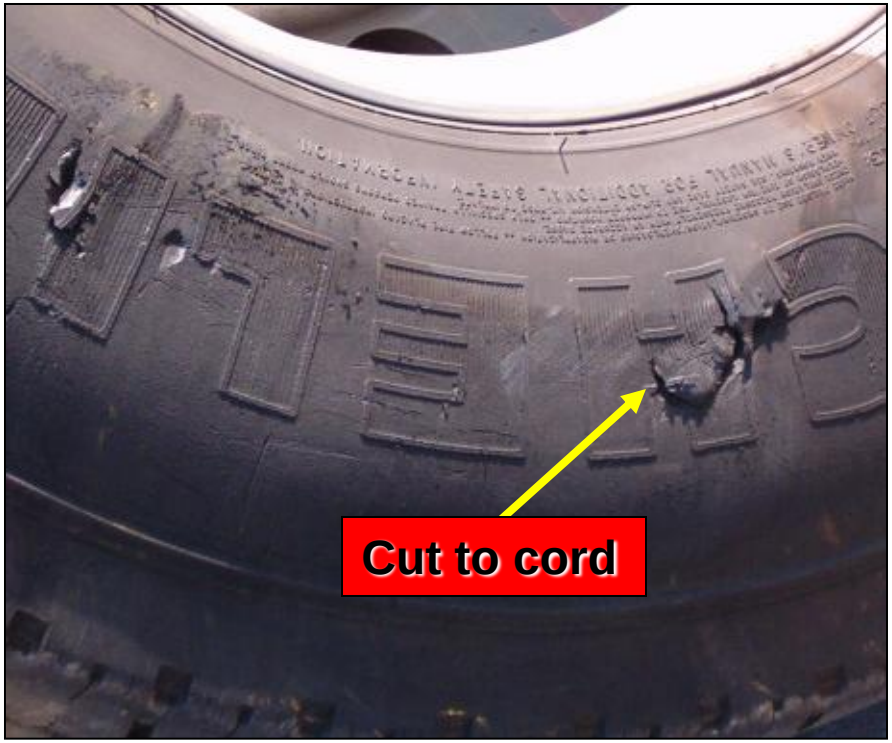
- Tires must be equal to or exceed the axle weight.
- Front tire must have at least 4/32 inch of tread.
- Rear tire must have at least 2/32 inch of tread.

Out Of Service Tires

- Steering tires with less that 4/32 inch of tread.
- Rear tires that have less than 2/32 inch of tread.
- Tire pressure that exceeds maximum air pressure of the wheel.
- Mismatched tires. (different load ratings, radial and bias belted on same axle, or different sizes)
- Dual tire's that are touching its mate when at maximum pressure.

Out Of Service Tires

- Tires that are cut to the cord on either sidewall or tread.
- Tire that is flat or has a detectable or audible leak.
- Any tire with a noticeable bulge on the sidewall



WHEELS

Single

Tubeless

Two piece

Flap & Tube

Three piece

WHEELS

- What type of wheel is on the apparatus ? One piece, two piece, or three piece ?
- Is the wheel aluminum or steel ?
- Does the wheel show any signs of cracking at the hand holds or bolt holes ?
- Are all of the studs and lug nuts present ? Are they all hand tight ?

WHEELS

WHEEL COVERS

- Can this wheel be inspected ?
- What does the wheel look like behind this cover ?

WHEEL COVERS

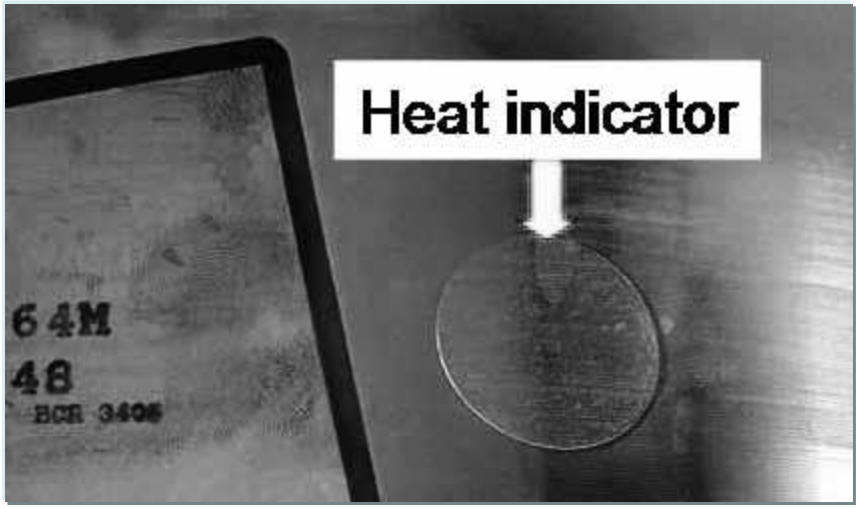
Out of Service Wheels

- Cracks from the bolt holes or hand holds
- Any bent rim that exposes the bead of the tire

Wheel Heat Sensors

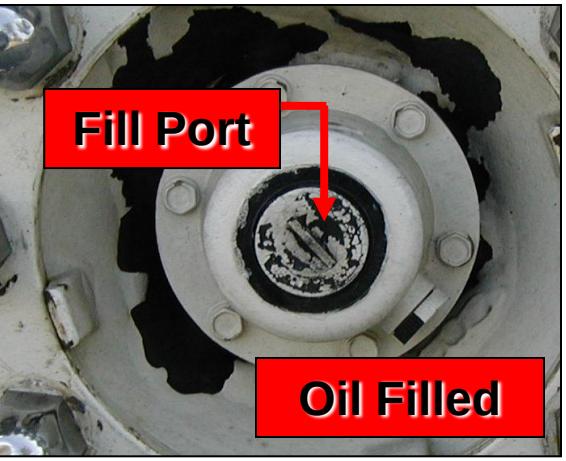
A blistered, blackened or cracked looking logo decal on an Alcoa wheel may indicate that the wheel has been exposed to excessive heat as shown in picture to the right, or discoloration of the wheel as shown in picture below.

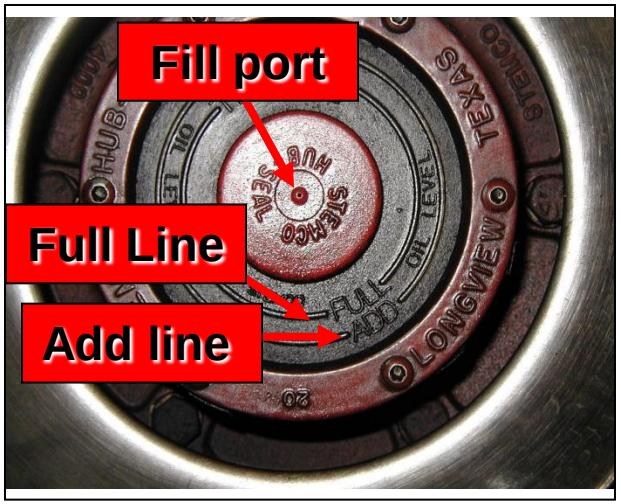
Wheel Heat Sensors



"Wheels manufactured as from February 2009 will have a 1 inch clear round heat indicator sticker"

Hub Caps





O O S Hubs

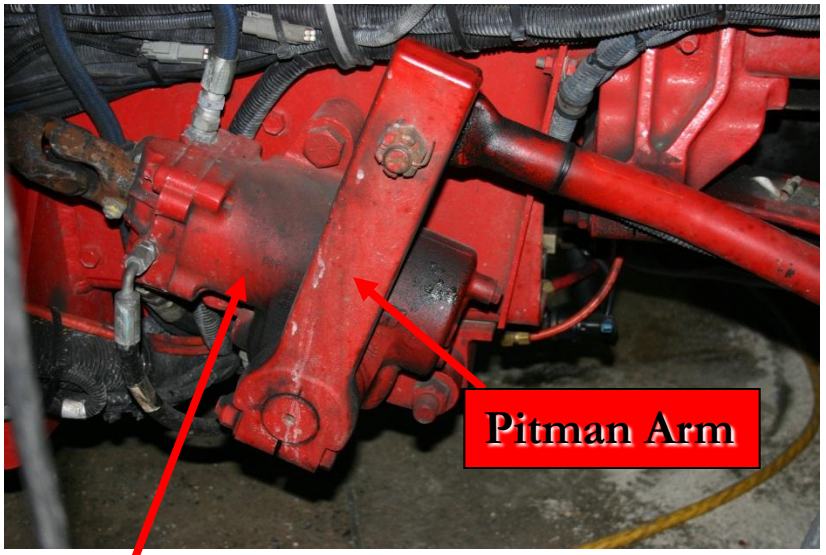
- Any hub with a class three leak
- Any hub without oil.

Note Do not remove center plugs with screwdrivers or tools. Damage to the rubber seal or housing will result

STEERING SYSTEM

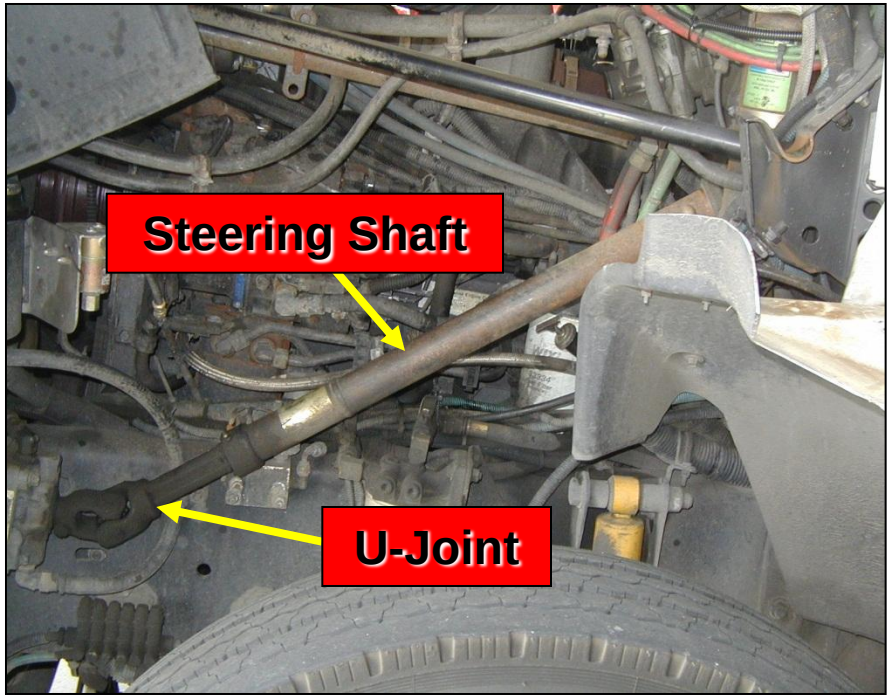
- Remember the order : Steering shaft to Steering Box. Steering output shaft to Pitman Arm. Pitman Arm to Drag Link. Drag Link to Steering Arm.
- Castle Nuts with locking pins hold the Drag Link to the Pitman Arm, and Steering Arm.
- Are all the parts secure ? And not bent, broken or missing
- Are there any class III leaks ?

STEERING SYSTEM

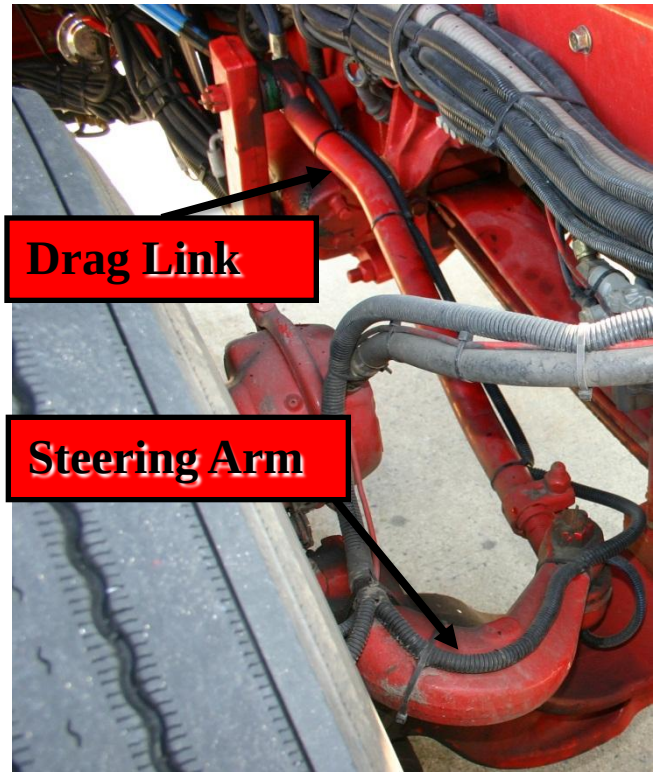


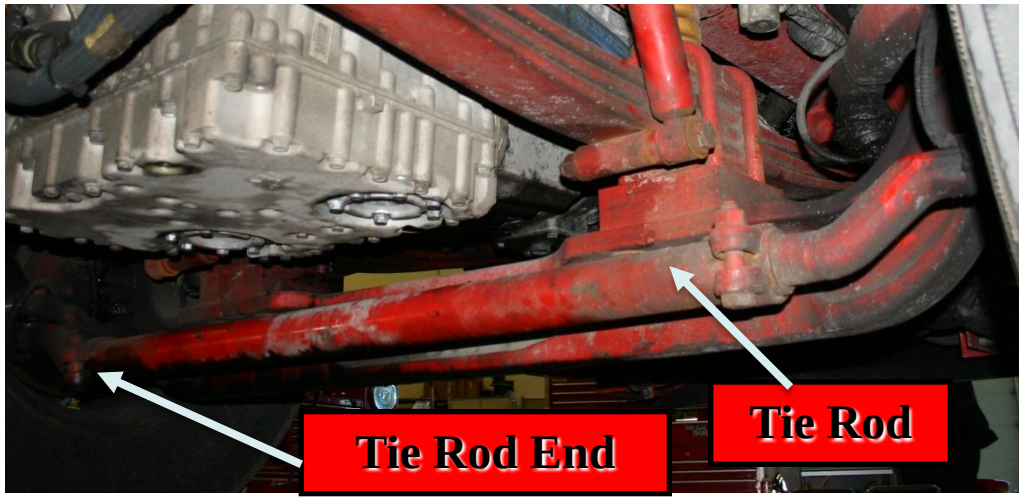
Steering System OOS Criteria

- Bent or broken steering shaft
- Any welded repairs
- Missing or loose parts at U-joint



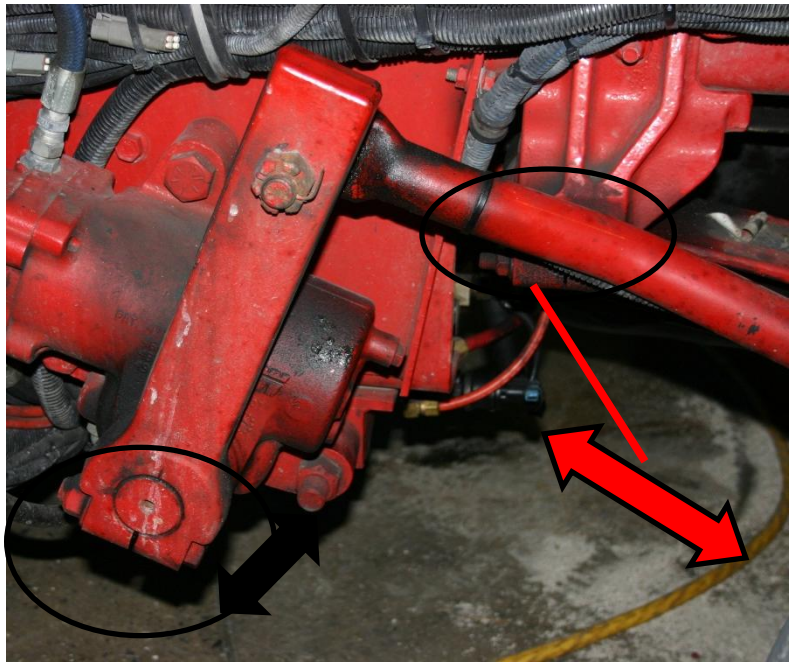
STEERING SYSTEM

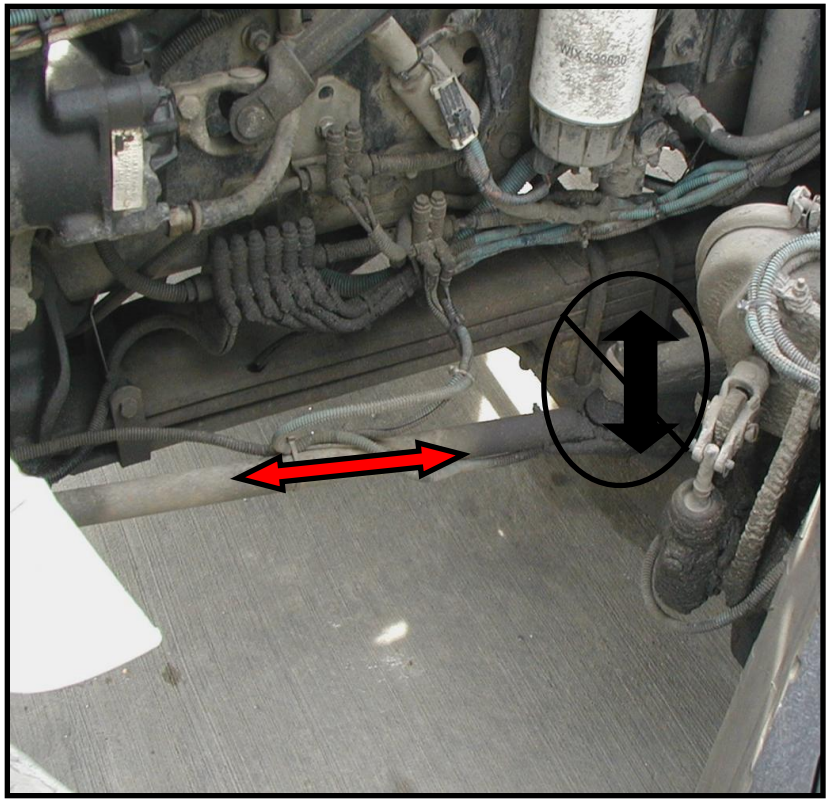




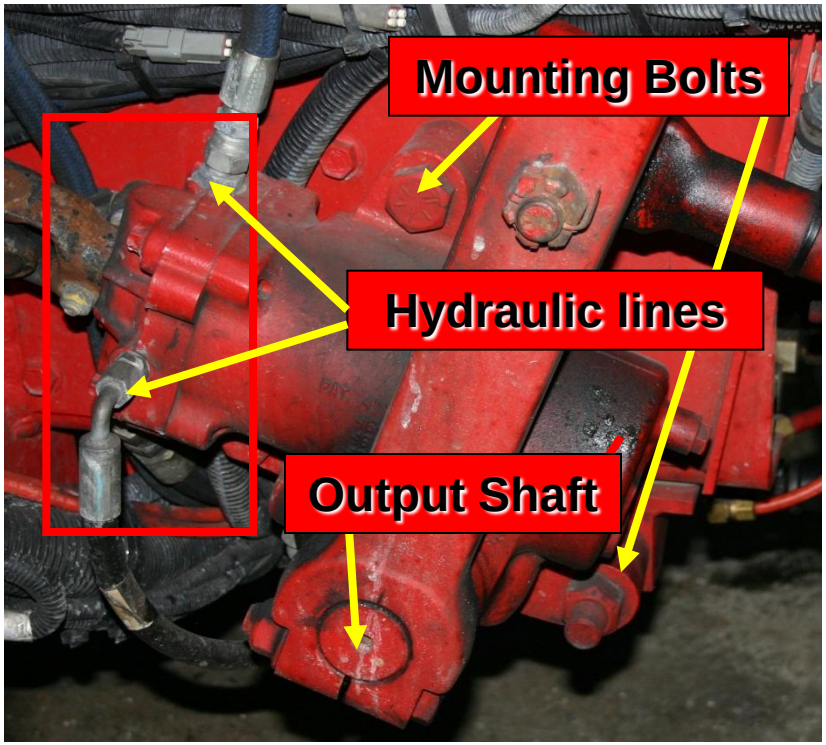
STEERING SYSTEM

Normal motion = ⟷ **Abnormal motion =** ⬭

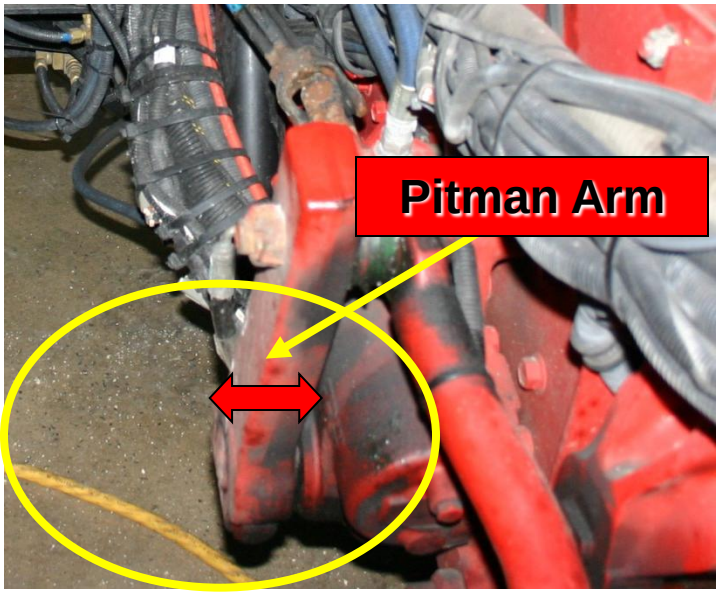




Steering System OOS Criteria

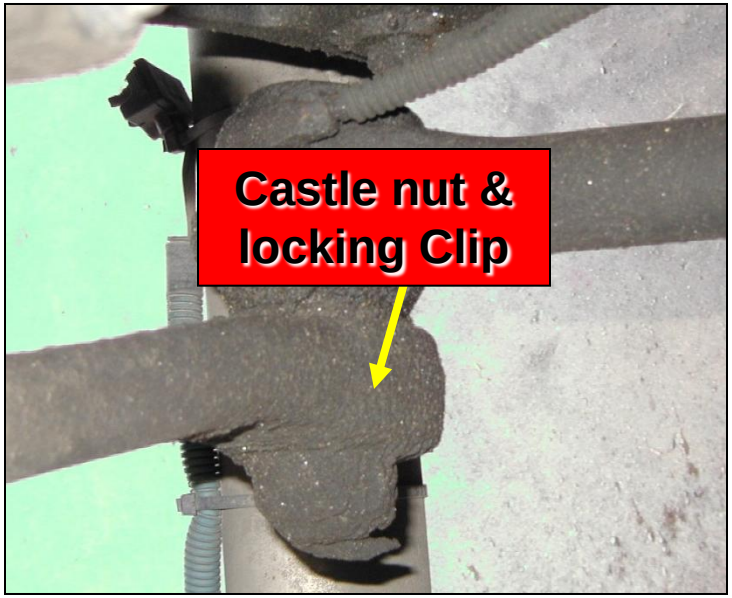


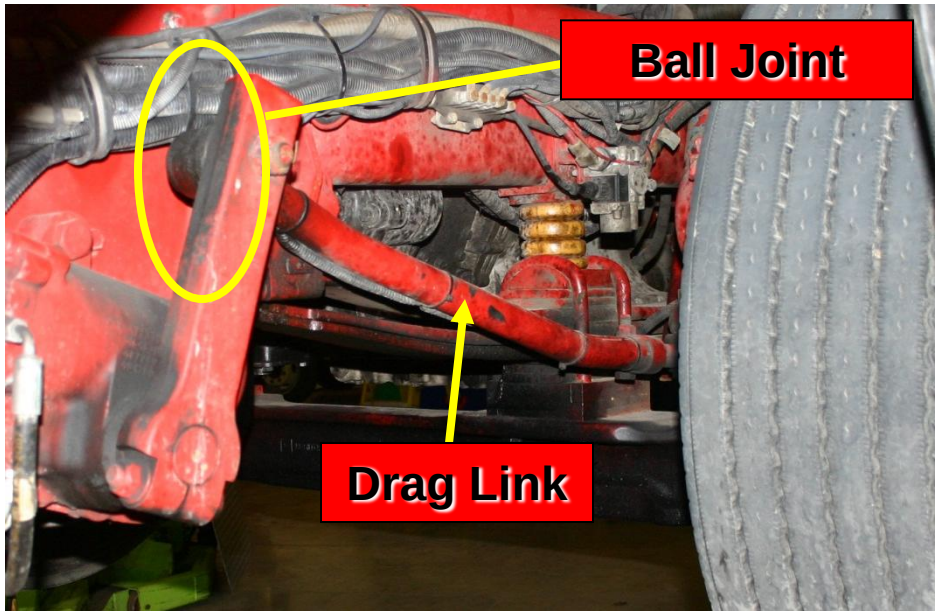
- Missing or loose mounting bolts
- Any class three fluid leaks



- No left or right play at Output Shaft and Pitman arm
- Loose or broken locking nut on Pitman arm/Output shaft

Steering System OOS Criteria

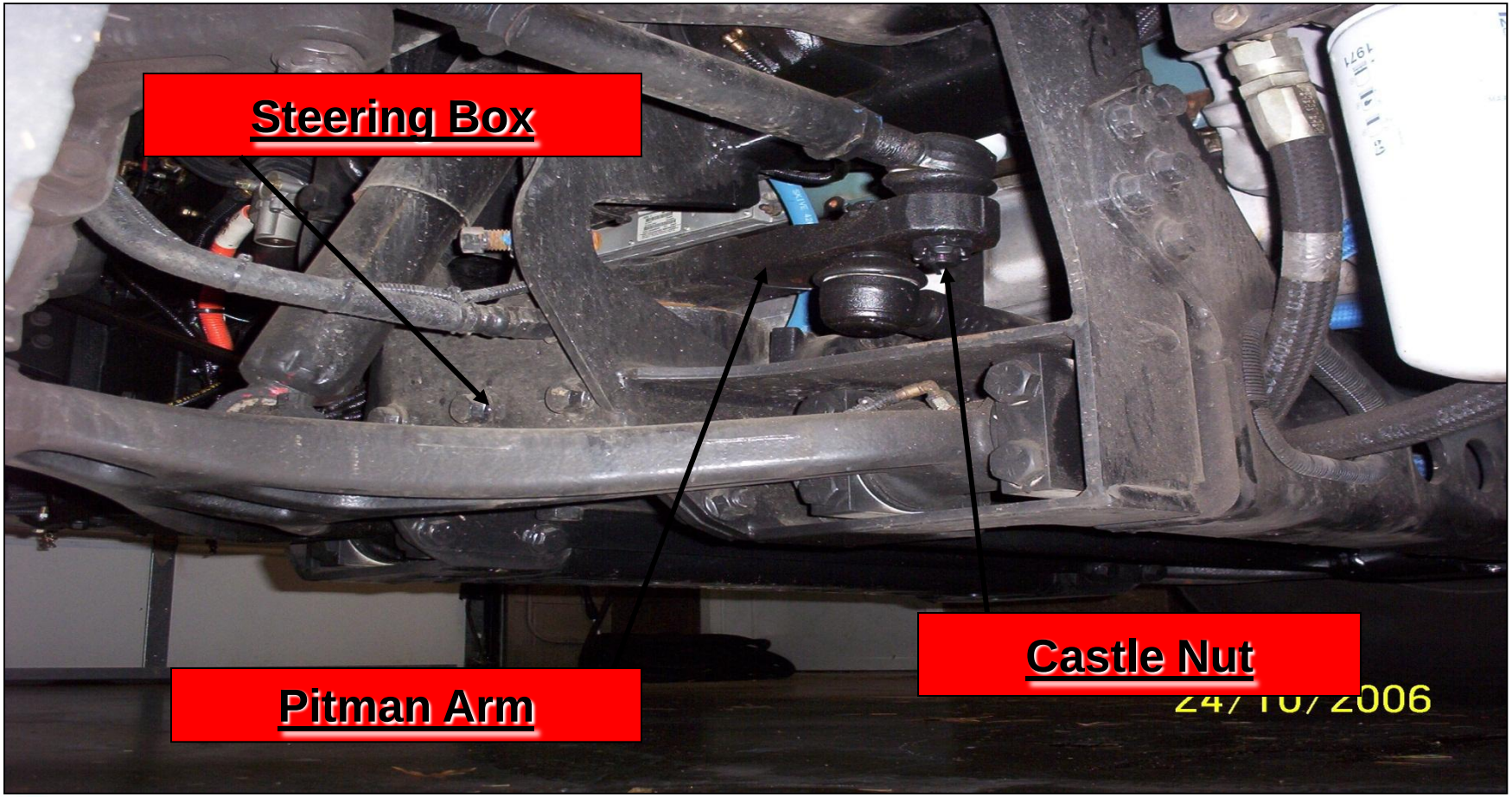




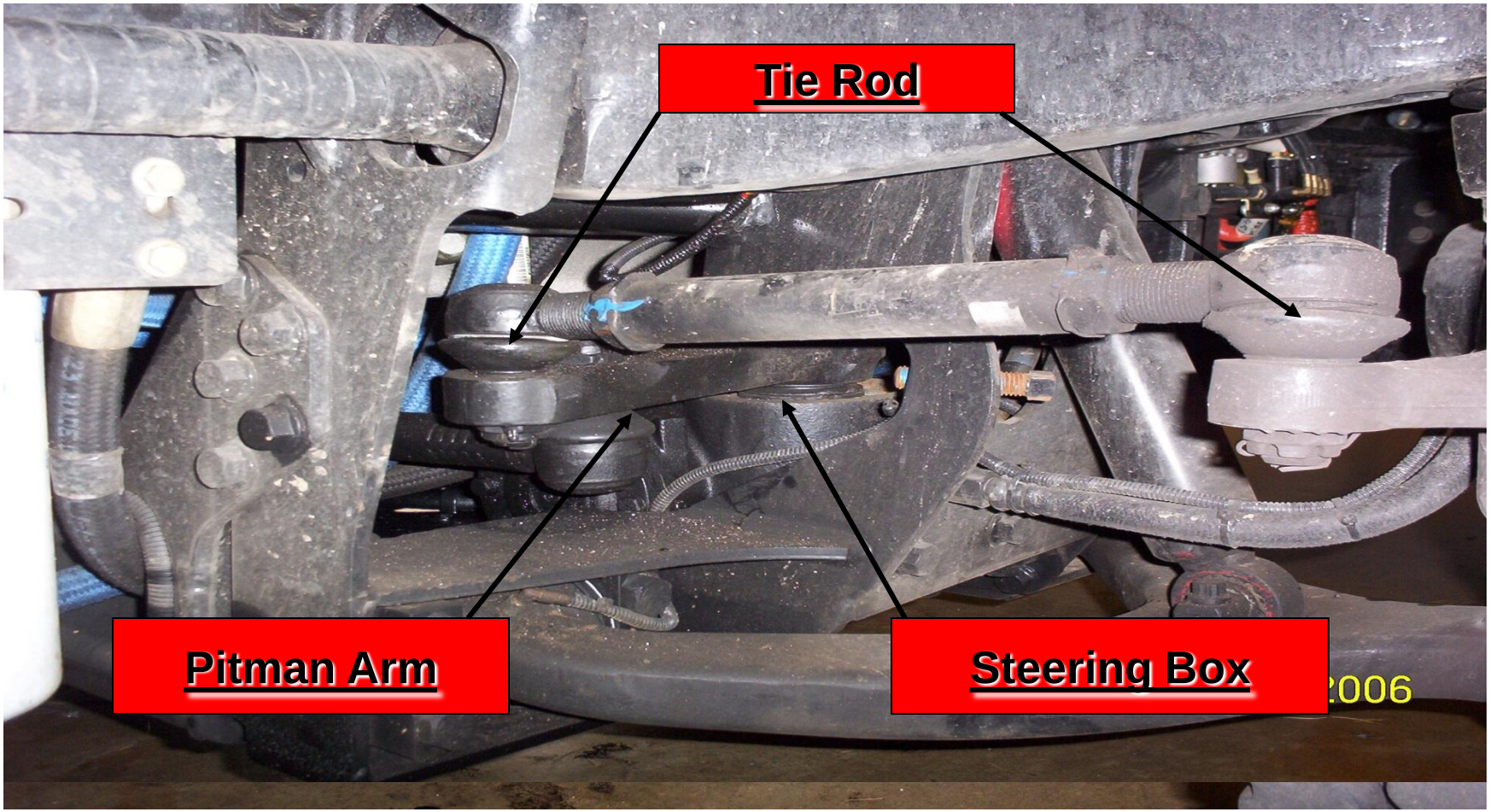
- Missing locking clip's on castle nuts
- Loose or missing Castle nuts

- Left and right movement at Pitman arm and Drag Link which exceeds 1/8 inch
- Up and down movement at Drag link and Steering Arm which exceeds 1/8 inch

TAK 4 STEERING SYSTEM



TAK 4 STEERING SYSTEM



TAK 4 STEERING SYSTEM

SUSPENSION SYSTEM

Why is the suspension system so important to us ?

SUSPENSION

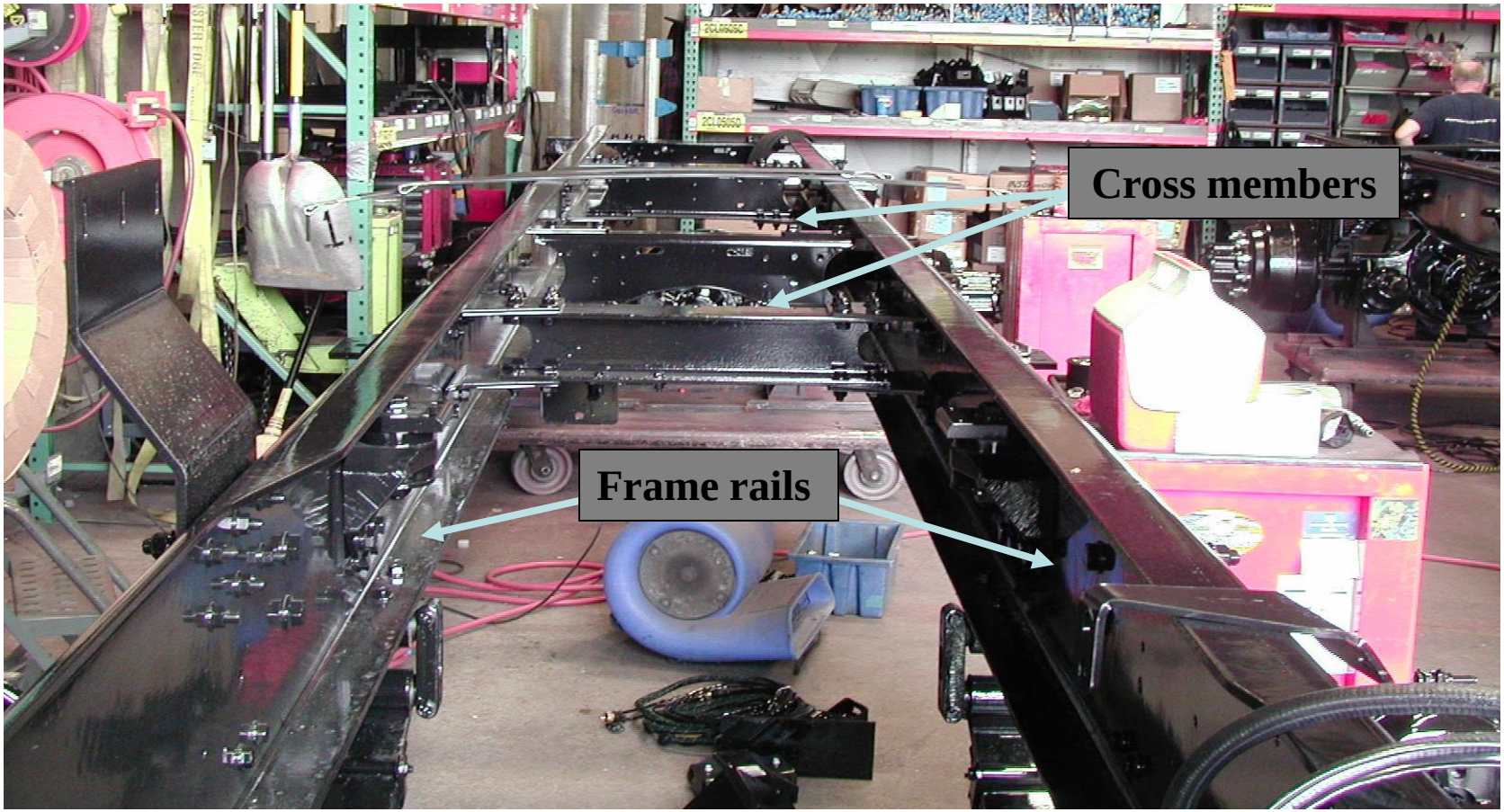
Crimson (OEM)

GVWR= 47,000lb

FRONT AXLE = 20,000lb

REAR AXLE = 27,000lb

FRAME

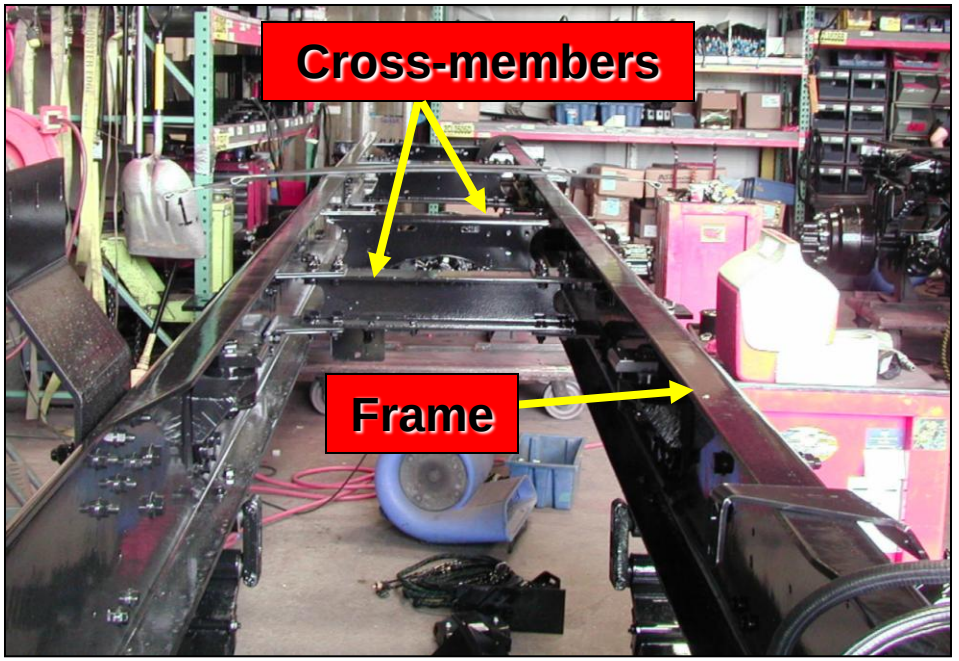


APPARATUS FRAME

- A frame consists of side frame rails and cross members.

OOS Conditions

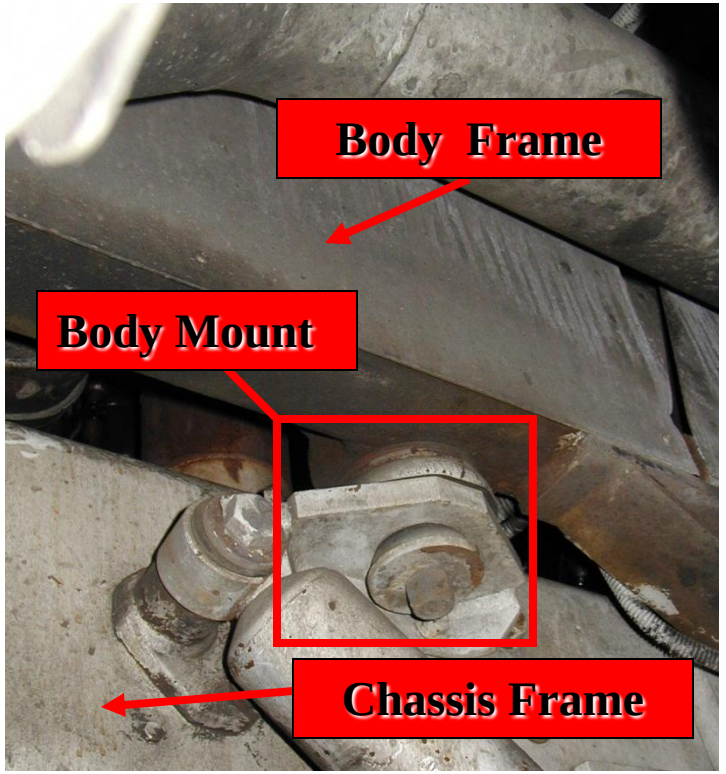
- Any bent or sagging frame rail
- Any cracks on frame rail or cross members
- Any illegal drill holes or illegal welded repairs
- Missing or broken bolts at cross member/side rail.



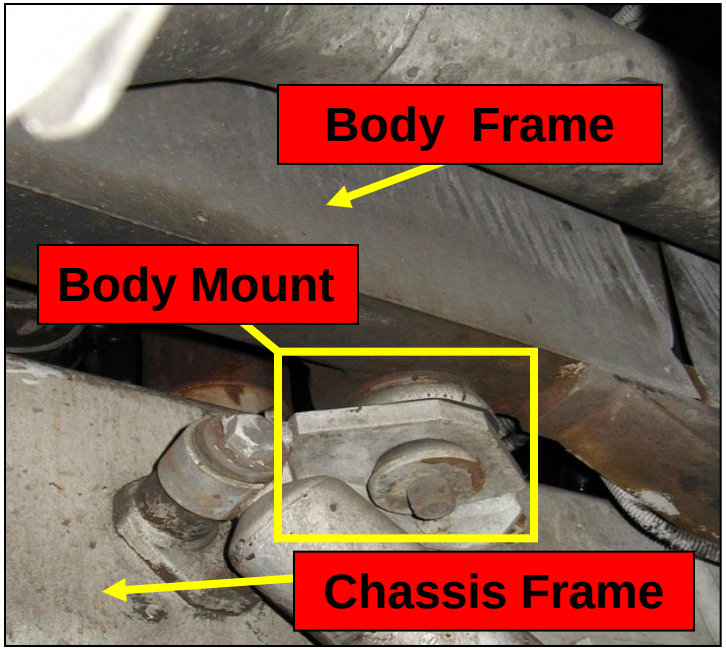
Crimson

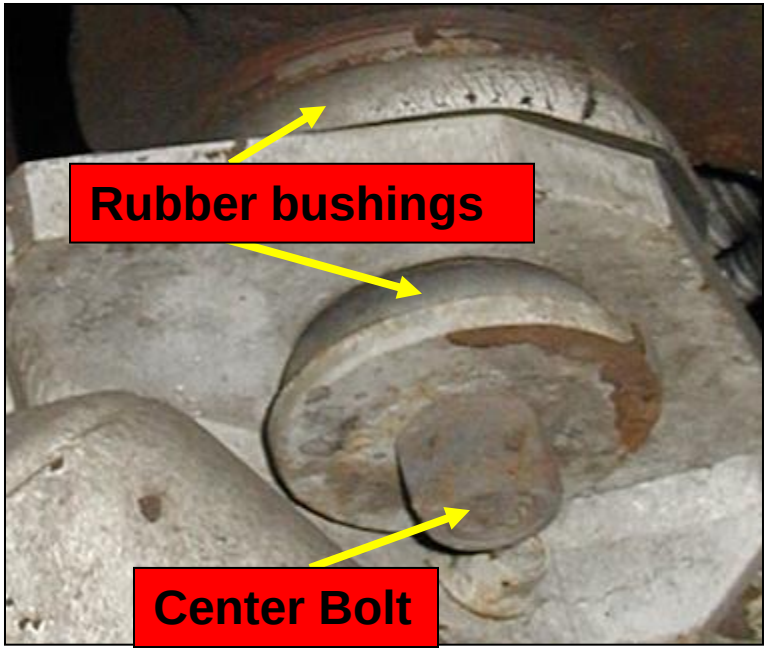
Cab and Body Mounts

- Body mounts are used to secure the body to the frame.
- There are a few types in use
- The rubber cushioned has a center bolt. And rubber bushings sandwiched between
- The U-bolt type slips over the body fame and is bolted to the bottom of the chassis frame



RUBBER CUSHIONED



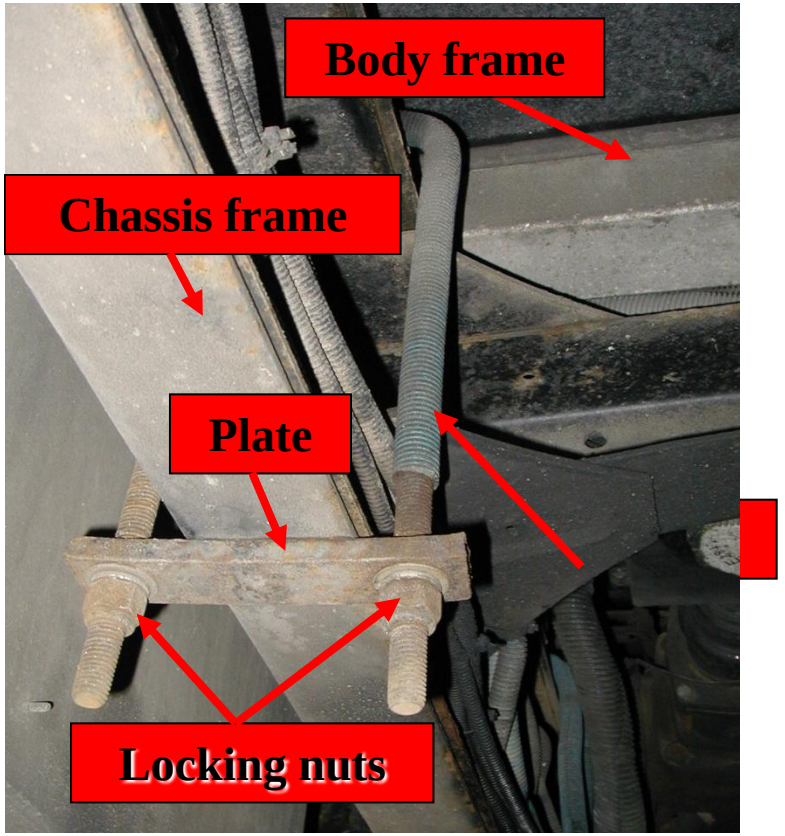


OUT OF SERVICE CONDITIONS

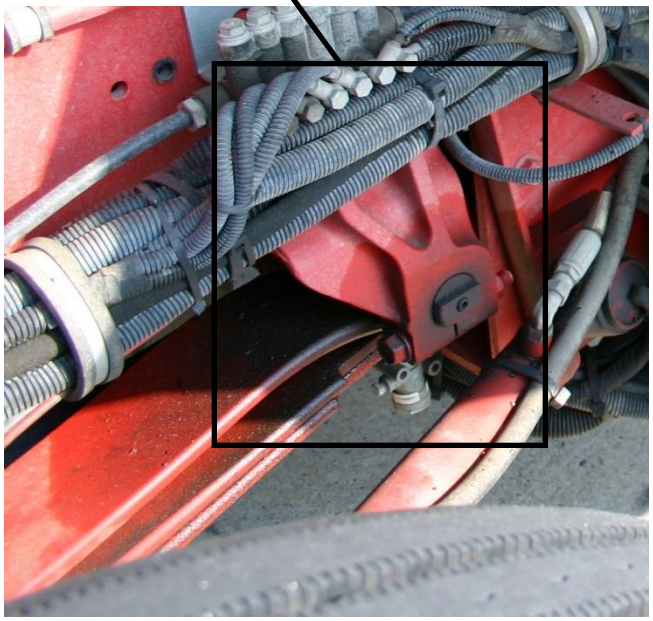
- **Any rubber bushings that are missing**
- **Any center bolt that is missing or will not tighten**
- **Mounts that have broken welds or not attached to the frame**

BODY U-BOLTS

- U – bolts hold the body to frame. The bolts are usually covered by a plastic sleeve.
- **OOS CONDITIONS**
- A broken u – bolt
- Any missing locking nuts
- A Loose u – bolt that allows sliding on the frame
- A cracked or broken plate between u – bolt.



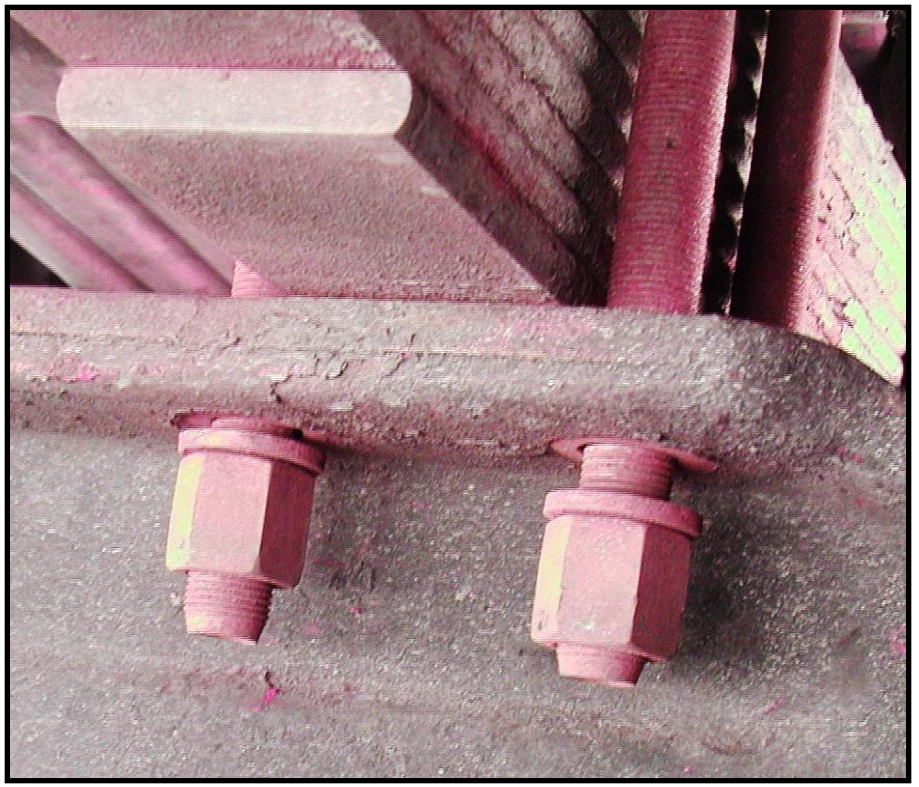
SPRING SUSPENSION



SUSPENSION SYSTEM

- Are all of the bolts tight on the Spring Mount that hold it to the frame?
- Are all of the Leaf Springs intact ? Make sure the Leaf Springs are not missing, bent, broken or misaligned.
- Are the U –Bolts attached to the Axle, and are the locking nuts present and tight ?

SUSPENSION SYSTEM



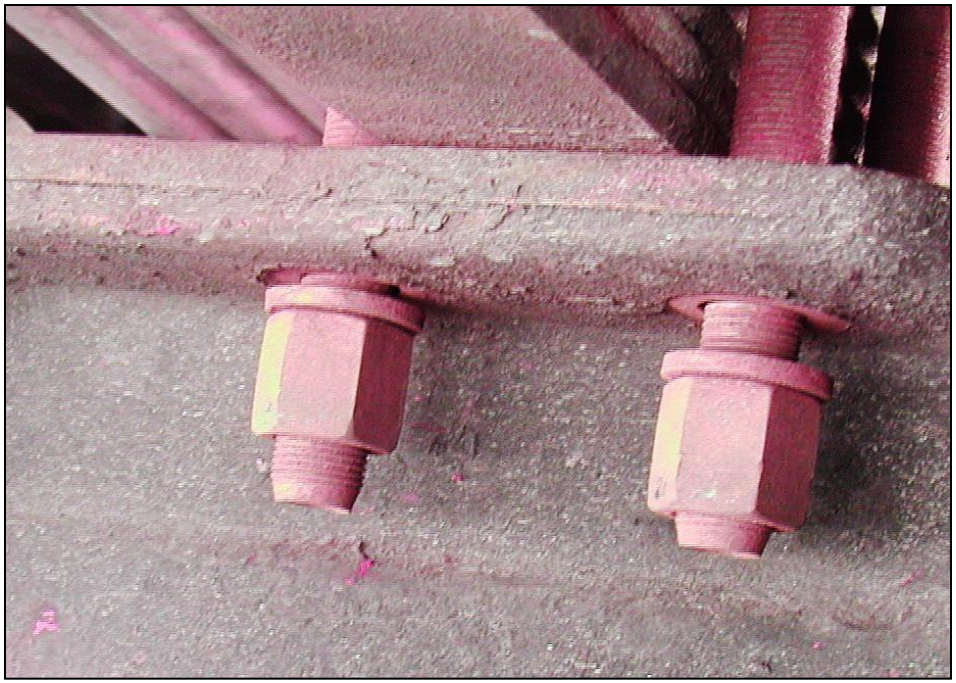
MCFRS Driver Training Program

OOS Suspension Component's

- Missing or misaligned leaf springs
- Cracked or broken leaf spring.
- Missing or loose bolts at spring shackle or spring mount

OOS Suspension Component's

- Missing or broken u-bolts
- Loose or missing u-bolt locking nuts.

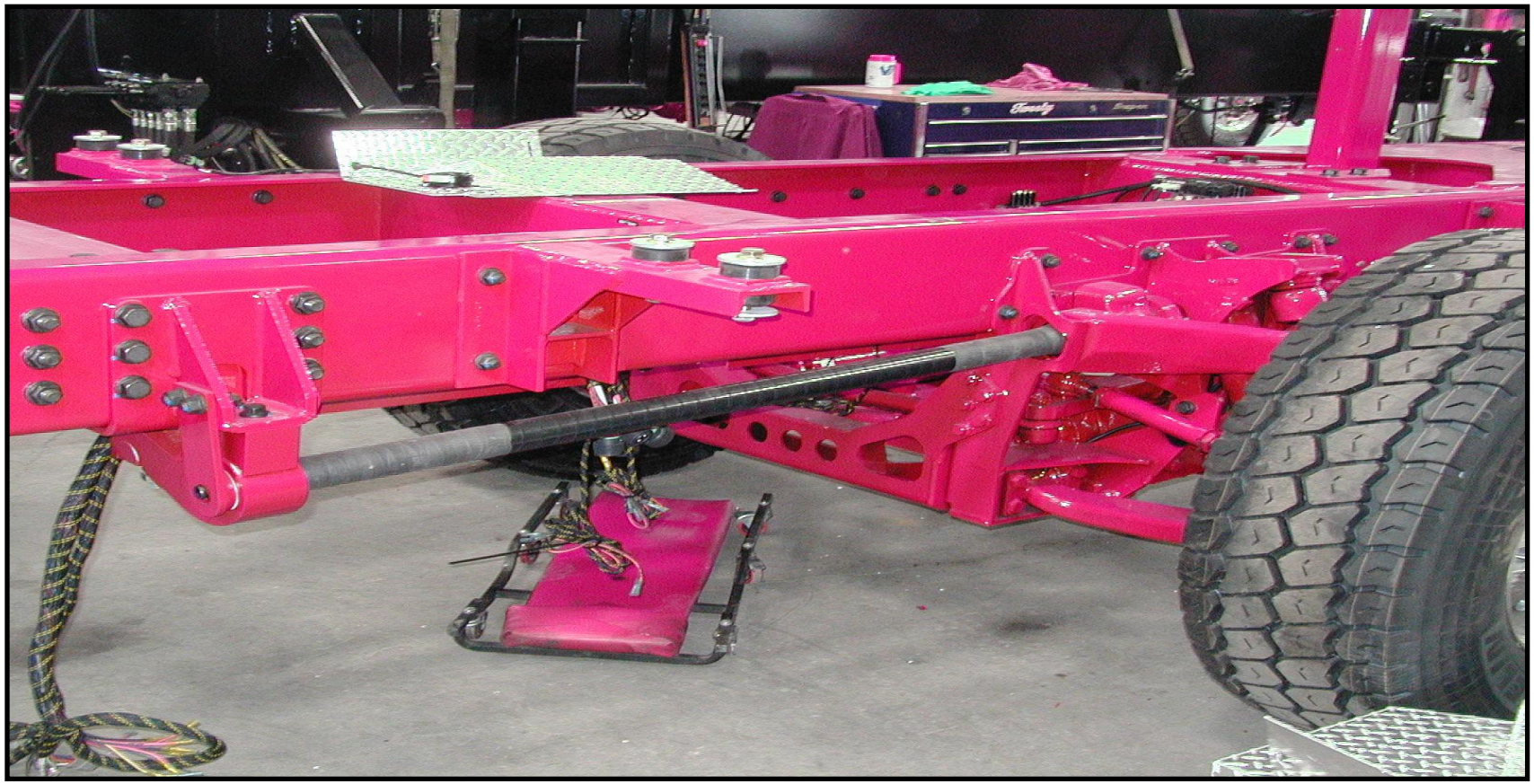


MCFRS Driver Training Program

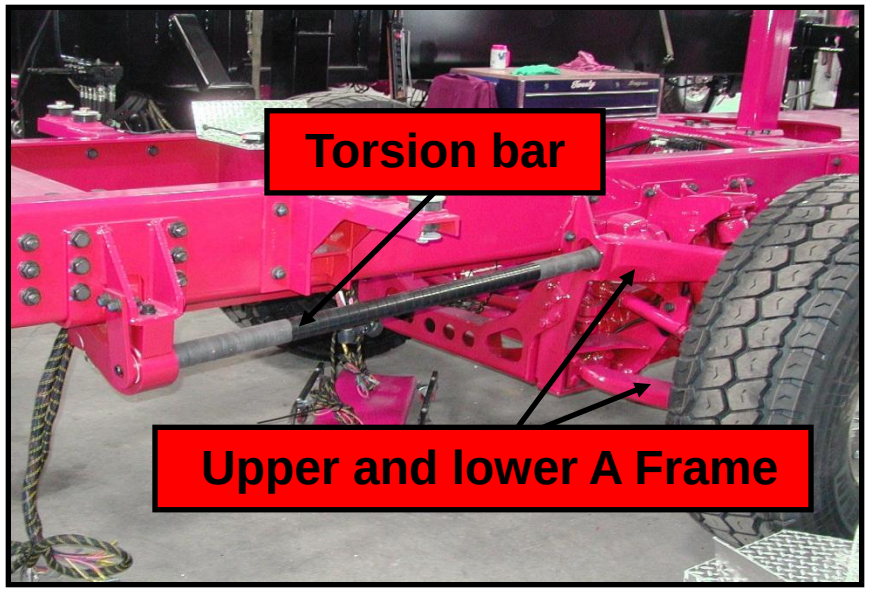
MCFRS Driver Training Program

MCFRS Driver Training Program

TAK 4 SUSPENSION SYSTEM



MCFRS Driver Training Program



- This is the Pierce-TAK4 suspension system.
- The Pierce-TAK4 suspension is a torsion bar system, with a upper and lower A-frame assembly. It has a shock absorber for wheel control.

Functions of the Braking System

- When you start the engine and the air tanks are empty the following occurs.
- The compressor starts to make air, this is known as loading the compressor. Compressor's can be belt or gear driven.
- The air leaves the compressor and travels to the air dryer. When the air enters the dryer oil and water moisture are removed and the air continues into the supply or wet tank.
- The air then travels to the primary tank which controls the rear brakes, or into the secondary tank which controls the front brakes.

Functions of the Braking System

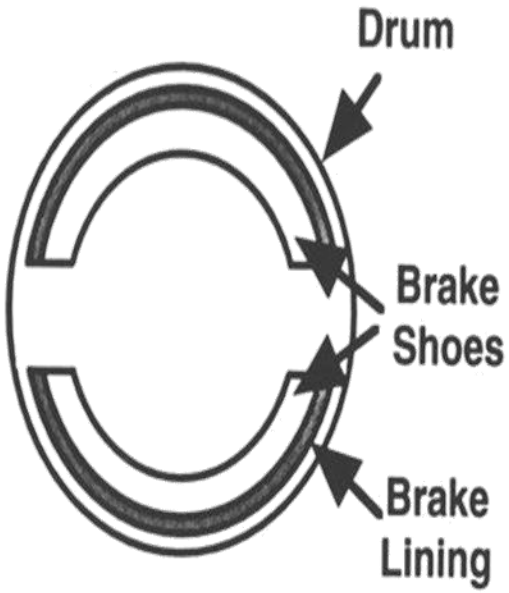
- The other air tanks are for accessory items or reserve tanks.
- When the air tanks become full it triggers the Air governor to stop the compressor from making air and puts the compressor in a unloaded state.
- It also triggers the air dryer to purge itself cleaning the cartridge and dumping the moisture.

Functions of the Braking System

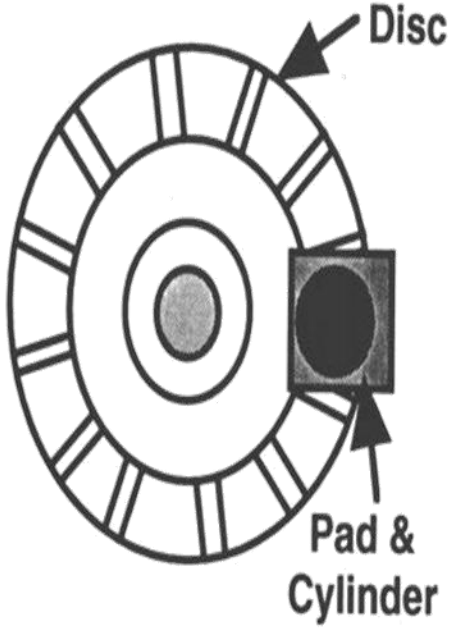
Disc brake

- Air disc brakes work like drum brakes except they squeeze on a rotor from both sides.
- Instead of having a s-camshaft they have a power screw.

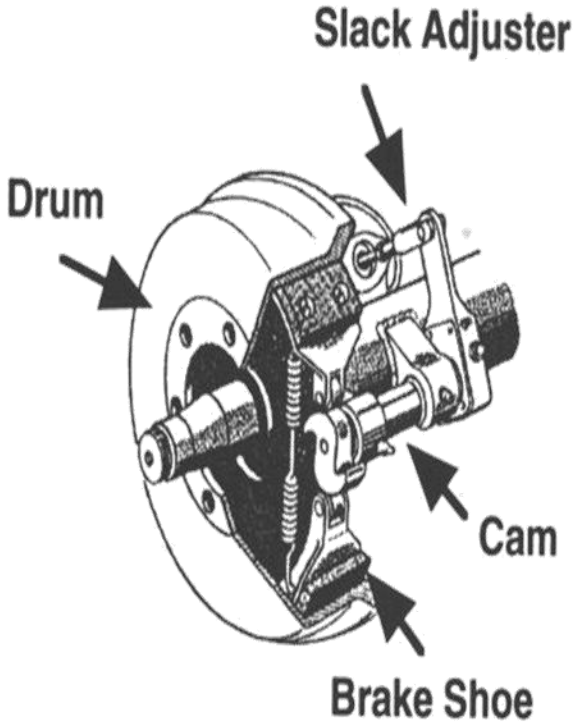
BRAKES



Drum Brakes

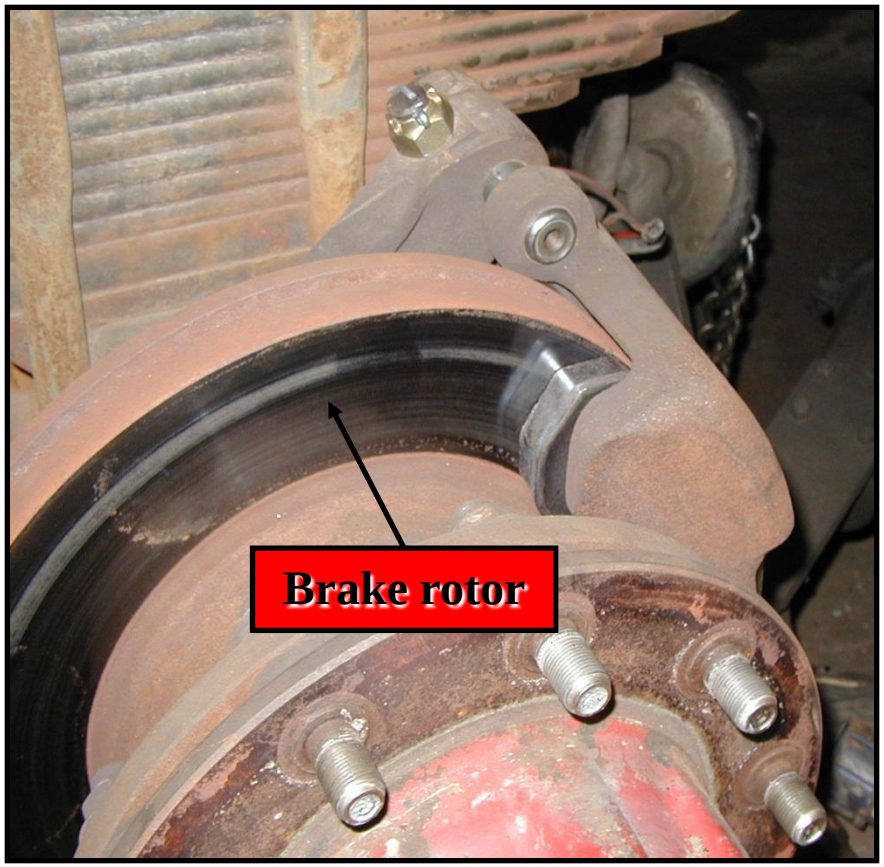


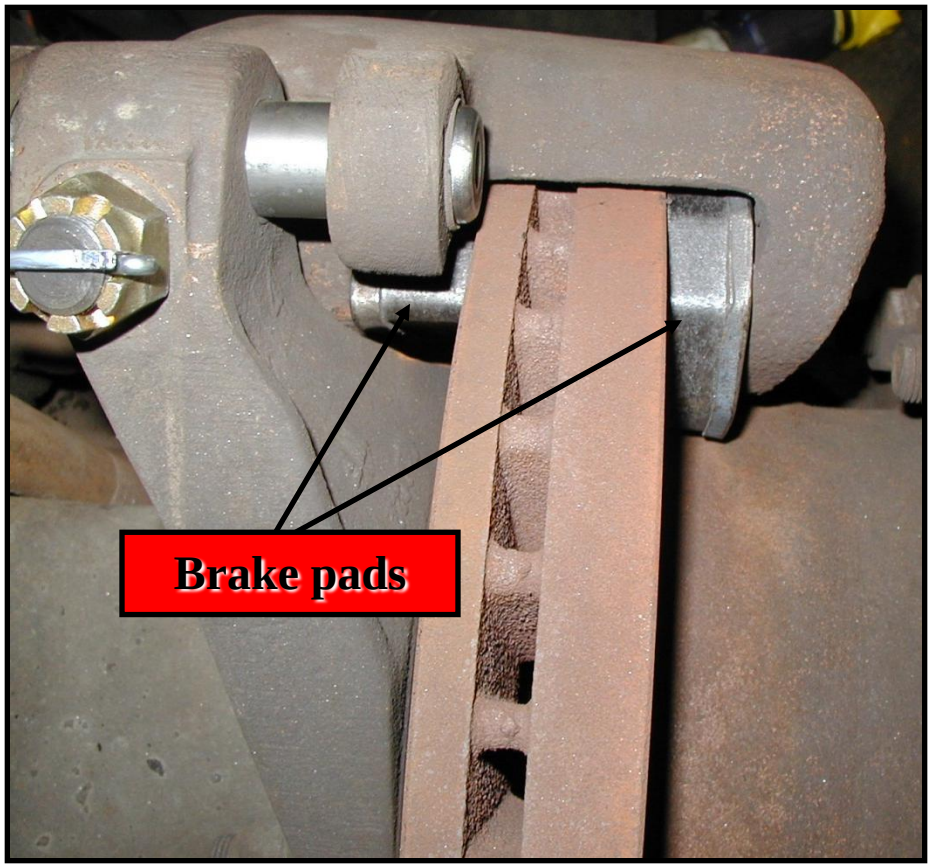
Disc Brakes



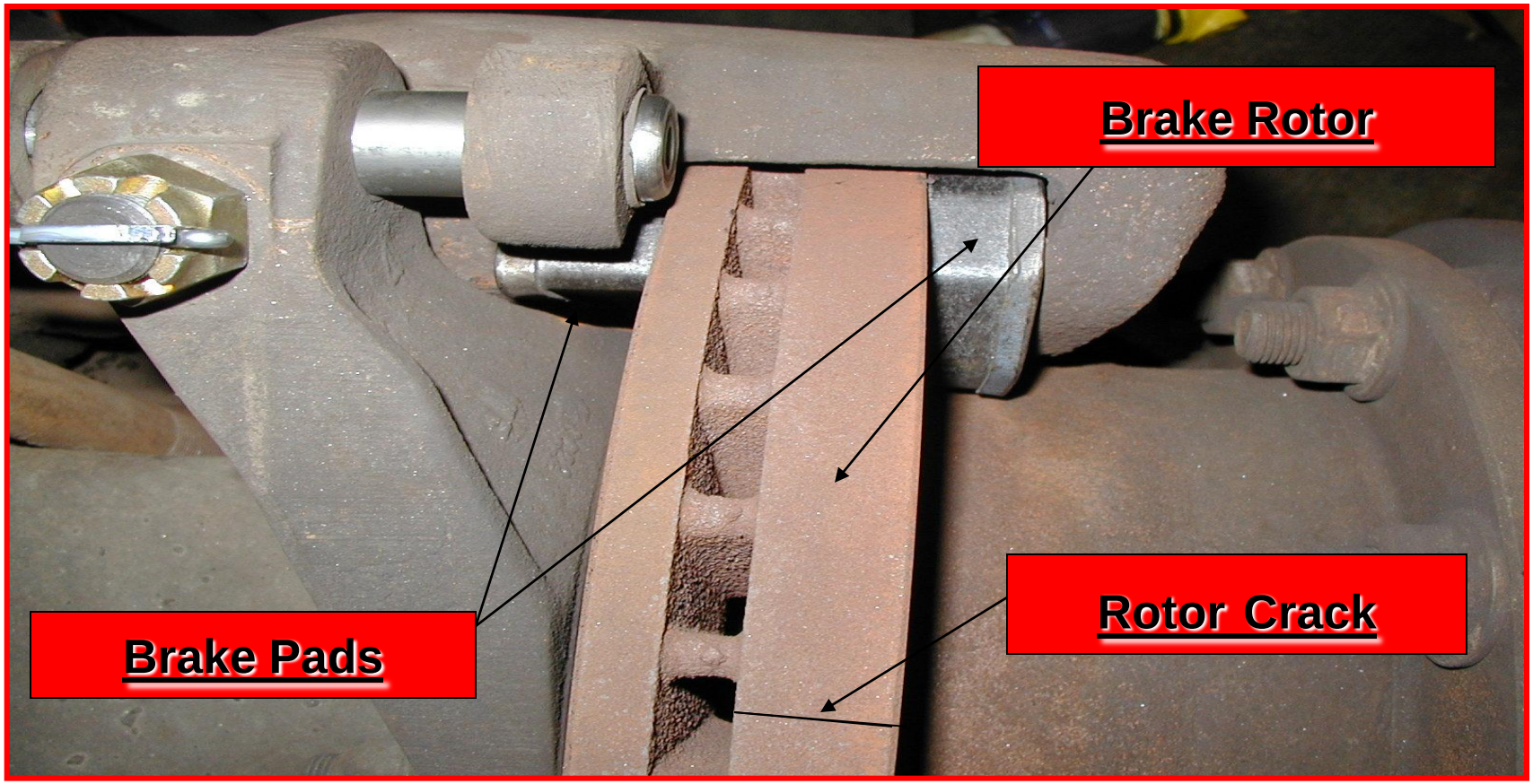
Air Brakes

DISC BRAKES

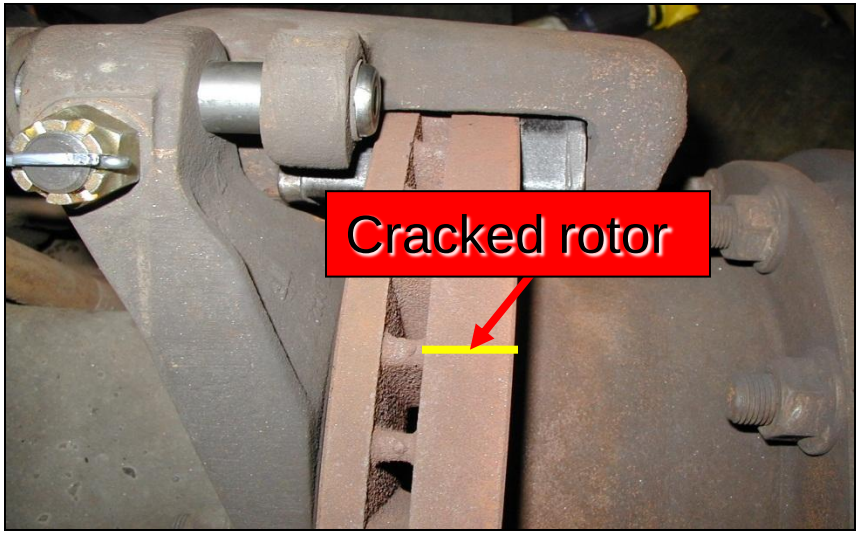


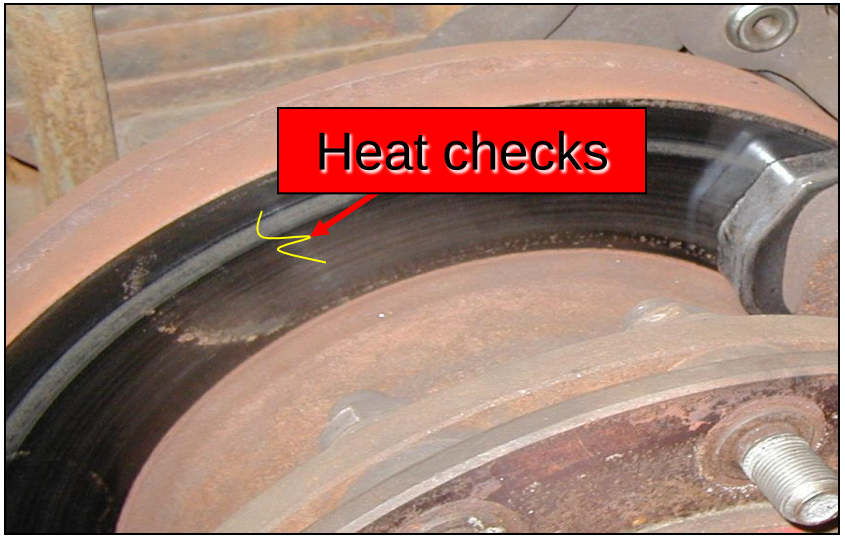


DISC BRAKES



Cracked Rotor & Heat Checks

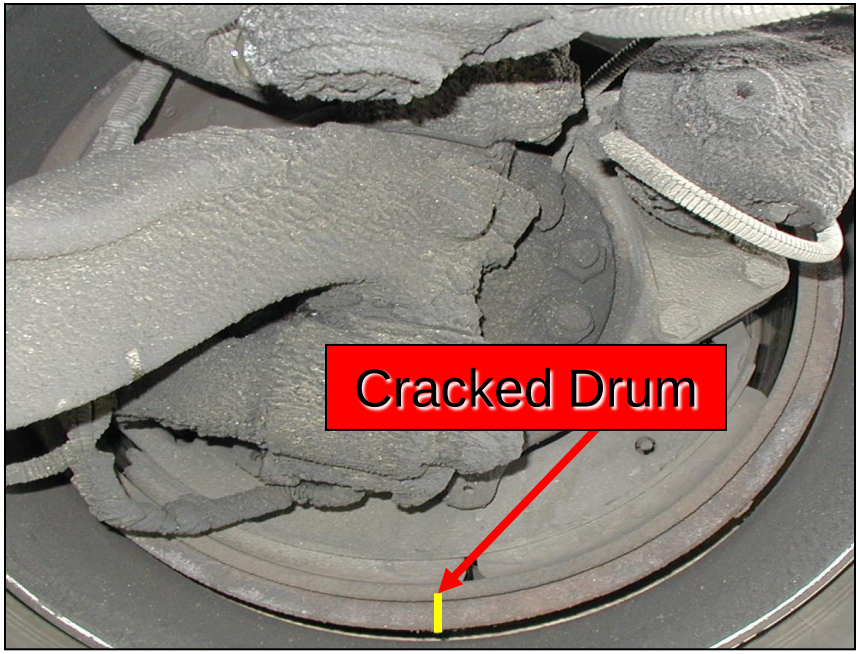


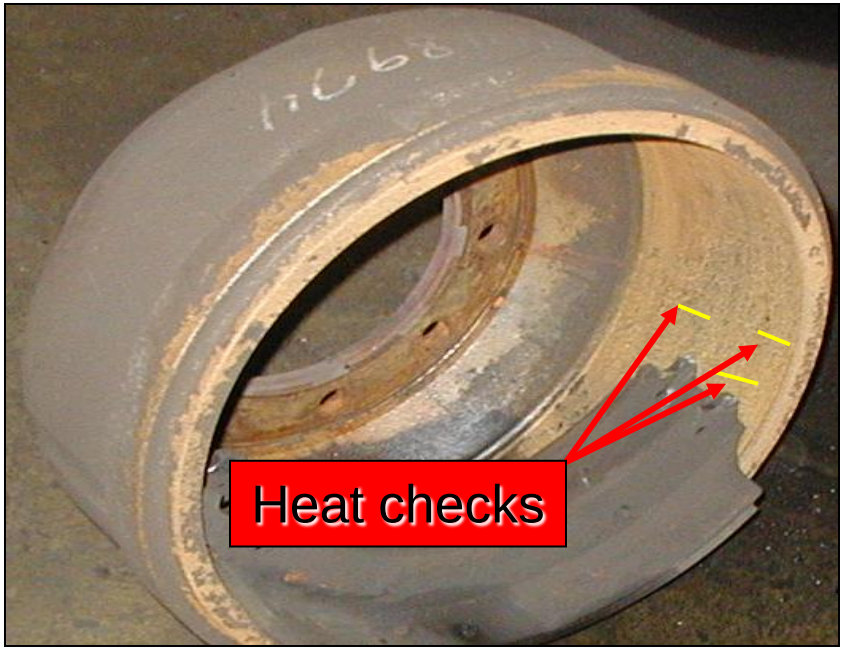


- A cracked rotor is a crack that extends from the face of the rotor to the cooling fins. This can occur on either side. This is a OOS condition.

- Heats checks are normal and as long as they are not more than 1/8 inch deep or extend more than ¾ across the face of the rotor

Cracked Drums & Heat checks





- Cracked drums are cracks that go thru the drum and expand when brake is applied. This is a OOS condition.

- Heat checks are numerous, but will be no longer than ½ the width of the drum. And no deeper than 1/8 inch deep

Hydraulic Brake Systems

OOS Criteria

- Brake system components that have a class 2 leakage of brake fluid
- Friction surfaces, brake shoes, or disc brake pads that have grease or oil on them.
- Brake pads with less than 1/4 inch pad (disc brakes is 1/8 inch on each pad)
- Braking operation that is ineffective
- Parking brake operation that is ineffective
- Brake warning light that is activated or brake pedal that falls away or drifts toward the flooring when brake pressure is applied

Functions of the Braking System

S-Cam Drum

- When the truck is parked and the parking brake is applied, the truck is being held in place by spring brakes. These springs apply approximately 1500 hundred pounds of force.
- When you release the parking brake you apply air pressure pushing off the spring brake.
- When you apply the brake on a normal stop you are using the service brake. You are applying air to all four chambers.

S-Cam Drum

- The primary air system takes care of the rear brakes, and the secondary system takes care of the front brakes
- When you apply the brake air leaves the reservoir tanks and enters the brake chambers at the applied pressure, when you release the brake air is exhausted thru exhaust ports.

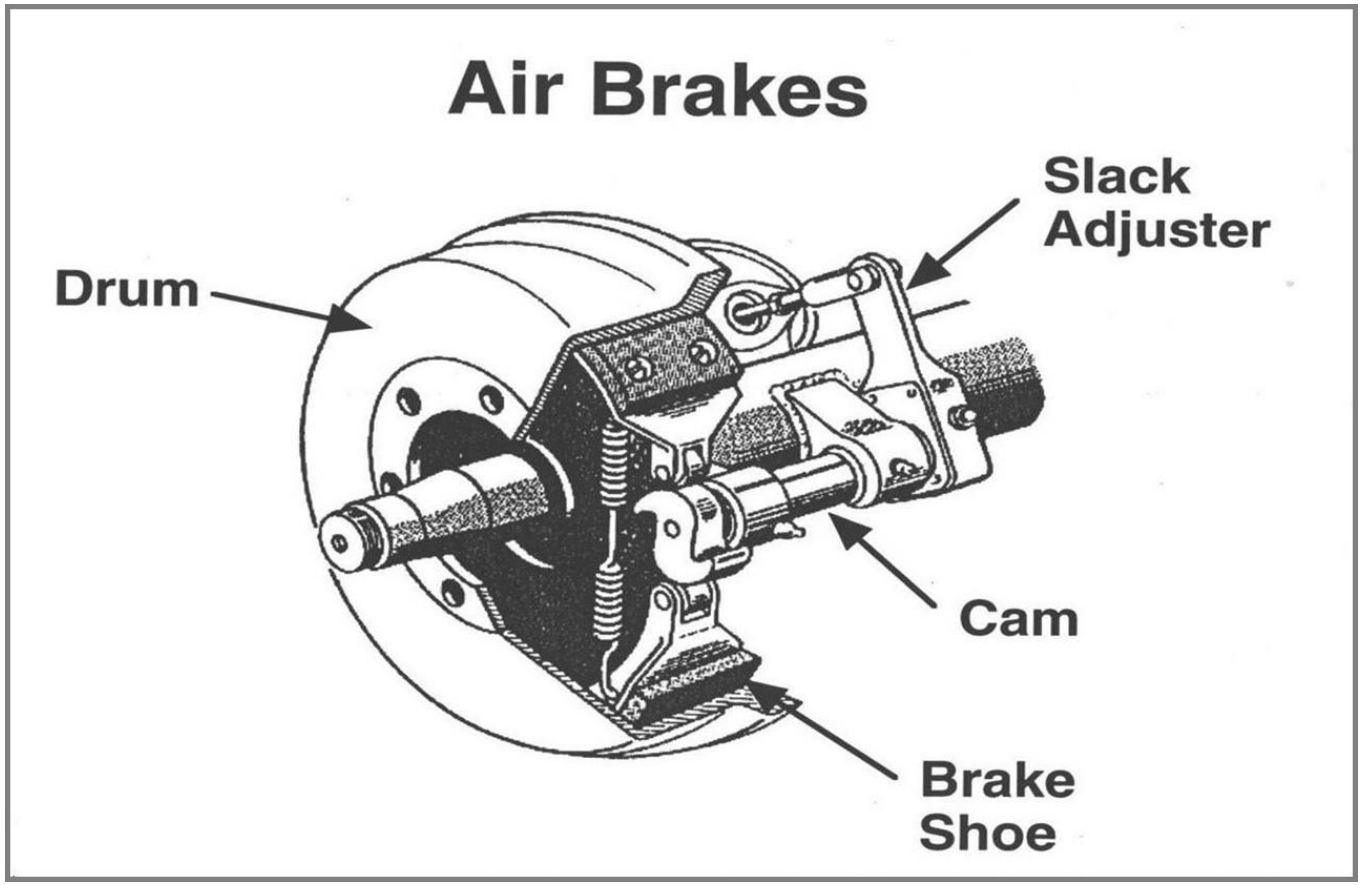
S-Cam Drum

- When applying the brake air pushes on the diaphragm moving it forward which in turn pushes the pushrod forward.
- If you have a 30 inch diaphragm and are applying 50lbs. Of air pressure, you are applying 1500lbs of force to the pushrod.
- The pushrod pushes on the slack adjuster which is no more than a mechanical lever and turns the s-camshaft in the wheel.

S-Cam Drum

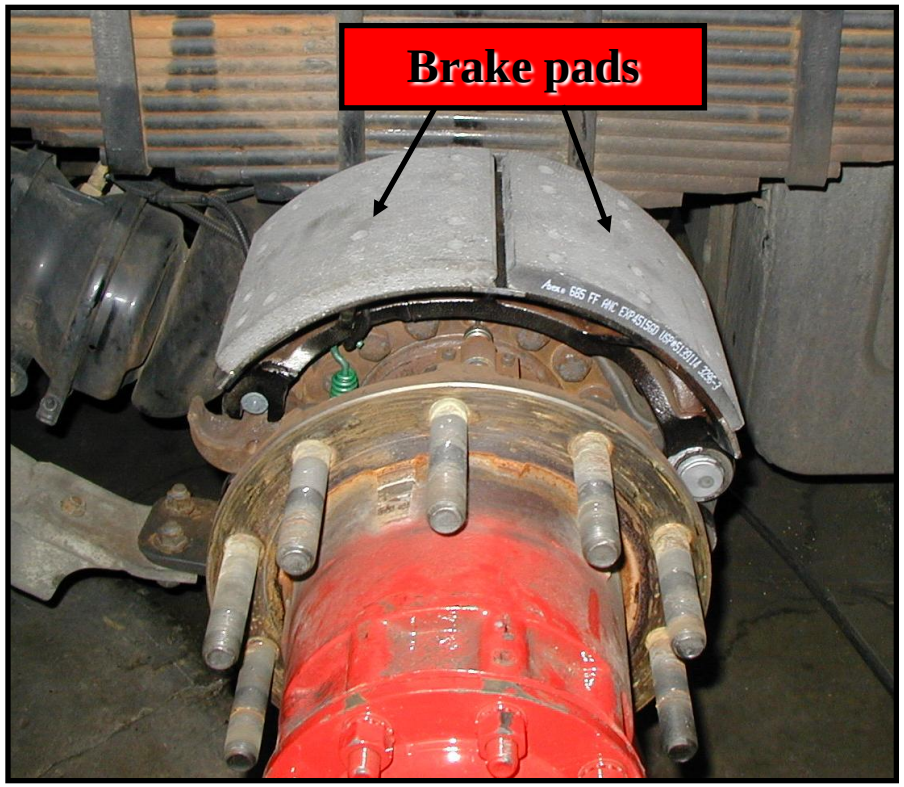
- You have 1500lbs. pushing on the slack adjuster which is 6 inches in length and now you have 9000 lbs of force on the s-camshaft
- The s-camshaft rotates forcing the brake pads into contact with the brake drum.
- When you leave off the brake return springs in the wheel, and brake chamber, return the brake to normal position

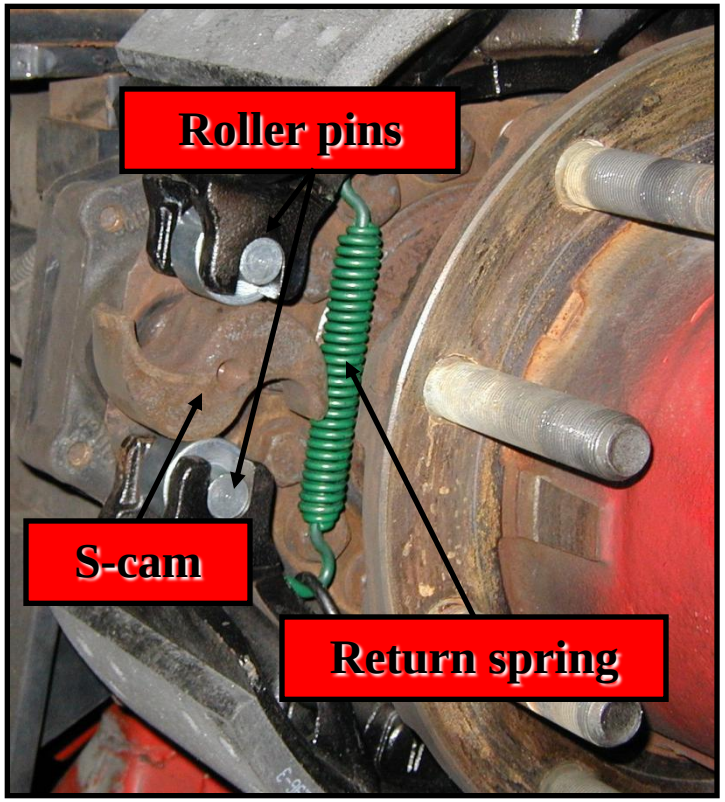
S-Cam Drum



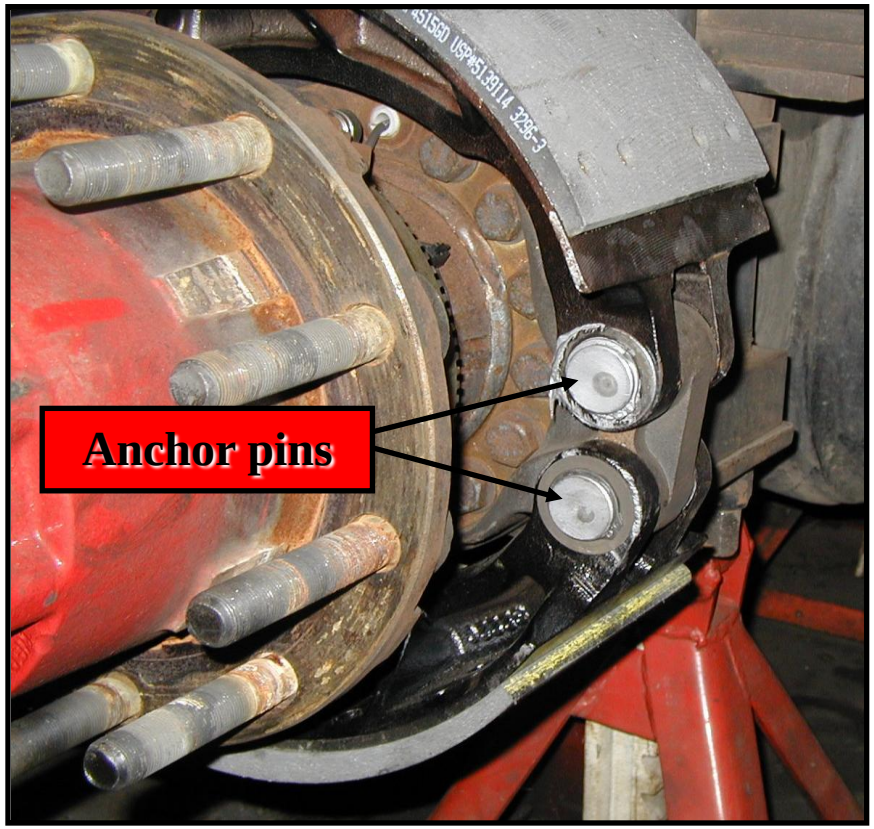
Braking Systems

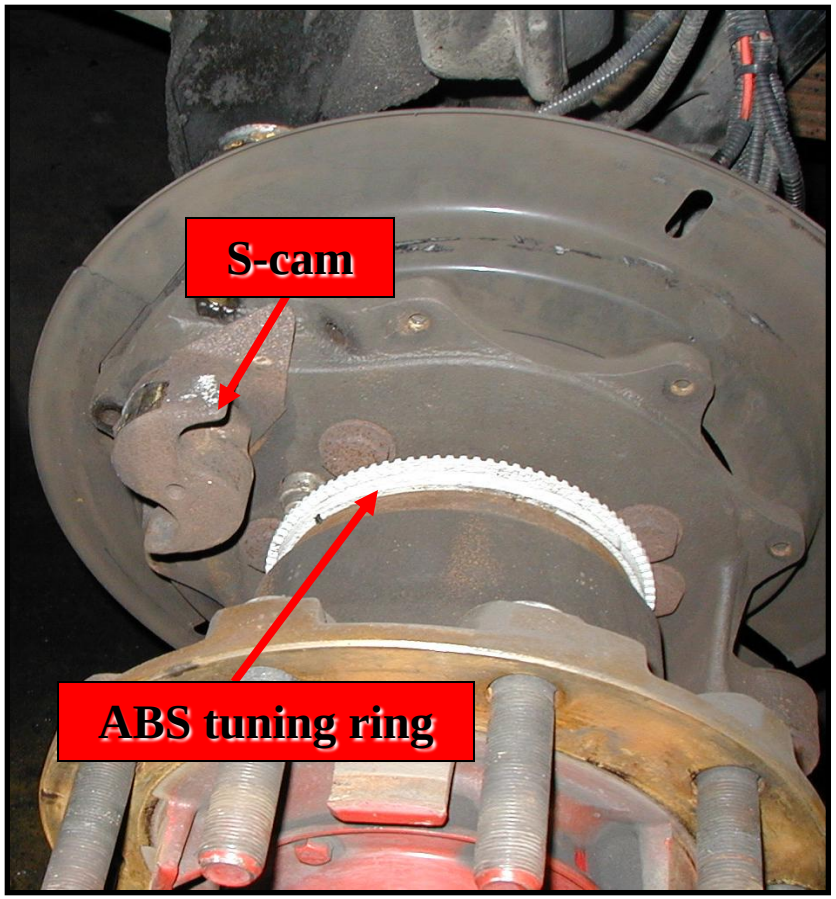
Brake Components





Brake Components





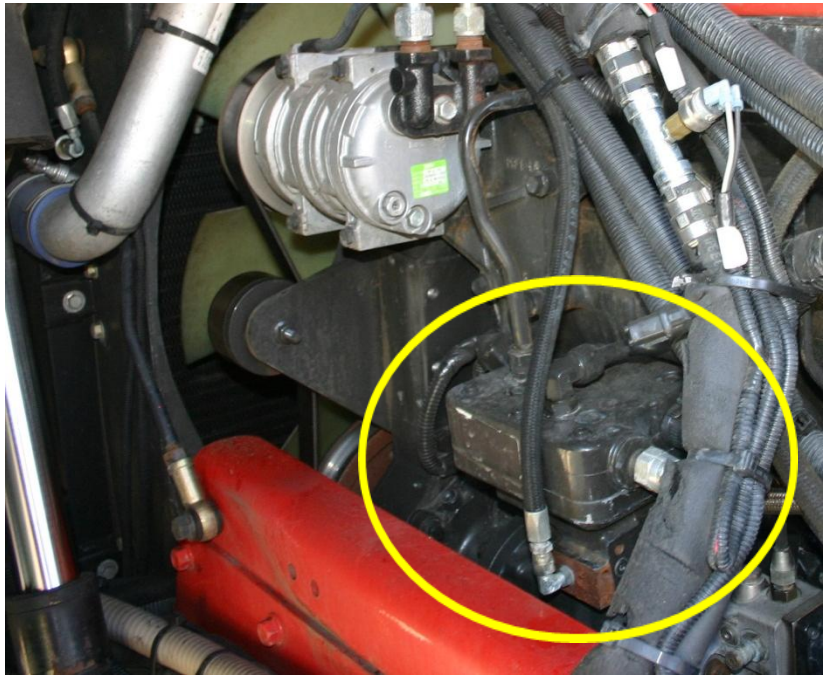
Crimson Disc Brake (Front)

Brake Wear Indicator

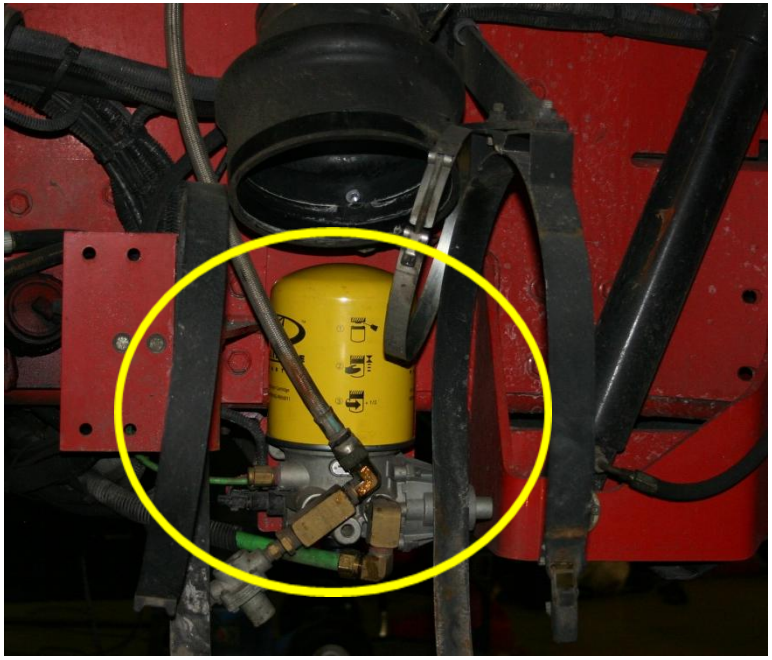
Crimson Drum Brakes (Rear)

Air Supply & Dryer

Air Compressor

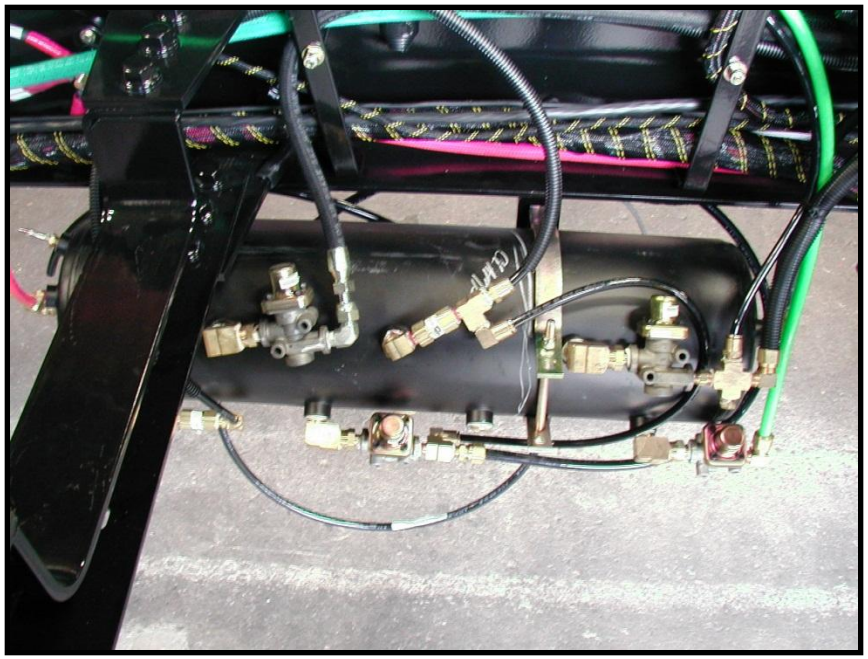


Air Dryer

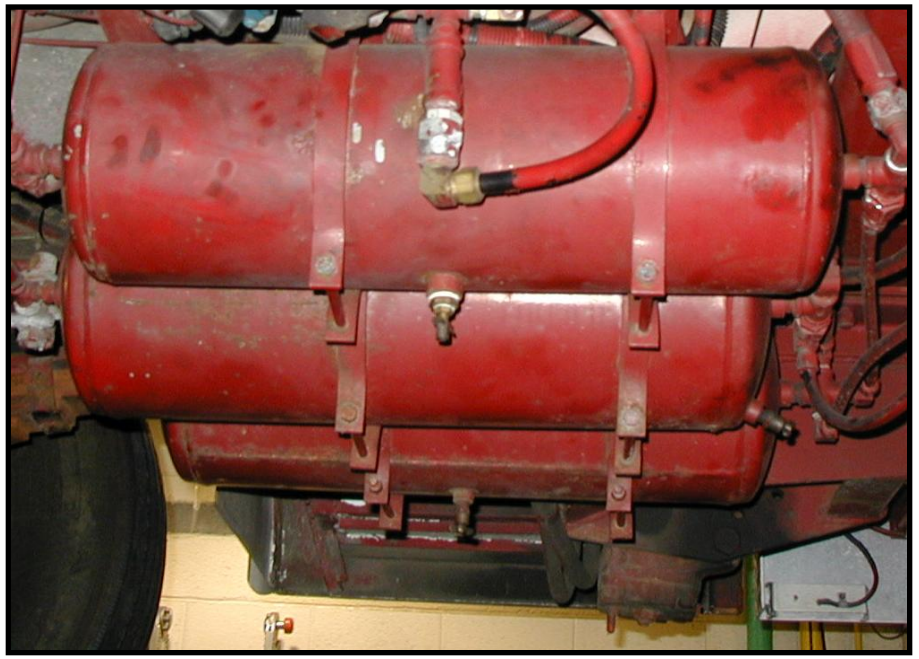


Air Storage

Supply Tank

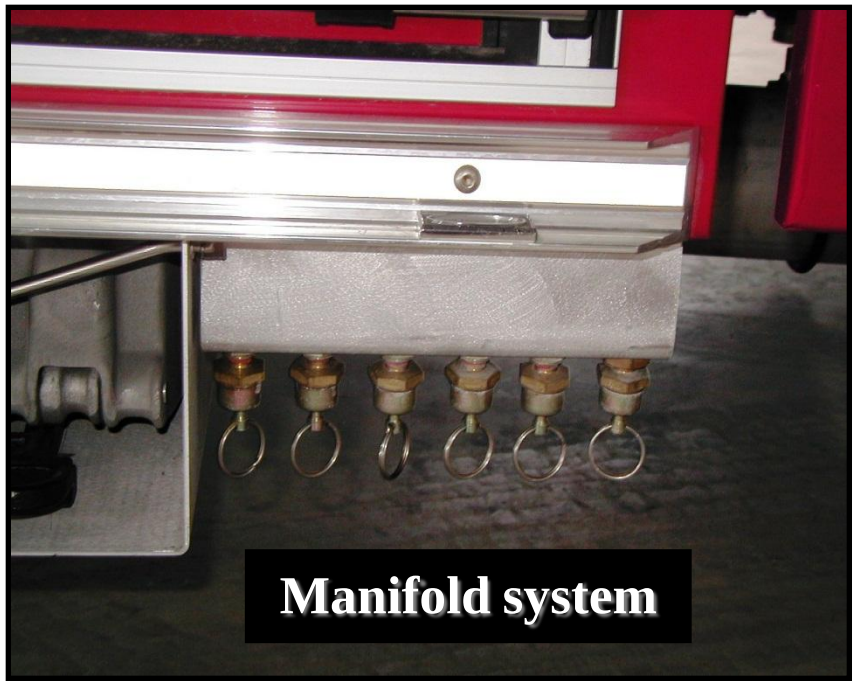


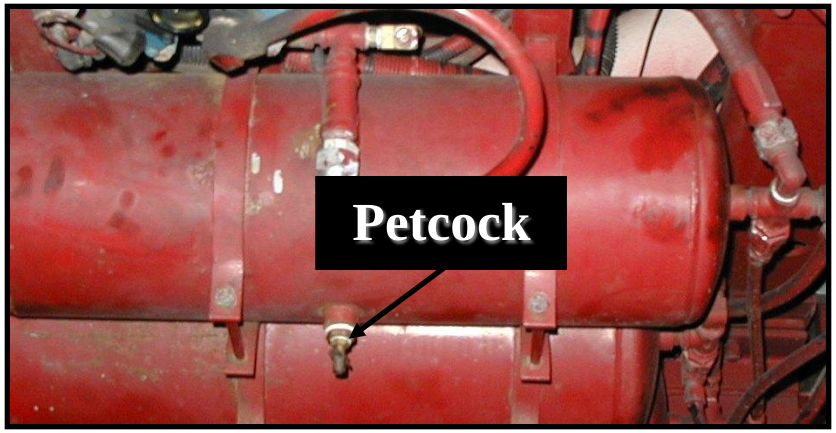
Storage Tanks

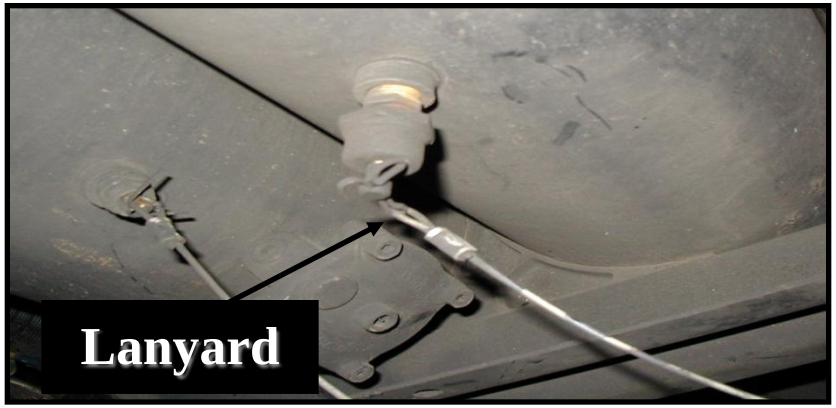


Crimson Air Storage

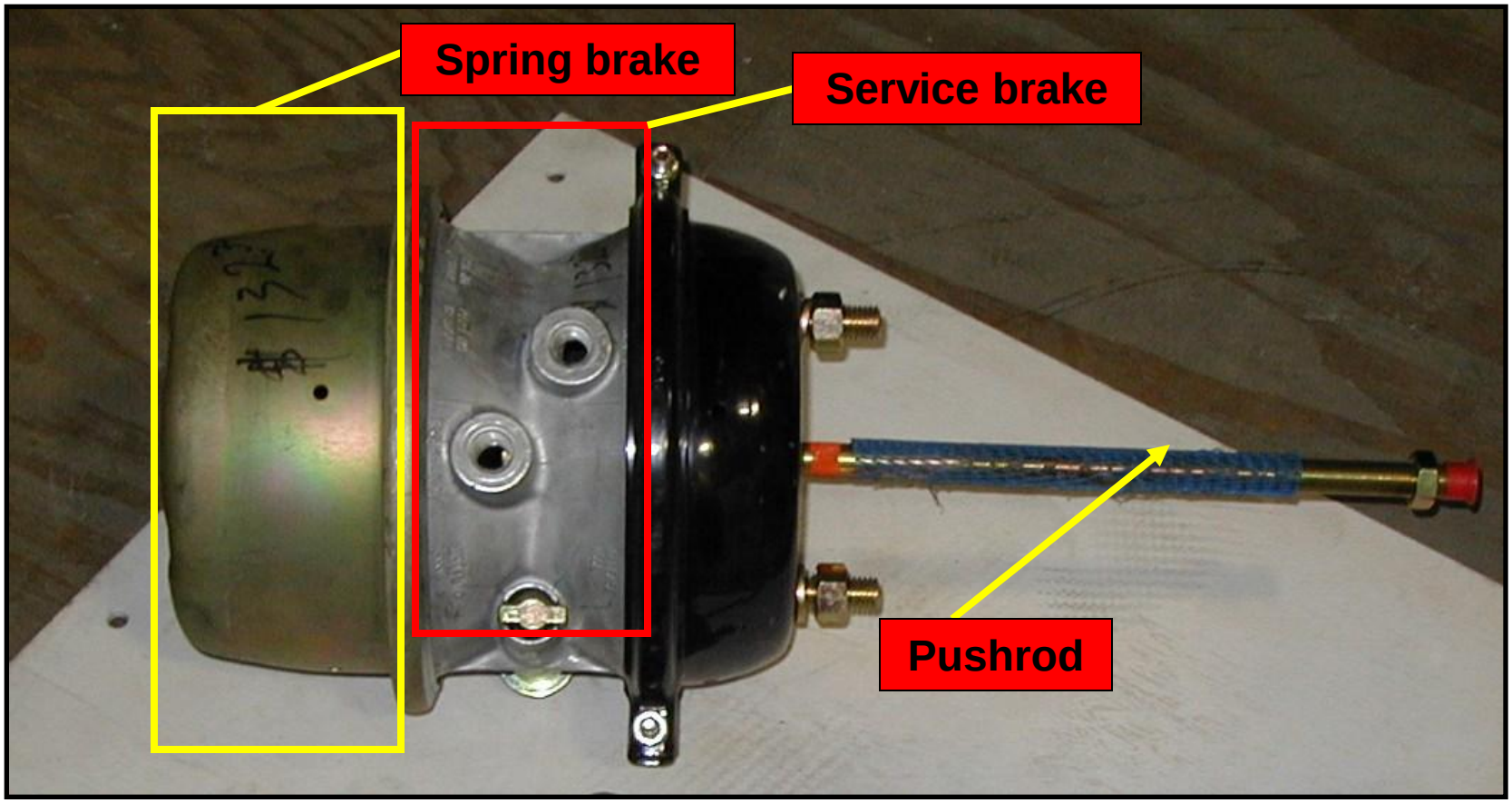
Types of Air Bleeding Systems





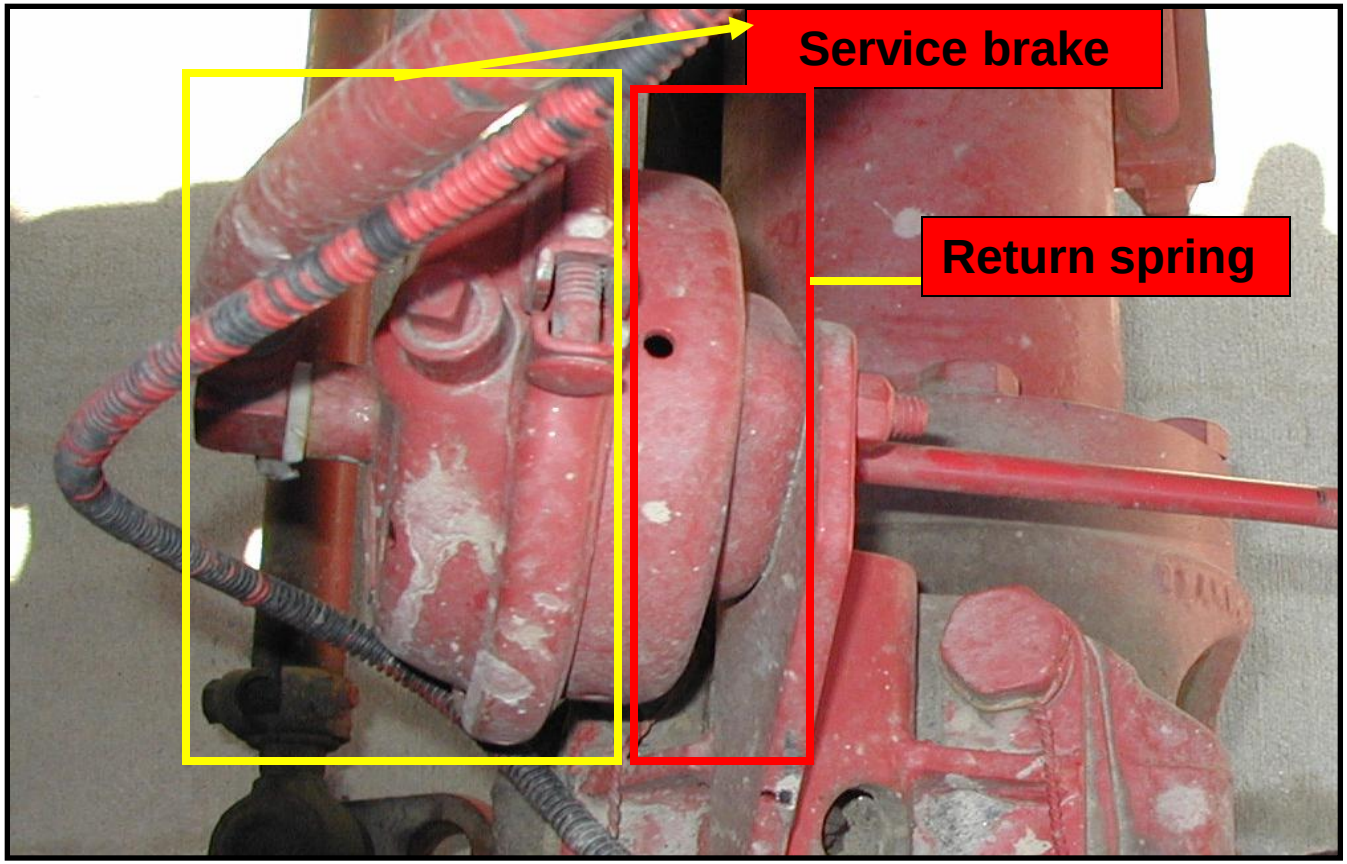


Doubled Chambered



Crimson Doubled Chamber

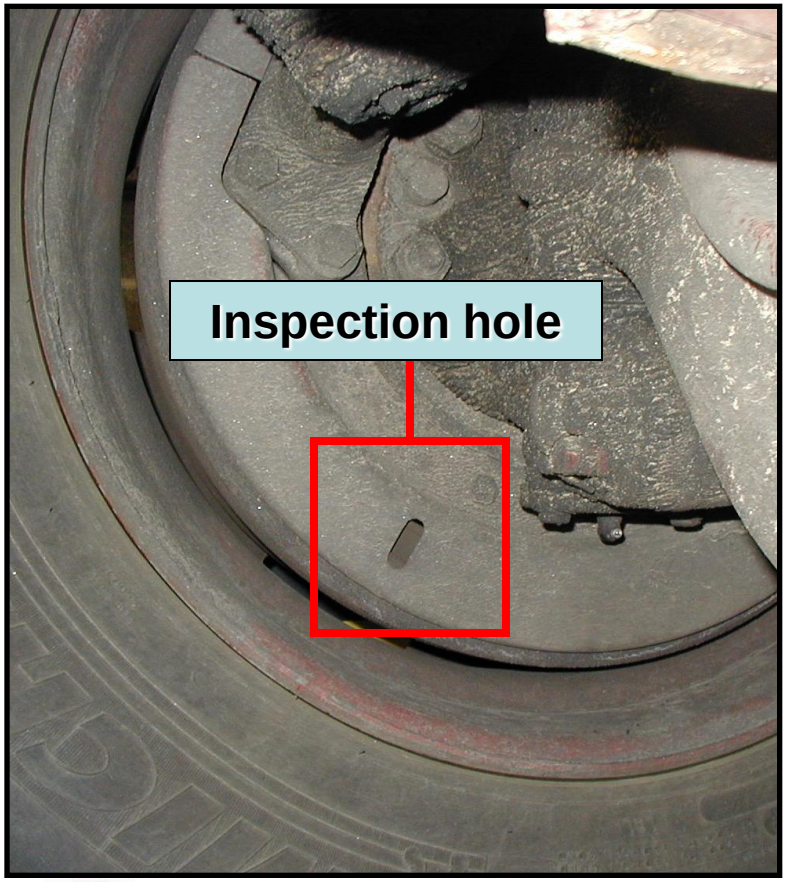
Single Chamber



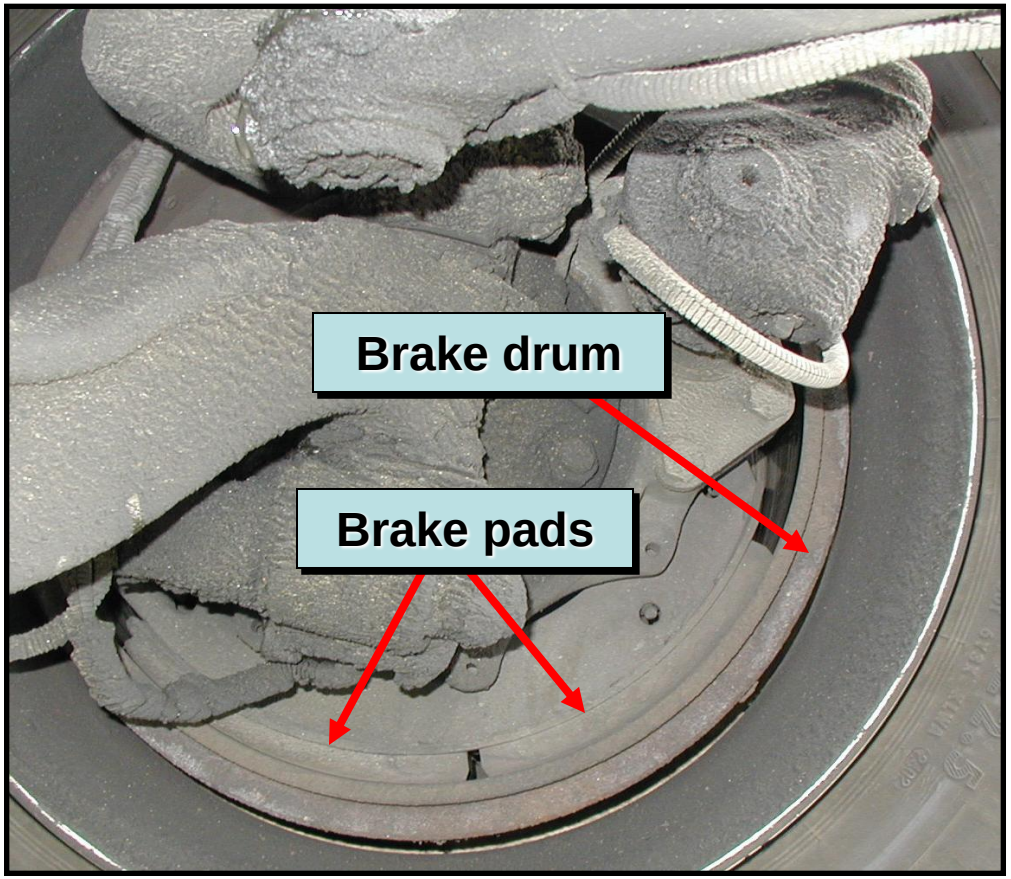
Crimson Single Chamber

Brake Pads

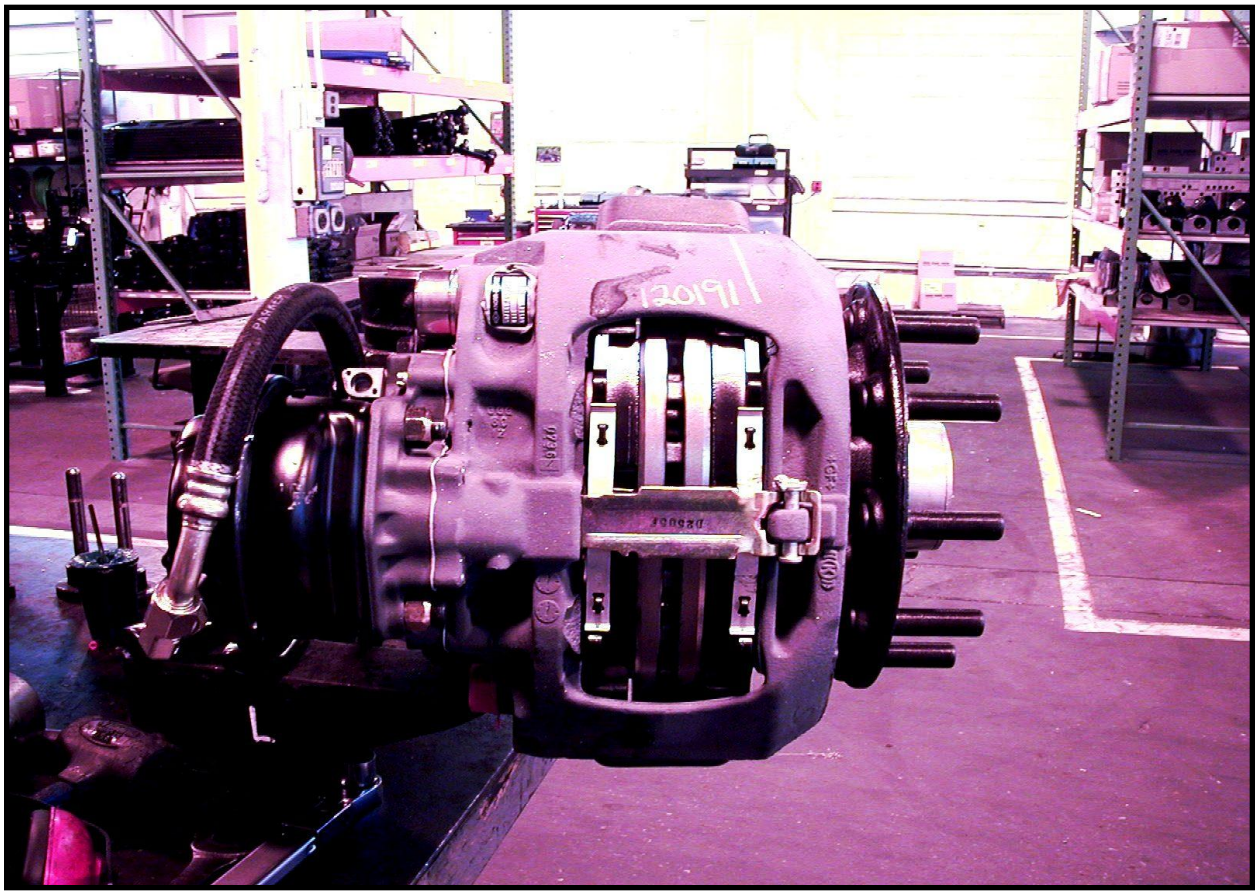
Dust Covered Wheel



Open wheel



Knorr – Bremse (Bendix)



Braking System

- What type of brake is on the apparatus ? Are they Disc brakes, Drum brakes, or a combination of both types ?
- Are the Drums or Disc present and intact ?
- Is there at least ¼” of brake pad and are they free from oil and grease.
- Is the air line to the brake chamber intact ? Is the air line cut or rubbed ?
- Do you hear any air leaking at the brake chamber ?

Braking System

- How many air Tanks are on the Apparatus ?
- When were the tanks drained last ?
- When the Air Compressor kicks off what does the air dryer Spit ? Is it a clear spray or is it oil ?
- When does the Air Compressor shut off ?
- When does the compressor start ?
- When does your low air warning devices activate ?
- When does the protection valve activate ?

Brake System OOS Criteria

- The following defects and deficiencies of the air brake system reduce the operational safety and performance of the fire apparatus and shall be considered when placing the apparatus out of service. Use the prescribed test procedure for MCFRS to assist with determining out of service condition.

Air Brake OOS Criteria

- Service brakes that have an air pressure drop of more than 3psi in 1 minute for a single unit or more than 4psi in 1 minute for a combination unit, with engine stopped and service brake released.
- Leak down rate (time) of the applied side of the air brake that is more than 3psi in 1 minute for a single fire apparatus or more than 4psi in 1 minute for a combination fire apparatus, with the engine stopped and the service brake applied

Air Brake OOS Criteria

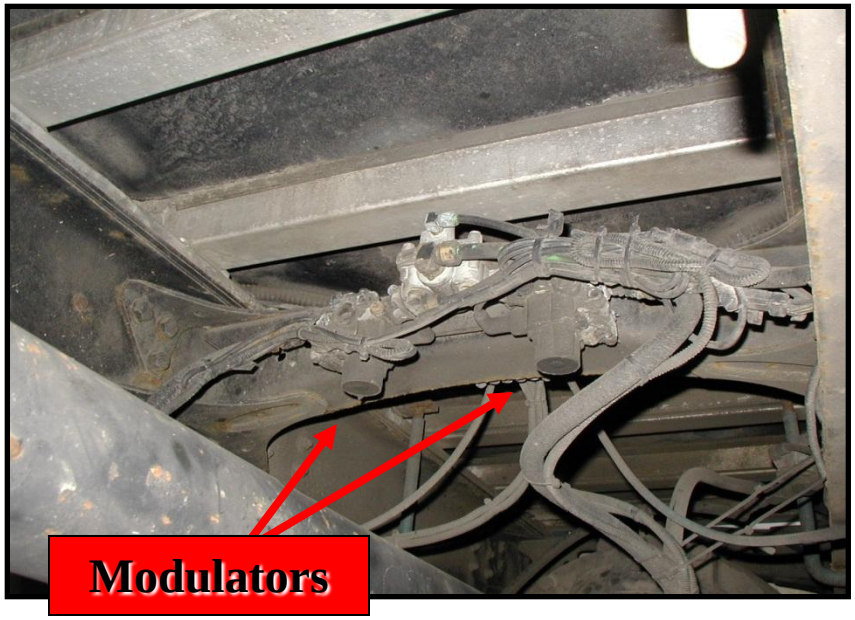
- Air compressor that fails to fill the air system to the air compressor governor cutout pressure with the service and parking brakes released
- The cut out pressure should not exceed 135psi
- The cut in pressure should not be less than 80psi

Air Brake OOS Criteria

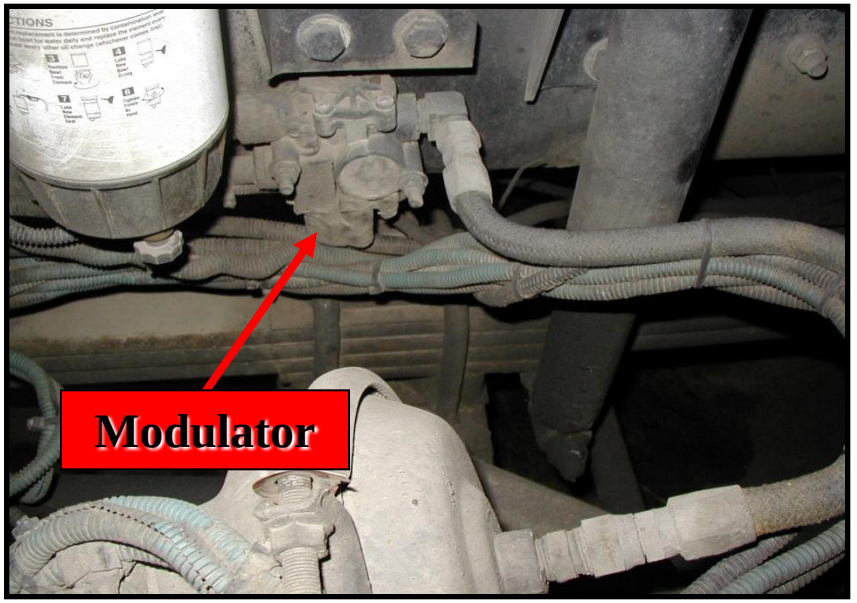
- Antilock braking system (ABS) warning indicator that is activated upon checking chassis operator's manual to determine the indicator's light's meaning. (The warning indicator generally indicates that the ABS is inoperable and the vehicle should be driven as such)

ABS Systems

Rear

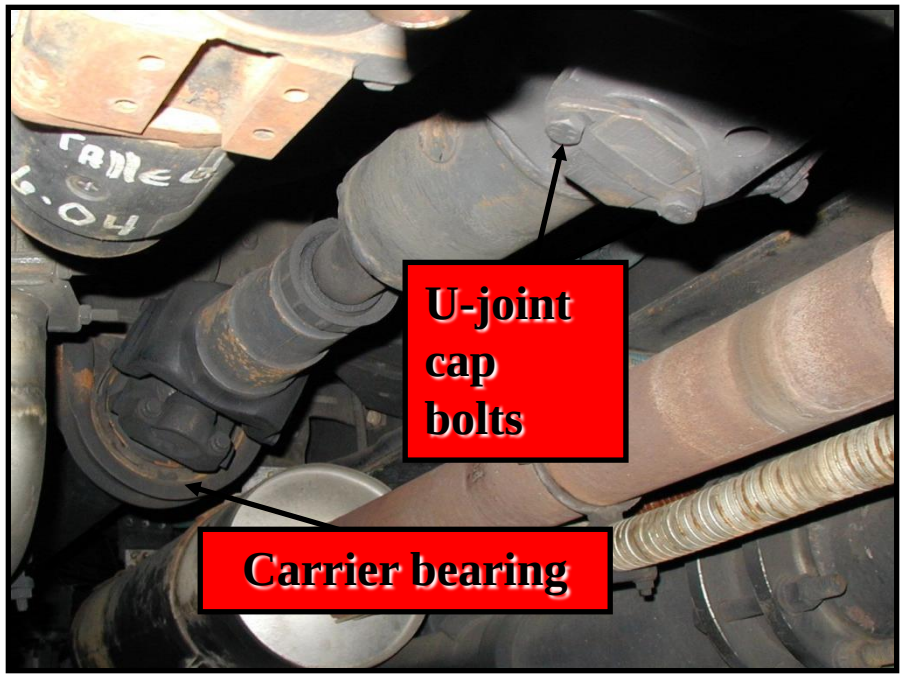


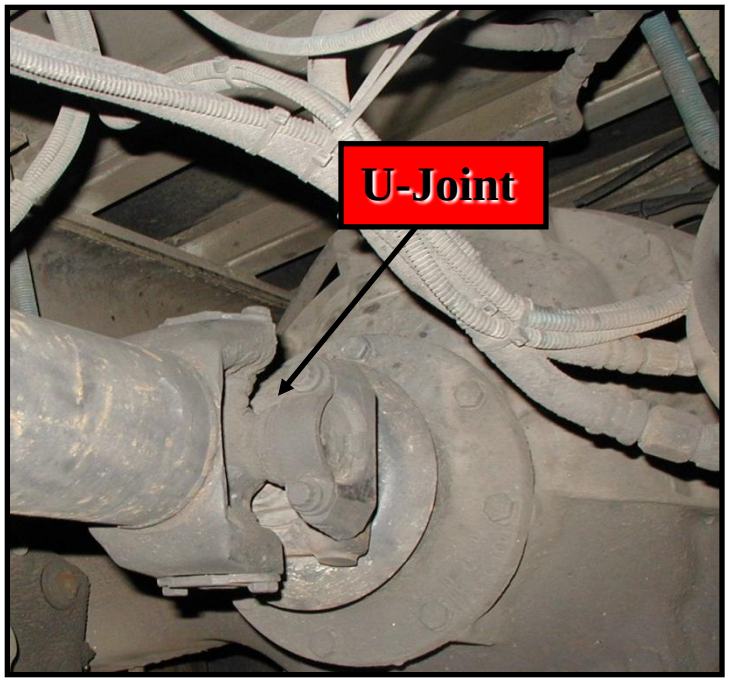
Front



- Modulators can be found on cross members or frame rails

Driveline Components





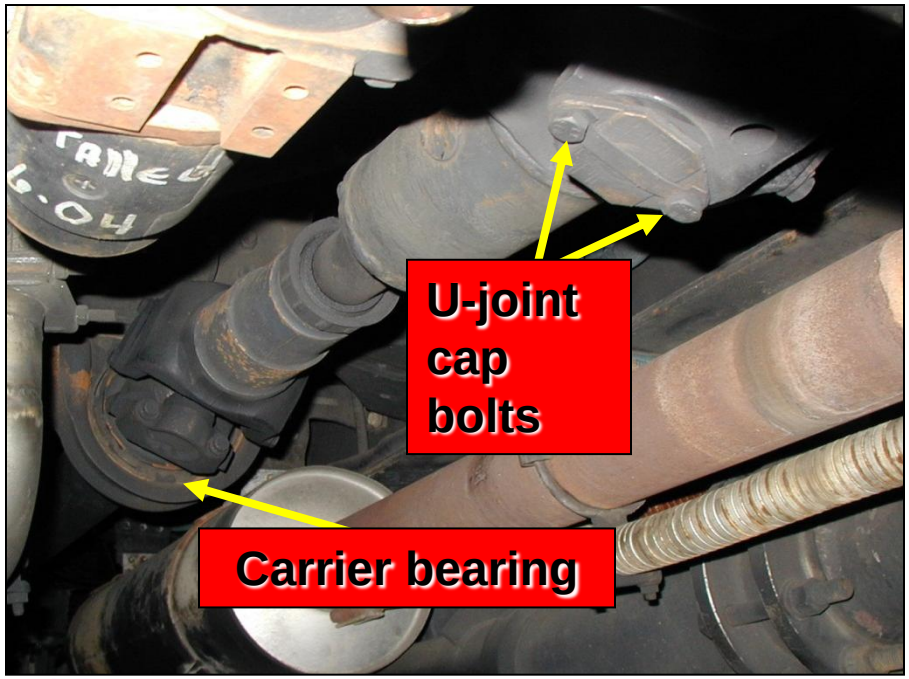
- Are all bolts in U-Joints, and are they tight ?
- Are all bolts in the carrier bearing ?

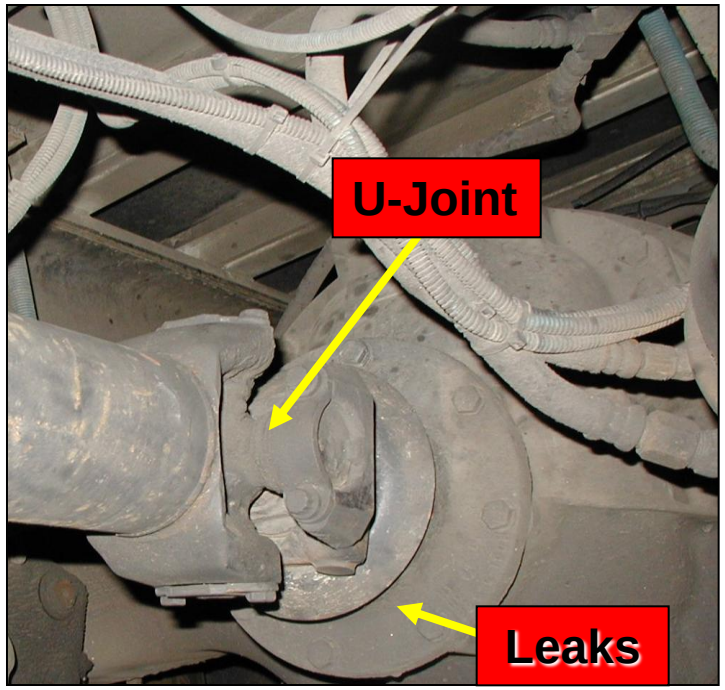
Crimson Driveline

Telma Retarder

Driveline OOS

- Missing or broken bolts on the carrier bearing
- Missing or broken bolts in the U-joints
- Class two fluid leak at rear pumpkin/driveshaft





D.O.T Brake Test

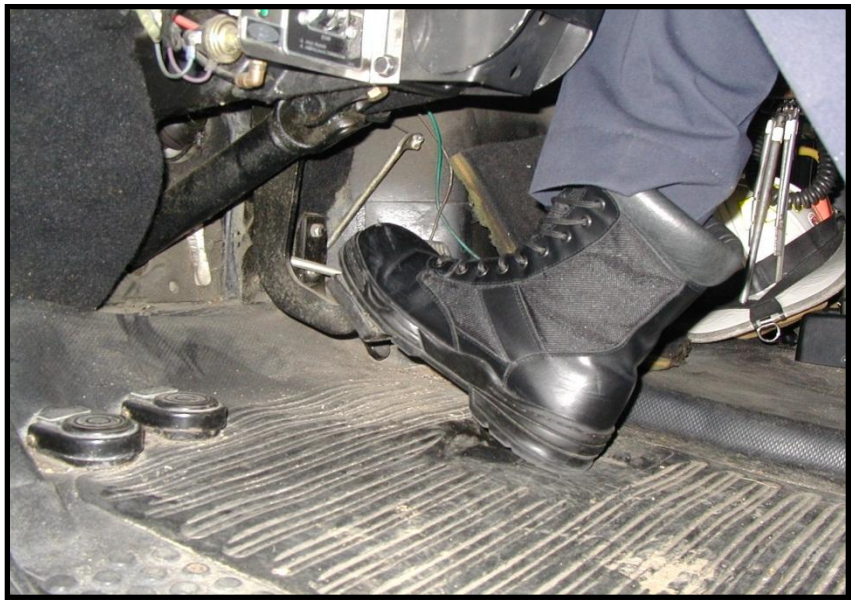
- This brake test must be preformed in this order
- Out of order sequence will result in failure !!!!
- Before you begin this test be sure that the wheels are chocked.
- Make sure battery and ignition is on so gauges will read, and warning devices will sound

D.O.T Brake Test

- Push Protection valve in charging the system
- Let tanks settle
- Tell instructor you are going to watch the gauge for 1 (one) minute.
- You are looking for air loss no greater than 3psi in one minute.(4psi for tiller trucks)
- Ask instructor to time you if you have no watch

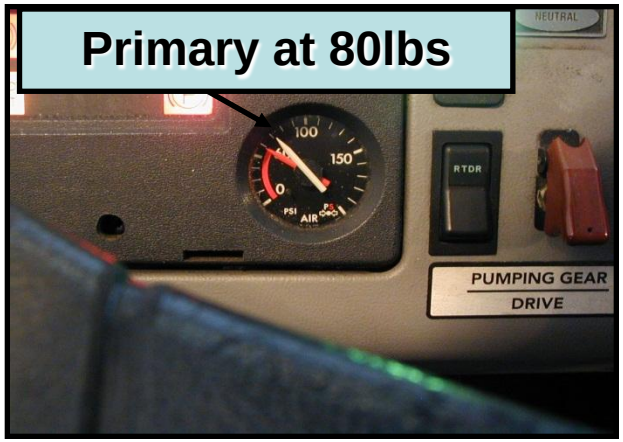
D.O.T Brake Test

- After one minute you will put your foot on the brake pedal and apply and hold steady pressure
- After tanks settle, time for one minute.
- You are looking for air pressure loss of no more than 3psi in one minute. (4psi for tiller trucks)



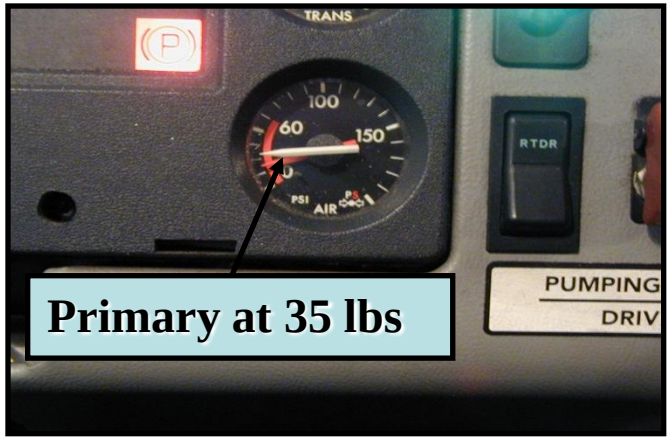
D.O.T Brake Test

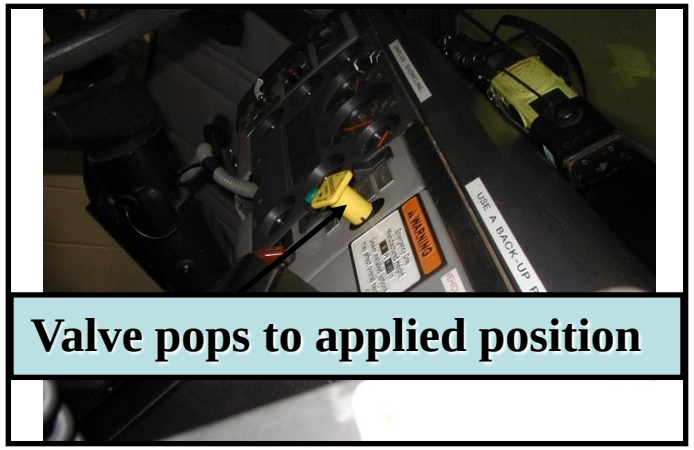
- After one minute you will start fanning the brakes
- Tell instructor “At approximately 60 to 90 lbs I will get a low air warning light and buzzer
- After light and buzzer activate, keep fanning brake



D.O.T Brake Test

- Tell Instructor “At approximately 20 to 40 psi my protection valve will pop”
- Keep fanning until it pops
- Once valve pops stop fanning brake





D.O.T Brake Test

- You will now start engine
- Air pressure must build from 50 to 90 lbs in 3 min. at 1200 RPM
- Ask instructor to time you

Note: Do not touch protection valve once you start the DOT brake test. If you touch it you fail

D.O.T Brake Test

- After starting the engine and waiting for pressure to reach 90lbs within 3 min.
- Tell instructor that all gauges are at working pressures
- After air pressure reaches 120-135 lb you may pick up your wheel chock and place unit into drive then reverse to show inspector that the spring brake works.

- NOTE: Do not step on throttle let engine tug at brakes at idle

Air Compressor

C.O.L.A

- C= Air Compressor Cut-In
- O= Air Compressor Cut-Out
- L= Low Pressure Warning
- A= Air Leakage Rate

ORDER

(1) Cut in pressure

(2) Cut out Pressure

(3) Low Pressure Warning

(4) Air Leakage Rate

Air Compressor

C.O.L.A.

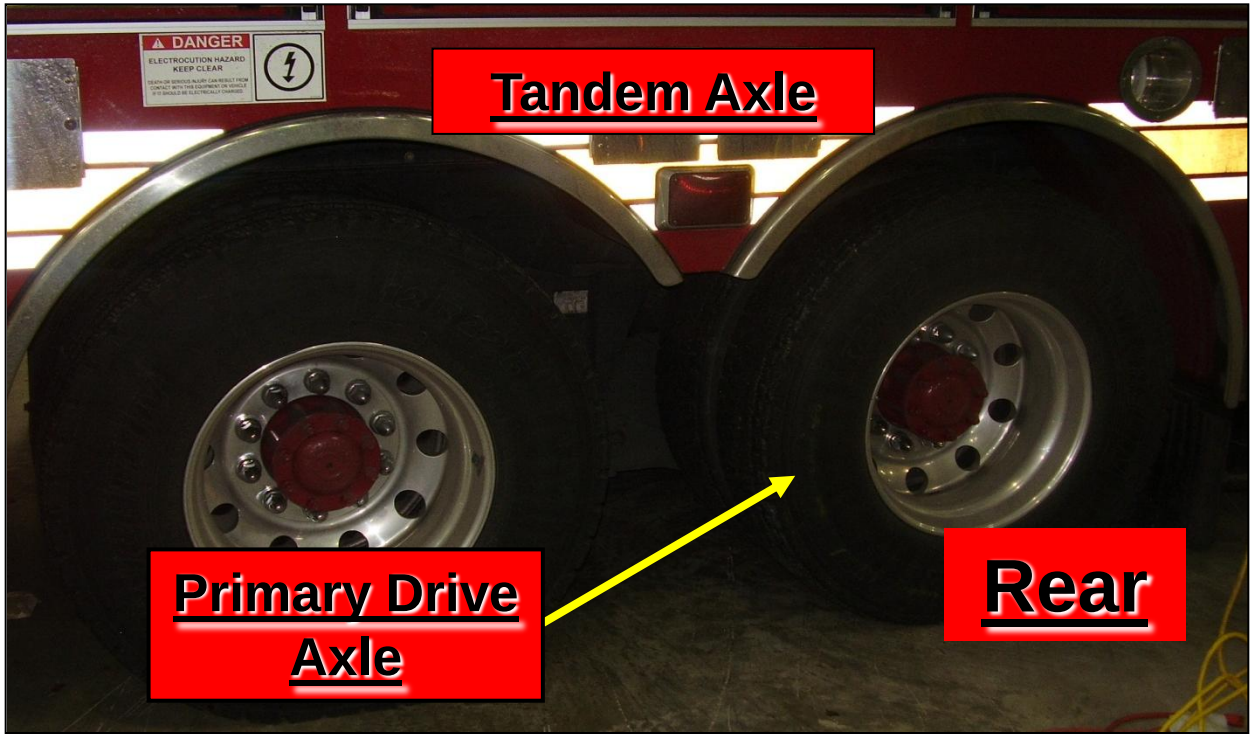
- **C=Cut in Pressure With motor running slowly fan brake, watch air gauge drop. When gauge reaches about 100psi compressor will come on stopping air drop age. This is the compressor cut in pressure. Any compressor which fails to cut in before 95psi will be reported to mechanic.**
- **O=Cut out Pressure With motor still running watch the air gauge rise and when you hear the air discharge that is the compressor cut out pressure. This will happen between 120 to 135psi. Any higher pressure cut out will be reported to mechanic. Now shut down the engine**

Air Compressor

C.O.L.A.

- L=Low Pressure warning With engine shut down but ignition on start fanning brake. When air pressure gauge reaches approximately 90psi you will get a low pressure light and buzzer. Any light or buzzer which fails to activate below 60psi will be reported to mechanic.
- A=Air Leakage rate With engine shut down air leakage will be less than 3 (three) psi per minute. This is with foot on or off brake pedal. 4 (four) psi in tiller trucks

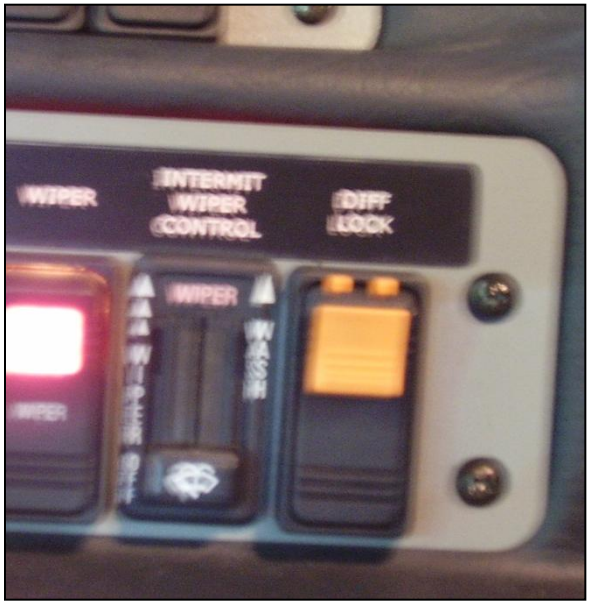
Axle Interlock, Differential Lock Off Road Traction



Axle Interlock

- When the axle interlock is off only the rear wheels have power to them
- When the axle interlock is engaged both sets of wheels have equal power
- The axle interlock acts as a third differential

Differential Lock



- On your drive axle only the right wheel has constant power
- When you engage the differential lock you have power to both wheels
- This is known as posi traction

Off Road Traction Control

- When you turn the switch for the off road traction you are actually turning off a component.

- Under normal driving if the ATC detects wheel slippage it tries to slow down the wheel by de-powering the engine
- The Off road traction switch takes this function away allowing for wheel spin

Warning

- When you turn on the inter-locks and differential lock the truck will follow the contour of the land in a wheel spin situation.
- If the truck is on a slight left hand lean the rear of the truck will walk to the left.
- So use the locking devices with care !!!!

AIR BRAKE SYSTEMS

Apparatus Division

Montgomery County Fire Rescue Service

Air Brakes

- Most air brake system do not automatically adjust for wear.

- Air enters the chamber when the brakes are applied, the push rod moves out turning the slack adjuster which then rotates the “S” cam forcing the shoe into the drum.

Air Brakes

- A full stop at 60mph might raise the drum temperature 600 degrees Fahrenheit.
- Drums that reach 800-1000 degrees Fahrenheit is dangerous.
- The temperature increases the size of the diameter of the drum which in turn increases the pushrod stroke.

Brake Fade

- Brakes are essentially composed of glue and a strengthening material.
- When this lining gets hot, the glue softens, starts to melt and the linings get slick.
- With the lining fade and the expansion of the drum, it is possible to run out of stroke before the shoes make contact with the drum.

Lag Time

- The time it takes the brakes to take effect after the brake pedal has been applied.
- Normally should be .5 – 1 second.
- The heavier and larger the truck, the longer the brake lag.
- Brake lag at 55mph can add 60 feet to your stopping distance.

Vital Questions to Ask

- Can I recognize a problem in the air brake system before brake failure occurs?

- If brake failure does occur, do I know how to safely stop the apparatus?

Air Brake Knowledge

Most air brake systems have two dashboard gauges. What do they indicate?

- First identifies the air pressure in the primary system (marked “primary”, “rear brakes” or has red needle). The primary system controls the rear brakes.

Air Brake Knowledge

Most air brake systems have two dashboard gauges. What do they indicate?

- Second identifies the air pressure in the secondary system (marked “secondary”, “front” or has white or green needle). The secondary system controls the front (steering) brakes and any air-operated accessories (such as air horns).

Air Brake Knowledge

For what two reasons does the driver-operator need to know how much pressure is in the system?

- **Can estimate how much braking power the apparatus has.**
- **If failure in one or both systems, the driver-operator can safely determine if an emergency stop is necessary or if they can safely return to quarters.**

Air Brake Knowledge

On apparatus with multi-air tanks, which tank is known as the “wet tank”?

- The main tank. It is the first tank to receive the hot compressed air from the compressor. When this hot air cools it leaves moisture in the tank. The air dryer makes a hissing/spitting noise every 10-15 minutes indicating the removal of the water. If excessive water/oil still comes from the system, the dryer needs to be repaired.

Air Brake Knowledge

How does the parking brake work?

- Installed on the rear axles and utilize the rear brake chambers.
- Springs apply the brakes and do not use air pressure.

Air Brake Knowledge

How does the parking brake work?

- Air is sent to the chambers which compresses the springs which then releases the parking brake.
- If you lose air pressure, the parking brake will apply automatically.

Auxiliary Braking Devices

Types of Auxiliary Braking Devices:

- **Transmission retarder**
- **Driveline retarder**
- **Engine Brakes**

Applies a retarding force to the drive wheels without the use of friction on the wheels

Auxiliary Braking Devices

- Know what system you have on your apparatus
- You may need to disengage when driving on slippery roads
- Can reduce reaction time allowing a shorter stopping distance in panic stops
- Helps in keeping the service brakes cool

Brake Failure

ABS Braking Systems

- ✓ Do not pump ABS Brakes (Air Brakes), this confuses the computer
- ✓ Apply firm pressure
- ✓ Downshift transmission
- ✓ Leave retarder system engaged

Brake Failure

ABS Braking Systems

- ✓ Steer to create more friction with tires
- ✓ Rub tires against curb
- ✓ Look for an escape path

Anti-lock Braking Systems

Four basic components wired together with a shielding harness:

- Electronic Control Microprocessor – compares and processes a signal it receives from each wheel. Controls the air pressure to the brake chamber from the modulation valve.
- Exciter or Pulse Ring – attached to the axle or wheel hub, it turns at the same speed as the wheel.

Anti-lock Braking Systems

- Wheel Speed Sensor – a small induction coil mounted in close proximity to the pulse ring. Generates an impulse to the electronic controller, which determines the speed at which each wheel is turning.
- Modulation Valves – control air pressure to the brake chambers on command from the electronic control. As quickly as 5 times a second, the valves can apply, release, or hold air pressure to the brake chamber.

Anti-lock Braking Systems

- Computer controlled.
- Determines if more or less air pressure is needed on a particular wheel.
- Brakes need to be firmly applied for the computer to complete its apply-and-release function.
- ABS will NOT work if brakes are “pumped”.

Anti-lock Braking Systems

- Designed to allow the tires to turn while the apparatus is slowing down – maintaining rolling friction with the road.
- Allows driver to maintain directional stability, control over steering and may reduce stopping distances.
- Stops the apparatus in the same – or shorter – distance than regular brakes.

THRESHOLD BRAKING

- Technique used for to maintain control of steering for Non-ABS brakes
- Brakes are rapidly applied up to pressure just prior to the wheels locking
- Brake pedal must be modulated if wheels lock

THRESHOLD BRAKING

- Technique used for slippery conditions when steering control is vital
- Avoid “ pumping the brakes”