Alberta LEARNING

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NAIT THE NORTHERN ALBERTA INSTITUTE OF TECHNOLOGY

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RDC Red Deer College

SAIT Building Careers Building Business

Heavy Equipment Technician
Hydraulic Brake Booster System
Fundamentals and Service

Hydraulic Brake Systems

First Period

Module 190103d

Objectives

1. Identify common power assist braking systems.

2. Explain the principles of operation for vacuum brake booster systems.

3. Describe the diagnosis and repair procedures for vacuum brake booster systems.

4. Explain the principles of operation of air-over-hydraulic brake booster systems.

Objectives

5. Describe the diagnosis and repair procedures for air-over-hydraulics brake booster systems.

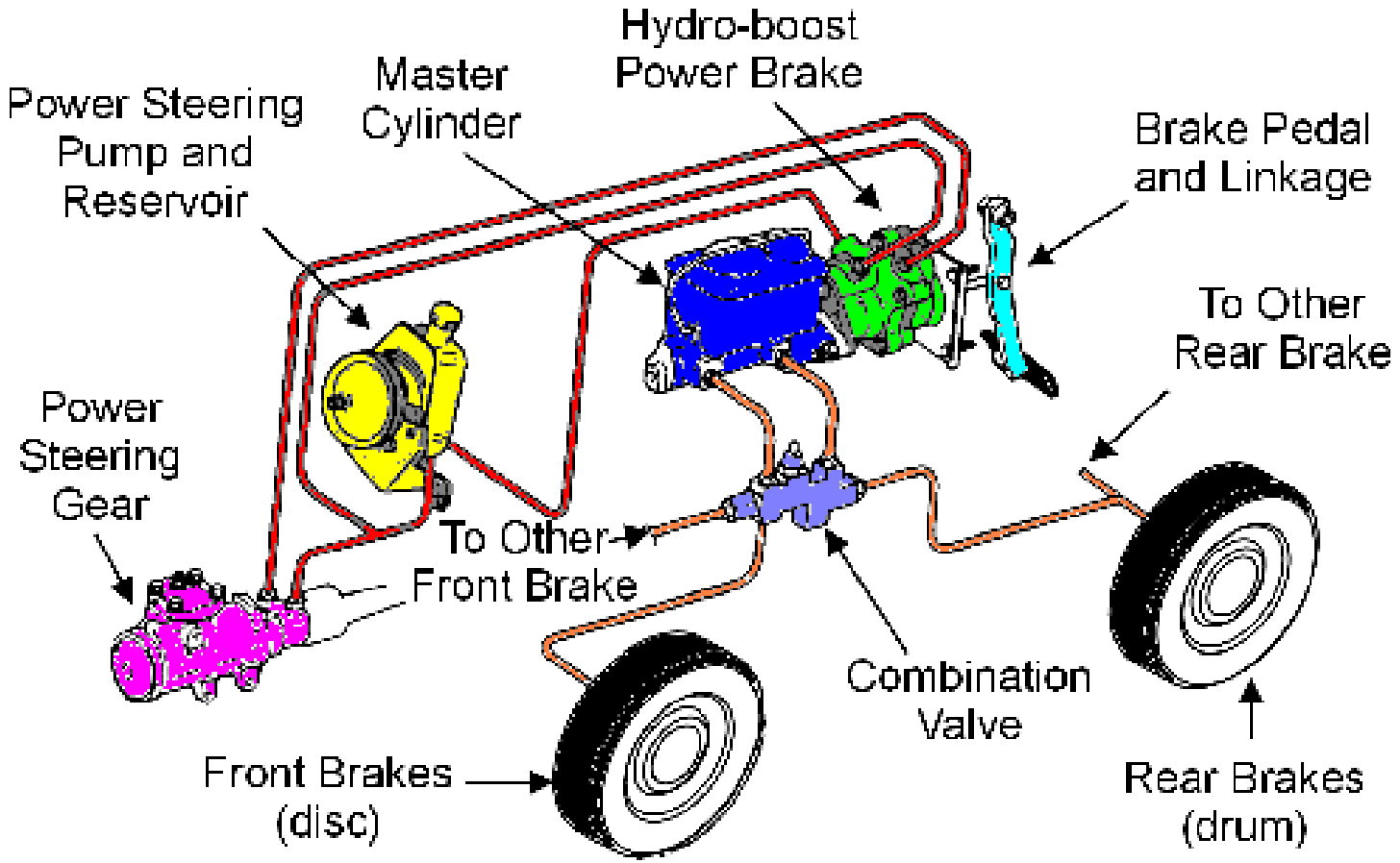
6. Explain the principles of operation for hydraulic over hydraulic brake booster systems

7. Describe the diagnosis and repair procedures for hydraulic over hydraulic brake booster systems

Objective One

Identify common power assist braking systems.

Hydraulic over Hydraulic (hydroboost) System

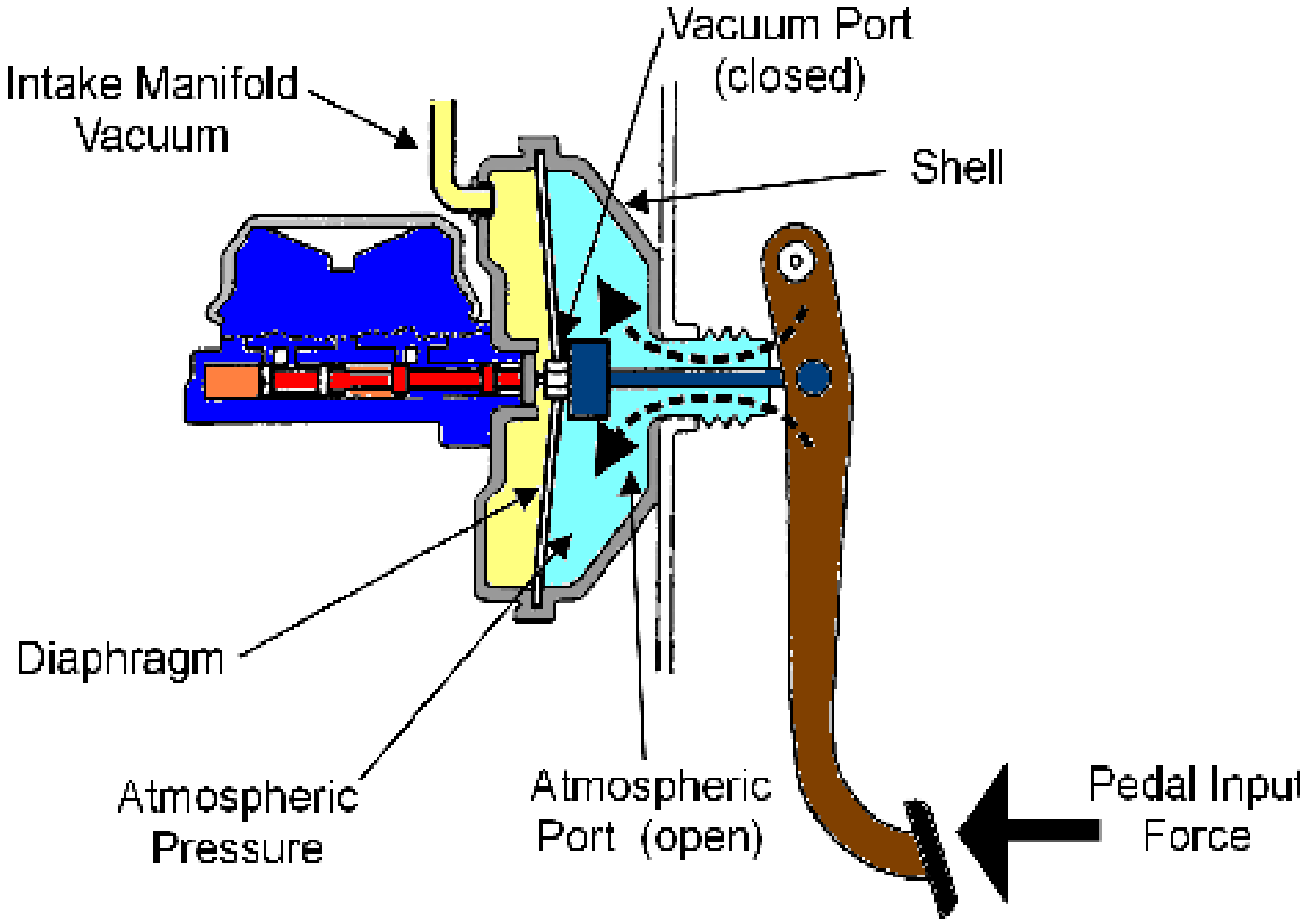


Uses power steering pressure to assist in braking.

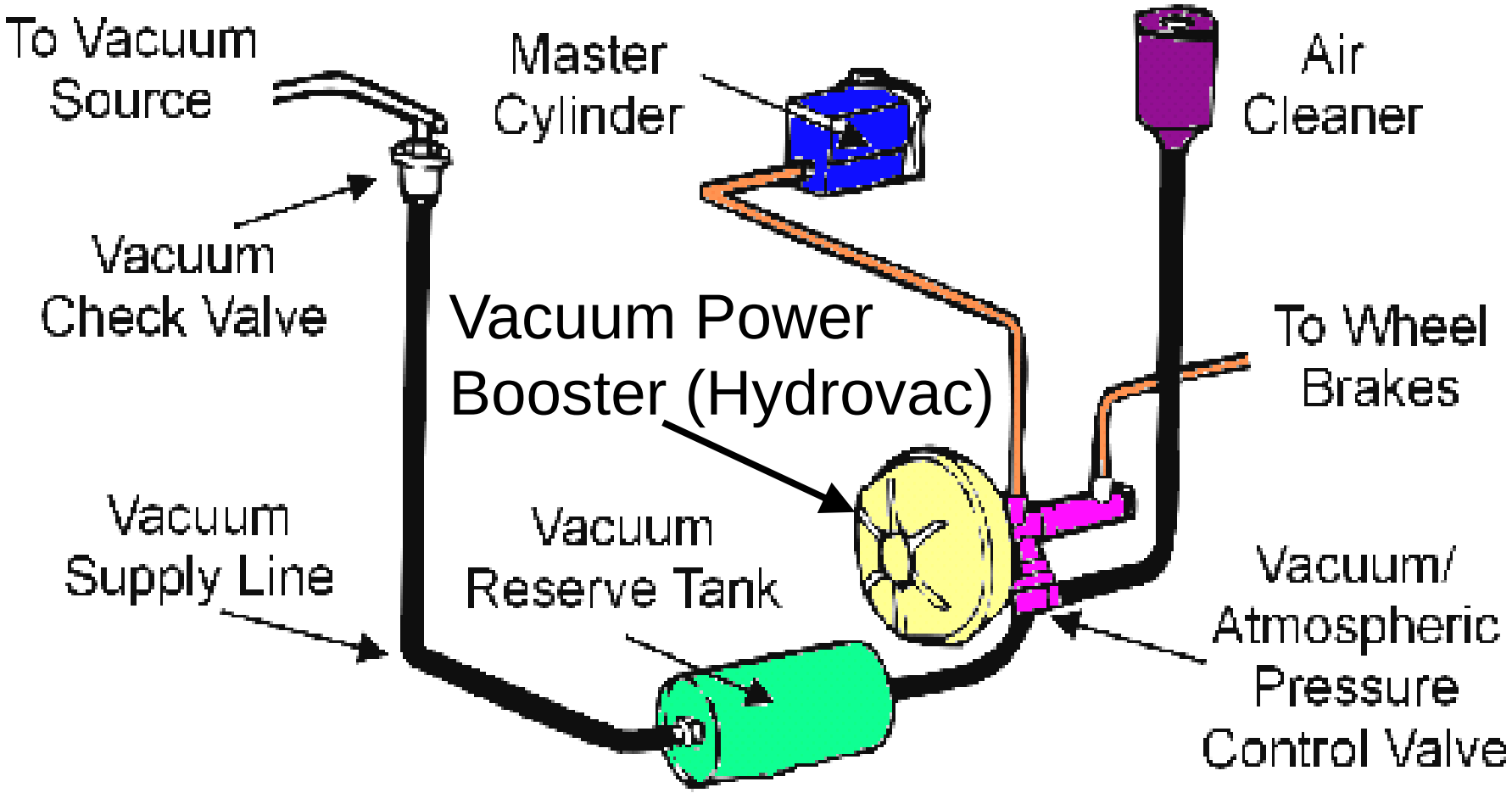
Used with both gas and diesel engines.

Vacuum / Atmospheric System

Uses vacuum and atmospheric pressure for assist.

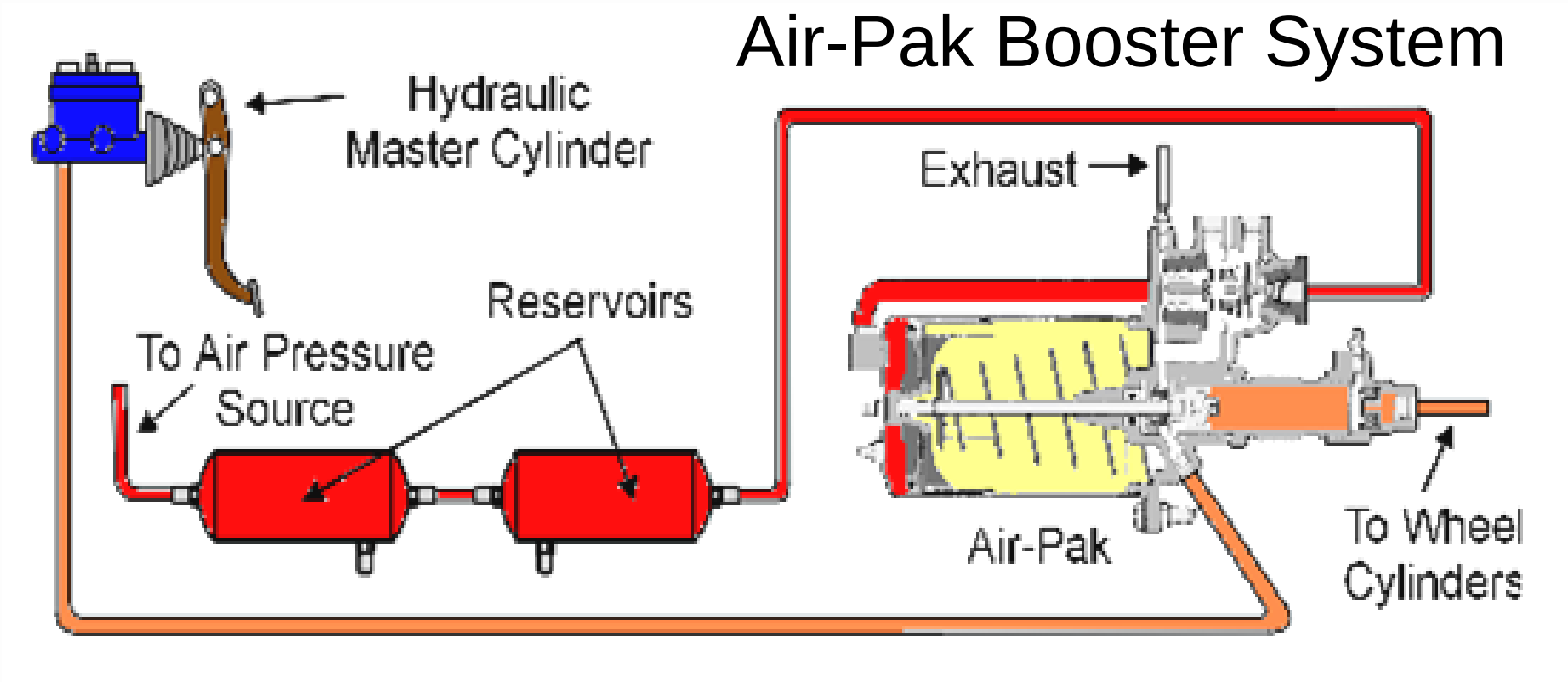


Vacuum / Atmospheric System



May have a remotely mounted unit (hydro-vac).

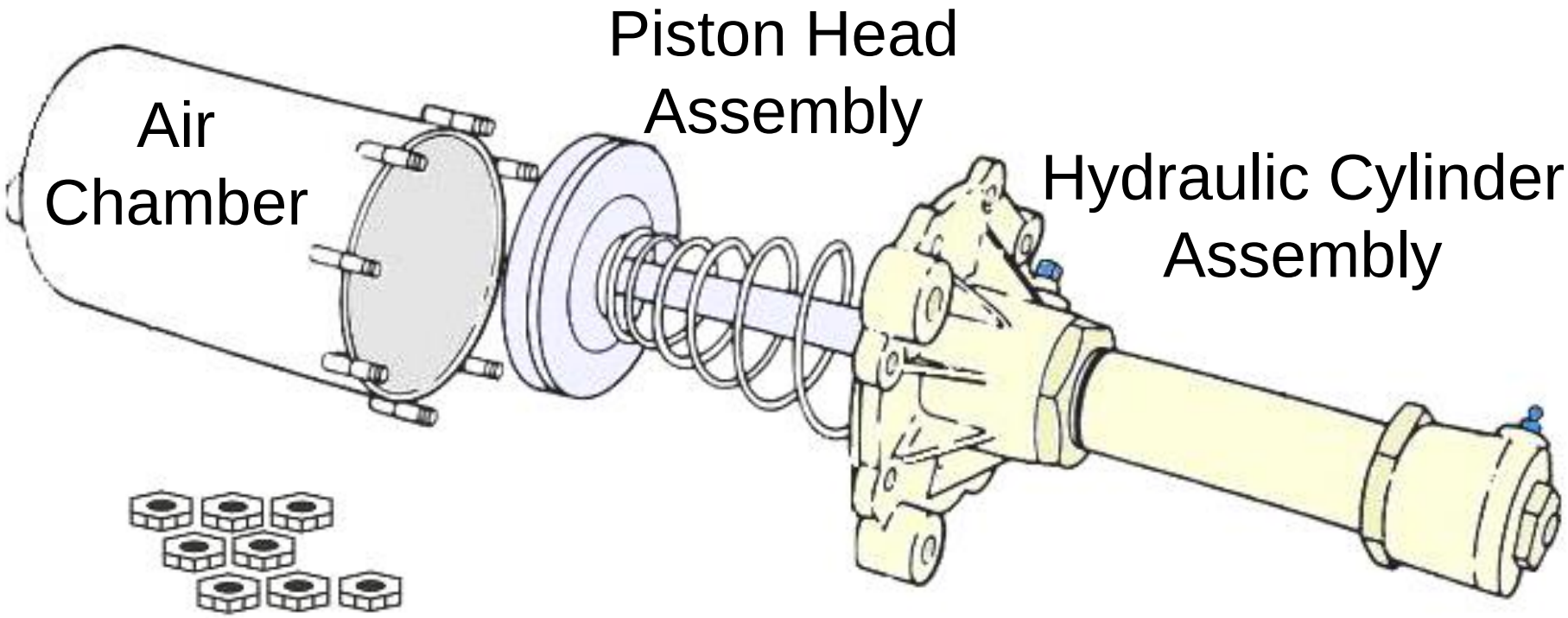
Air-Over-Hydraulic Systems



Uses pressurized air from a compressor.

Usually remotely mounted.

Air-Over-Hydraulic Systems

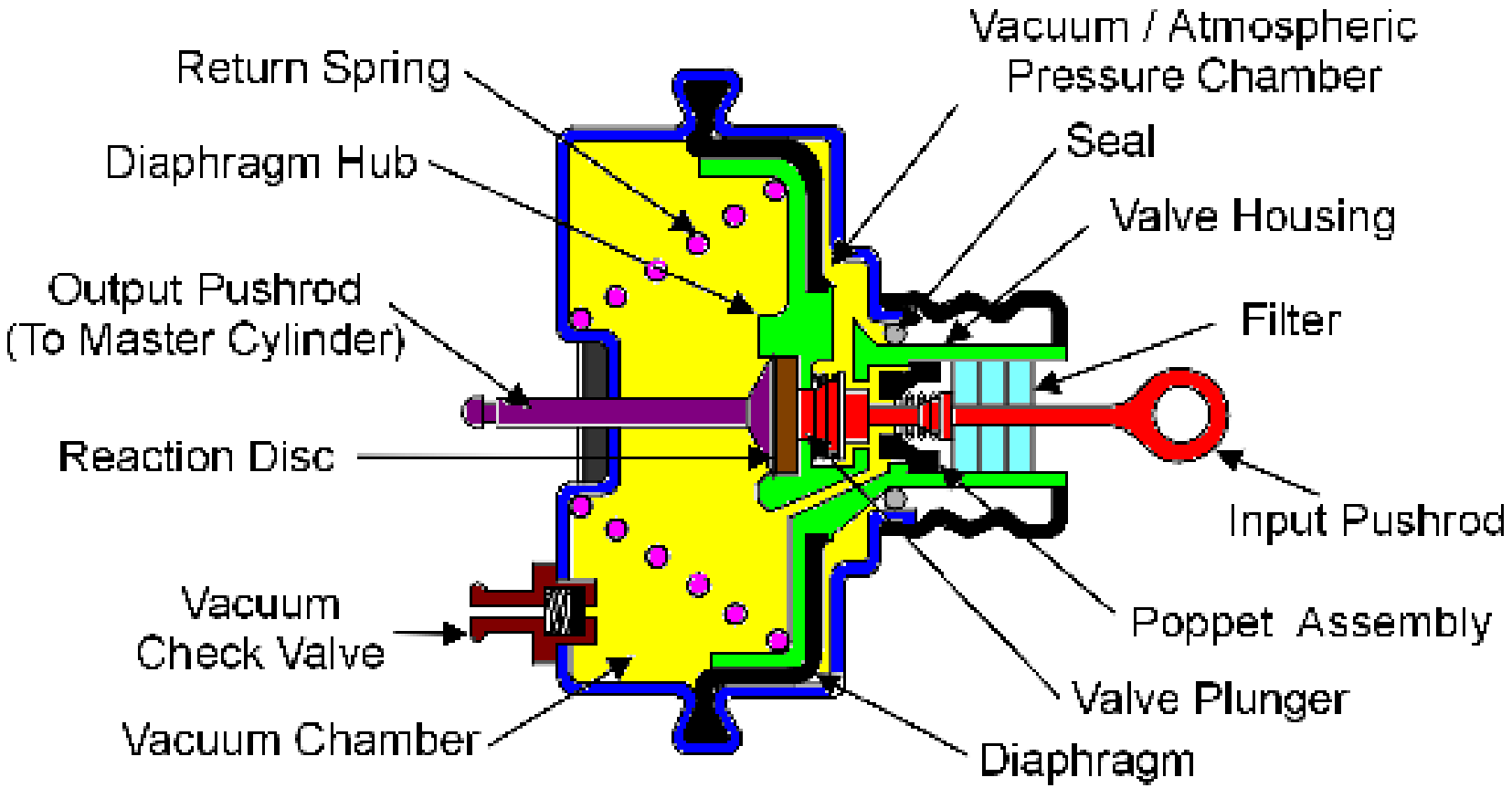


The power cluster can be coupled directly to a master cylinder or to a hydraulic slave cylinder.

Objective Two

Explain the principles of operation for vacuum brake booster systems.

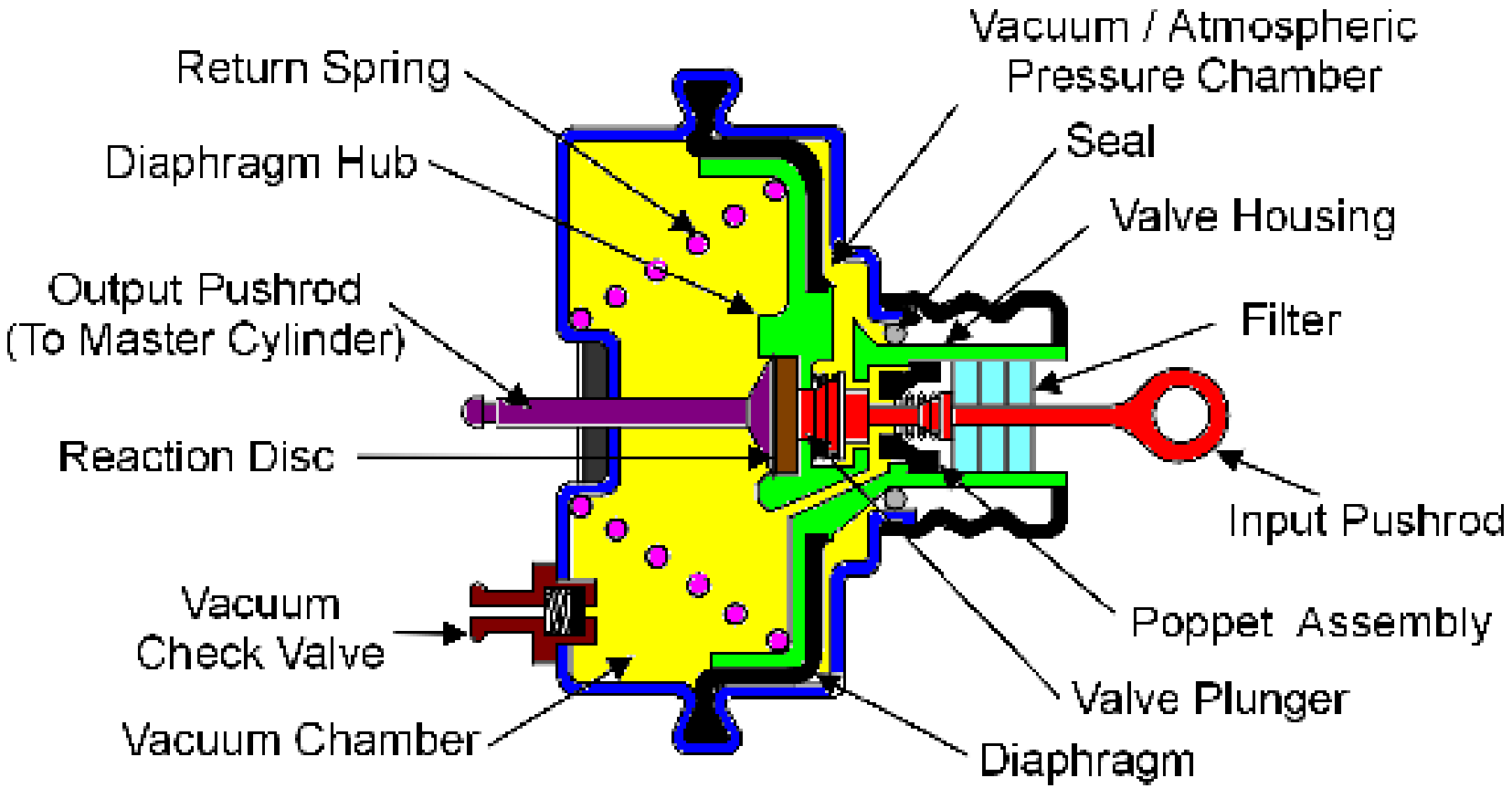
Integral Power Brake Booster Vacuum Suspended



Round shaped housing mounted to fire wall..

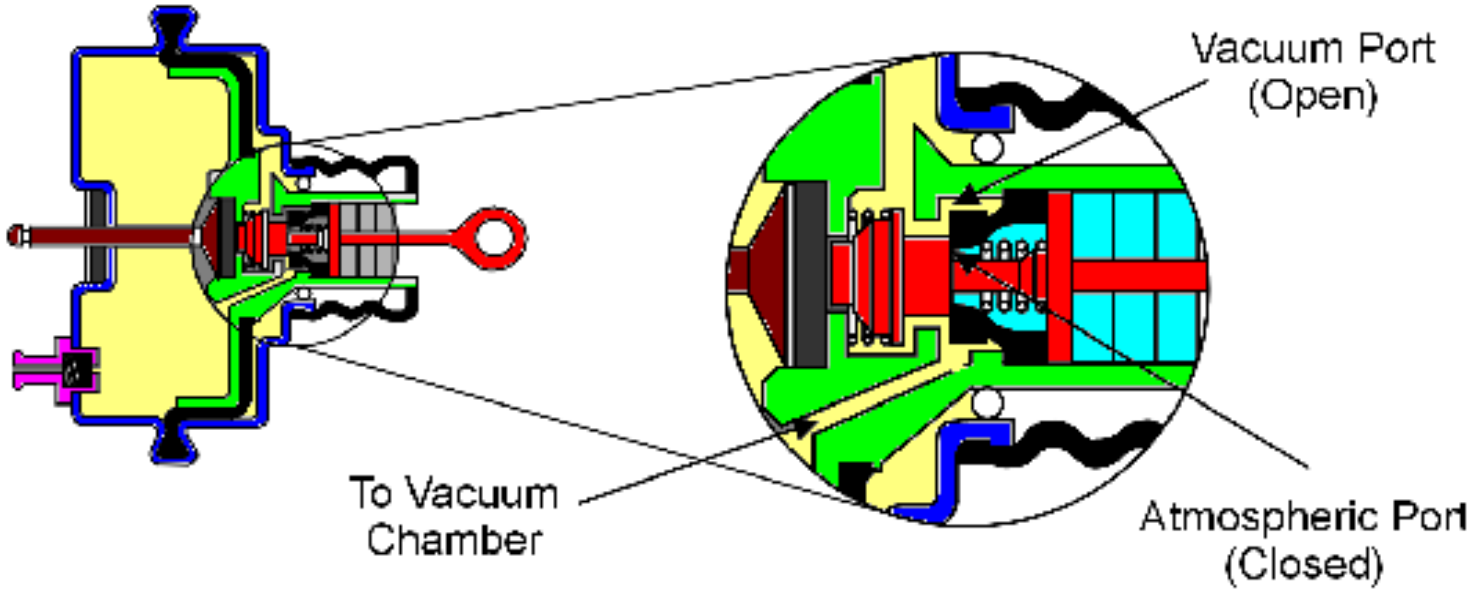
Master cylinder mounted on booster.

Integral Power Brake Booster Vacuum Suspended



Uses vacuum created in the engine and atmospheric pressure to move diaphragm

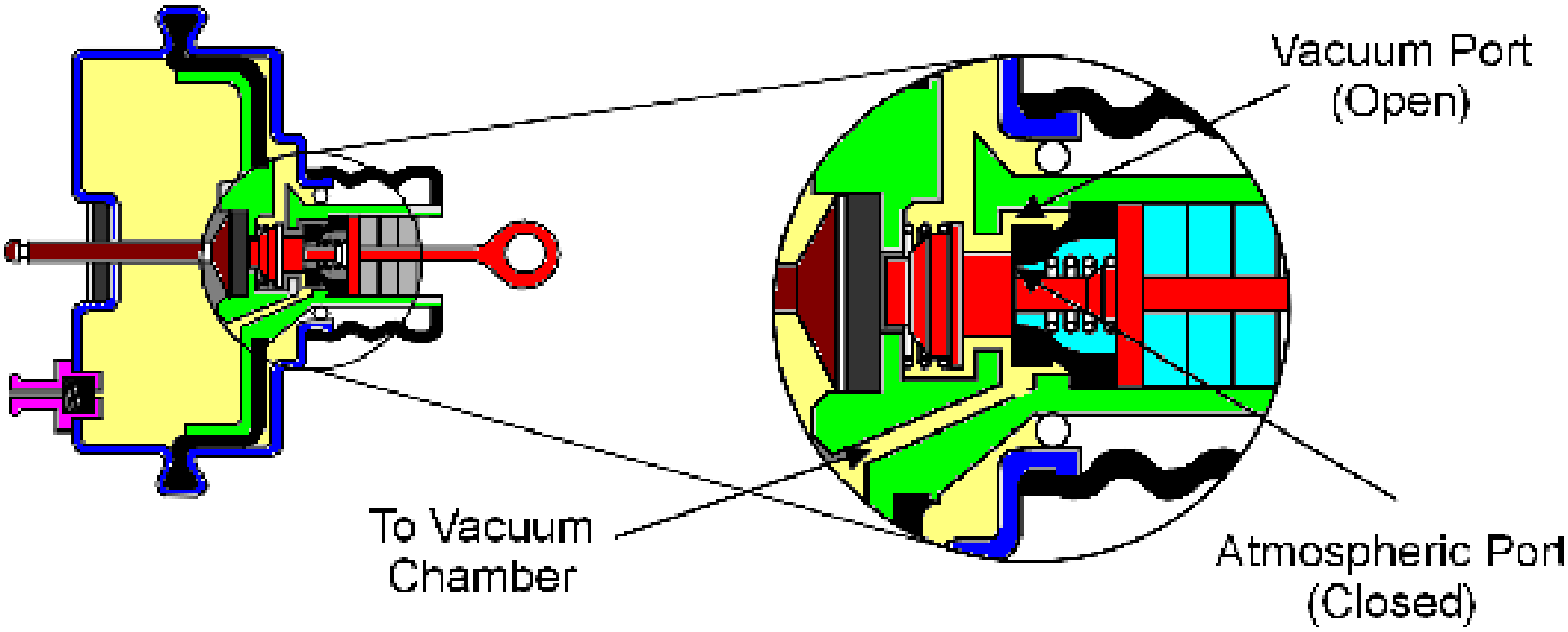
Integral Power Brake Booster Vacuum Suspended



Vacuum is low pressure and atmospheric pressure is high..

Controlled by a valve operated by the brake pedal.

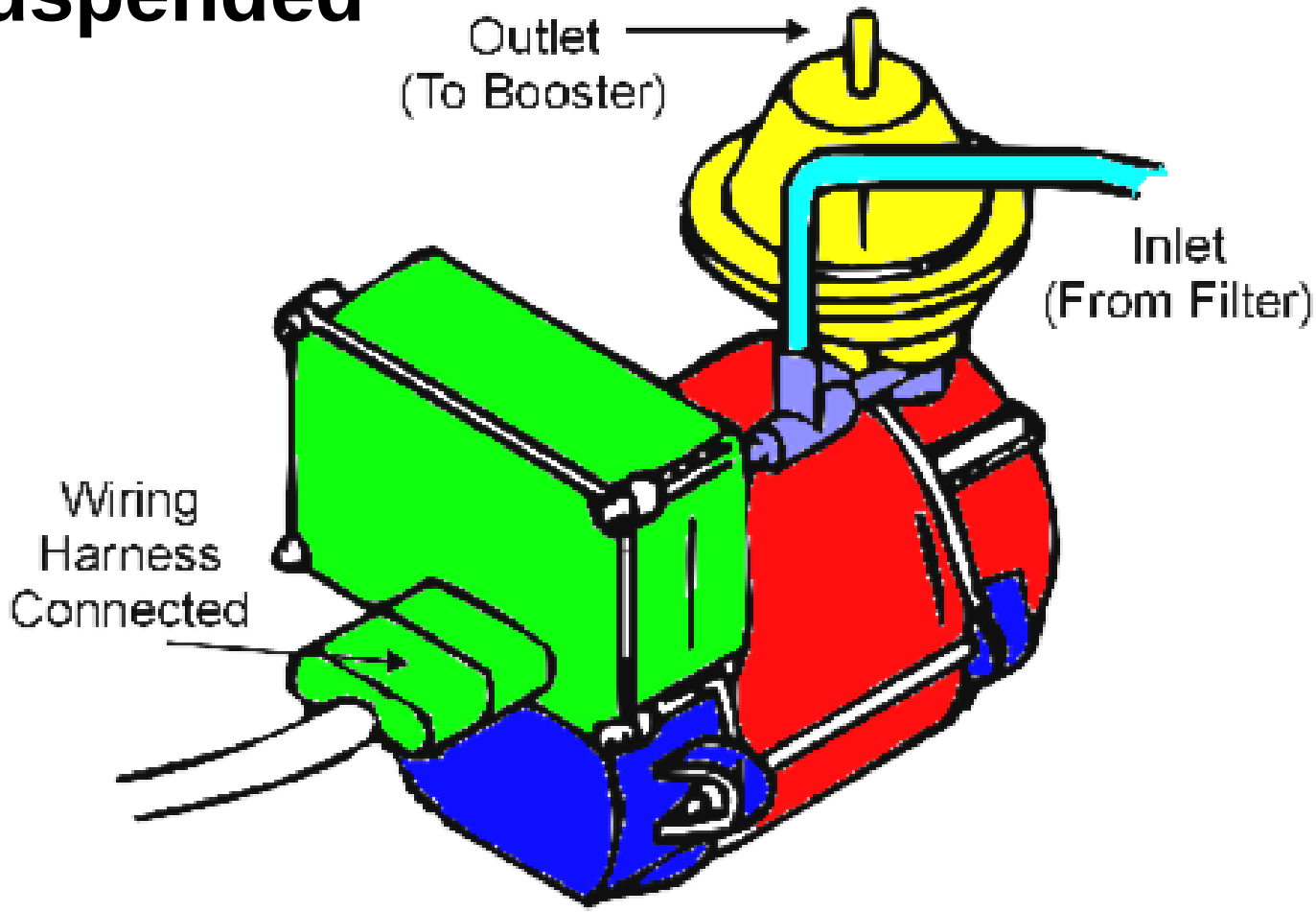
Integral Power Brake Booster Vacuum Suspended



In the released position, the diaphragm is suspended by vacuum (vacuum on both sides)..

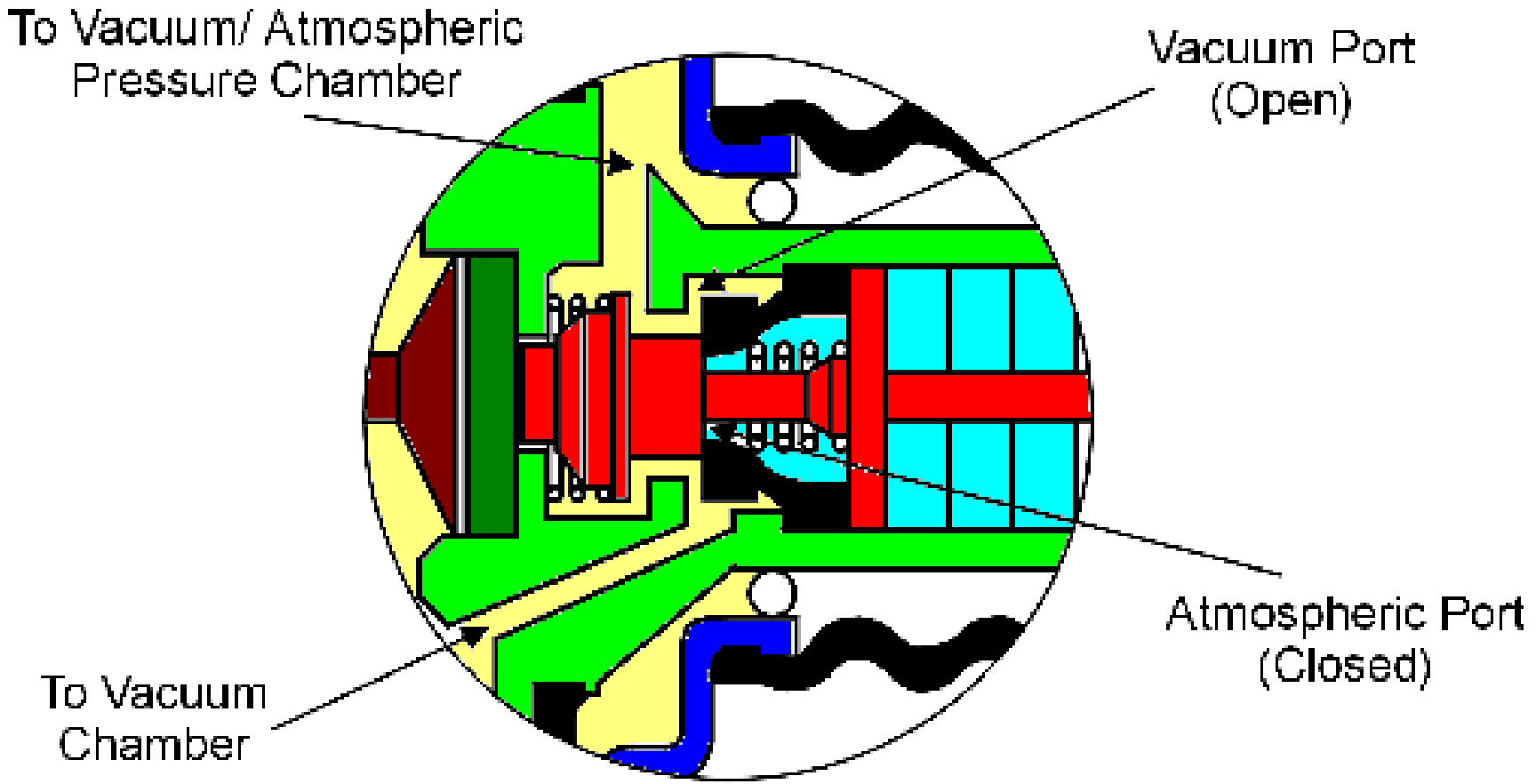
A spring pushes the diaphragm to the released position.

Integral Power Brake Booster
Vacuum Suspended



An electric vacuum pump may be required if the engine is diesel.

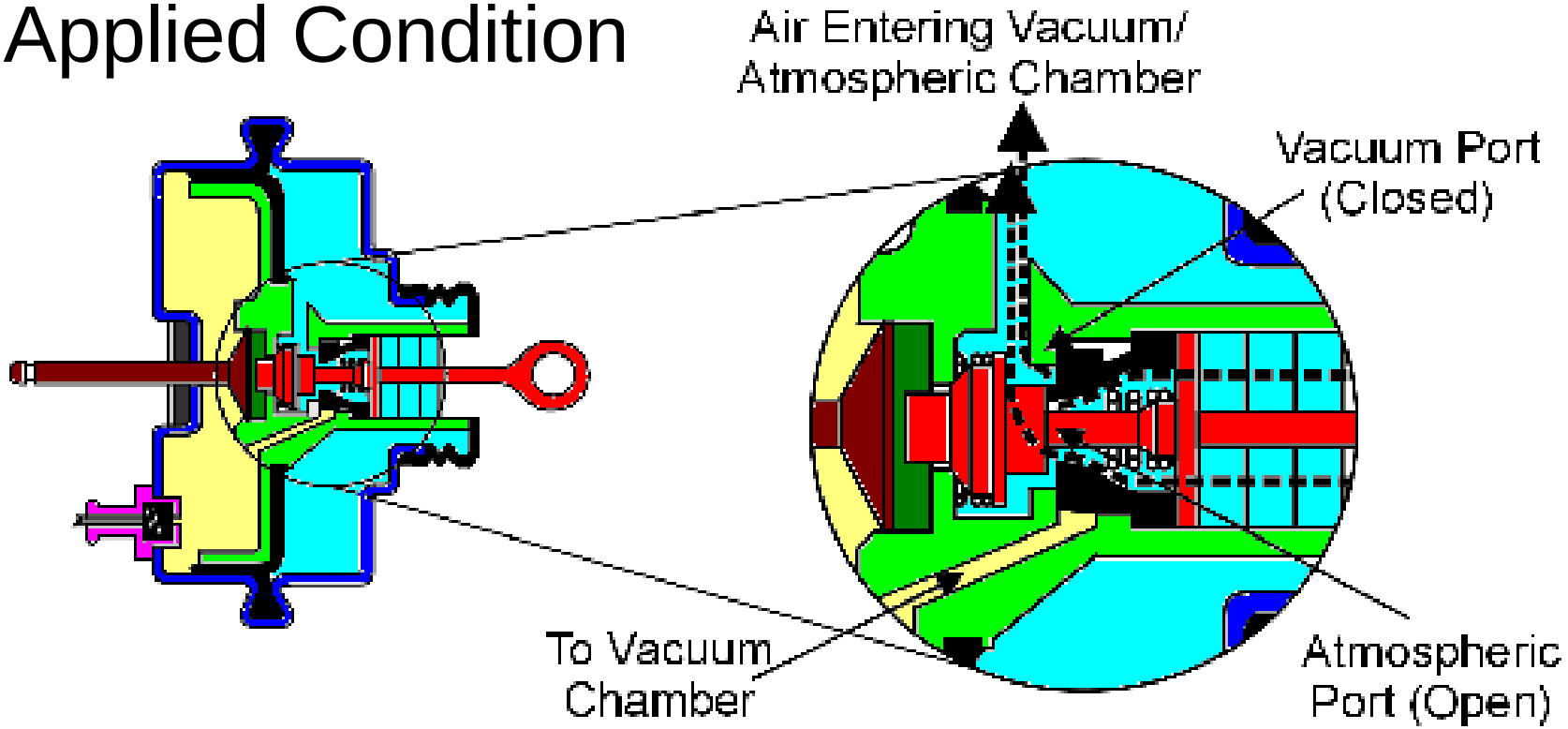
Integral Power Brake Booster Operating Conditions



Control valve assembly for the vacuum and atmospheric ports.

Integral Power Brake Booster Operating Conditions

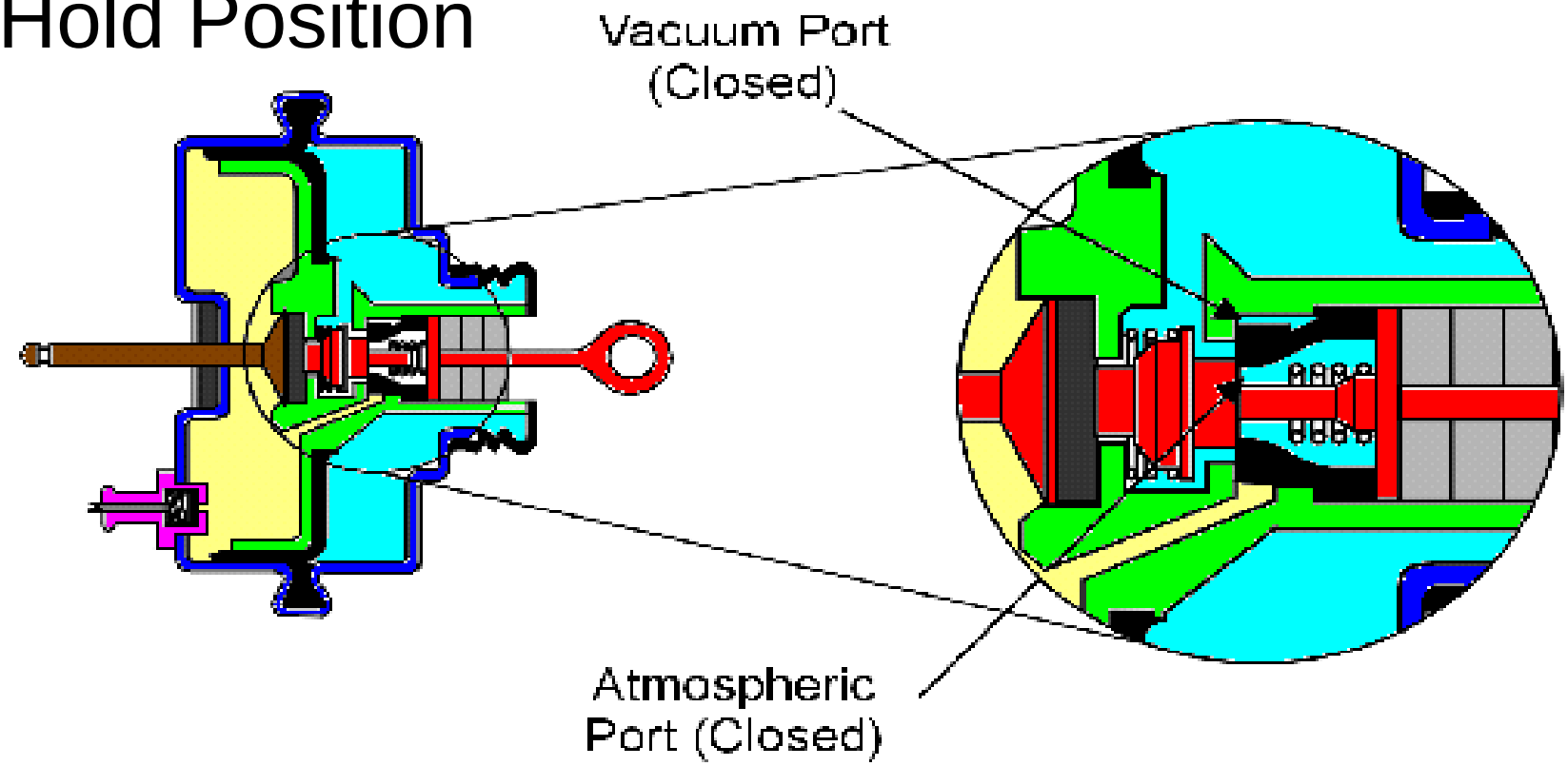
Applied Condition



Vacuum valve closes and atmospheric valve opens, and atmospheric pressure enters the chamber and exerts a force of 14.7 psi.

Integral Power Brake Booster Operating Conditions

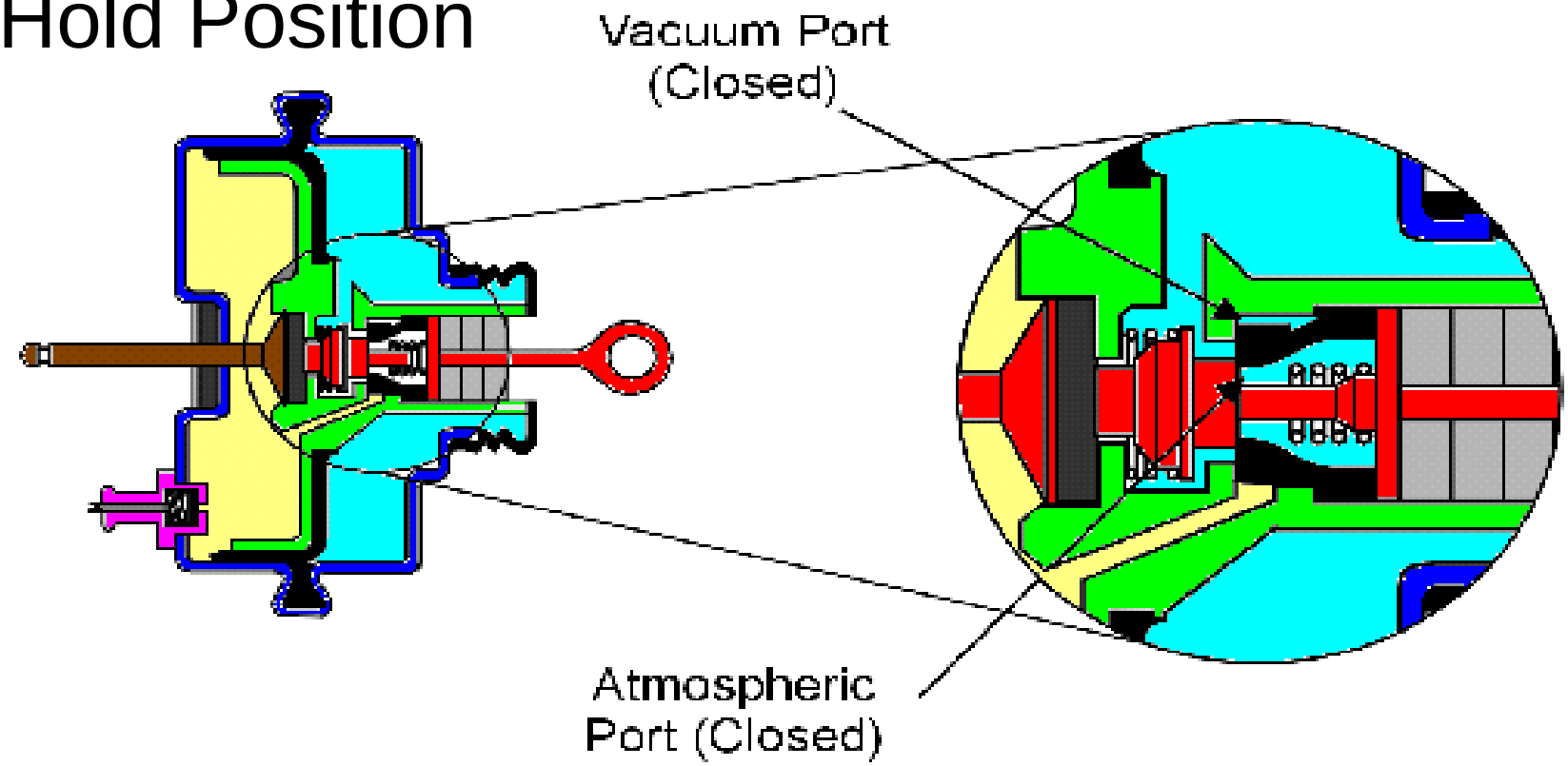
Hold Position



Operator stops pushing (holding vehicle stationary), the reaction disc pushes back to close atmospheric valve (brake feel).

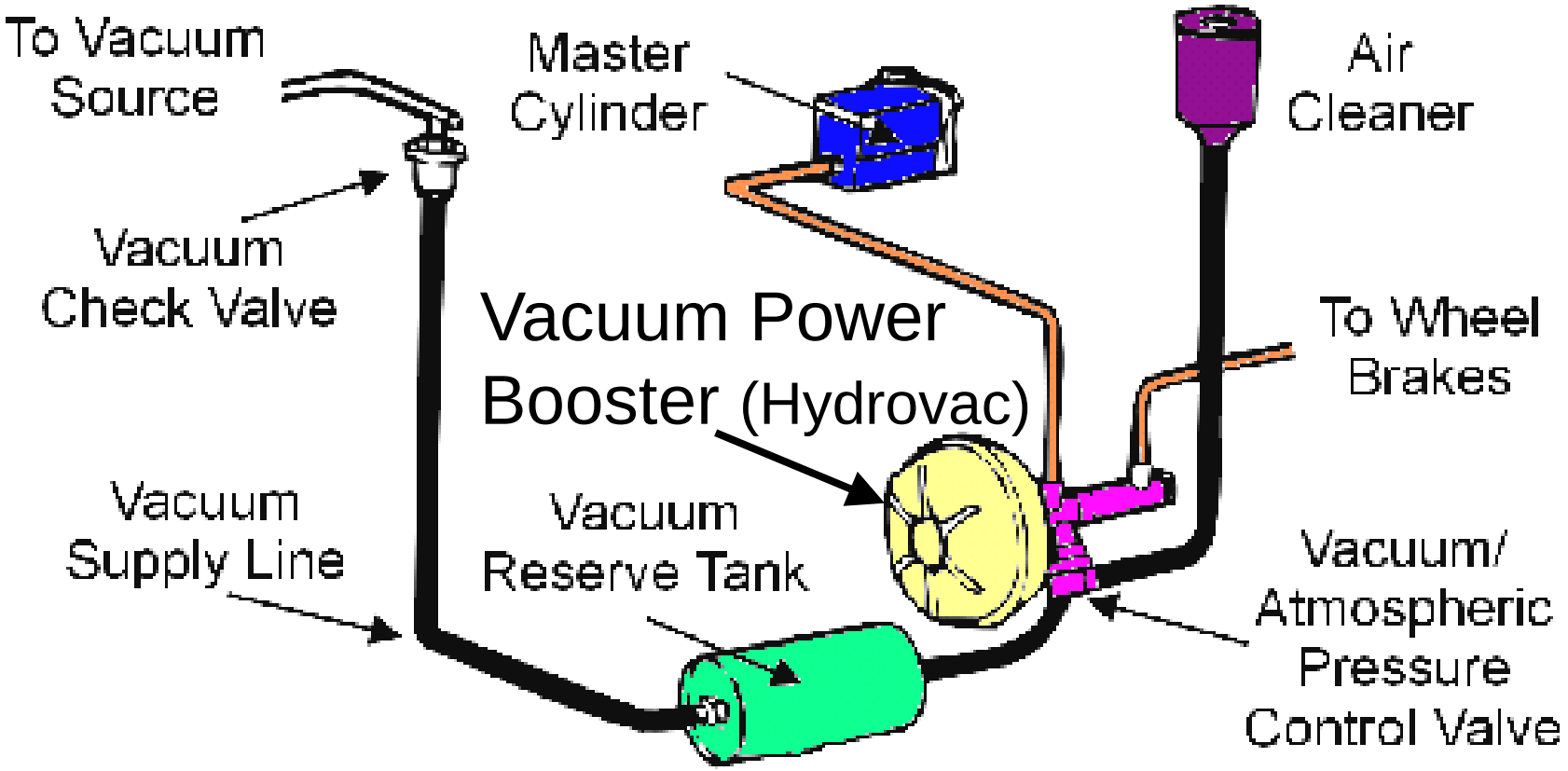
Integral Power Brake Booster Operating Conditions

Hold Position



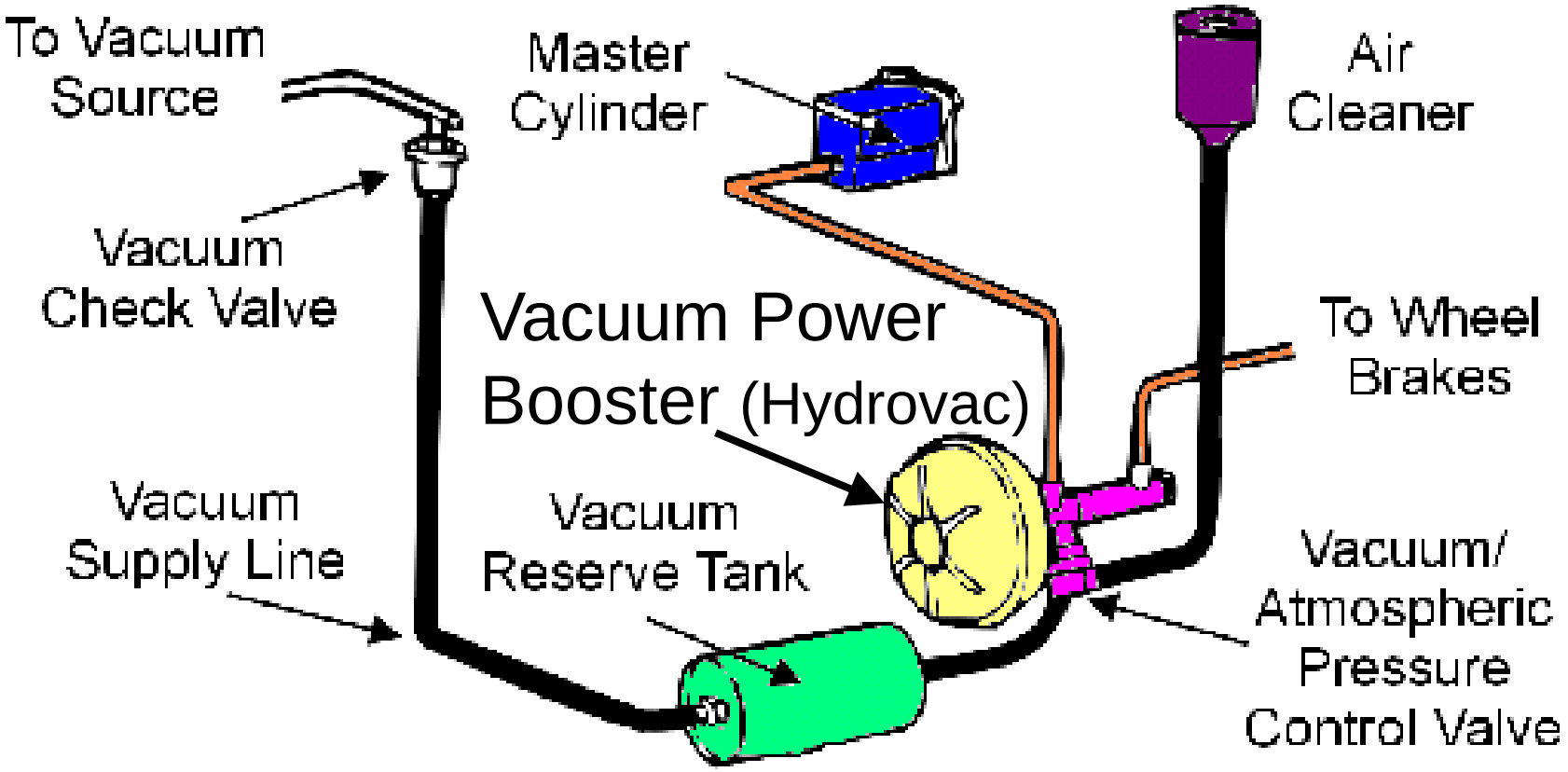
Vacuum valve closes and atmospheric valve closes, and the diaphragm stops and brakes are held in that position.

Remote Power Brake Booster
Vacuum Suspended



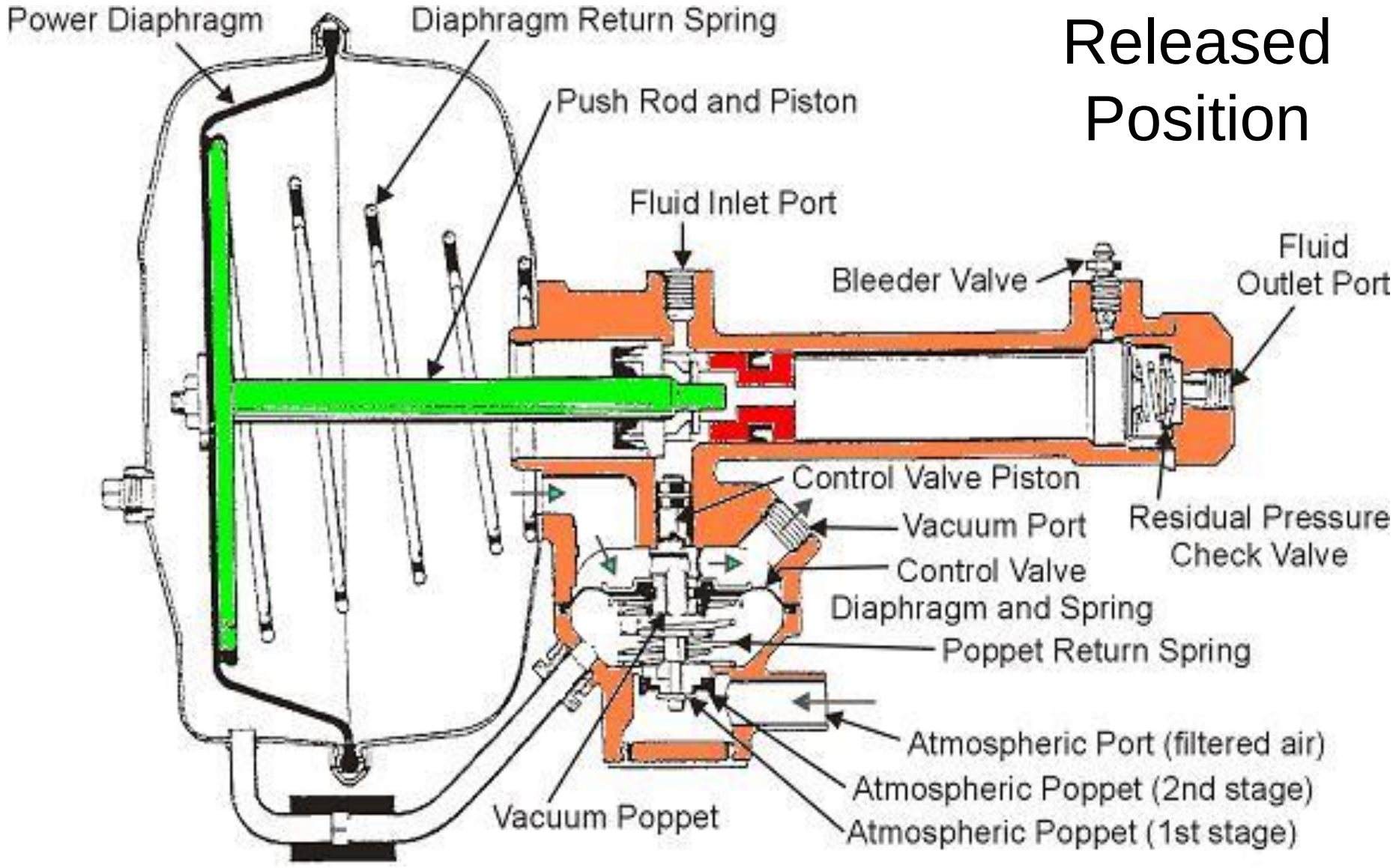
Remote mounted brake booster (hydro-vac) is mounted under cab on the frame because of its size.

Remote Power Brake Booster
Vacuum Suspended



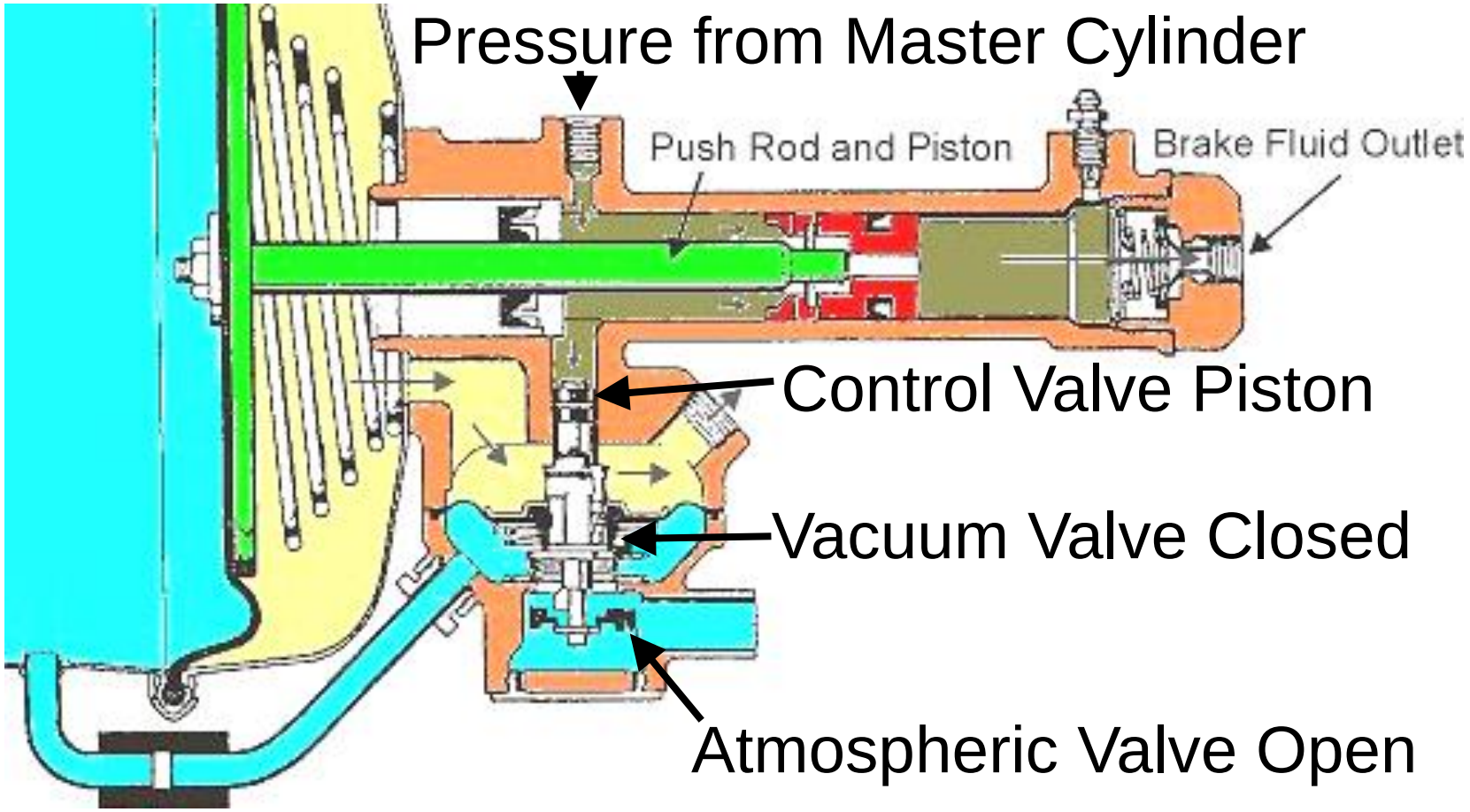
Booster works the same as a vacuum suspended, and is triggered by the master cylinder to operate the slave cylinder.

Remote Power Brake Booster
Vacuum Suspended



Remote Power Brake Booster
Vacuum Suspended

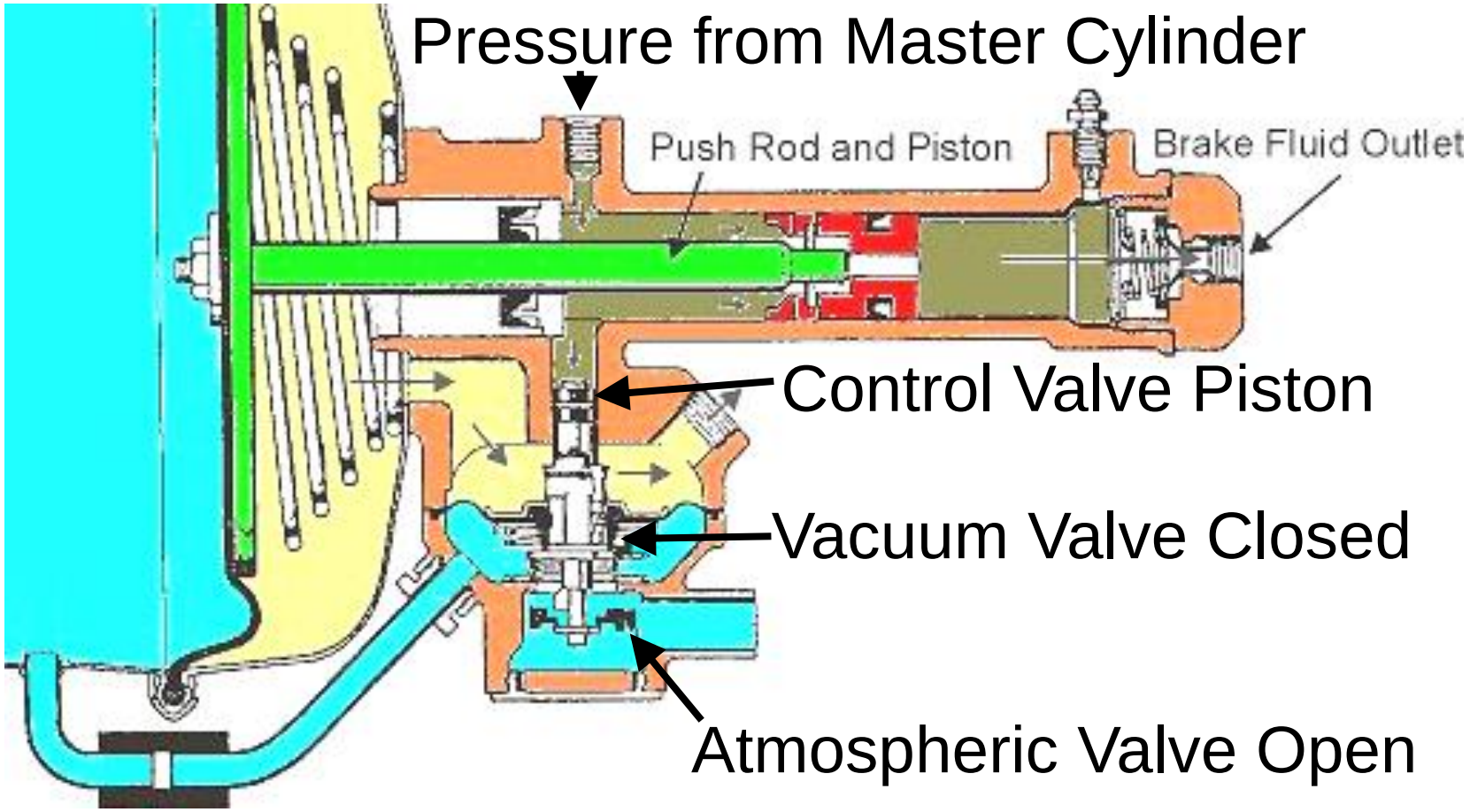
Applied Position



Control valve piston is activated by a low pressure signal from that master cylinder.

Remote Power Brake Booster
Vacuum Suspended

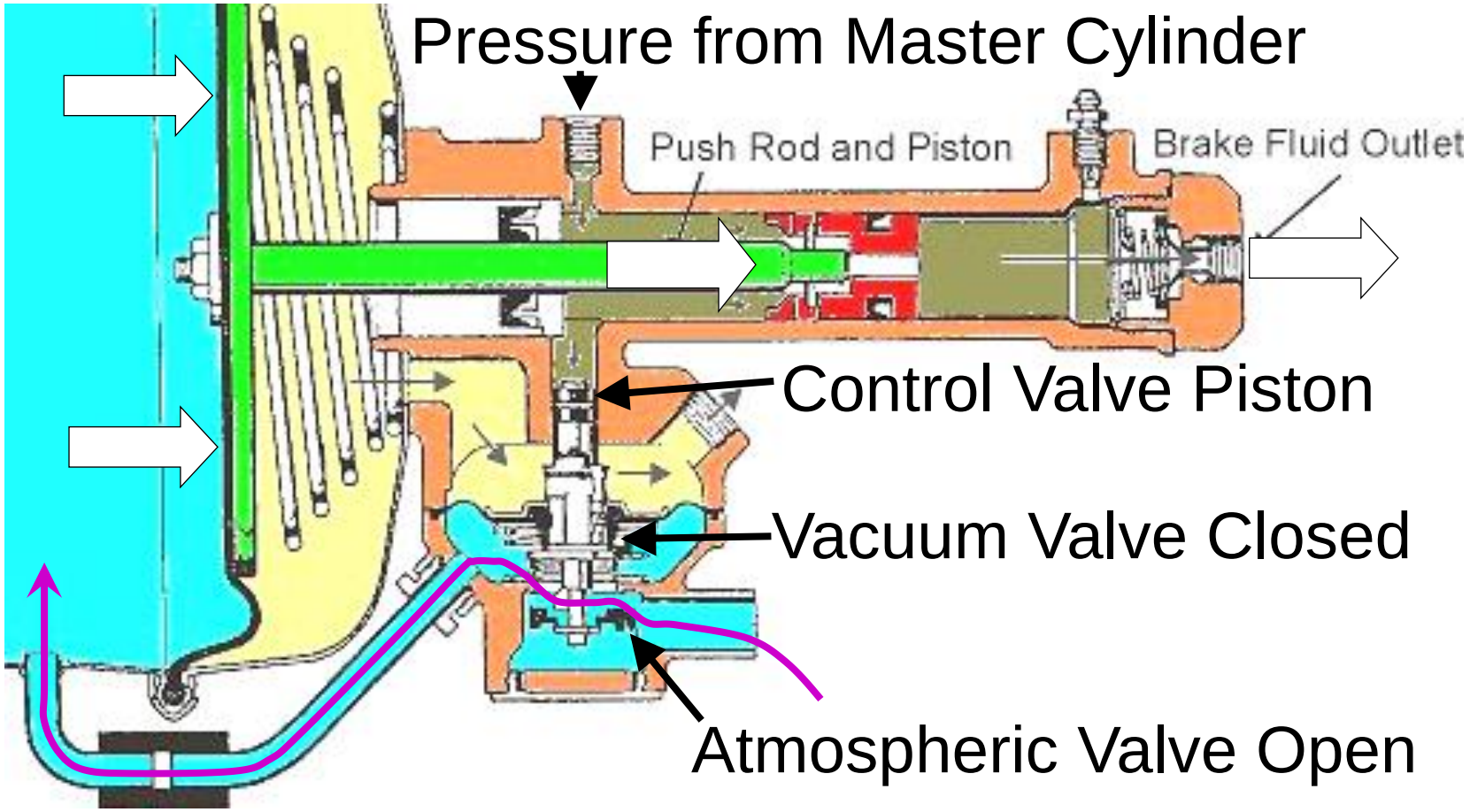
Applied Position



Master cylinder pressure is cut off to the integral hydraulic cylinder.

Remote Power Brake Booster
Vacuum Suspended

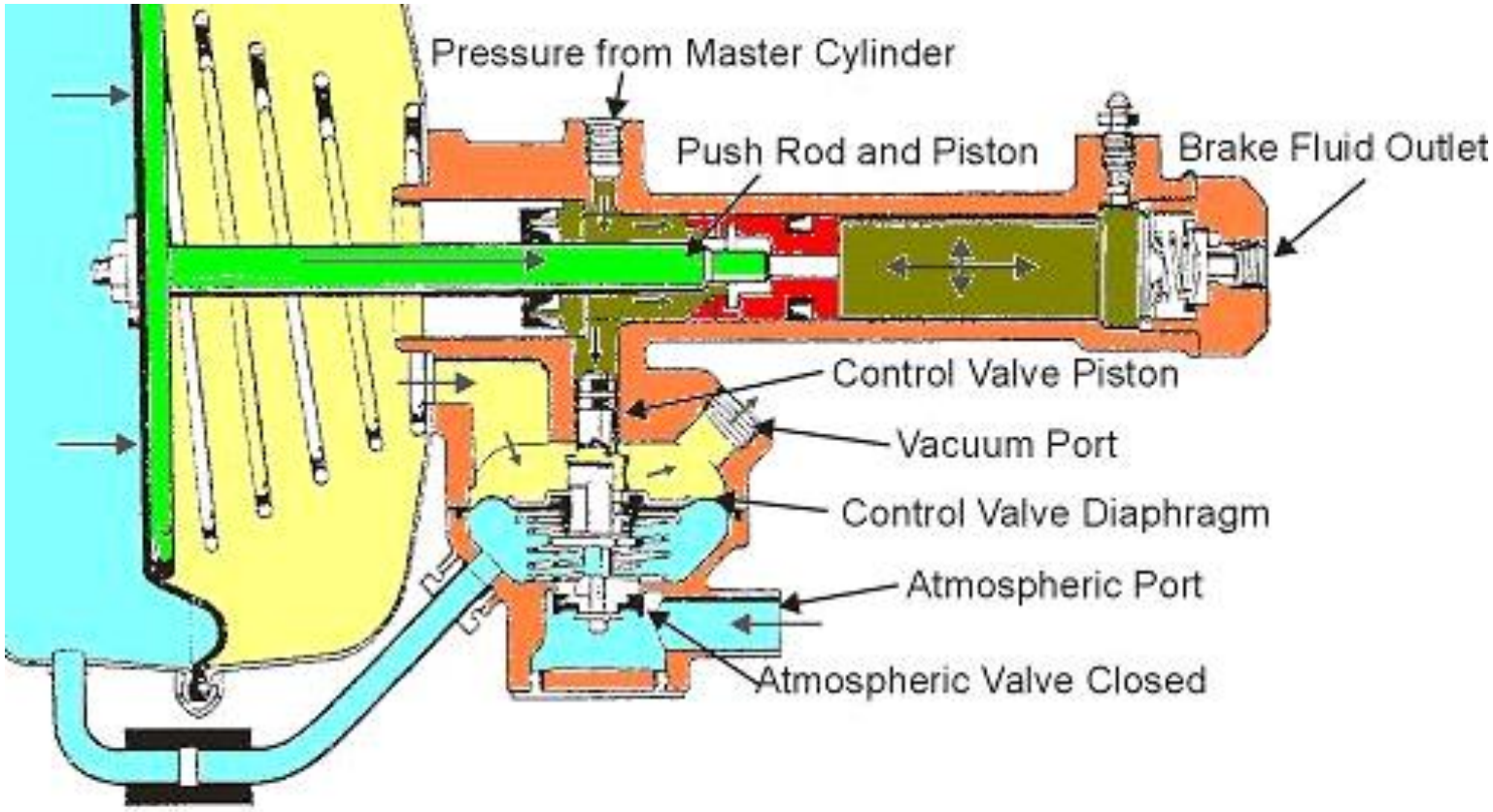
Applied Position



Atmospheric pressure enters the diaphragm chamber and boost pressure is created.

Remote Power Brake Booster
Vacuum Suspended

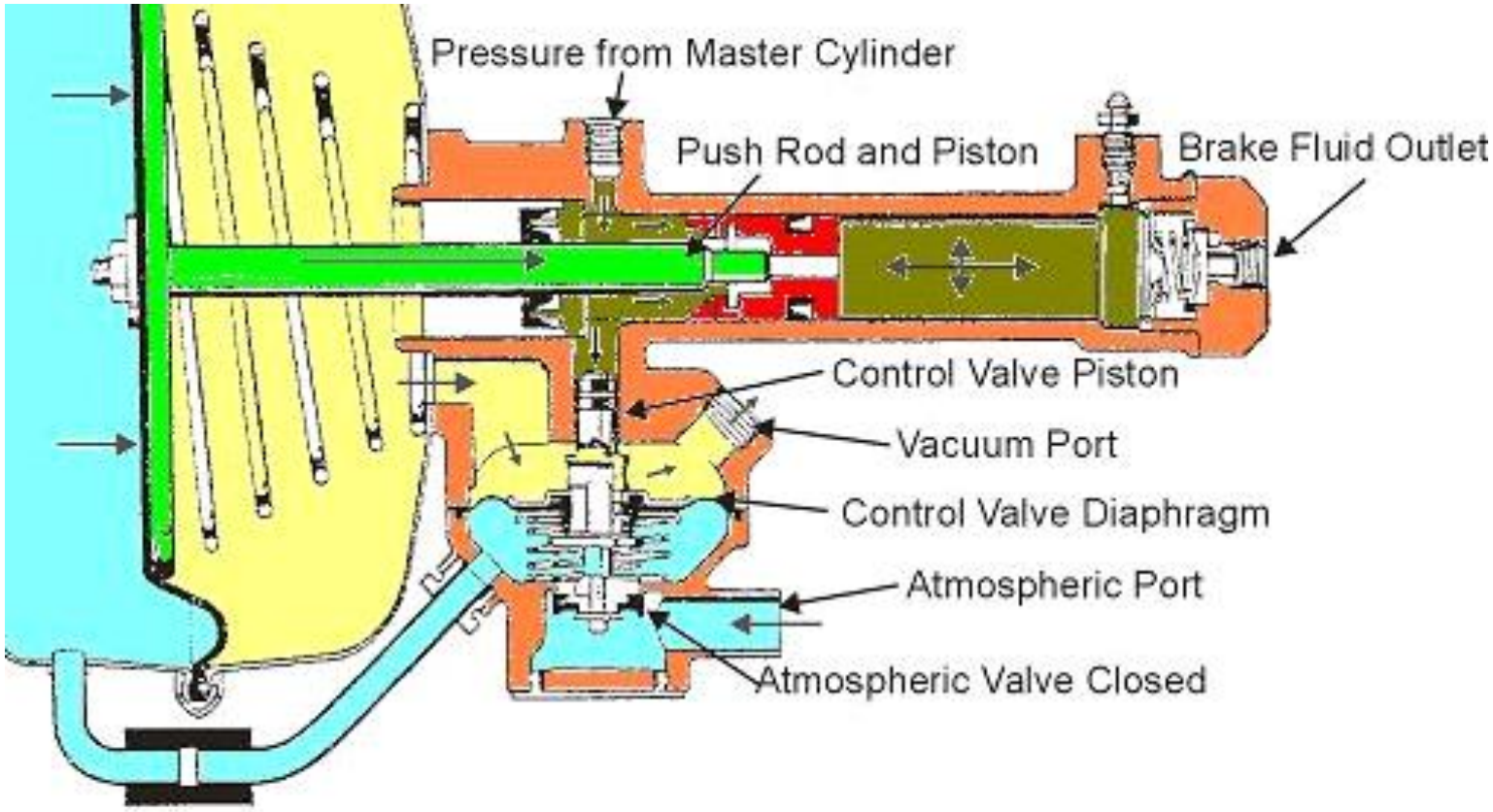
Hold Position



Control valve piston moves up slightly, closing the atmospheric port, but not enough to open the vacuum port.

Remote Power Brake Booster
Vacuum Suspended

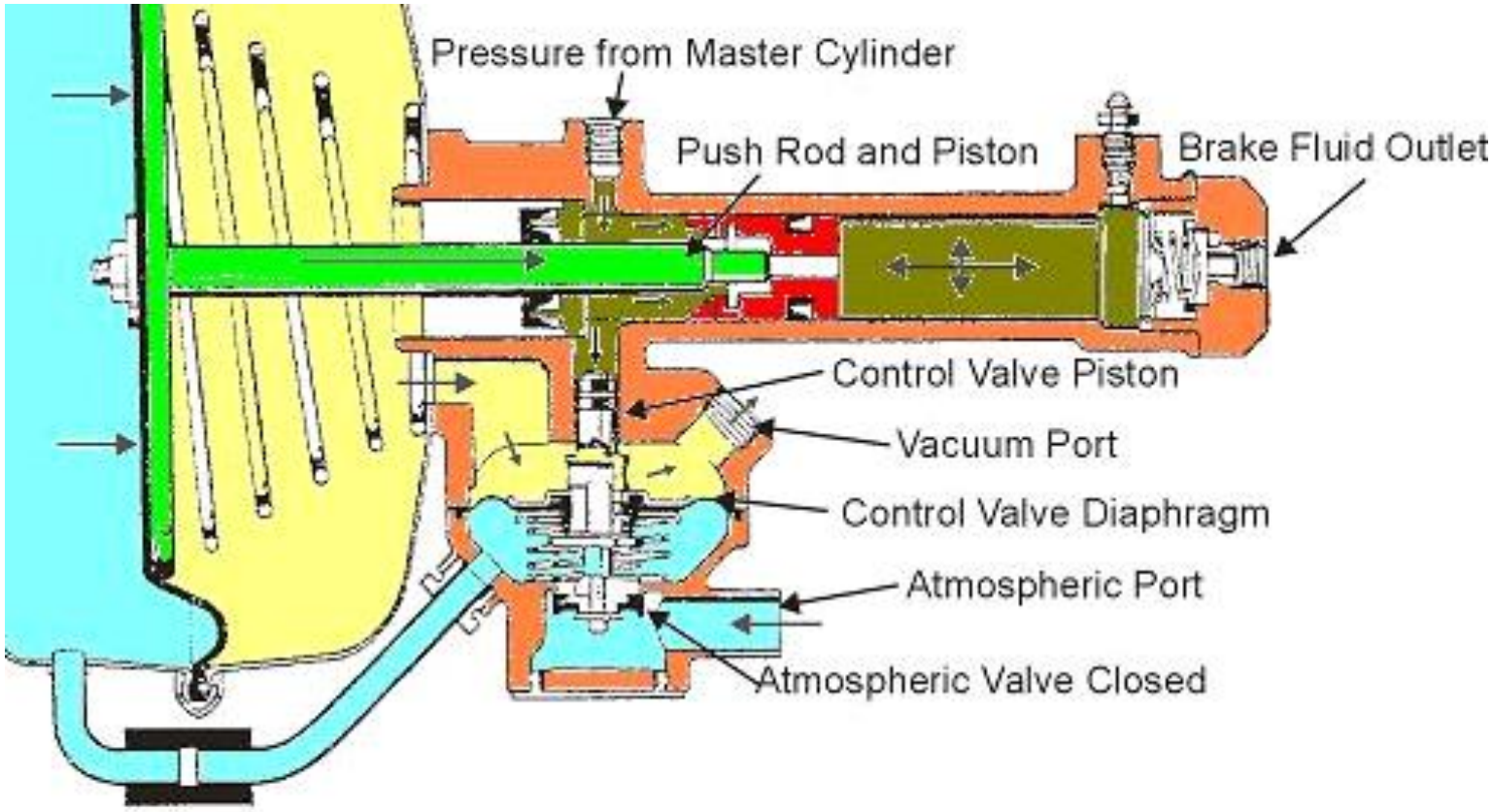
Hold Position



Atmospheric pressure is trapped on one side of the diaphragm and full vacuum exists on the other side.

Remote Power Brake Booster
Vacuum Suspended

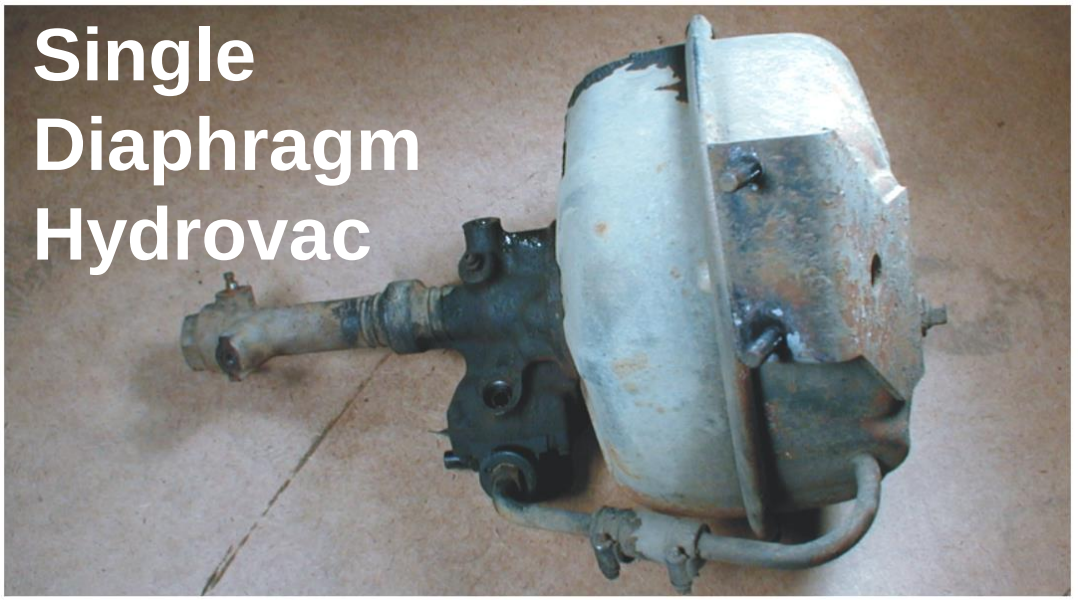
Hold Position



The power diaphragm assembly and the hydraulic cylinder pushrod and piston assembly move back slightly, holding the vehicle stationary.

Remote Power Brake Booster Vacuum Suspended

Both units show signs of leakage.



Power Brake Booster
Atmospheric Suspended

Vacuum booster may also be called atmospheric suspended.

When the brakes are released and the engine is running, there is a balanced atmospheric pressure on both sides of the diaphragm and no boost pressure can be created.

To activate this unit a vacuum must be created in the diaphragm chamber closest to the master cylinder (integral) or the integral hydraulic cylinder (hydrovac style).

Objective Three

Describe the diagnosis and repair procedures for vacuum brake booster systems.

Power Brake Booster – Vacuum Suspended

Troubleshooting

Very simple operation - not many problems..

To test, depress the brake pedal and start vehicle..

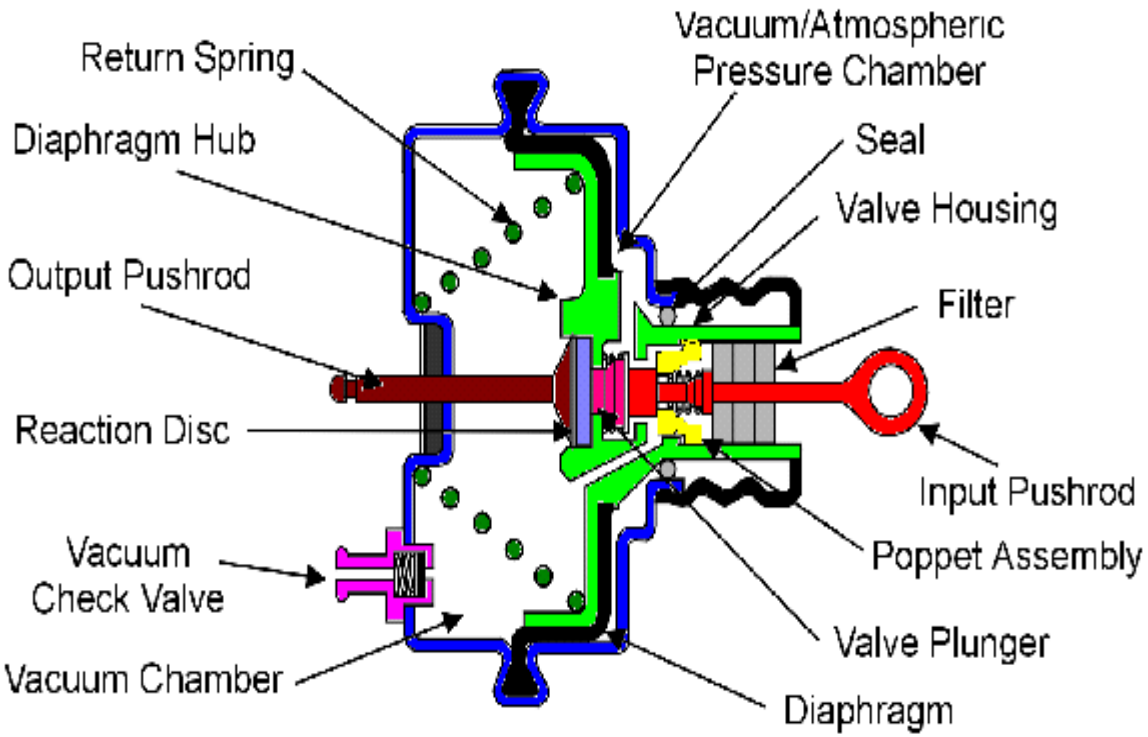
Use vacuum gauge to measure engine vacuum..

Check for broken or leaking vacuum lines..

Check output push rod for proper adjustment.

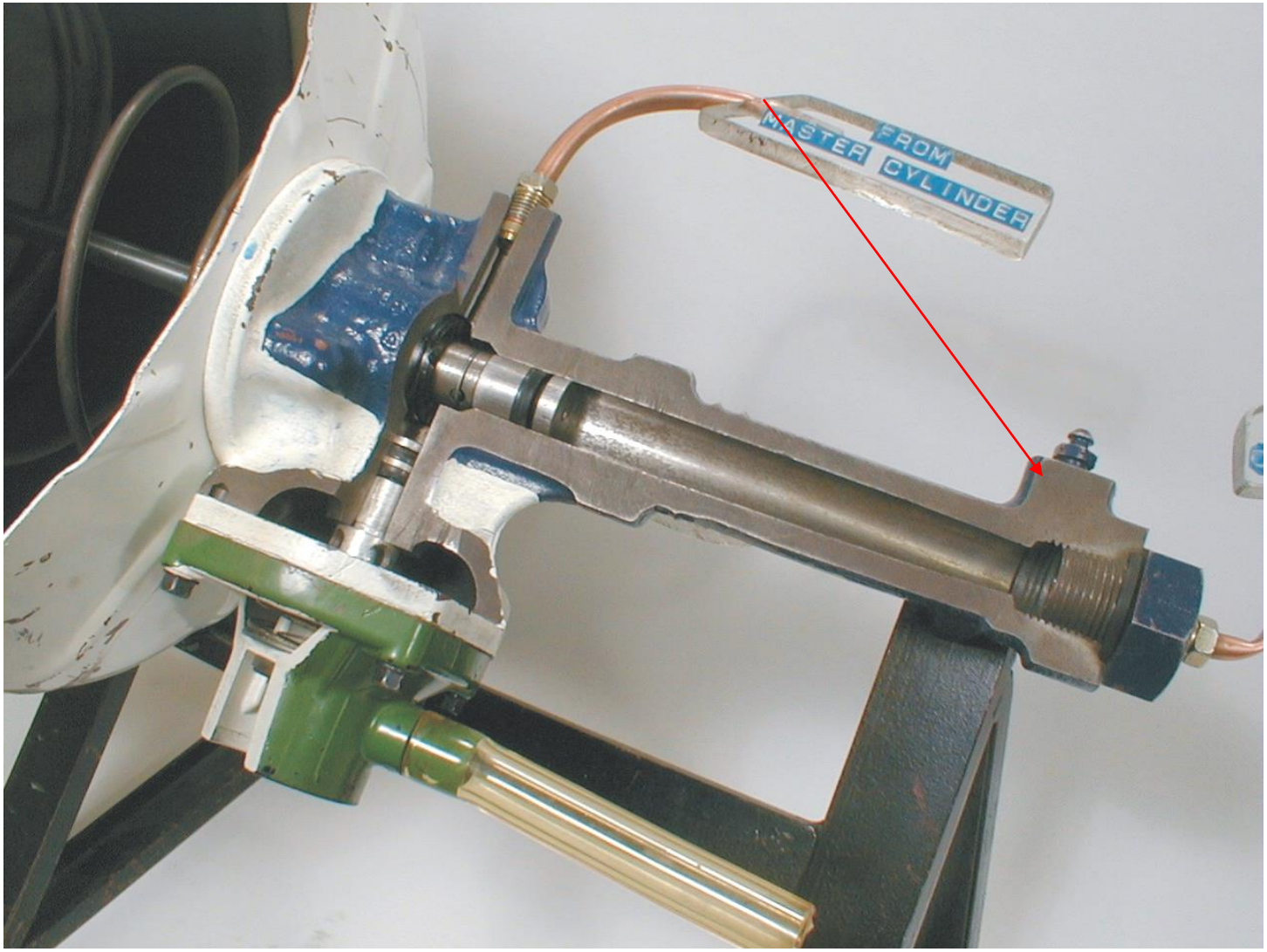
Troubleshooting

The volume of vacuum is critical to ensure full power braking..



Check vacuum reading, apply brake, note the vacuum drop, and how soon it returns to normal indicates volume.

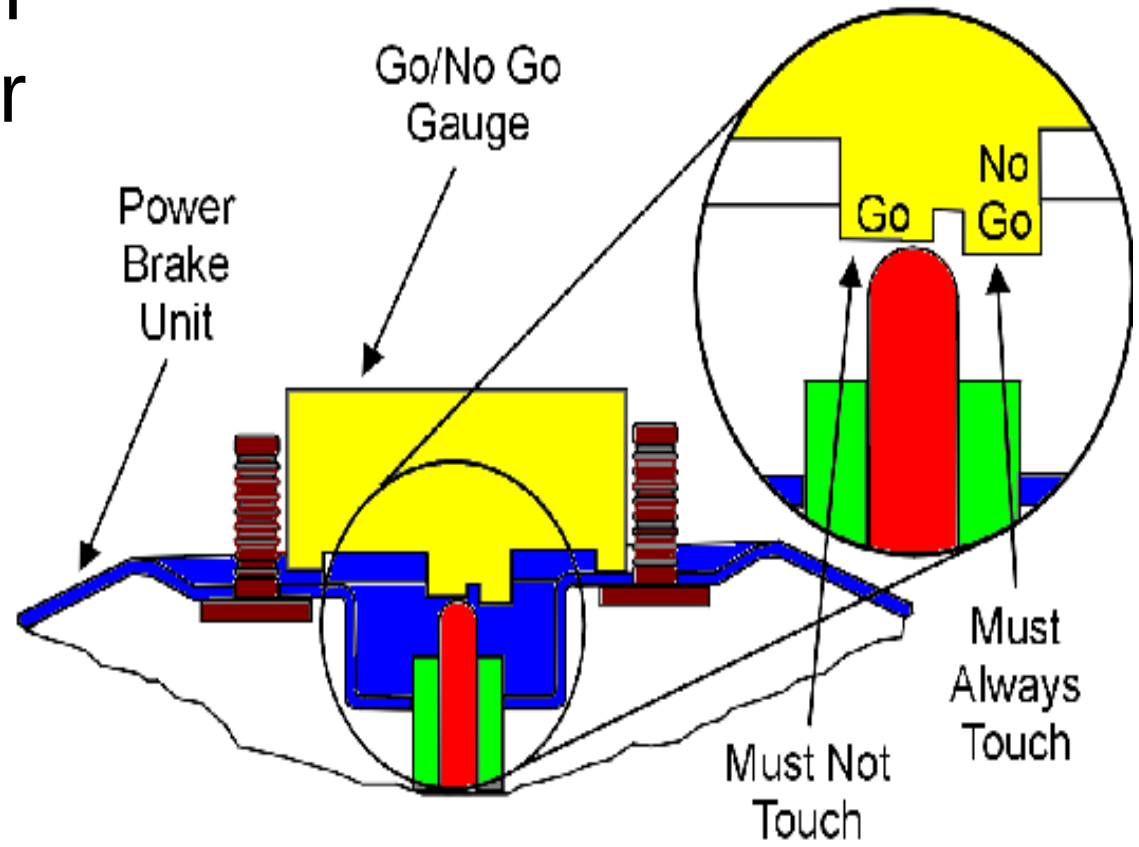
Troubleshooting



Hydro-vac should be bled first.

Troubleshooting

Integral vacuum booster must have a specific clearance between the master cylinder pushrod and primary piston..



Some booster are pre-adjusted for particular applications, while others have to be adjusted.

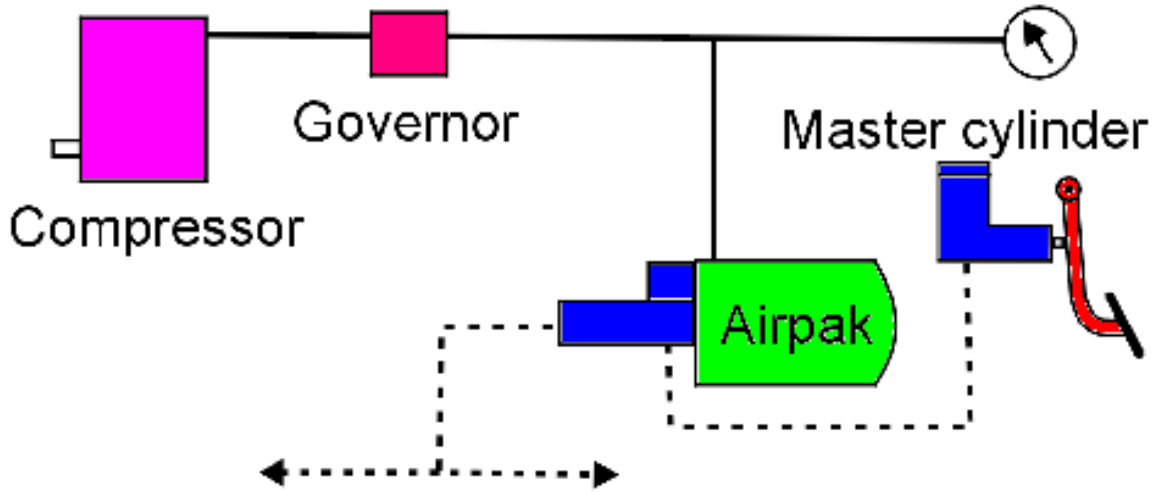
Objective Four

Explain the principles of operation of air-over-hydraulic brake booster systems.

Power Booster-Air Pack (or Air Pak) System

Air Over Hydraulic System

Uses compressed air to move a piston..

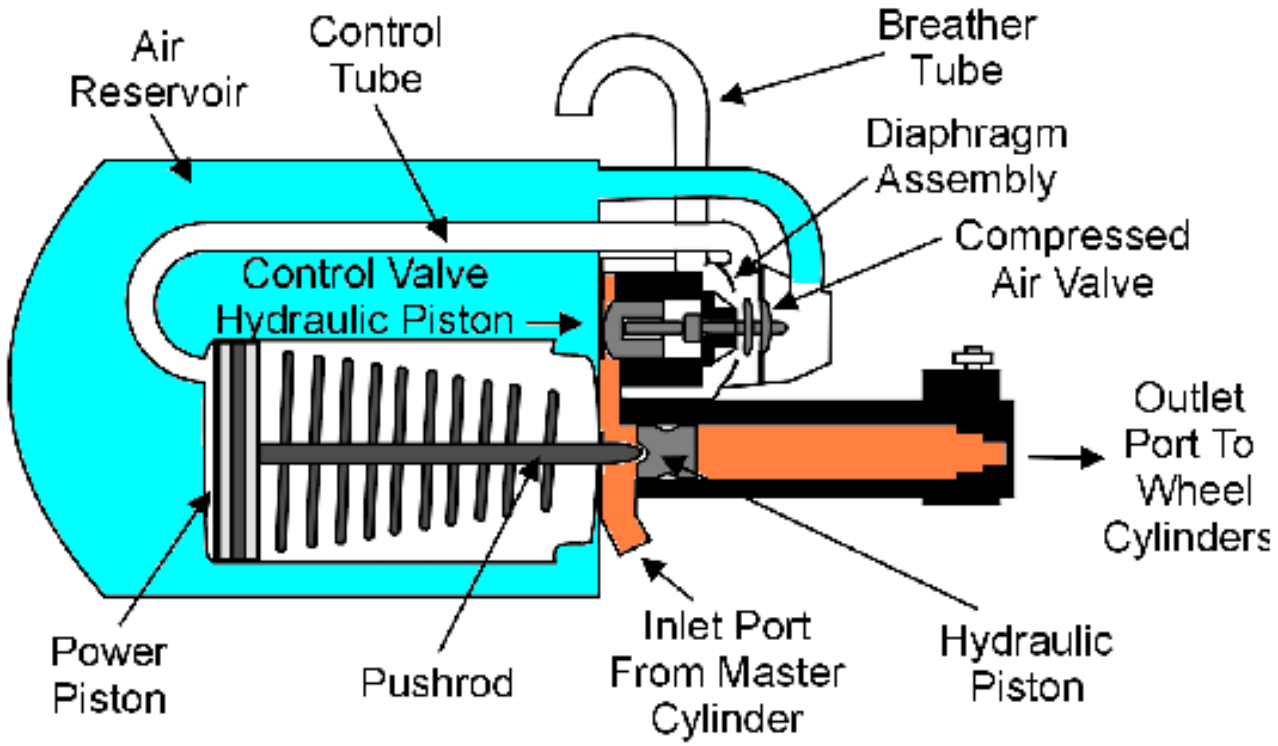


Triggered by the master cylinder fluid pressure to operate a slave cylinder..

Compact unit that is remotely situated the same as a hydrovac.

Power Booster-Air Pack (or Air Pak) System

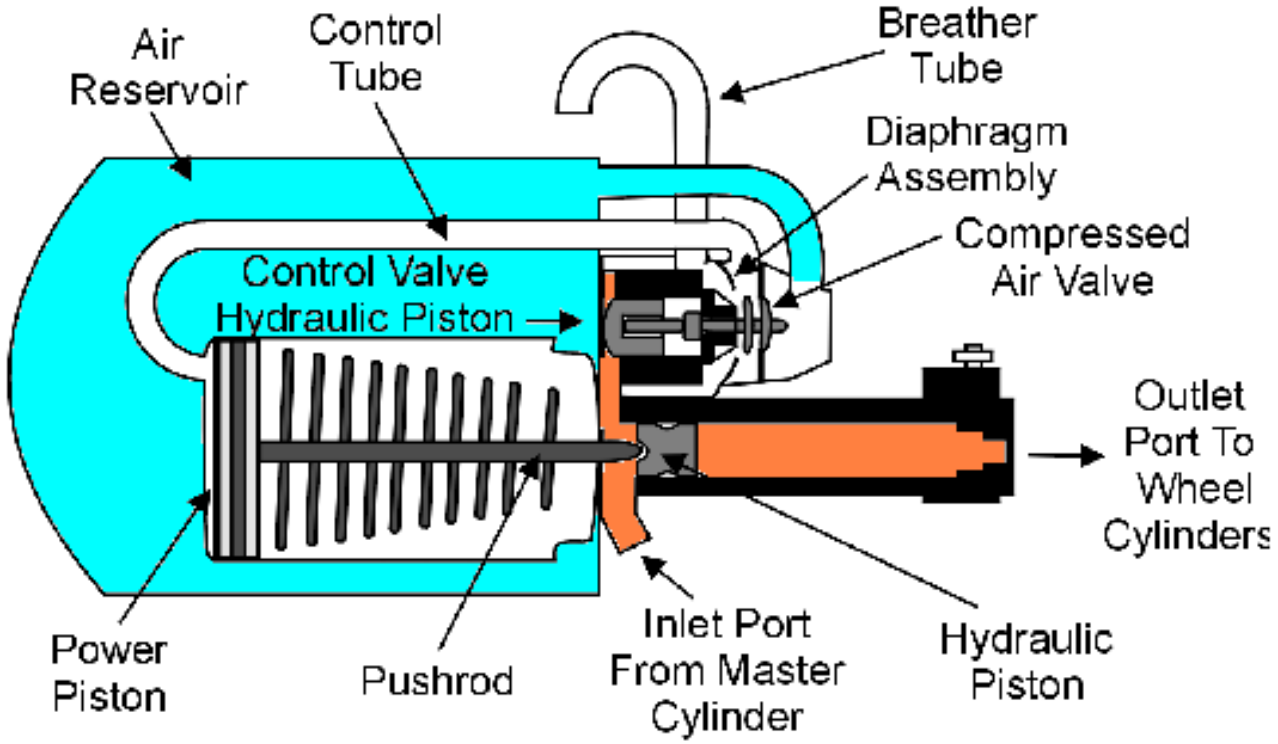
Released Condition



With no pressure signal from the master cylinder, the compressed air valve is closed and the exhaust port is open.

Power Booster-Air Pack (or Air Pak) System

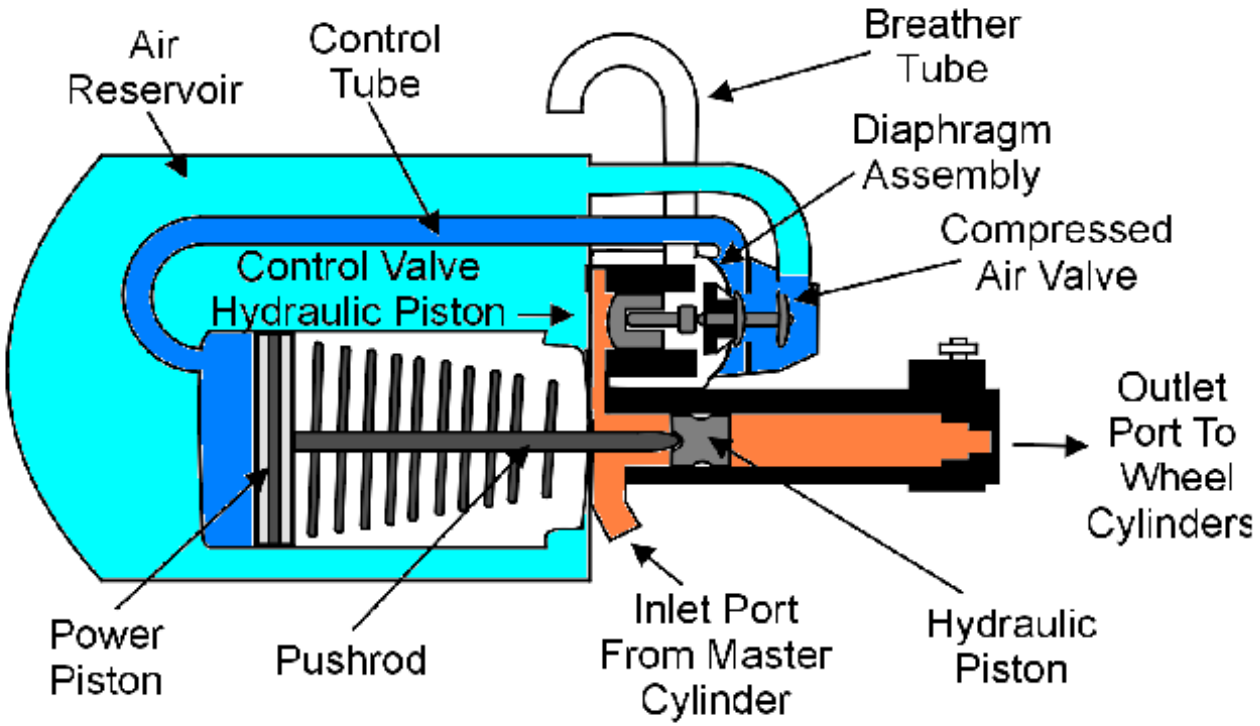
Released Condition



The power piston/pushrod is moved back by spring pressure and no hydraulic pressure is exists in the integral cylinder.

Power Booster-Air Pack (or Air Pak) System

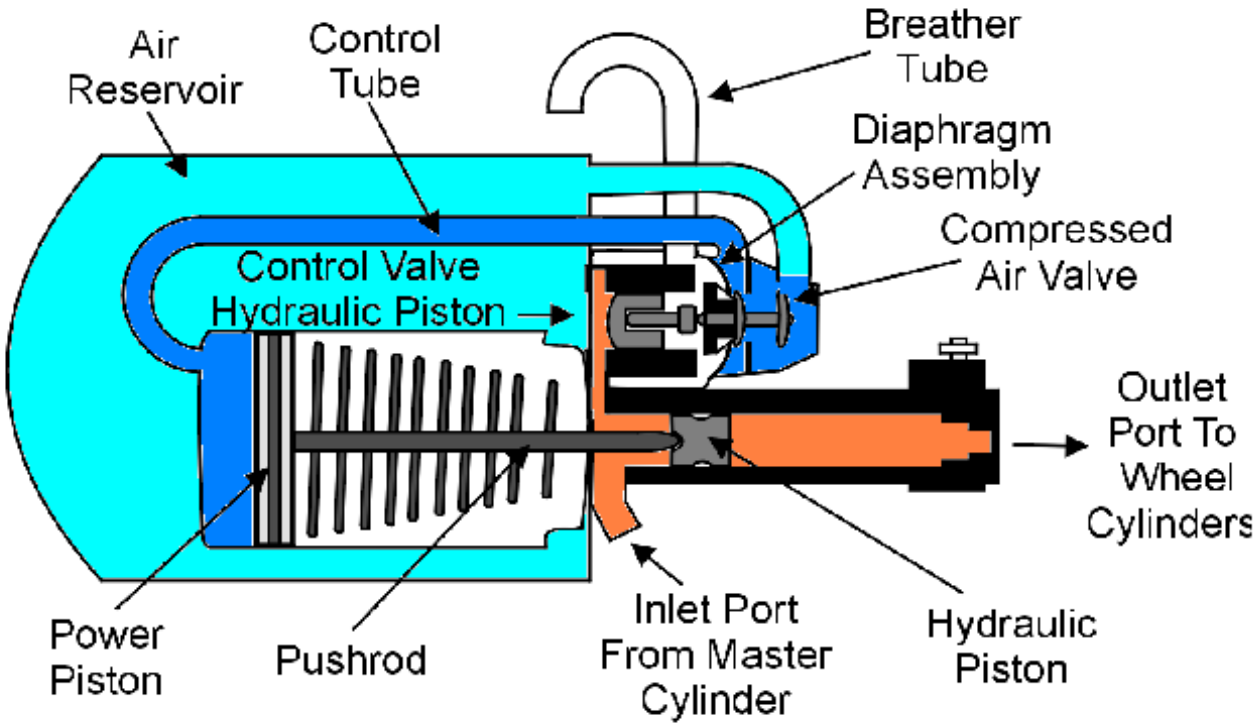
Applied Condition



Pressure signal from the master cylinder opens the compressed air valve and closes the exhaust port.

Power Booster-Air Pack (or Air Pak) System

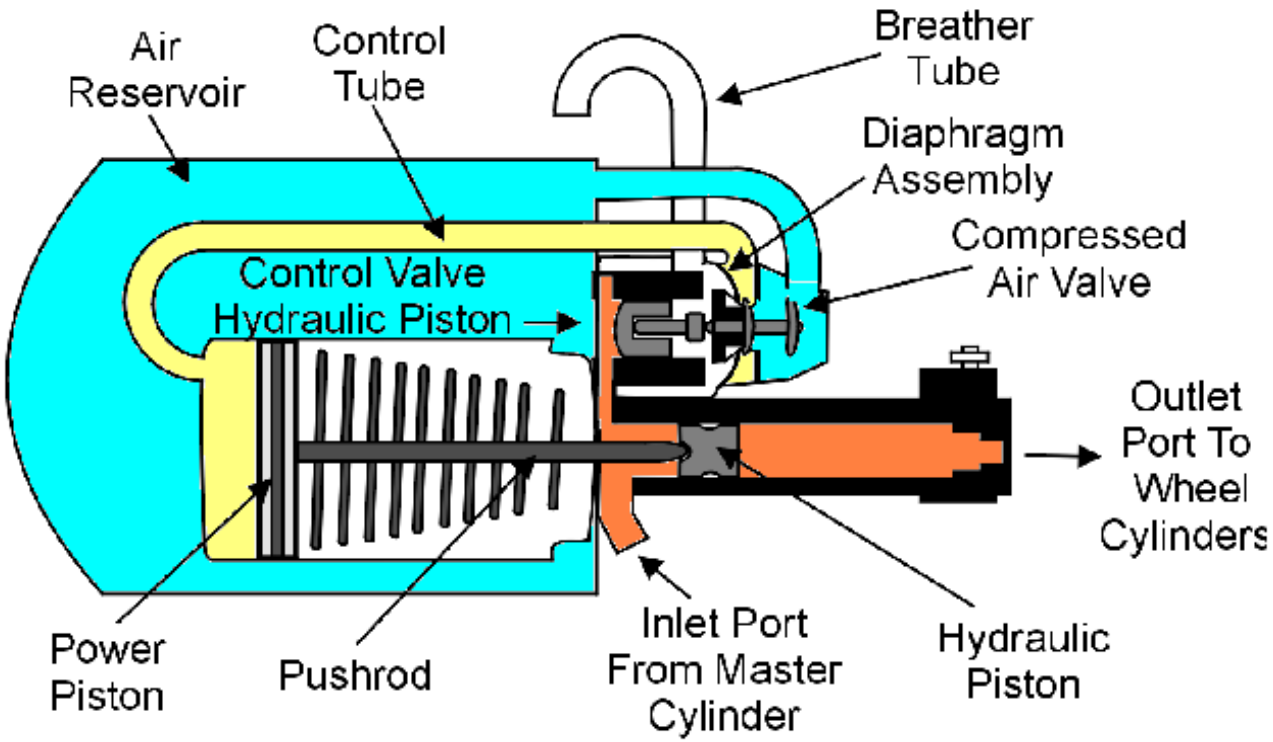
Applied Condition



Compressed air is directed to the back of the power piston, and the pushrod moves the brake fluid under boost pressure to the brakes.

Power Booster-Air Pack (or Air Pak) System

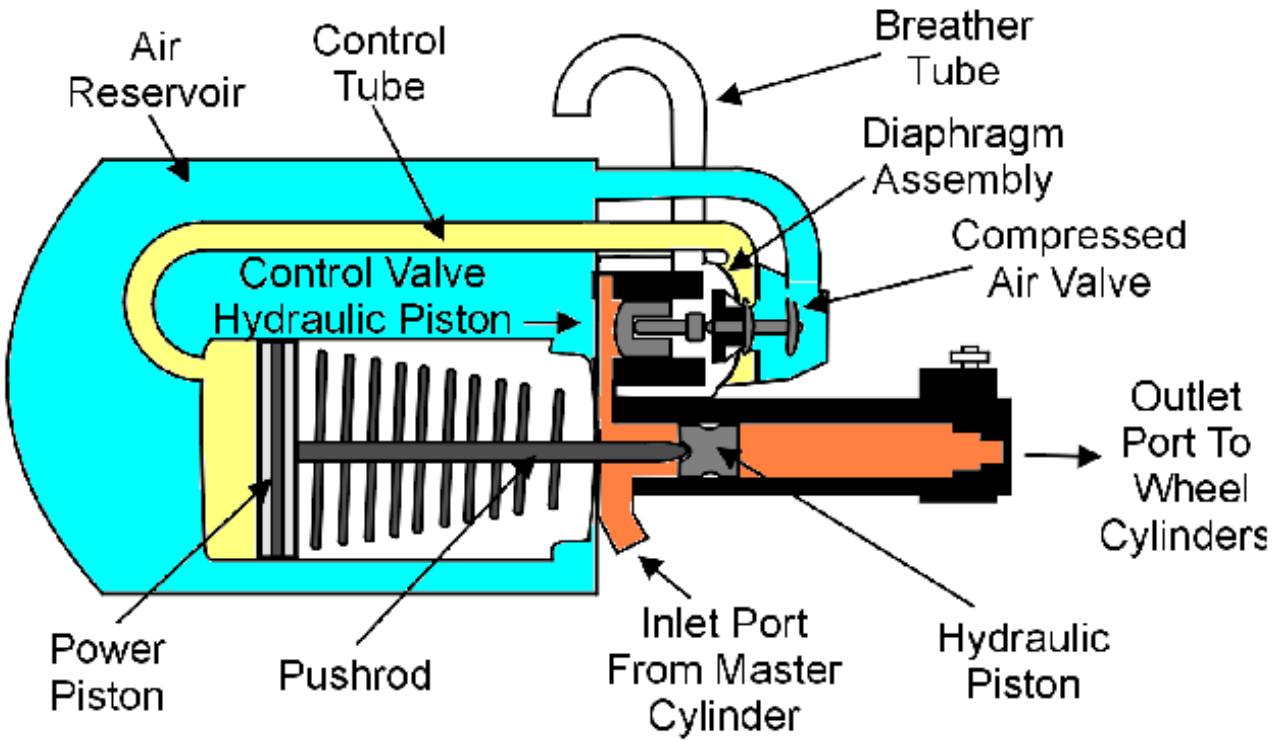
Hold Condition



Master cylinder pressure signal is reduced and the control valve hydraulic piston moves back slightly.

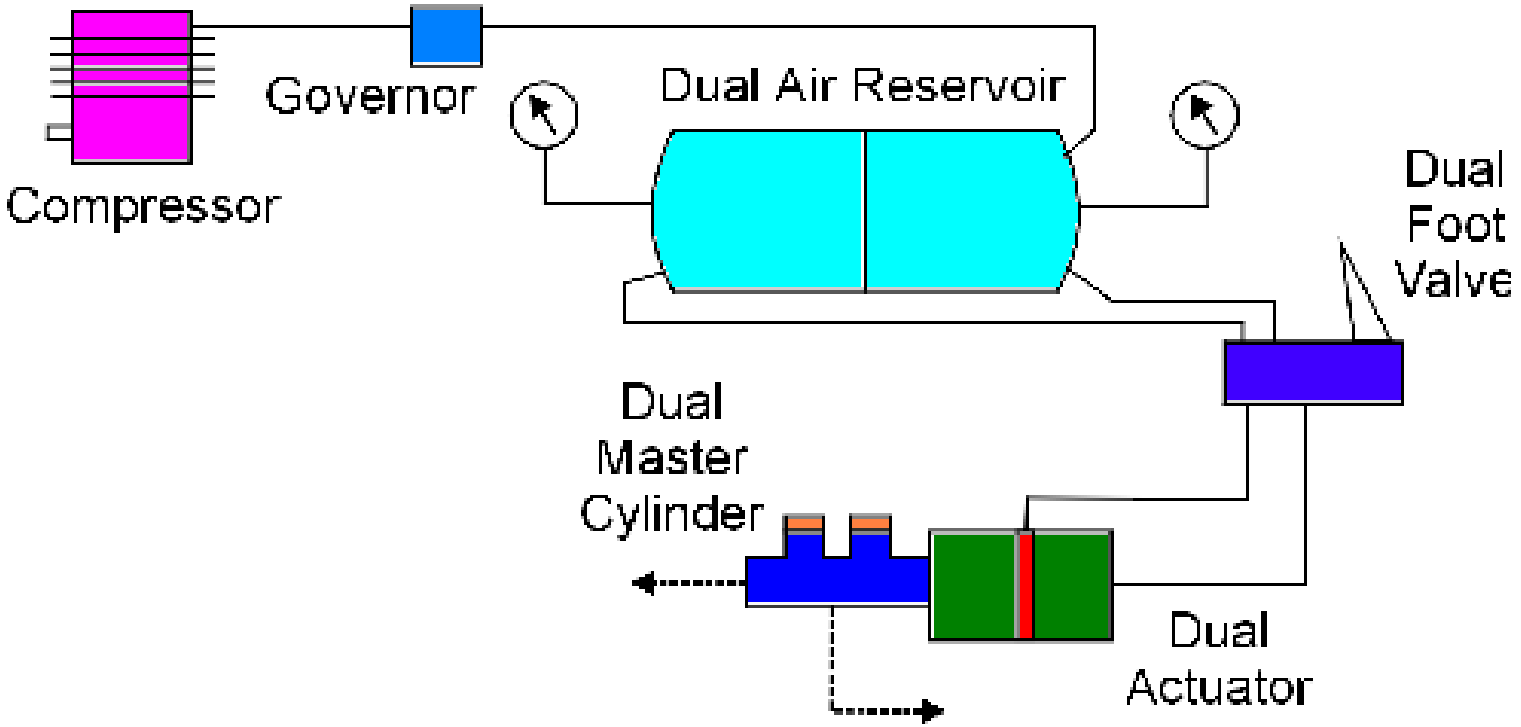
Power Booster-Air Pack (or Air Pak) System

Hold Condition



The compressed air valve closes, the exhaust valve is still closed and the air is trapped in the air reservoir.

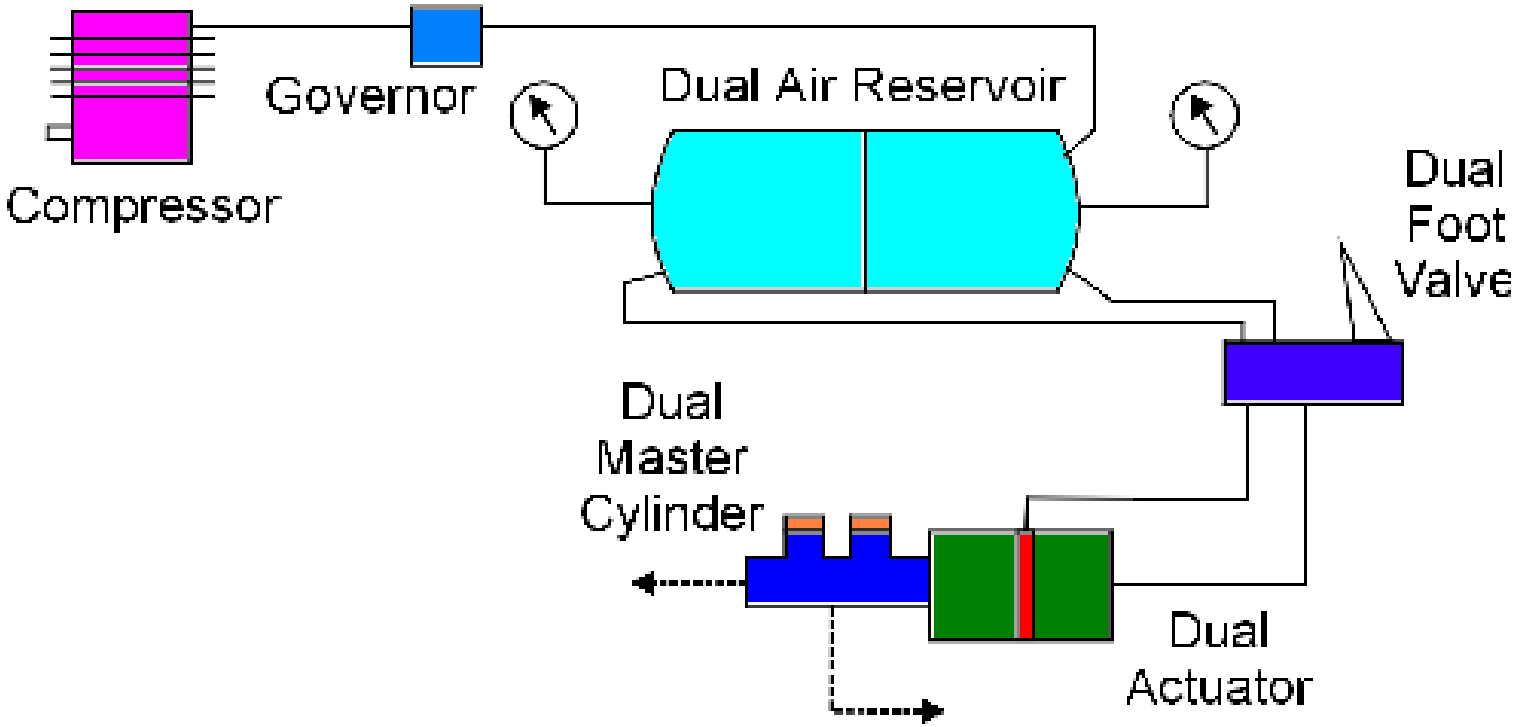
Power Booster – Power Cluster System



Uses compressed air.

Master cylinder and booster remotely mounted.

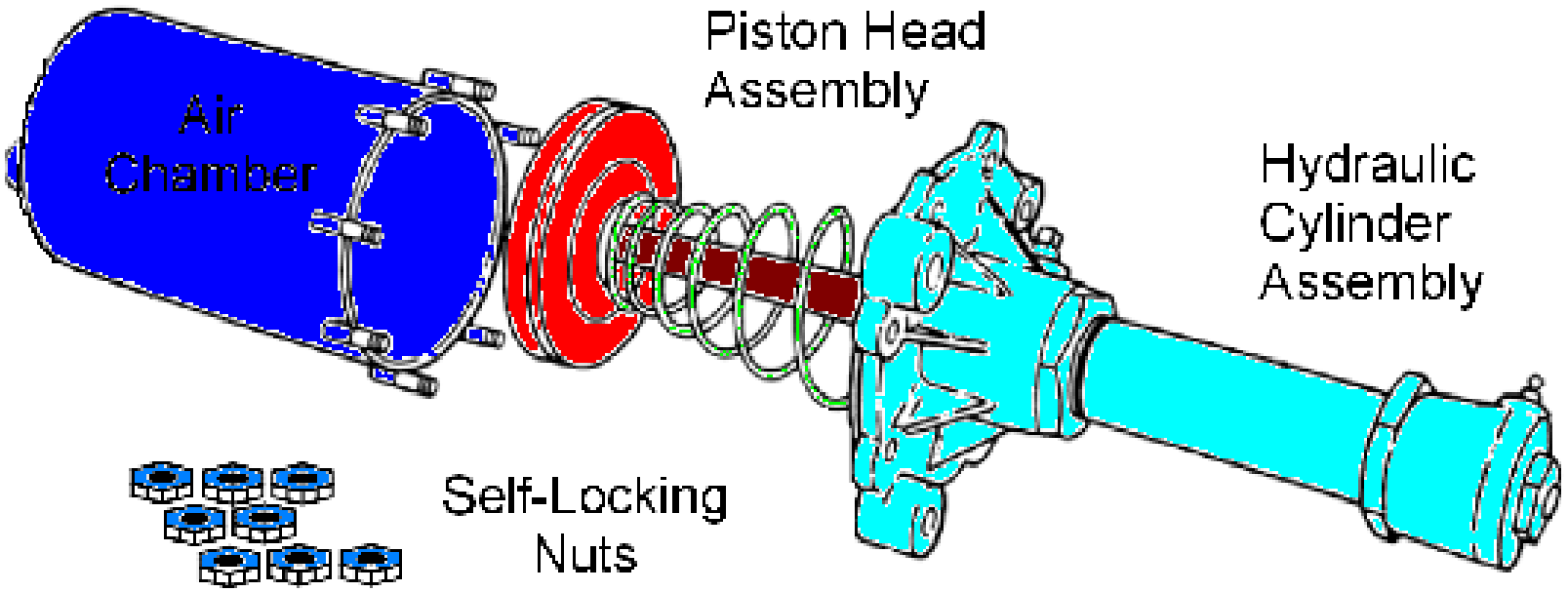
Power Booster – Power Cluster System



Uses a treadle valve or air valve as a brake pedal.. (same as air brakes)

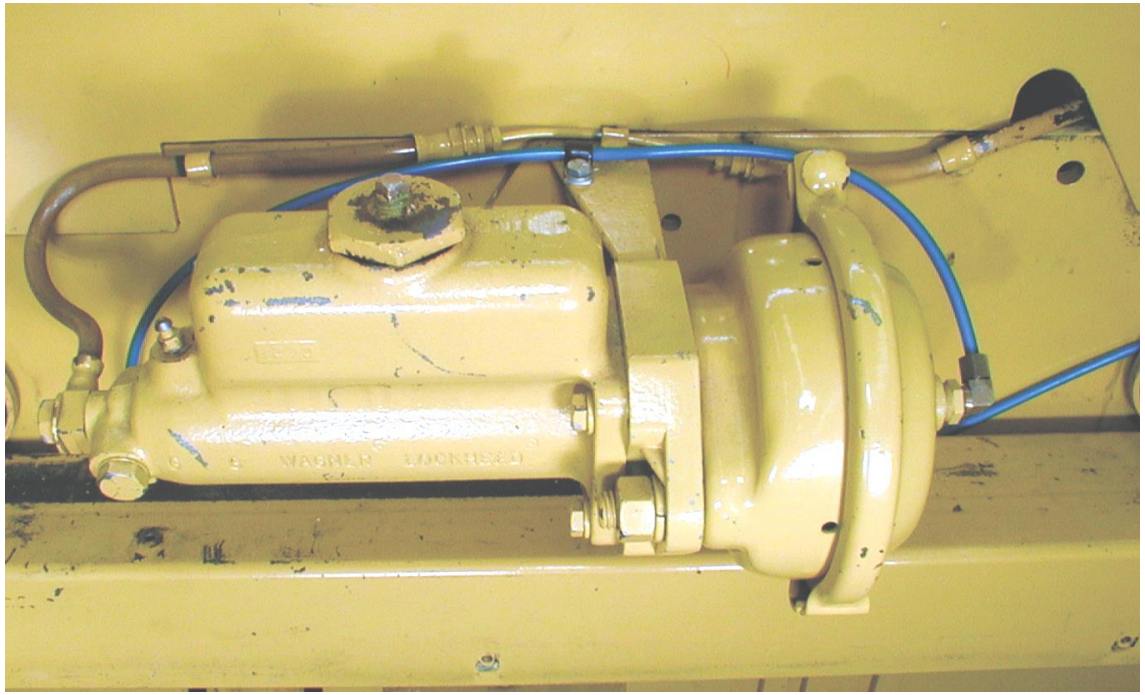
Used mostly on heavy equipment. (loaders, graders, scrapers etc.)

Power Booster – Power Cluster System



Can be connected to a hydraulic brake slave cylinder, and when air is supplied to the air chamber, the hydraulic brake slave cylinder send brake fluid under boost pressure to the brakes.

Power Booster – Power Cluster System



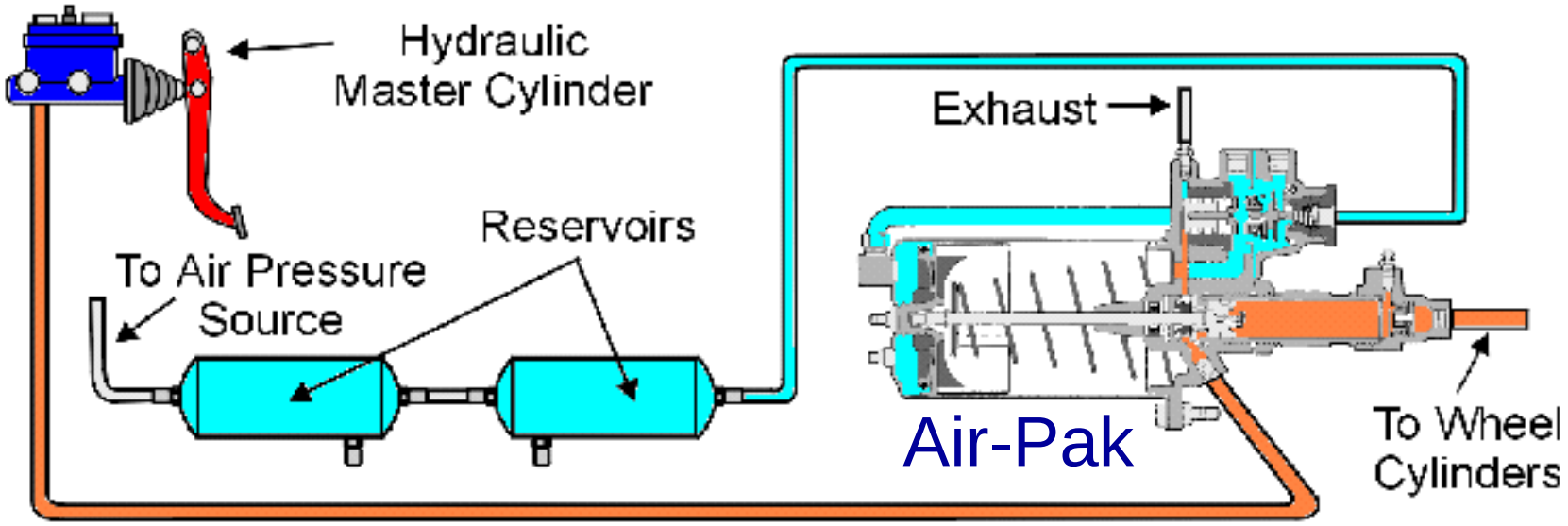
When coupled to a master cylinder, air from the threadle valve acts on large surface area of the air piston and rod assembly, sending boost pressure on the brake fluid leaving the master cylinder.

Objective Five

Describe the diagnosis and repair procedures for air-over-hydraulics brake booster systems.

Air-Over-Hydraulic Power Assist System

Troubleshooting

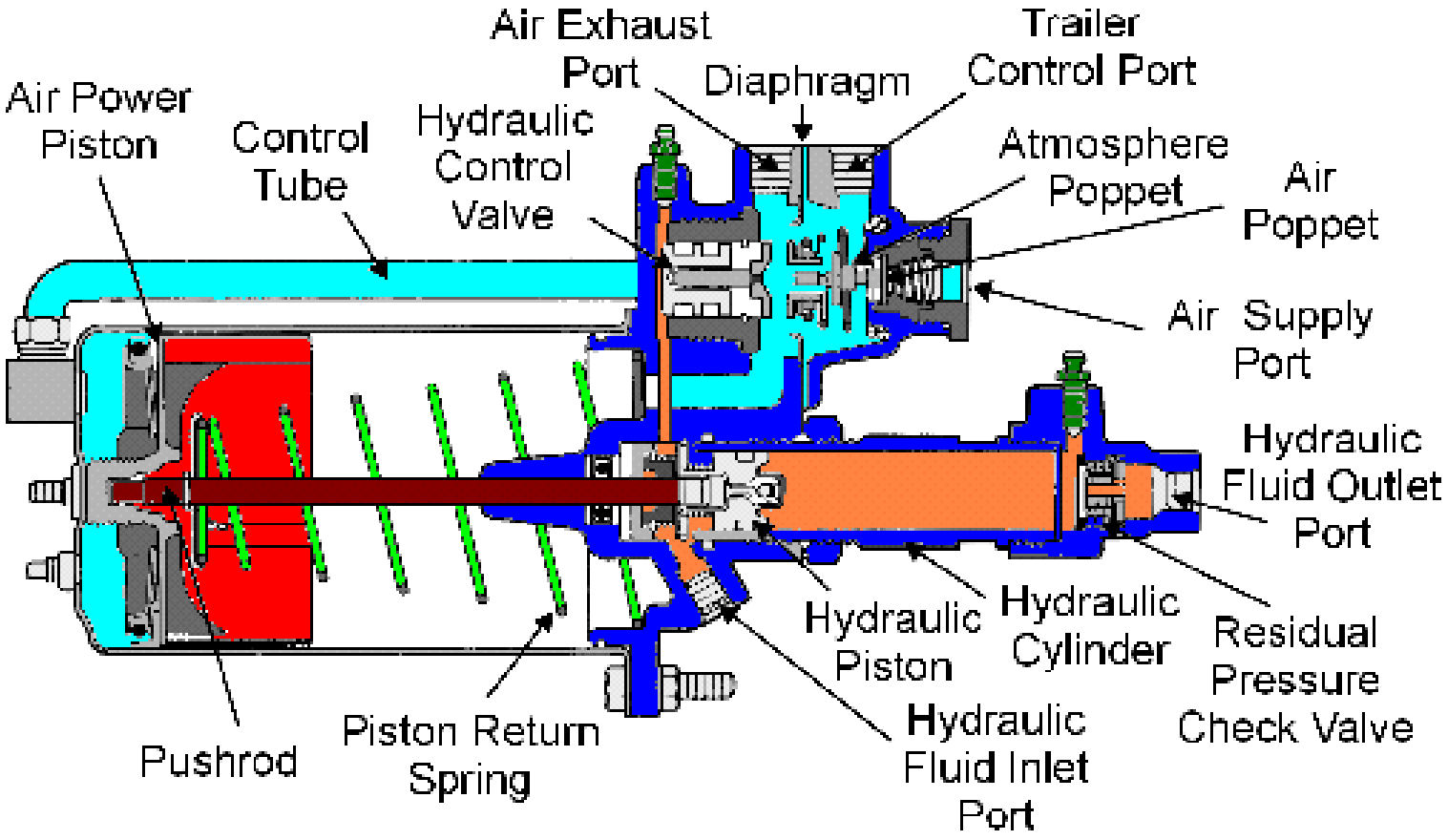


Check air pressure.
Check for brake fluid leaks.
Cycle brakes and check for leaks.
Check service manual for specifications.

Air-Over-Hydraulic Power Assist System

Repair

Air Pack Assembly



Caution: Piston return spring should be secured during disassembly.

Air-Over-Hydraulic Power Assist System

Repair

Scribe marks on housing to before disassembly to ensure air hoses and hydraulic lines line up when installing..

Do not over tighten in the vice.. (cylinder distortion)

Light honing using brake fluid as a honing fluid is suitable for light scratches.

Follow manufacturers recommendation for replacement of seals and diaphragm and lubrication.

Air-Over-Hydraulic Power Assist System

Repair

When bleeding, drain of fill air reservoir to approximately 20 psi (130 kPa) to prevent fluid from exiting the bleeder screw at high velocity.

- If unit has two bleed screw alternate between the two until all air is bled.

Air-Over-Hydraulic Power Assist System

Repair

Danger

When the brake pedal is released, compressed air will exhaust from the breather tube on the air-pak assembly..

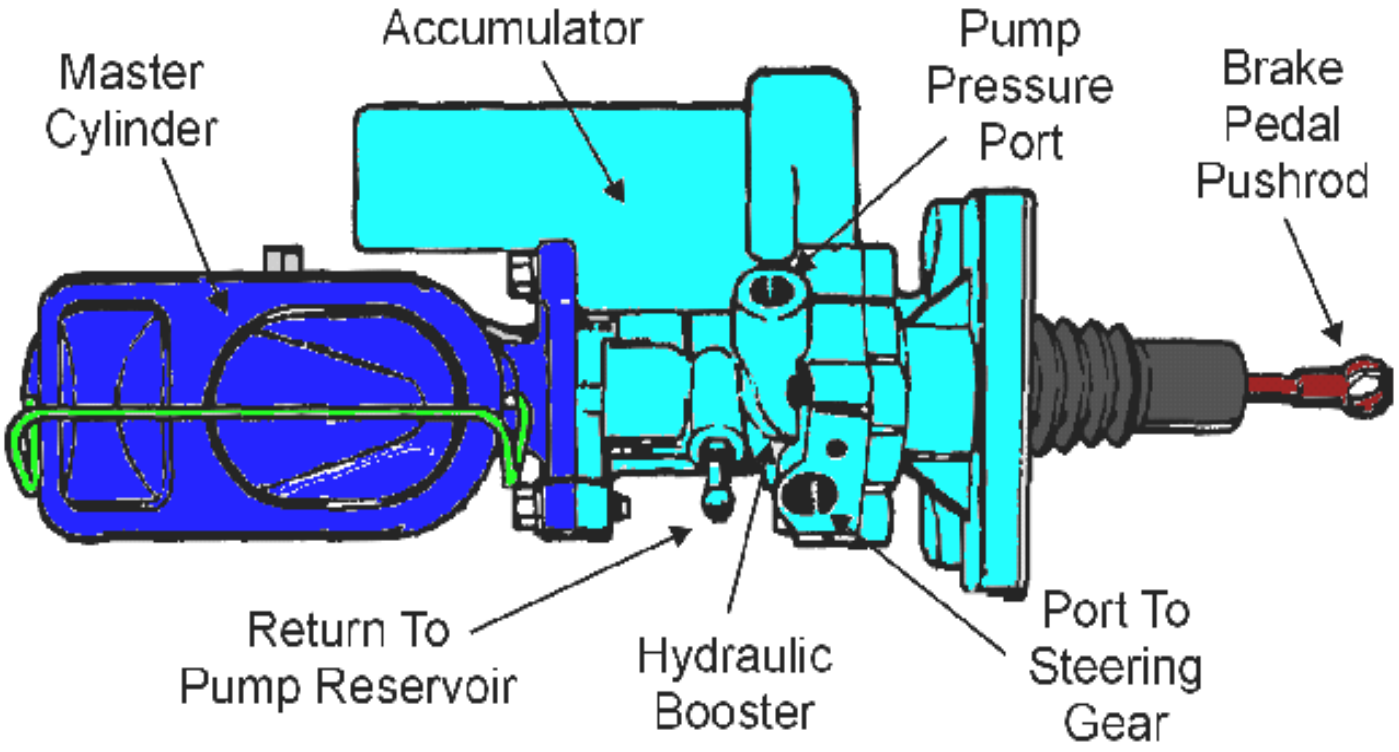
It could blow dirt in the vicinity into your eyes..

Objective Six

Explain the principles of operation for hydraulic over hydraulic brake booster systems

Hydraulic Over Hydraulic Brake Booster Syster

System Components



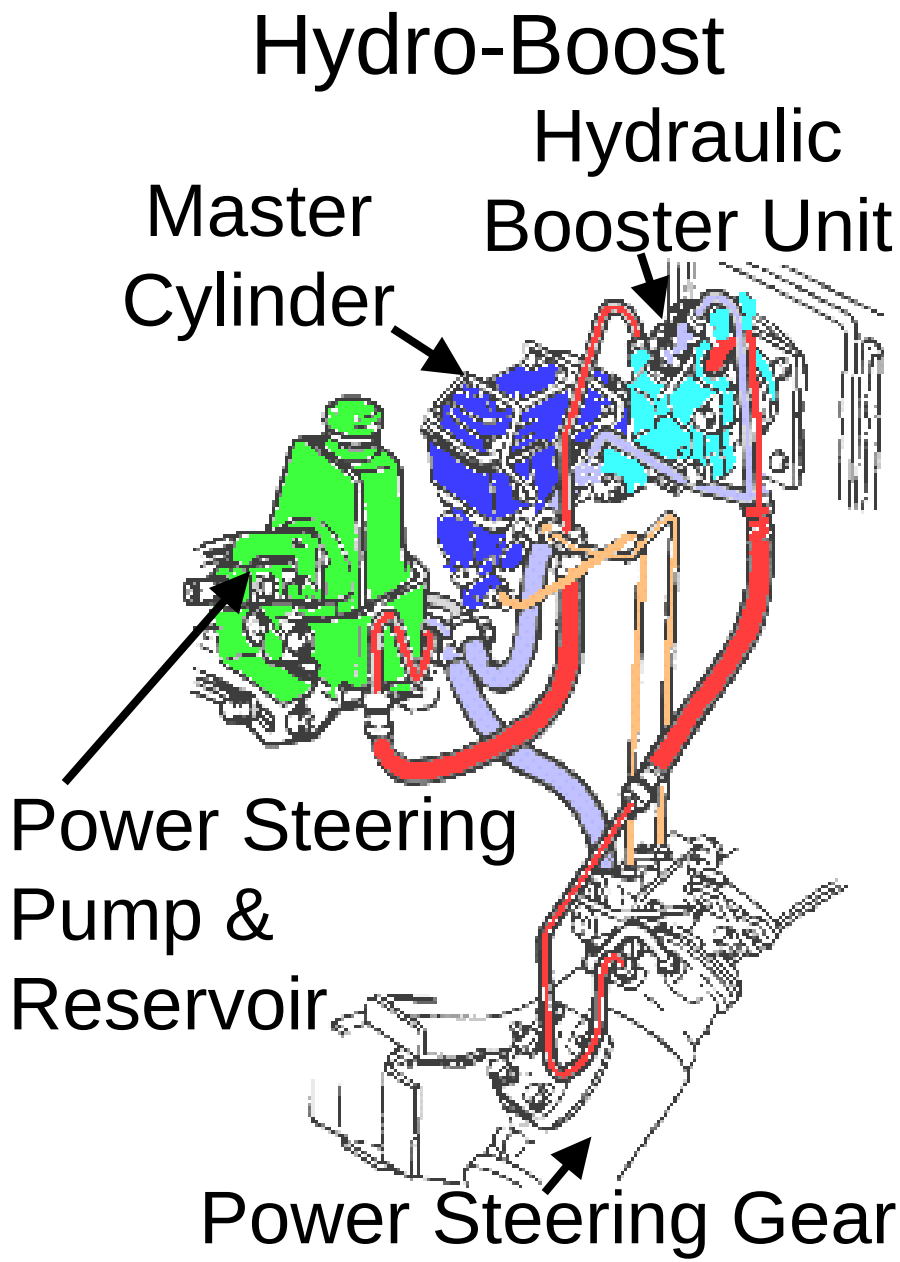
The brake portion of the overall system uses brake fluid, but the hydraulic booster section uses a hydraulic fluid.

Hydraulic Over Hydraulic Brake Booster Syster

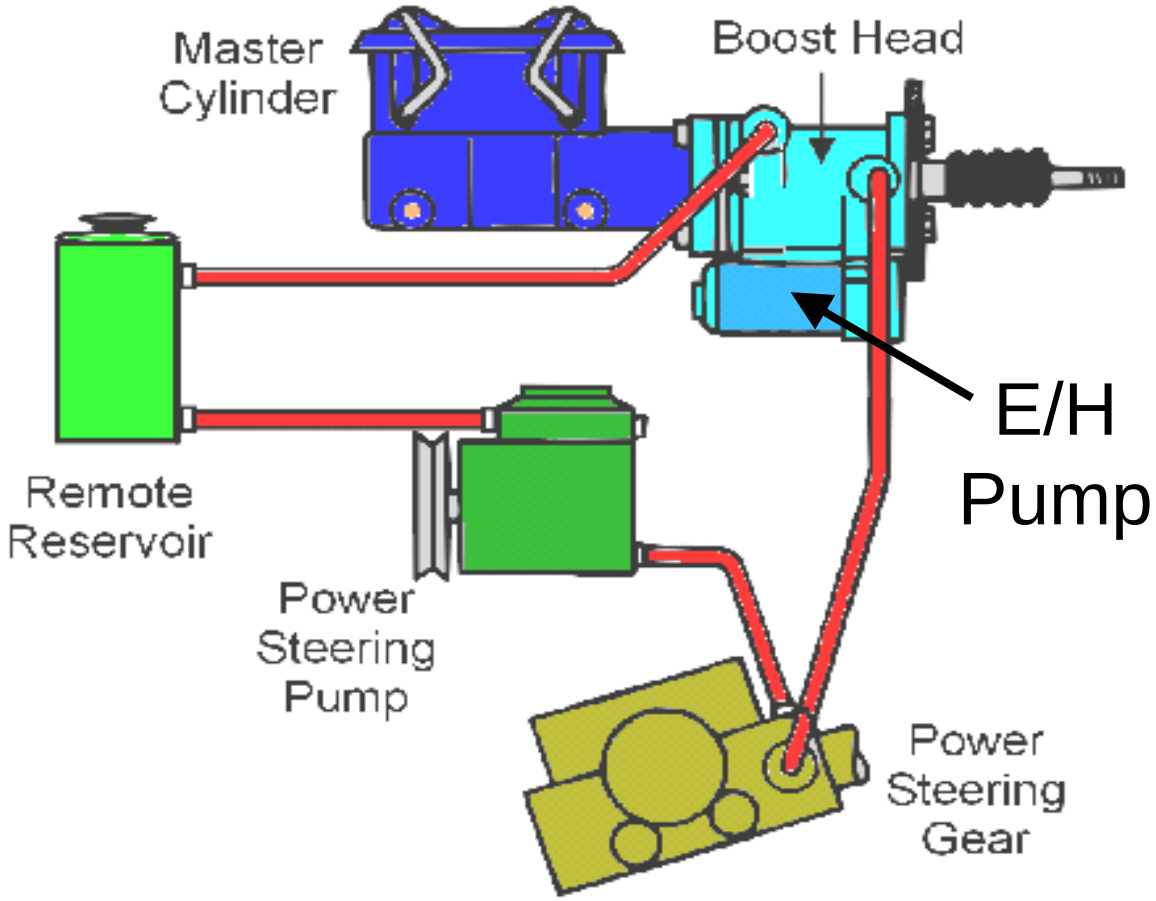
Mounted on the fire-wall.

Utilizes the power steering pump to supply high pressure fluid to assist in applying the brakes.

May contain an accumulator or electric pump for a back up.

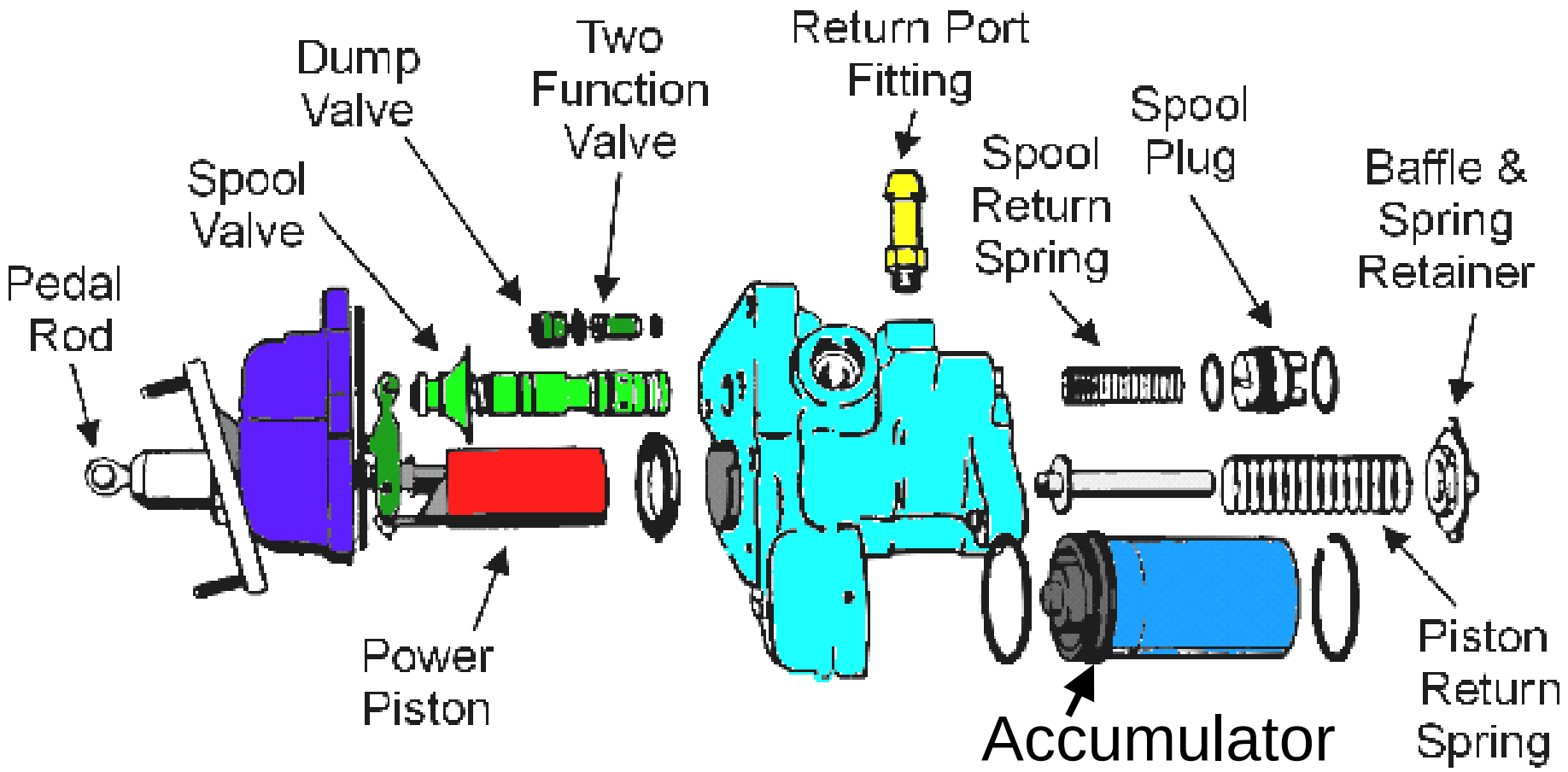


Hydraulic Over Hydraulic Brake Booster Syster



The Electric/Hydraulic Pump provides power assisted braking to stop the vehicle if power steering belt breaks.

Hydraulic Over Hydraulic Brake Booster Syster



The accumulator provides power assisted braking to stop the vehicle if power steering belt breaks.

Hydraulic Over Hydraulic Brake Booster Syster

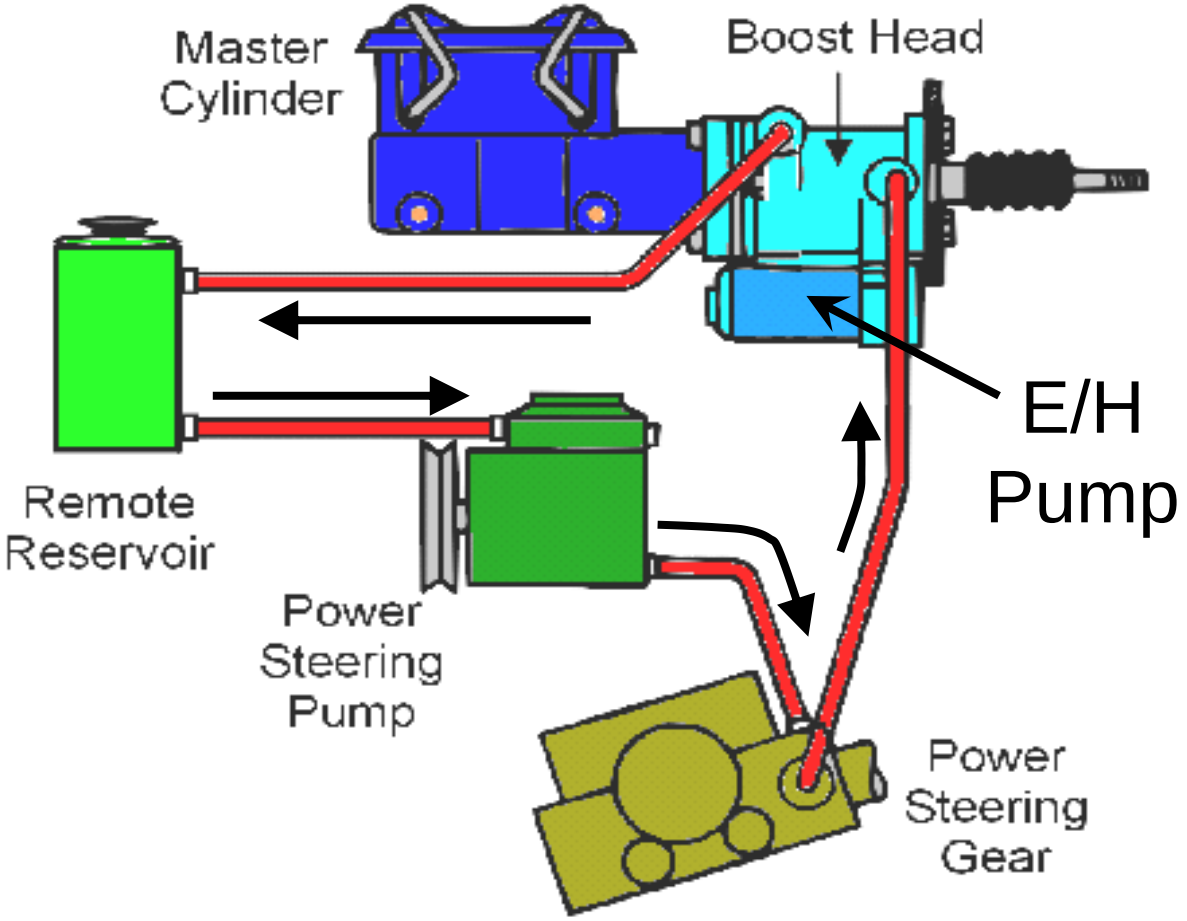
Danger

Accumulator contains fluid under high pressure..

Great care should be taken when opening any lines..

Most units are not repairable.

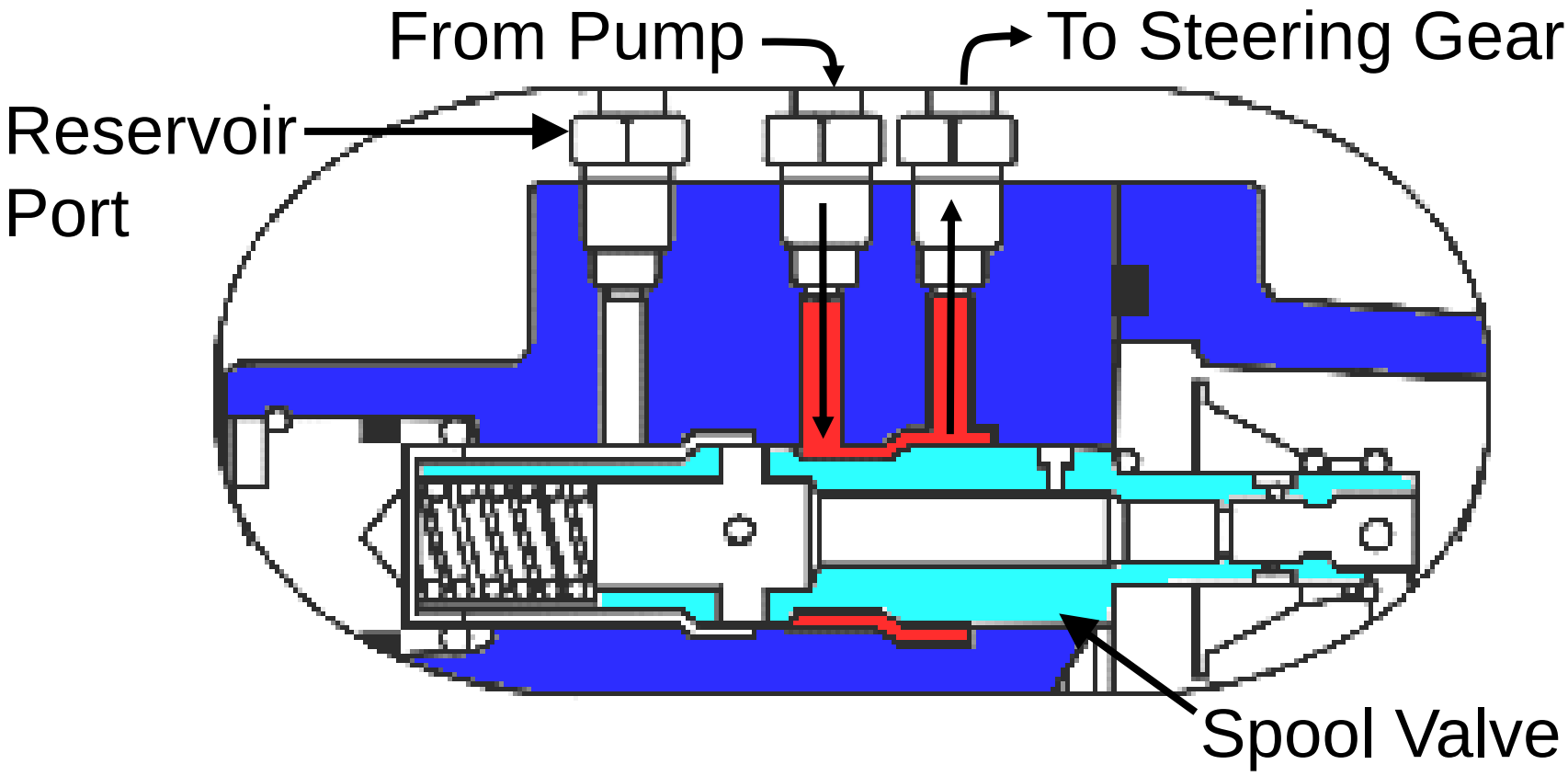
Hydraulic Over Hydraulic Brake Booster Syster



Some manufactures direct fluid from the pump through the booster to the steering gear returning to the pump and reservoir.

Hydraulic Booster Operation

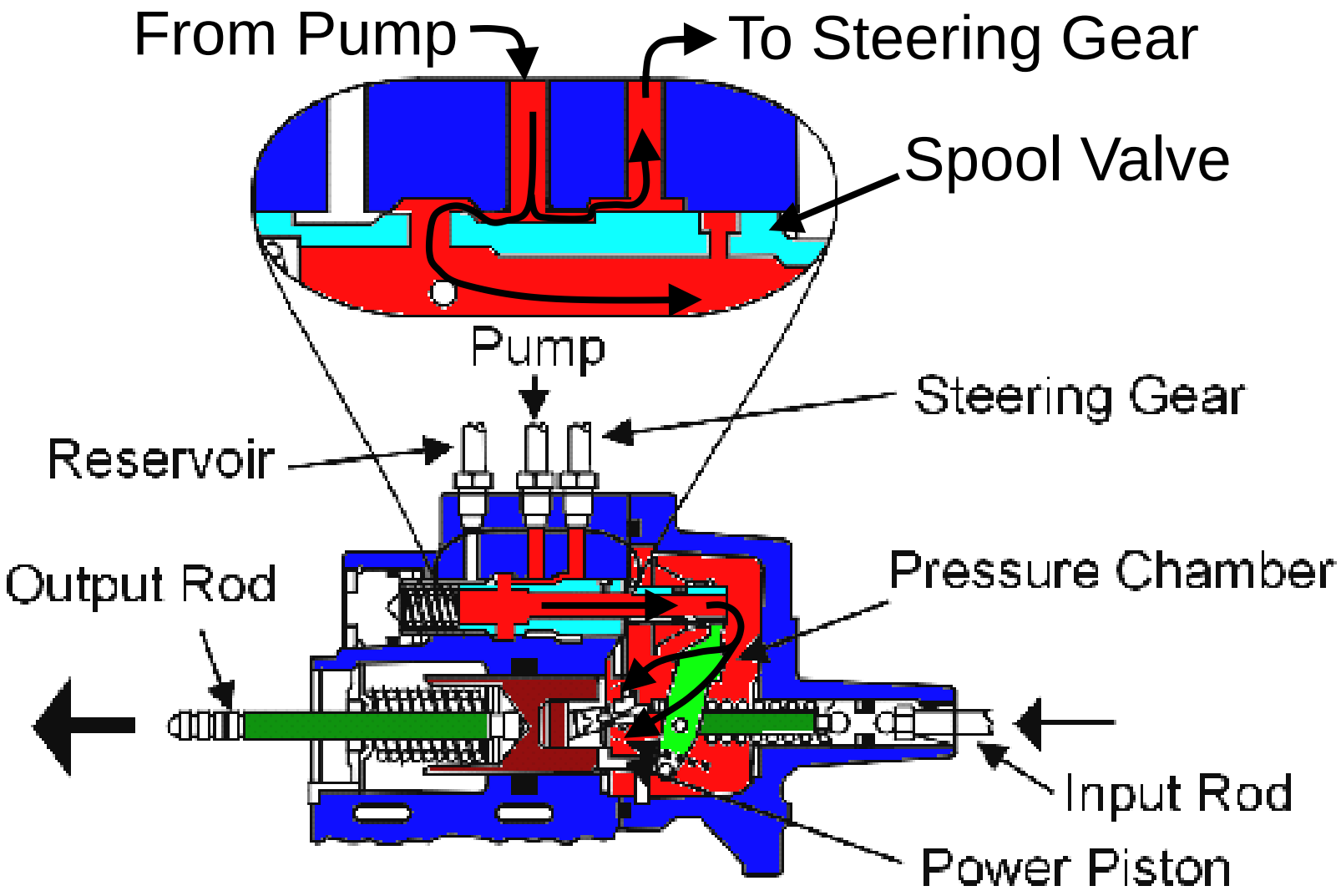
Released Condition



Hydraulic fluid from power steering pump flows through a spool valve and to the steering gear.

Hydraulic Booster Operation

Applied Condition



Hydraulic Booster Operation

Holding Condition

Spool move back slightly restricting the flow through the spool valve and increasing flow to the steering gear..

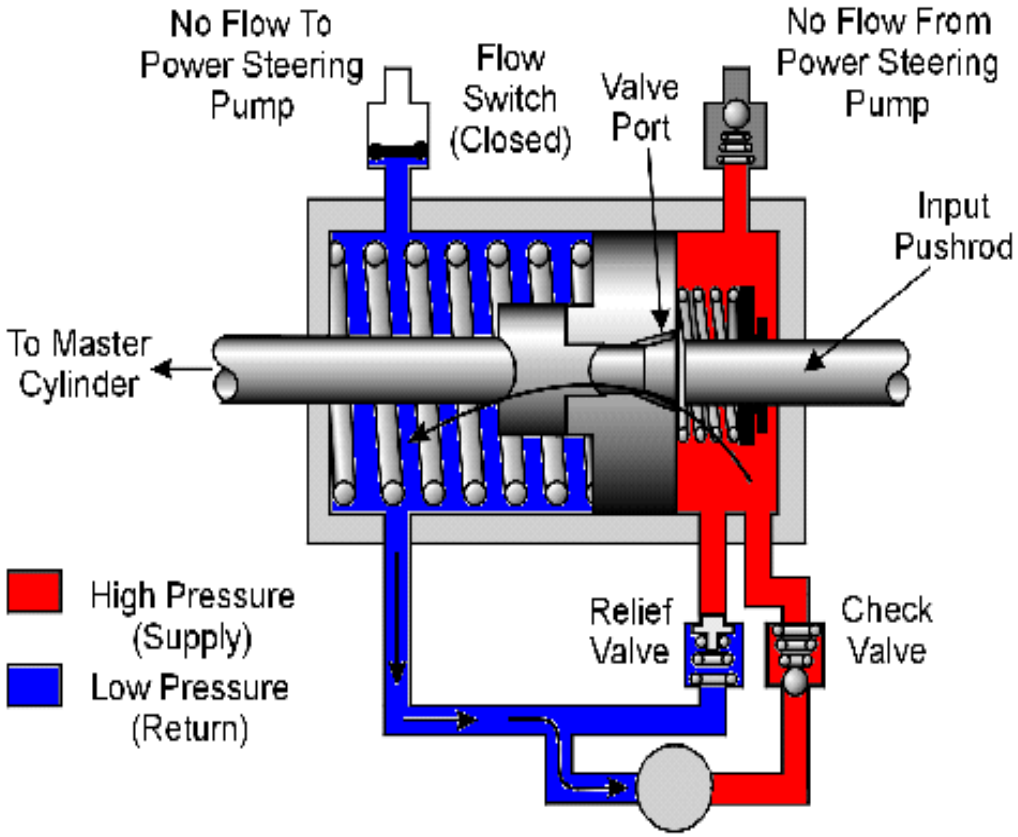
- Maintains enough flow to maintain boost pressure to hold the vehicle stationary.

Hydraulic Booster Operation

Emergency Operation

Will occur if there is a fluid flow loss from power steering pump

Electric/Hydraulic pump supplies fluid for some booster action

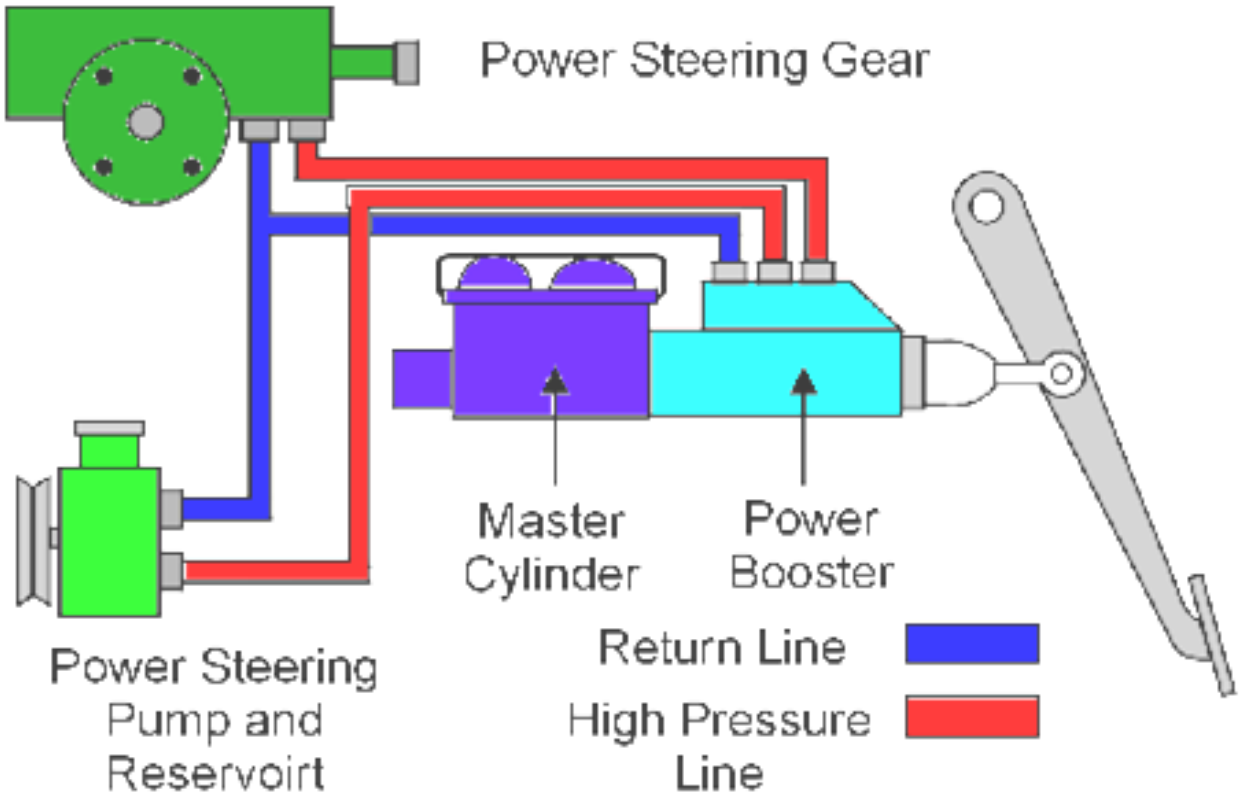


Electric/Hydraulic Pump

Objective Seven

Describe the diagnosis and repair procedures for hydraulic over hydraulic brake booster systems

Hydraulic Over Hydraulic Power Brake System Service



Both systems have different fluids, therefore incorrect filling could lead to contaminated systems

Troubleshooting

Check for any fluid leaks from both systems..

Depress the brake pedal and start the engine..

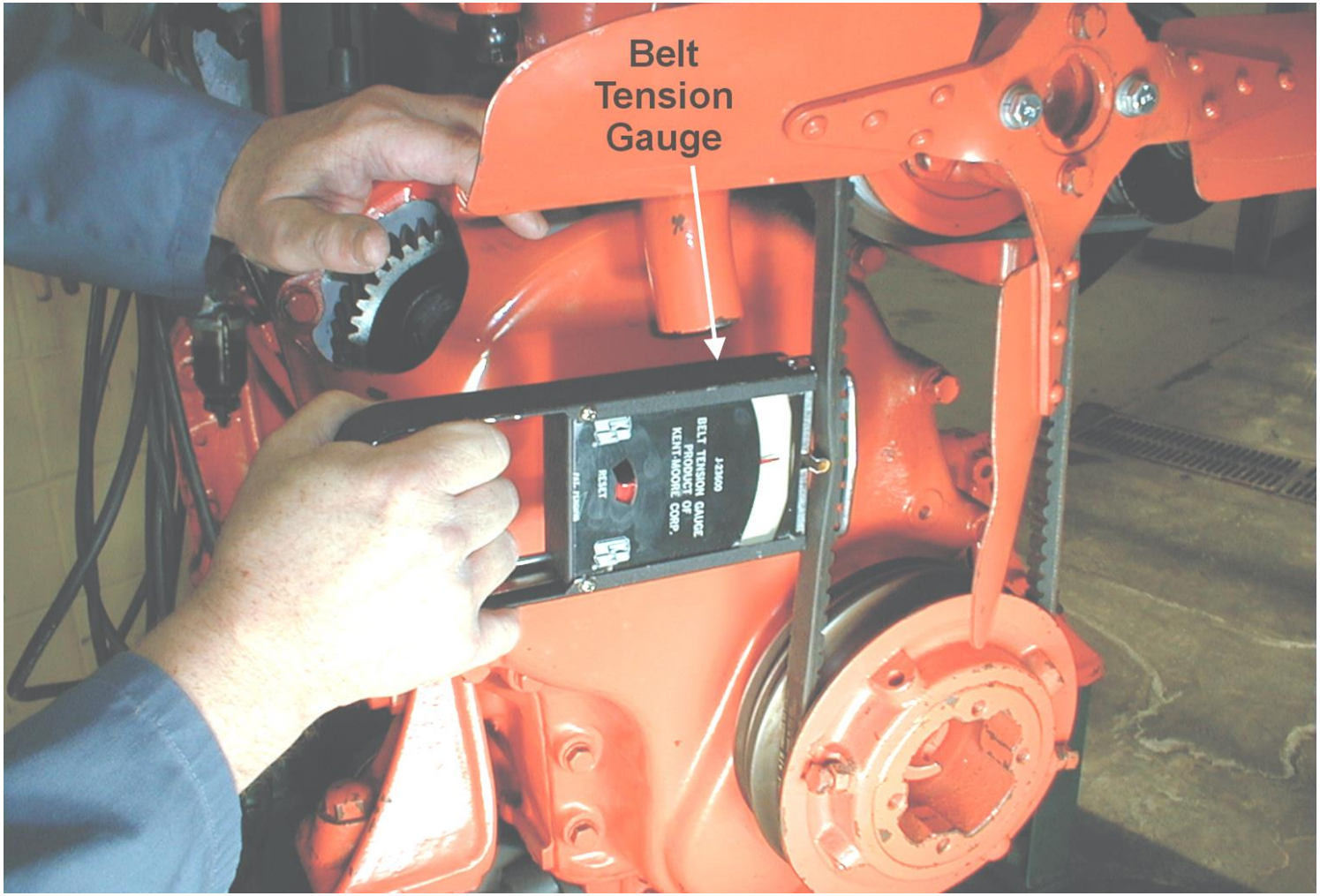
Cycle brakes and check for feedback through the pedal..

Pressure checks should be done on the PS pump..

All hydraulic pumps will have a pressure relief valve..

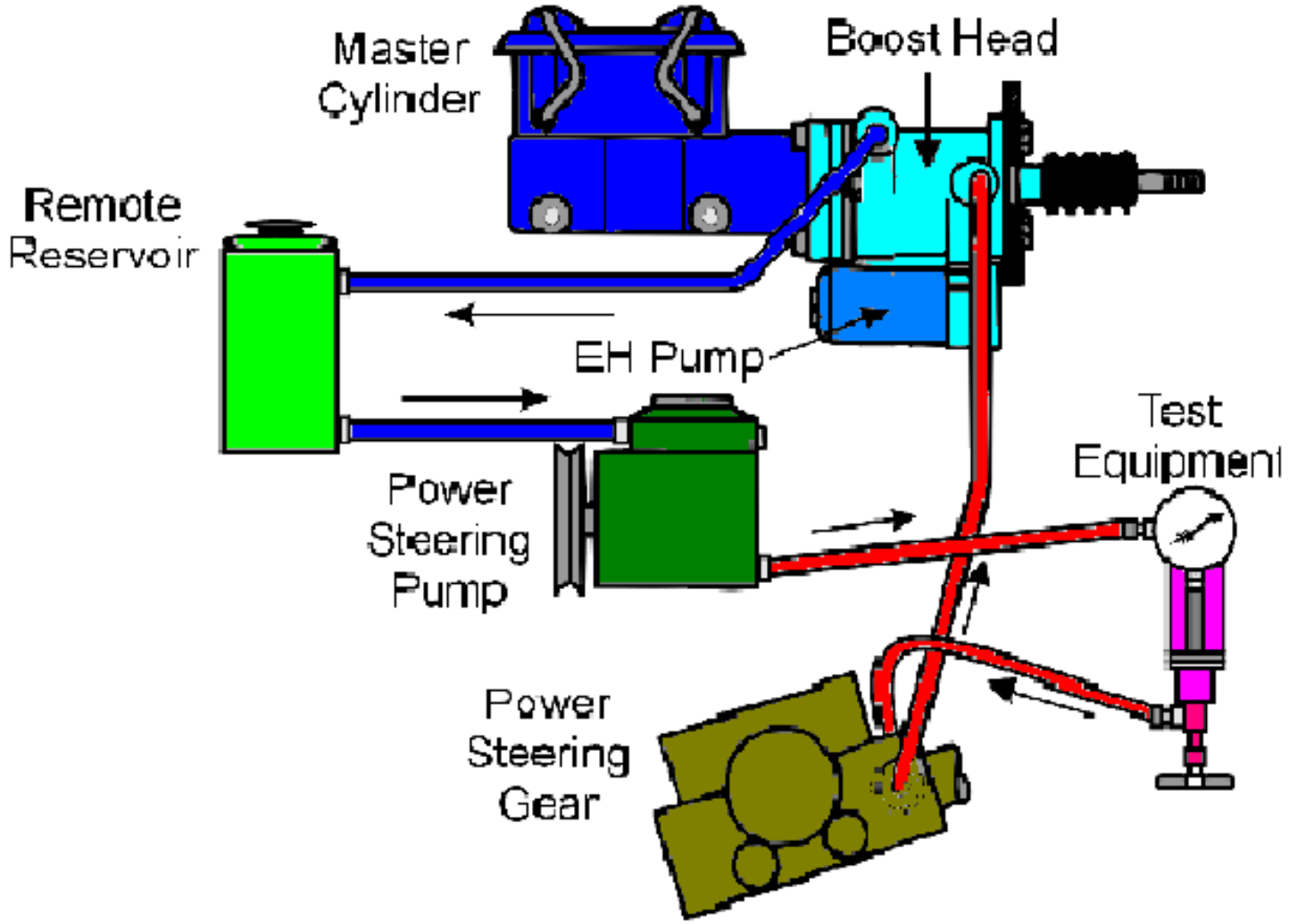
Check manufacturer’s specifications and procedures.

Troubleshooting



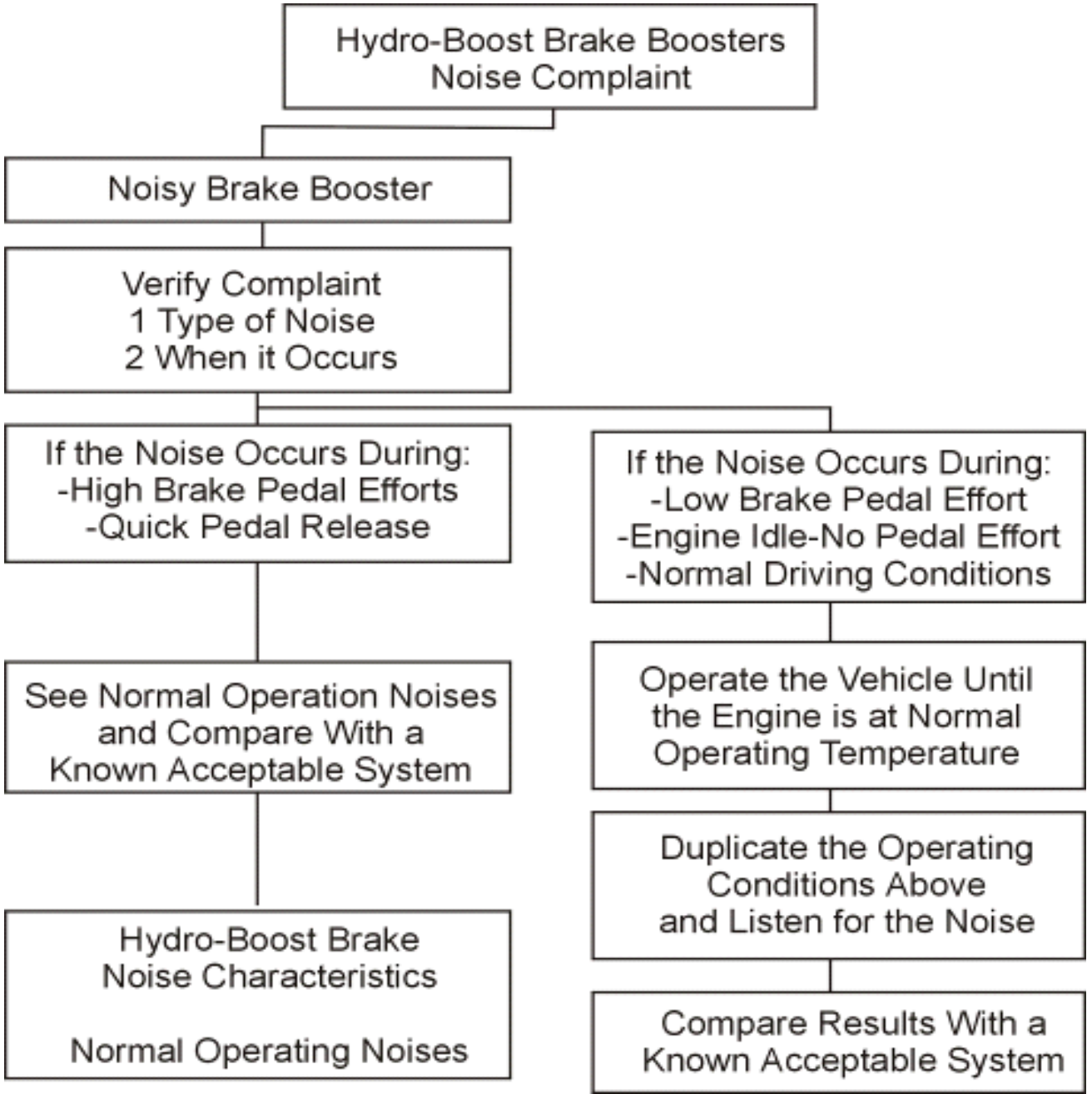
Inspect power steering pump belt tension and condition.

Troubleshooting



Testing power steering pump pressure.

Troubleshooting Flow Charts



Troubleshooting Flow Charts

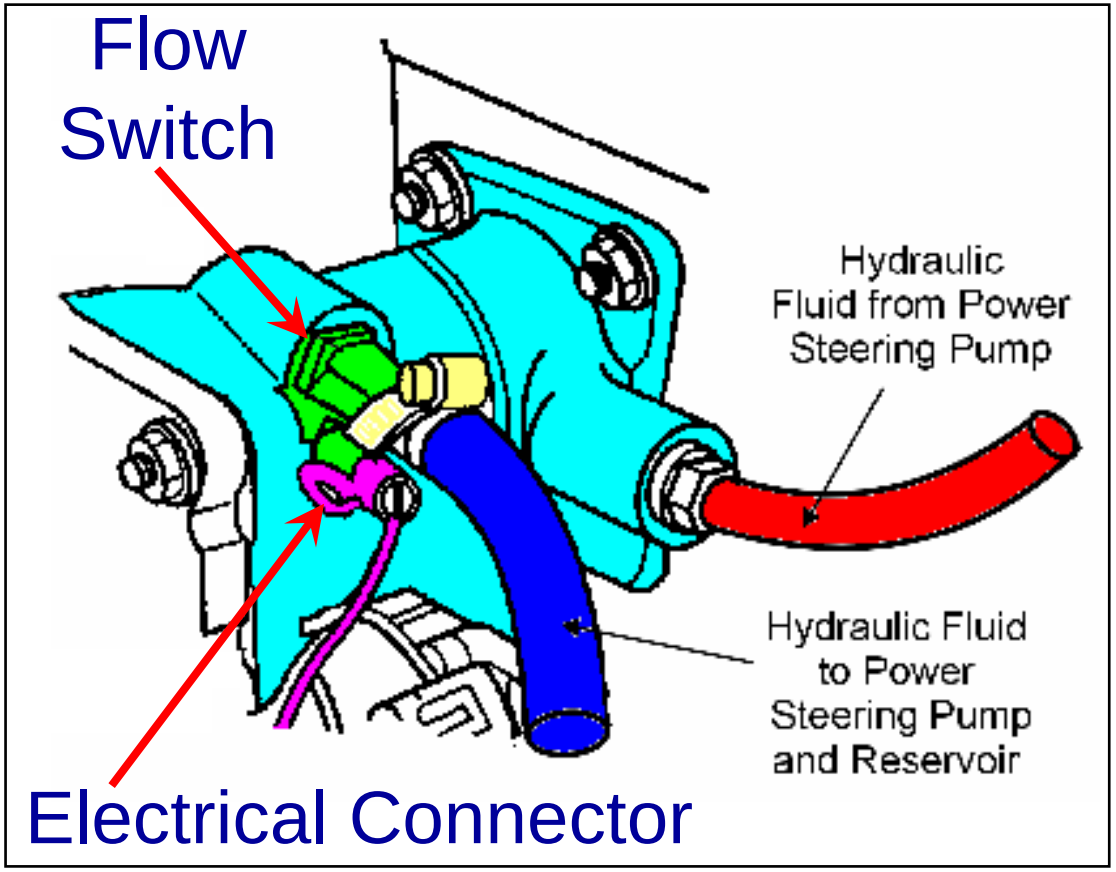
Danger

Before disconnecting any hydraulic lines, ensure system pressure has been relieved.

Apply and release the brakes several times with the ignition and engine off.

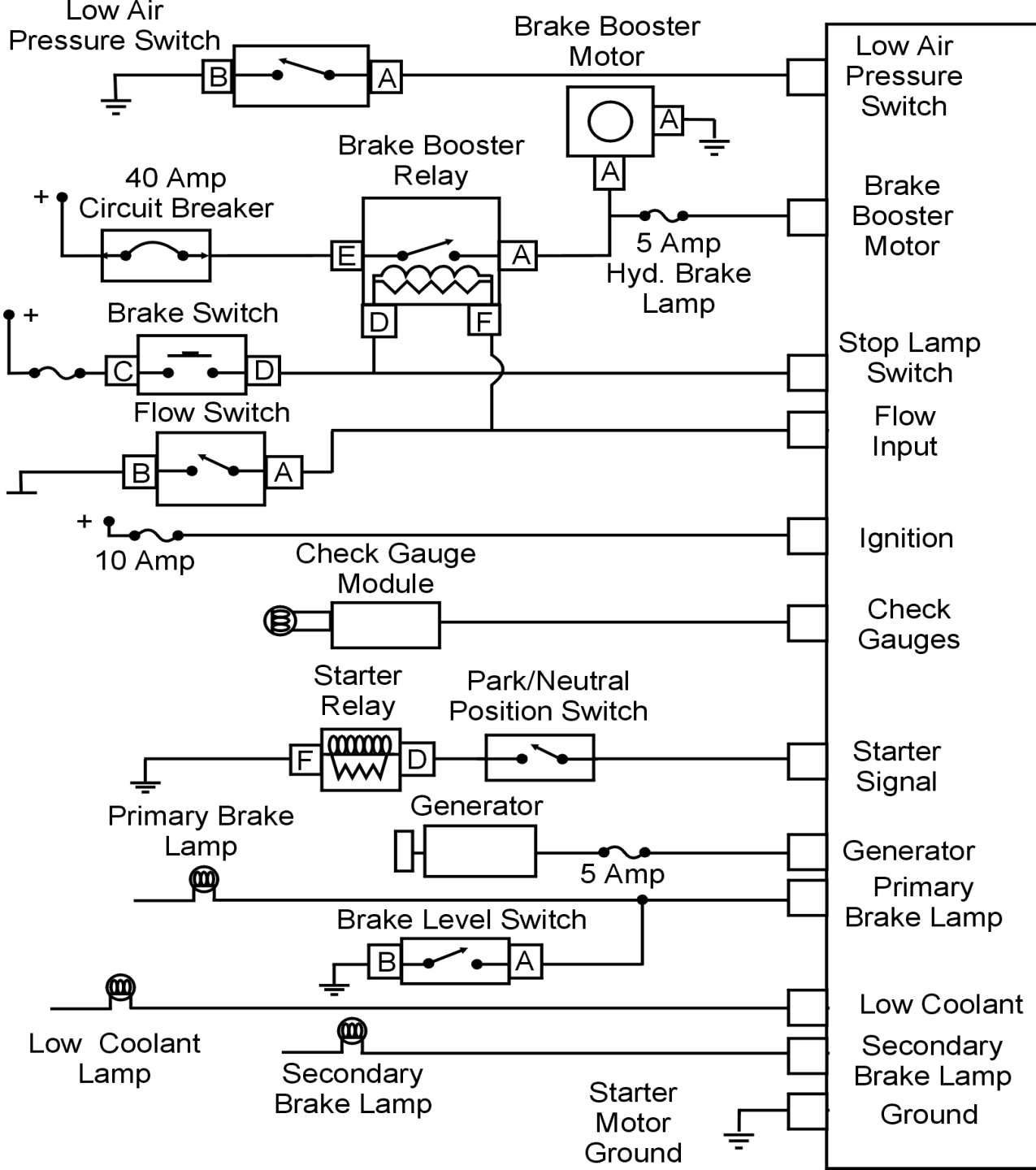
Troubleshooting

Flow switch used to activate electric/hydraulic pump.

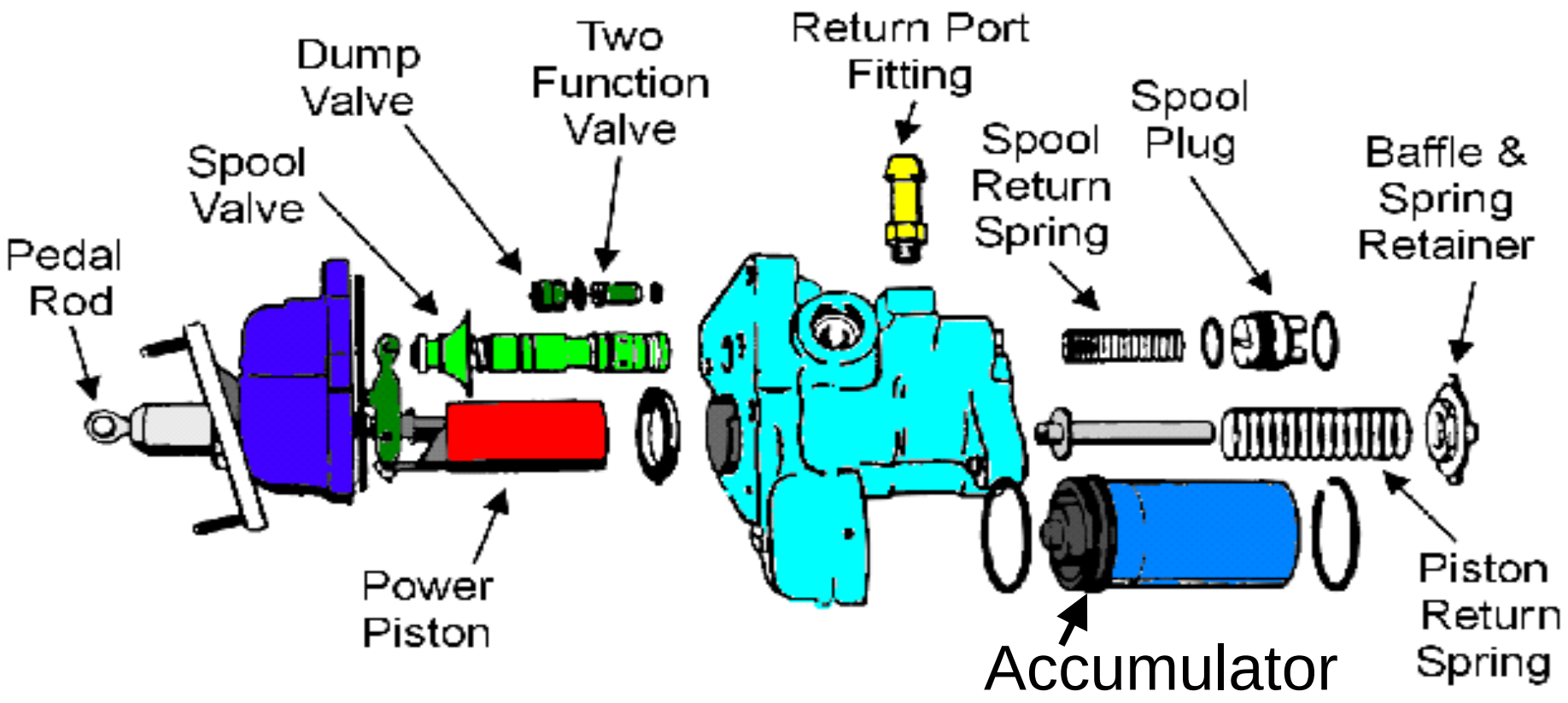


Electrical connections, conductors and electronic modules also require inspection.

Brake Booster Module Wiring Schematic

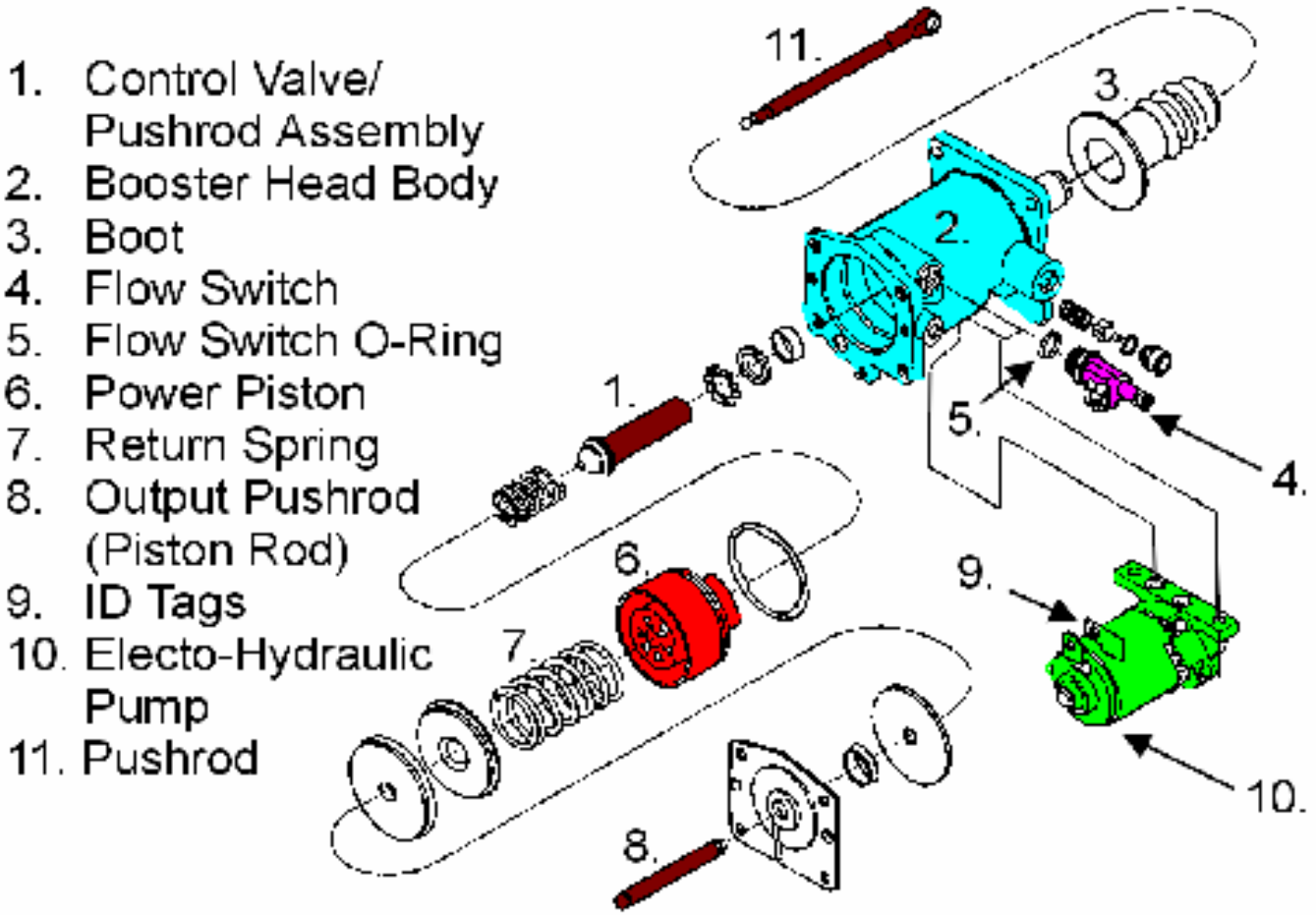


Repair



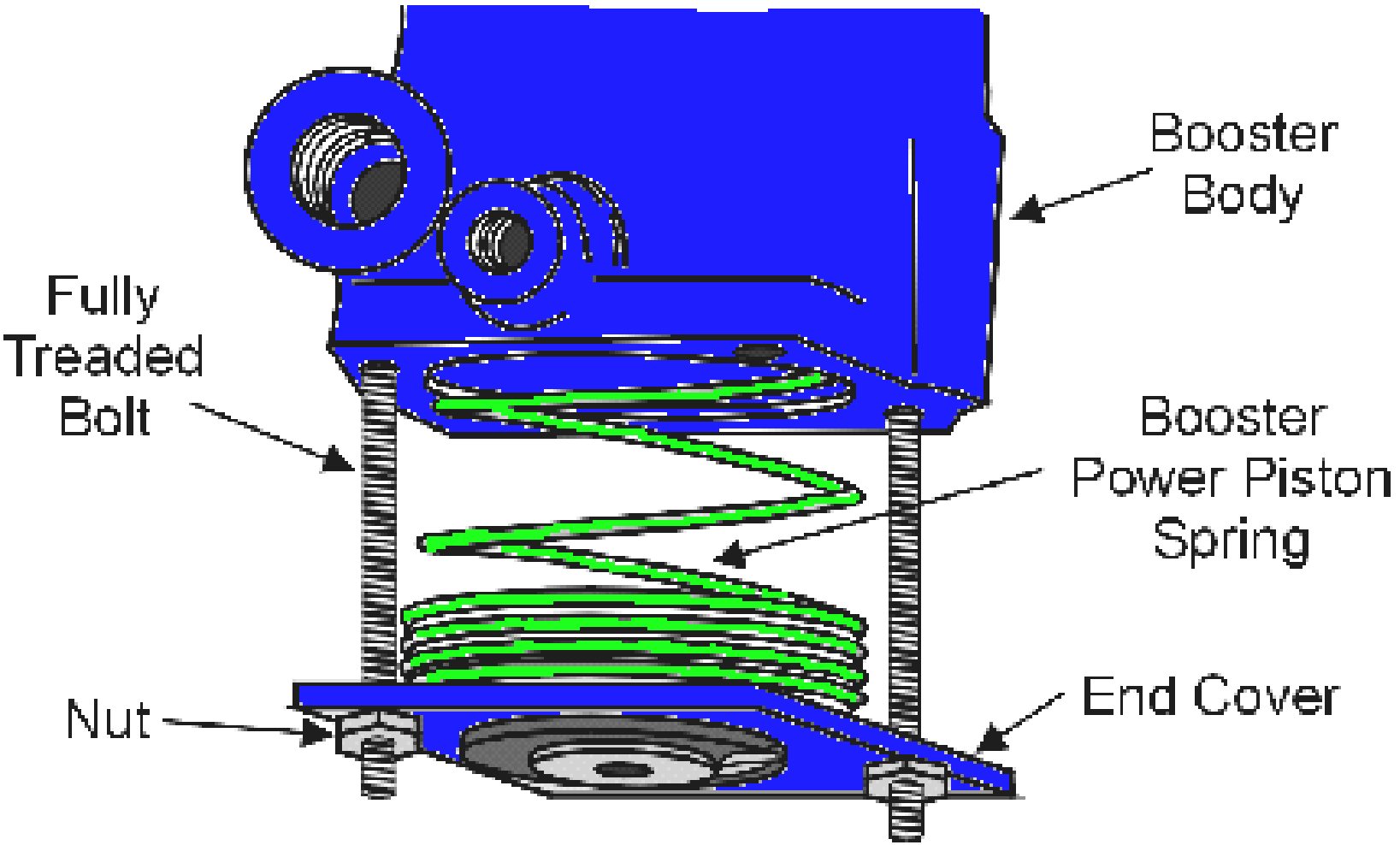
When disassembling provide a soft surface for valves and spools to lay on.

Repair



When servicing booster service the electro-hydraulic pump also, since both components share the same hydraulic fluid.

Repair



Removing power piston spring in a controlled manner.

THE END