NEW

# PETERBILT ESSENTIALS

## MODULE 6

- Braking System

Peterbilt

CLASS PAYS

# PETERBILT NEW ESSENTIALS – MODULE 6

## Introduction

Today trucks primarily use an air system to operate the brakes on all heavy duty, most medium duty, and trailers. Peterbilt Class 7 and 8 vehicles are equipped with air braking systems, while Class 6 vehicles can be specified with either air or hydraulic brakes. The air system supplies compressed air for both the tractor and trailer brakes, as well as for many other components, including the following:

- Service brake
- Parking brakes
- Transmission shifters
- Fifth wheel locks
- Air seats
- Air horns
- Air suspensions
- Axle shifters
- Trailer hitch
- Liftable axles

This module covers air brake systems, foundation brakes and emergency/parking brakes.

## How To Use New Peterbilt Essentials

1. Print the module and study the information. To print, click the printer icon on your browser. Highlight material that is new to you, or complex.
2. When you are ready to take the online test, click the "Begin" button in the "Test" column for the desired module. When the test is completed, it will automatically be scored and the results will be entered in the Peterbilt training records database.
3. Upon successful completion of all modules, you will receive a personalized certificate.

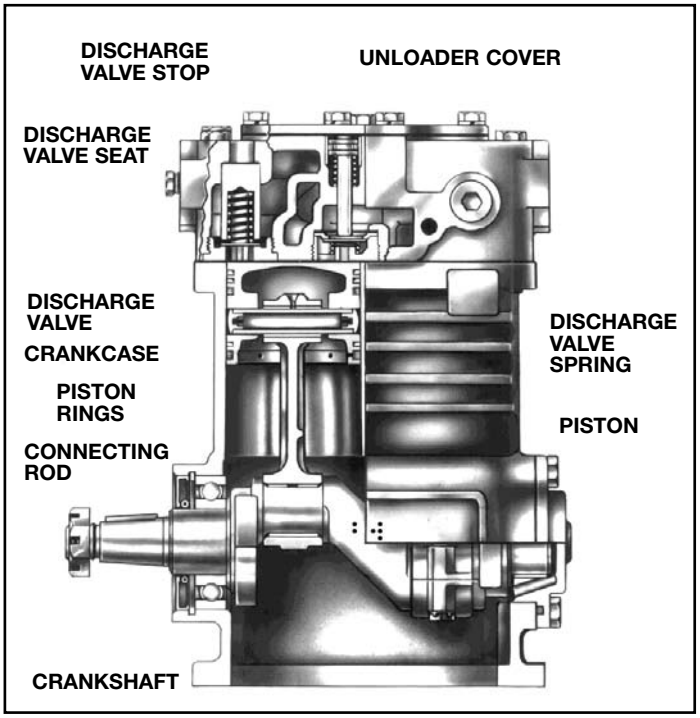
**It is recommended that you complete these training modules in sequence since each succeeding module builds on the previous module.**

## Air Compressor

An air system requires a source of pressurized air. All Peterbilts, except some medium duty vehicles, use an air compressor that is gear-driven directly off the engine to pressurize air and force it into a closed system for use as needed. The mechanics of the compressor consist of a crankshaft, connecting rods, pistons and valves. The compressor is lubricated by the vehicle's engine oil and cooled by the vehicle's cooling system.

### Compressor Operation

Air is drawn into the compressor during the compressor piston's downward stroke. As the piston travels up, the air is compressed, and the discharge valve automatically opens, allowing air to pass into the system. The amount of air that the compressor will "push" is measured in cubic feet per minute (CFM).




*Cross Section of Bendix TU-FLO 550 Air Compressor*

Depending upon the engine specified and the number of air-operated items, compressors with a range of 14.0 CFM to 38.0 CFM are available.

The pressurized air contained in a system is measured in pounds per square inch (psi). One-hundred pounds of pressure simply means that 100 pounds of force is exerted upon every square inch of the confining space.

The minimum amount of air contained in the system before the vehicle can be safely operated is 70 psi. The maximum system pressure for a Peterbilt is limited to 130 psi by the compressor's internal unloader mechanism and by a governor. When 130 psi is reached, the governor will route the pressurized air to the compressor unloader mechanism, preventing further compression of the air.

The compressor actually works like a pump to compress incoming air and push it into a sealed air system. Since air leaving the compressor is heated by compression, it is discharged into a teflon-lined stainless steel hose designed to handle high temperatures.

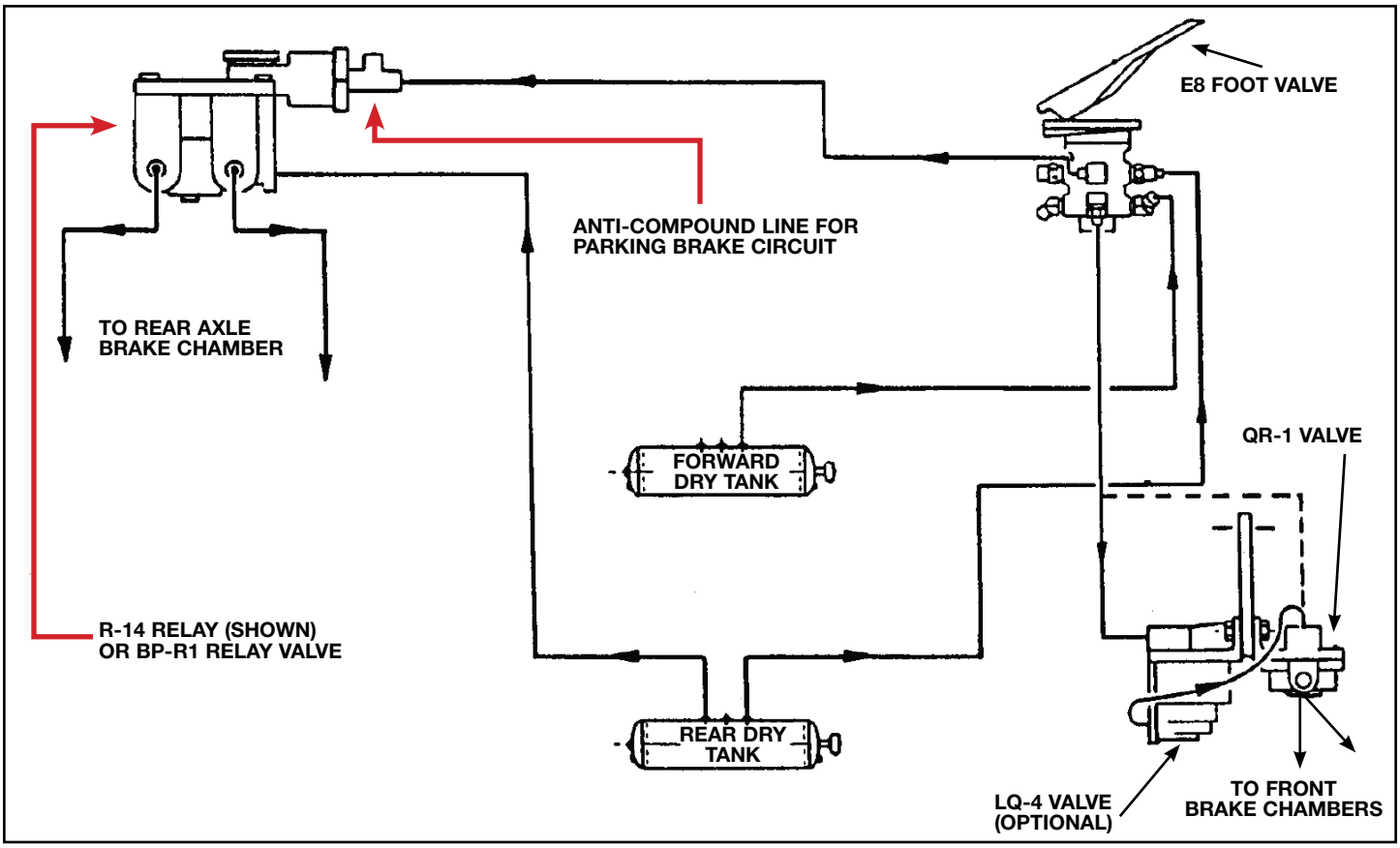
## Air Tanks

Most Peterbilt vehicles use a dual air system consisting of a forward dry tank and a rear dry tank. Tanks allow the air to cool and any moisture to condense and be drained.

Pressurized air from the wet tank is then piped to the two dry tanks. Air enters the dry tanks through a single check valve, a type of valve that allows air to flow in only one direction. A failure in one system would drain one dry tank, but enough air would remain in the other dry tank to make a limited number of safe stops. This ensures the integrity of the braking system.

The forward dry tank supplies the front brakes and all non-brake air-operated components. It is also a secondary source for the parking and trailer brakes. The rear dry tank supplies the rear service brakes and is the primary source of air for the parking brakes and the trailer brakes.

When several air-operated options are specified, more than two dry tanks can be used. The source of air for additional tanks will usually be the forward dry tank and will never come from the rear dry tank. When a vehicle demands a very high volume of pressurized air, an air system charge valve can be specified. This valve will allow the vehicle's air system to be charged from a source of pressurized air other than the vehicle's compressor.




*Basic Dual Air Brake System Without ABS*

## Tank Locations

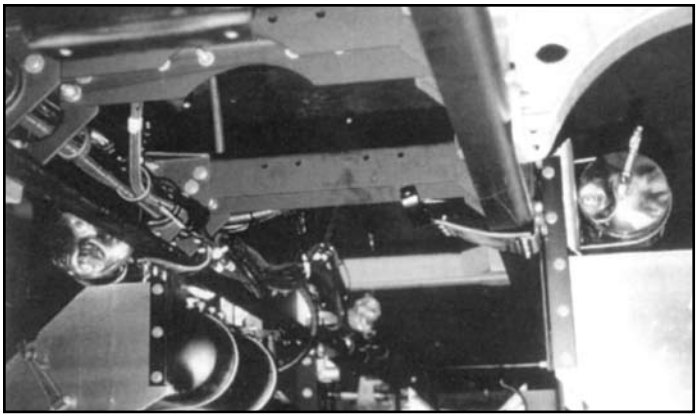
Tanks are placed in various locations to include:

- Behind the battery box
- Over the tool box
- Over the battery box

On a Model 320, a wet tank (if equipped) and one dry tank are mounted perpendicular to the frame under the battery box. The other dry tank is mounted under the frame. Although these are the standard configurations for stock vehicles, Peterbilt offers countless configurations based on vehicle requirements.

When a vehicle is ordered, the volume of air required is determined. The size of the tank will be determined by available rail space, vehicle application and customer preference. Peterbilt offers a great deal of flexibility both in air tank design and in installation. For example, Peterbilt can install air tanks between the frame rail flanges or behind the rear suspension. This flexibility allows tanks to be custom-located when additional ground clearance is required or when possible interference with body installation is a concern.

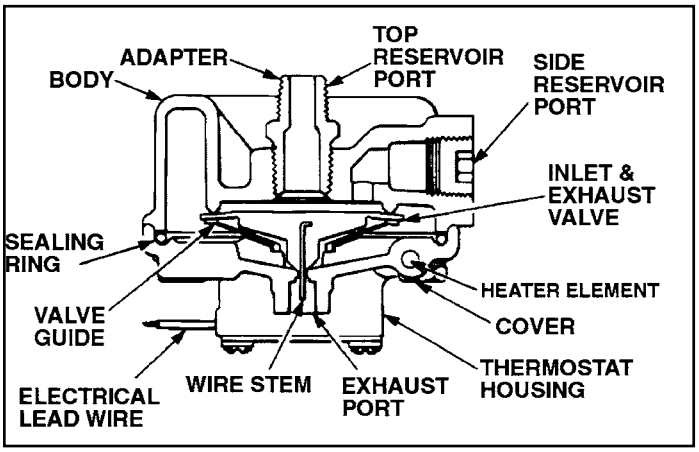
Peterbilt offers steel tanks as standard; aluminum tanks are also available. Steel tanks are painted. Aluminum tanks may be painted, polished or left natural.



*Standard Air Tank Placement*

## Drain Valves

Air coming from the compressor contains water and oil. Water vapor condenses as the air cools and expands. Small passages in the air system may become blocked if these contaminants are allowed to collect, which may shorten the life of the air system components. Water freezing is also a major concern. All air tanks are equipped with drain valves. Manual drain valves are standard and are activated by means of a pull cord or a rotating valve head. Automatic drain valves are optional and operate by using a spitter valve that is automatically activated when a designated pressure is reached. Air tanks that are not equipped with automatic draining devices should be manually drained every day.

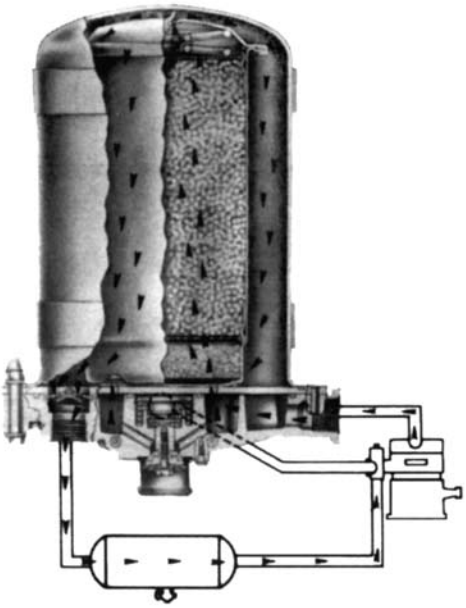



*Drain Valve*

## Air Dryers

Peterbilt highly recommends installing an air dryer as part of the air system. The air dryer is a device used to remove moisture and contaminants from the air coming from the compressor. Peterbilt installs desiccant air dryers.

This type of air dryer uses a chemical that attracts, collects and adsorbs moisture and oil. The desiccant type dryer does not require greater than normal external air flow, but should be kept clear of the engine or exhaust environment.



Air dryers are equipped with an ejector valve to provide a means of expelling the accumulated water and contaminants.

All air dryers on Peterbilts use a spin-on cartridge. It has four pressure protection valves located directly on the air dryer module so accessories can be plumbed straight from the air dryer instead of connecting through either of the two air system reservoirs. This design feature minimizes possible leak points. The dryer also purges air from a self-contained reservoir, allowing the truck's air system reservoirs to maintain consistent pressure during the purge cycle. The modular design results in fewer system components, so it simplifies maintenance and reduces the weight of the air system.

## Low Pressure Warning System

All Peterbilt vehicles requiring compressed air are equipped with low-pressure warning systems on both dry tanks. If the pressure in either dry tank falls below 70 (± 6) psi, the driver is alerted by indicator lights and a buzzer. Two separate gauges also provide air pressure information to the driver.

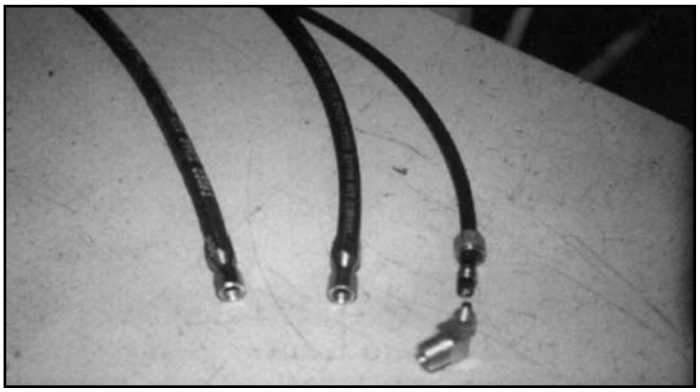
## Distribution System

Compressed air from the dry tanks must be distributed to the air-operated components at the proper time and in the proper amounts. To achieve this, a distribution system is used that incorporates hoses, fittings, bulkheads and valves.

### Hoses

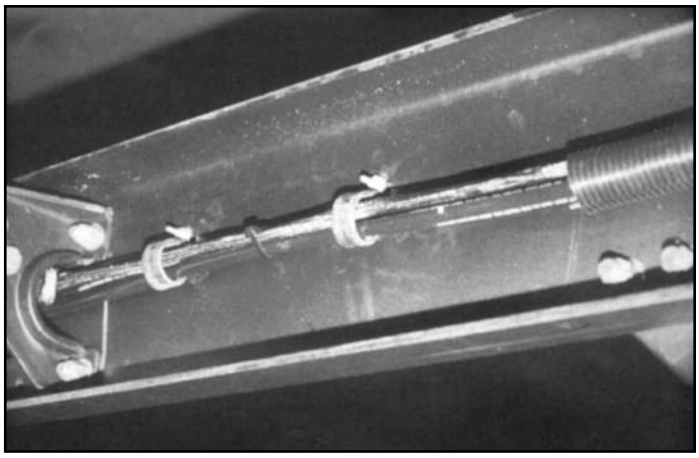
Four types of hoses are used on a Peterbilt air system:

- Nylon hose is used for general air brake and under-dash piping. Standard on all Peterbilts is seamless 100% nylon-core hose with one textile reinforcement and a smooth over-sheath of nylon.
- Medium-pressure rubber hose is used for general air system piping such as brake air lines to the brake chambers. Rubber hose provides more flexibility than nylon hose.
- Medium-pressure wire braid hose is used for general air system piping when there is a need for a wire-reinforced, abrasion-resistant air system.
- Teflon/stainless steel hose is used for compressor discharge piping.



*Wire-Braid (L), Rubber (C) and Nylon Hose (R)*

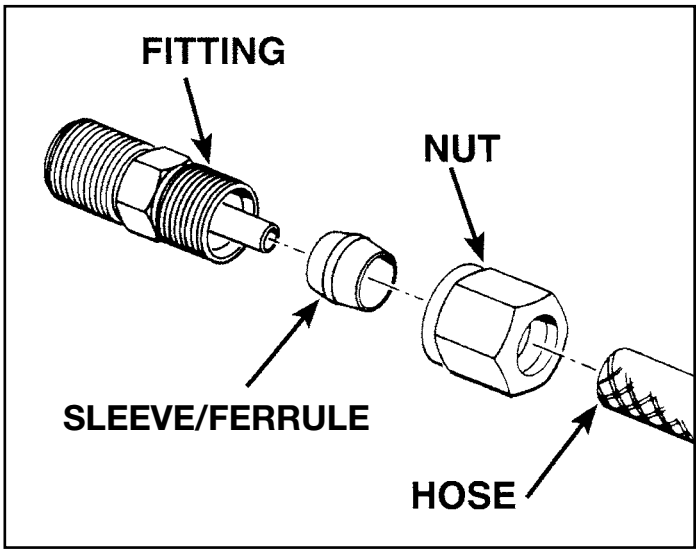
Hoses are routed along the frame rails and supported by rubber cushioned clips or frame-supported straps to minimize wear and abrasion. The flexibility of Peterbilt manufacturing allows special routing of air lines to accommodate different body installations or special customer requirements. For example, Peterbilt can mount air and electrical lines on a movable end-of-frame crossmember – an option popular with loggers. A dash-mounted hand valve for operating trailer brakes is also available.



*Typical Hose Routing. Note the Rubber-Cushioned Clips.*

### Fittings

For ease of repair, rubber and wire braid hoses are equipped with replaceable ends. Fittings have four parts: the body, the hose support insert, the sleeve/ferrule and the nut. The hose support insert is required for DOT compliance. This insert provides a rigid area for the sleeve to compress. It also prevents the hose end from collapsing when the nut is tightened.

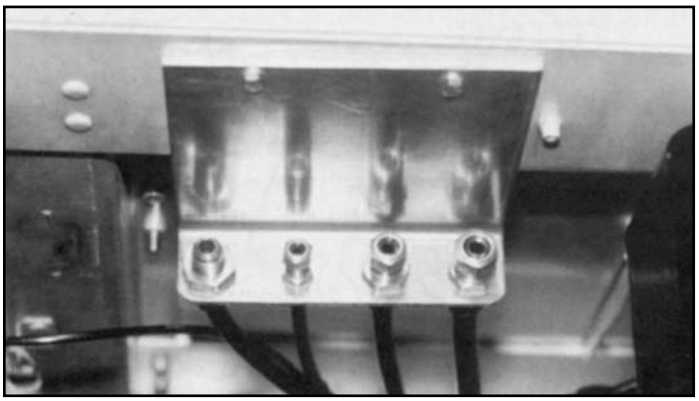



*Compression Fitting*

## Bulkheads and Manifolds

Bulkheads and manifolds are used  to distribute air to the air-operated components.

The primary air distribution components are the back-of-cab bulkhead and the firewall manifold. The bulkhead and manifold can be thought of as a junction where a number of hoses connect to provide for air distribution and ease of servicing. The back-of-cab bulkhead provides an interface for pressurized air to be routed from the dry tanks to the various control valves located in the cab. Normally at this bulkhead you will find two **source lines** routing air from the forward and rear dry tanks into the cab and two **brake lines** routing air from the foot valve (brake pedal) in the cab back to the brake circuits.

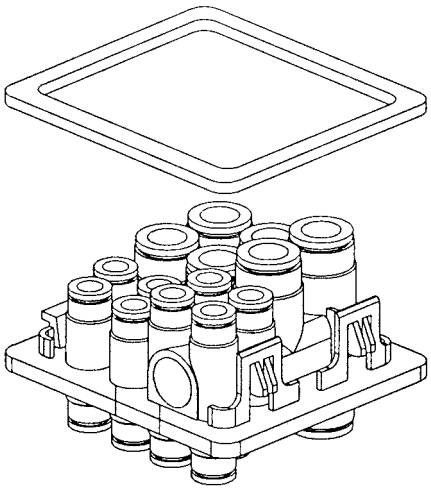


*Back-of-Cab Bulkhead*

The Model 320 LCF distributes air through a junction plate on the driver's floor, a forward manifold block and a rear manifold block. Both manifold blocks are mounted on the inside firewall ahead of the steering column.

## Firewall Cab Air Manifold

In most models, the cab air distribution manifold is located in the lower left-hand corner of the cab next to the electrical distribution fuse panel. The firewall manifold provides an interface for engine, chassis and cab air hoses.



## Control Valves

For most air accessories other than brakes, dash-mounted valves control the pressurized air to activate the accessory. Some items, such as air suspensions, do not require a control valve in the cab. An axle- or frame-mounted leveling valve controls the air pressure that is supplied to the air springs. For the cab manifold or accessories that do not require control valves in the cab, air is normally supplied from the forward dry tank directly to the valve that controls the pressurized air.


*Dash-mounted Control Valves*

## Air Braking System

Federal Motor Vehicle Safety Standard (FMVSS) 121 sets performance and equipment standards for all vehicles equipped with air brake systems. Unless exempted, all Peterbilt vehicles comply with FMVSS 121.

The brake system uses air pressure to provide both the control and the actuation forces for the vehicle brakes. There are three air brake system circuits:

- Truck/tractor service brake circuit
- Truck/tractor parking or emergency brake circuit
- Trailer brake circuit

### Service Brakes Circuit

The service brakes are used to slow and stop the vehicle during normal operation and are controlled through the foot valve and optional hand valve. The service brake circuit is also equipped with an electronically controlled anti-lock braking system (ABS).

#### *Anti-Lock Braking System (ABS)*

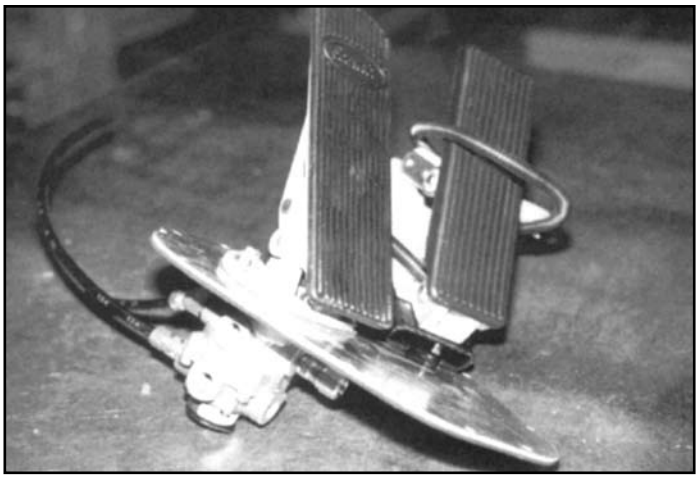
Peterbilts are equipped with an anti-lock braking system. This system automatically adjusts air pressure to the brakes during braking to prevent wheel lockup and optimize the use of available traction. With the ABS installation, an acceleration slip regulation, or automatic traction control, feature can also be added. This system automatically reduces spinning of drive wheels during starting or accelerating. It also transfers drive torque to the wheel with the greatest traction. ABS is covered in detail on page 15.

#### *Service Brakes Operation and Components*

The service brakes circuit is actually comprised of two separate circuits. Each has its own air supply and is independent of the other, so a failure in one circuit will not affect the other circuit. This dual system insures braking capacity if one circuit is damaged.

#### *Foot Valve*

The foot valve is commonly referred to as the brake pedal; it is activated by pedal movement. This valve has two separate circuits, an upper circuit and a lower circuit. Each circuit includes two supply ports and two delivery ports. The bottom half receives air from the forward dry tank and operates the front steer axle brakes; it also serves as a secondary air supply for the trailer brakes. The top half receives air from the rear dry tank and operates the rear brakes and trailer brakes.



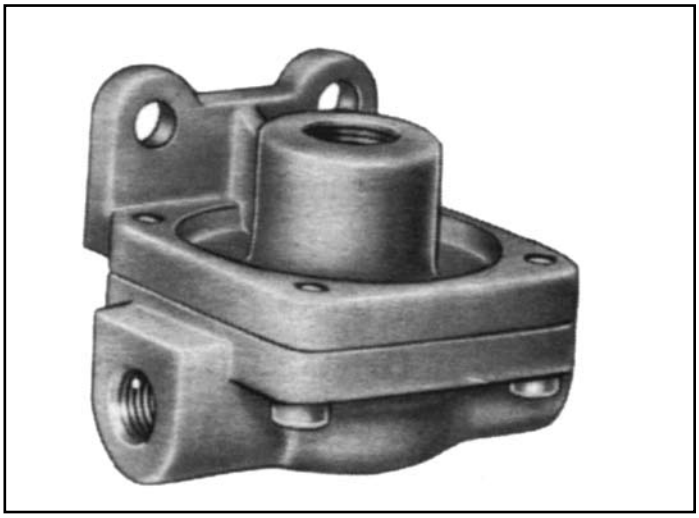
*Foot Valve (Brake Pedal)*

#### *Front (Steer) Axle Brake Circuit*

The forward dry tank provides the air supply for the front brakes. Air from the forward dry tank is sent to the supply port on the lower half of the foot valve. When the brakes are applied, air is forced through the delivery port on the lower half of the foot valve to the front axle brake chambers through a quick-release valve (QRV).

#### *Quick Release Valve*

As the name implies, the quick-release valve ensures the quick exhaust of air pressure when the brakes are released. The QRV also acts as a “T” to the front axle brake chambers. When the brakes are applied, a diaphragm in the valve seals the exhaust port, and air from the QRV flows to the brake chambers, where it is converted to linear force to apply the brakes. When the brake pedal is released, back pressure in the brake chambers will cause the diaphragm to seal the supply inlet and allow air to flow out the exhaust port.



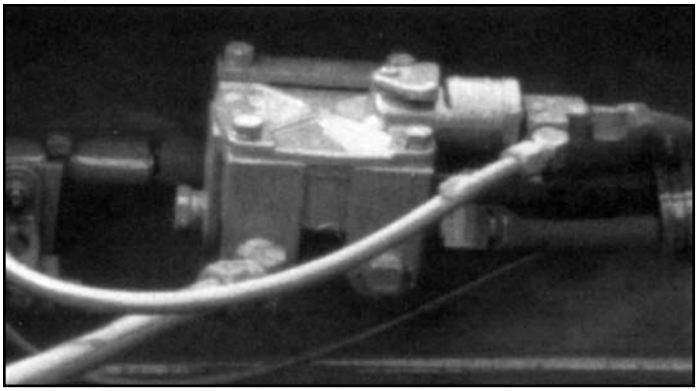
*Quick Release Valve*

### *Rear Axle(s) Brake Circuit*

The rear dry tank supplies air for the rear axle's (or axles') brakes. Air from the rear dry tank enters the supply port on the upper half of the foot valve. When the brake pedal is depressed, air pressure is delivered from the foot valve to the relay valve.

### *Relay Valve*

The relay valve speeds up the application and release of the brakes. A quick release exhaust port allows air to escape from all the rear axle chambers when the brake pedal is released. Thus the relay valve ensures proper brake timing. The relay valve is often part of the ABS combo valve package.



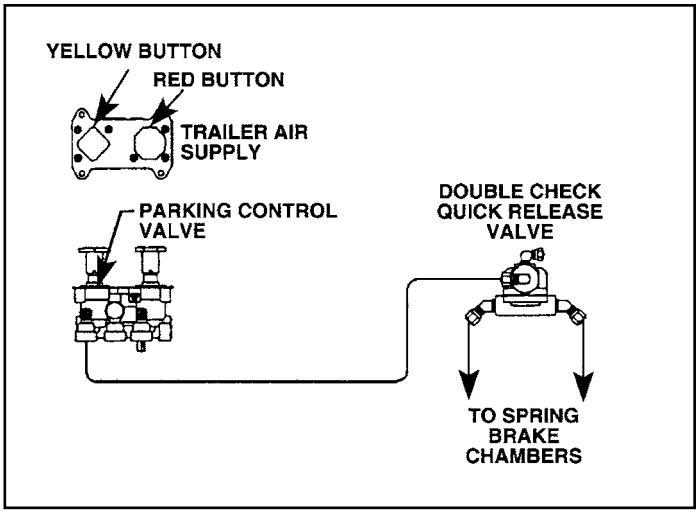
*Relay Valve*

### *Parking/Emergency Brake Circuit*

The parking or emergency brake circuit controls the spring brakes on the rear axles. The operation of the spring brakes is opposite that of the service brakes – supplying air pressure to the spring brakes releases them, and removing air pressure applies them.

Air pressure for the spring brakes is supplied from the rear dry tank or the forward dry tank through a dash-mounted push-pull control valve. The double check valve ensures that both dry tanks must lose air pressure before the spring brakes will automatically apply.

The yellow dash-mounted push-pull Parking Control Valve controls the spring brakes. **Pushing in** the control knob allows air pressure to be delivered through a QR-1C double check/quick-release combination valve to the spring brake chambers; this releases the parking/emergency brakes. **Pulling out** on the control knob blocks the air flow to the brake chambers, allowing the air in the chambers to exhaust at the QR-1C valve. At this point, the parking brakes are applied.




## Double Check/Quick Release Valve (QR-1C)

The QR-1C double-check/quick-release valve serves two functions:

1. The **quick-release** feature allows air in the spring brake chambers to exit quickly through the large exhaust port of the QR-1C.
2. The **double check** feature is used for anti-compounding purposes. Anti-compounding prevents the application of both service and spring brakes at the same time. The compounding of service and spring brake forces could damage the slack adjusters and other brake components.

A one-valve park control system is used on vehicles that do not have trailer connections. A two-valve system is standard on vehicles with trailer connections on which one valve will be used for tractor parking brake control and the other valve will be the trailer air supply control. Peterbilt uses a single-body multi-valve component, in which an integral double check valve ensures air supply to both tractor spring brakes and trailer air supply reservoirs. In both configurations, the push-pull control valves are designed to apply the spring brakes automatically if the air system pressure drops below a specific level.

## Push-Pull Control Valve Operating Variations

**Single-valve:** If the system pressure from both supplies falls below 40 psi, the control valve will pop out and apply the truck spring brakes.

**Two-valve:** Once the system reaches 65 psi, both dash control valves will stay in when they are pushed in. This charges the trailer system and releases the tractor parking brakes. If both dry tanks fall below 40 psi (± 5 psi), the trailer emergency control valve will pop out and exhaust the trailer air supply. This will apply the trailer spring brakes. If the pressure in both tanks continues to fall below 30 psi (± 5 psi), the tractor control valve will pop out, setting the tractor spring brakes as well.

### *Spring Brake Modulator Valve*

A spring brake modulator, or SBM, valve is added to the vehicle's park/emergency brake circuit when the payload is carried other than by means of a fifth wheel (as with trucks, loggers and dromedary. The SBM valve is a safety-emergency valve designed to allow the spring brake chamber air pressure to be modulated, or changed, by front service brake application if the rear dry tank supplying the rear service brakes loses air pressure. Such action increases braking capacity in this emergency situation by making the spring brake chambers apply the force that the service brake chambers would apply under normal conditions.

*Spring Brake Modulator (SBM) Valve*

When an SBM valve is installed on a vehicle, it is configured for operation as follows:

The SBM valve is installed in the park brake system between the dash control valve and a spring brake relay valve ahead of the spring brake chambers. A line from the rear dry tank to the SBM is needed, as is one from the steer axle service brake quick release valve to the SBM valve.

If the rear dry tank pressure drops below 55 psi, the SBM valve will modulate the spring brake chamber air pressure based on the front brake application pressure. When the front brakes are applied, the SBM valve will reduce the spring brake chamber pressure by an amount proportional to the pressure being applied to the steer axle service brakes. This reduction in air pressure will cause the spring brake chambers to apply the rear brakes in the same way as the front brakes are applied. When the front brakes are released, the spring brake chamber pressure will build back up to system pressure level.

The SBM valve provides for a limited number of safe, controlled "service-like" brake applications before the remaining dry tank pressure drops to the minimum level and causes the spring brakes to be applied.

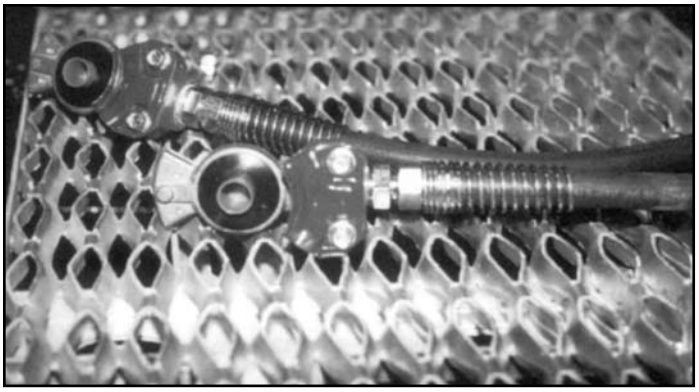
### *Trailer Brake Circuits*

The trailer brake system is comprised of two circuits:

- The service circuit, which controls the trailer service brakes.
- The emergency circuit, which supplies air for the trailer air tank(s) and controls the trailer spring brakes.

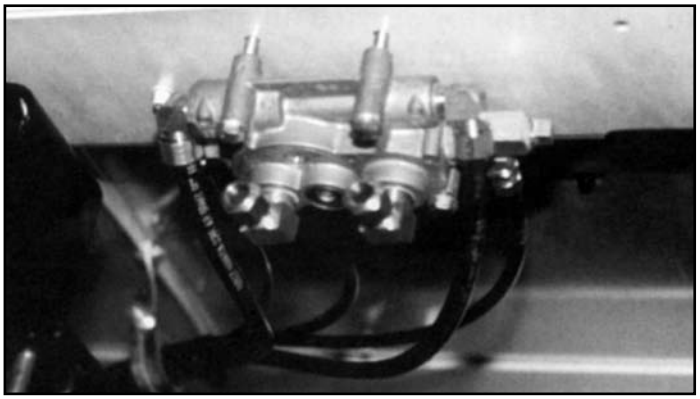
### *Trailer Service Brake Circuit*

The trailer service brake circuit is controlled by the foot valve or a hand valve that can be either column-mounted or dash-mounted. While the foot valve operates both tractor and trailer brakes, the hand valve normally operates the trailer brakes only. Double check valves allow the hand valve and either the upper or lower half of the foot valve to apply and release the trailer service brakes. When the foot or hand valve is applied, pressurized air flows through the double check valves, the tractor protection valve and a quick-connect coupling (gladhand) to the trailer relay valve, applying the trailer service brakes.



*Gladhands*

Gladhands are quick-connect couplings used to connect the towing vehicle (truck or tractor) air systems to the trailer. Rubber grommets act as seals by being compressed together when the tractor and matching trailer gladhands are connected. Blue “service” gladhands connect the tractor service brakes to the trailer service brakes, while red gladhands (labeled “emergency”) are used for the trailer air supply connection.



*Protection Valve*

The tractor protection valve allows air to flow out through the trailer service line to the gladhand only when the emergency or supply circuit is pressurized. This feature prevents the tractor service brake application pressure from being depleted by the service gladhand or the trailer service circuit if the trailer service circuit fails or if a trailer is not connected.

The tractor protection valve receives all brake signals from the foot valve, hand valve and trailer air supply valve. In response, a signal is sent to the trailer’s service and emergency gladhands. The body of the valve contains two double check valves to define the greatest pressure from the foot valve and the hand valve for trailer service brake applications. Tractor protection is achieved by the shutoff of all service brake applications to the trailer if the emergency line is separated from the trailer. A quick release exhaust port allows air pressure in the trailer brake chambers to escape once the brake pedal is released.

### *Trailer Emergency Brake Circuit*

The emergency circuit is controlled by the trailer air supply valve, which is the red push-pull knob mounted on the dash. When the trailer air supply valve is **pushed in**, the emergency circuit is pressurized. Air pressure then flows out the emergency line, where it pressurizes the trailer air tanks and releases the trailer spring brakes. This action opens the tractor protection valve to allow air to flow out through the trailer service line to the gladhand when the service brakes are applied. When the trailer air supply valve is **pulled out**, the emergency circuit air pressure is exhausted; this in turn allows air pressure to exhaust from

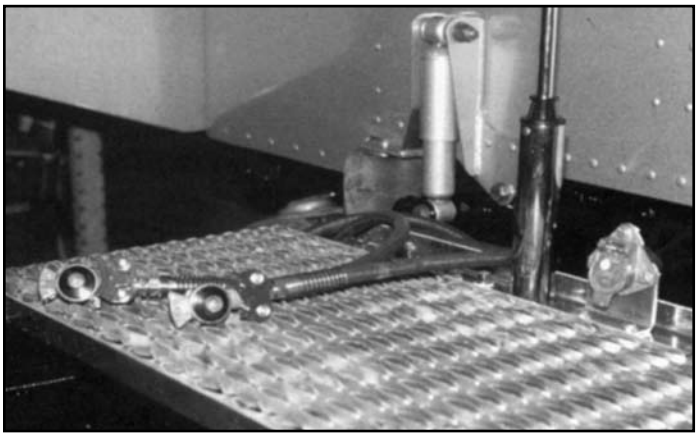

*Trailer Air Supply Valve (L) and Parking Control Vavle (R)*

the trailer spring brakes and causes them to apply. This action closes the trailer service line at the tractor protection valve. The trailer air supply valve will also automatically exhaust the emergency circuit air pressure if the tractor service air pressure drops below a minimum level.

The parking functions of the tractor and trailer are usually controlled by two dash-mounted valves. The yellow valve is the tractor parking control valve, and the red valve is the trailer supply valve. Depending on the sequence of operation, the driver can set the park brakes on the tractor only, the trailer only or both simultaneously.

### *Trailer Air Hoses*

Two air hoses connect to the trailer. One is the trailer supply (or emergency) hose, which is normally at full system pressure. The other is the trailer service or signal hose, which is connected to the hand valve and foot valve. Since tractors are not always operated with trailers, there must be a way of shutting off these two hoses when the tractor is operated bobtail (without a trailer). This is done through the red trailer supply valve on the dash. When this valve is pulled out, it shuts off the trailer supply line and causes the tractor protection valve to close the trailer service line. This system is also used to protect the tractor air system in case of a trailer breakaway or similar failure. In a breakaway, the trailer supply valve on the dash automatically pops out when the trailer supply line separates. When this valve is out, both trailer lines are shut off.



*Trailer Air Hoses*

At times, the driver may want to park the tractor but still supply air to the trailer. This can be accomplished by pulling out (closing) the yellow parking control valve and pushing in (opening) the red trailer supply valve.

## Brake Operation

### Spring Brakes

The spring brakes are vital to the vehicle's stopping ability if air flow to the rear system is disrupted, creating an emergency situation. The spring brakes also serve as the vehicle's parking brakes.

The function of the spring brake chamber is to supply mechanical force for parking. A powerful coil spring constantly pushes the rod in the application direction, but air pressure keeps the rod from applying its brake. When air pressure is intentionally released (for parking), or when it leaks off (an emergency situation), the spring applies the brakes with such force that the truck cannot be moved until the spring is backed off. There are two methods of compressing the coil spring to its original position.

The first is to reintroduce air into the spring brake chamber by depressing the yellow park valve in the cab. This is the normal unpark procedure. The other method, called caging the spring brake, is mechanical and can be used if there is no compressed air available.

***WARNING: Caging the spring brakes can be very dangerous and should be done only by a trained technician. Also, it is important to note that a truck should not be driven without air pressure. Caging spring brakes on the road is used only to tow the vehicle to the shop.***

A special spring brake caging bolt is carried on the side of the spring brake chamber. After the protective cap is removed from the chamber end, the caging bolt is inserted into the chamber and engaged in the internal spring retainer plate. A nut is then tightened onto the caging bolt. This action pulls the spring retainer toward the brake chamber end. This compresses the coil spring and removes the spring pressure from the brakes.

### Foundation Brakes

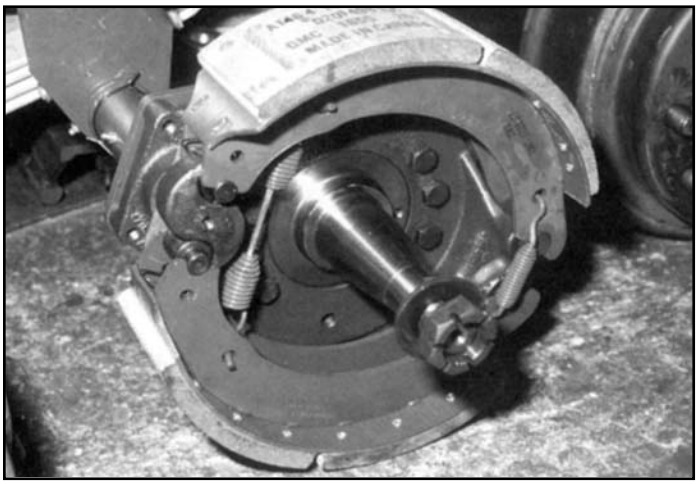
Brakes take the energy of motion and convert it into heat by forcing friction material against a drum or disc. The brake then dissipates this heat into the atmosphere. This is accomplished by the foundation brakes. The two styles of foundation brakes are drum brakes and disc brakes.

### Drum Brakes

Drum brakes consist of two arc-shaped shoes lined on their outside surfaces with friction material that is designed to press against the inner surface of an iron drum. When this occurs, the wheel, which is attached to the drum, is

slowed. Disc brakes have a flat steel rotor (the disc) which is squeezed on both sides by pads of friction material that are forced against the rotor by a caliper.

The pushing or clamping force in either brake type comes from the truck's compressed air system by way of the brake chamber, which in effect connects the air system to the foundation brakes. The chamber converts air pressure into mechanical force. When the valve is open, pressurized air pushes against a diaphragm at the end of a pushrod connected to the brake's slack adjuster. The pushrod pushes out of the chamber and rotates the adjuster (which serves as a lever arm) and it twists the actuation mechanism inside the foundation brake. The diaphragm's area in square inches identifies the chamber size. For example, a chamber with a 30-square-inch diaphragm is a type 30 chamber – a common chamber on heavy-duty vehicles.



*S-Cam Type Brake (Steer Axle)*

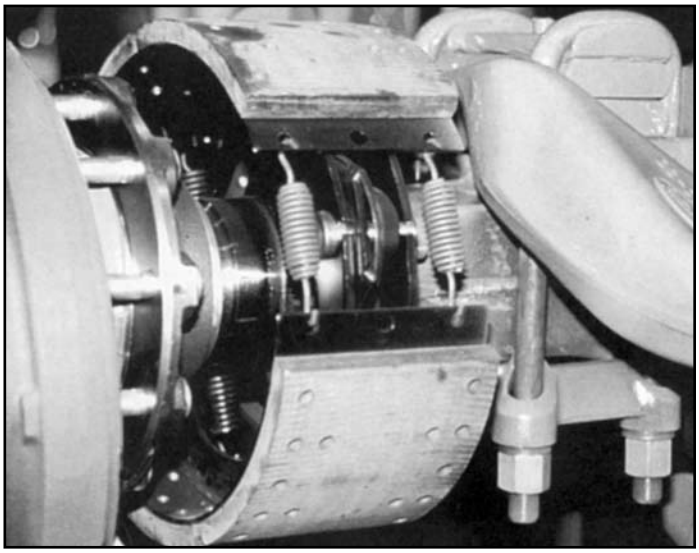
Drum brakes are mostly of the S-cam design. The S-cam has a main shaft with an S-shaped end which, when the shaft is twisted, pushes the two shoes apart and presses them against the drum.

Drum brakes vary in size depending on the axle weight rating and the surrounding wheel-tire assembly. For example, with 22.5-inch diameter wheels (a very common wheel size) on the drive axles, the brake "package," excluding the drum around it, measures 16.5 inches in diameter, and lining on the shoes is 7 inches wide. This brake is thus referred to as 16.5 by 7.

Because tractor steer axles are generally rated at 12,000 pounds, the brakes on a steer axle are smaller, usually 15 by 4 – that is, measuring 15 inches in diameter and 4 inches wide.

### *Drum Mounting*

Drums are classified as "outboard" or "inboard," depending upon their position relative to the axle end. Outboard mounted drums are the most common arrangement. In this case, the brakes are mounted just inboard of the hubs to a flange on the axle housing. The drum slips over the hub and brake with the drum flange secured by the wheel studs between the hub and wheel. The advantage of the outboard drum type is that the drum can be removed to reveal the brake shoes without disturbing the hub, wheel bearings or oil seals. This design results in lower cost brake repairs. Peterbilt is standard with outboard-mounted brake drums.



*Outboard Drum Type*

With an inboard drum, the brakes are mounted farther in on the axle, so it is necessary to remove the hub to perform brake maintenance.

Most drums are made of cast iron, which is very effective at absorbing and dissipating heat from friction; cast iron hubs also wear well. For weight-sensitive haulers, a lighter steel shell drum is available. It is fabricated from sheet steel onto which molten iron is applied in a unique centrifuge process.

### *Hubs*

A vehicle's wheel is placed on the hub. The hub contains the inner and outer wheel bearings and is connected to the axle shaft at its outer-most end. The hub also contains the wheel seal. While hubs are usually made of cast ductile iron, they are also available in cast aluminum, which offers a substantial weight savings.

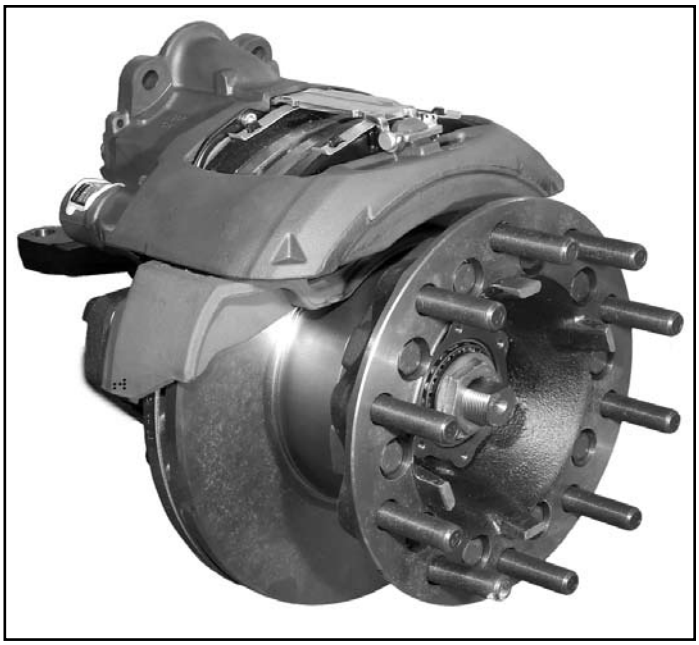
Peterbilt vehicles are standard with a hub-piloted wheel mounting system. Hub-piloted mounting is more effective at centering the wheel than ball seat mounting and thus affords a smoother ride and better tire wear. It also saves weight and provides for easier maintenance.

### *Brake Linings*

Suppliers of brake linings have various formulas for the composition of their linings, but fiberglass is commonly used. Linings are classified with alphabetical designations according to "aggressiveness." That is, an "FF" lining would be more aggressive than an "AA" lining. Lining aggressiveness is only one factor in the complex matter of setting up a truck braking system, so changing to a more aggressive lining will not necessarily mean better stopping ability.

## Disc Brakes

While newer cars and lighter-duty trucks use disc-type brakes, most heavy trucks still use drum brakes. Disc brakes are very effective in stopping a vehicle.



*Disc Brake Assembly*

Air pressure delivered to the brake chamber forces a brake piston to push the inner brake pad against the brake rotor (disc). The brake caliper slides on its guide pins to force the outer brake pad against the brake rotor, creating a squeezing action against both sides of the rotor. The squeezing on both sides of the rotor is why disc brakes are very effective at stopping a vehicle.

## Anti-Lock Braking Systems (ABS)

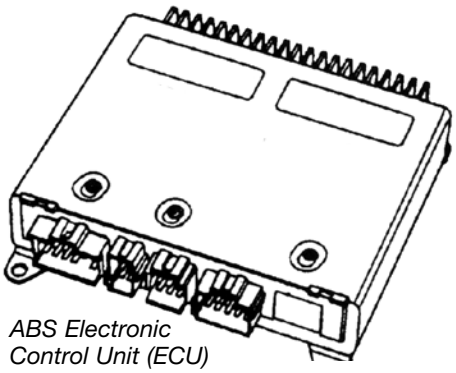
Safety has always been a concern in the trucking industry. After anti-lock brake systems were introduced, their use on passenger cars and light trucks grew rapidly, and this increased the public's awareness of the ABS system's advantages. Today, all Peterbilts are equipped with ABS, unless they are exempt from FMVSS 121.

Anti-lock is just what the name implies: a system that helps prevent wheel lock-up during severe braking. This is extremely important, especially for heavy trucks, since preventing wheel lock-up can reduce braking distances and the incidence of jackknifing.

The standard anti-lock system utilizes four wheel-end speed sensors that "read" the wheel speed. These sensors are mounted at the wheel ends themselves or in the drive axle housings.

Each sensor is installed so that its end is against a tooth wheel on the hub of the monitored wheel. The rotation of the tooth wheel changes the sensor's magnetic flux, creating a low-intensity AC electrical current. The sensor reads these changes as information, which it then sends to the electronic control unit (ECU).

The ECU is the brain of the system. It receives wheel speed information from the sensors, then sends signals to the modulator valves, which control the air pressure to each brake chamber. During normal braking, the modulator valve allows compressed air to flow freely to the brake chamber. During ABS operation, the modulator valve adjusts air pressure to the brake chambers to control wheel lock. As wheel speed decreases and approaches lock-up, the ECU modulates brake pressure at that wheel or axle to allow the wheel to continue rotating at just above the lock-up point so it won't lock and skid.



*ABS Electronic Control Unit (ECU)*

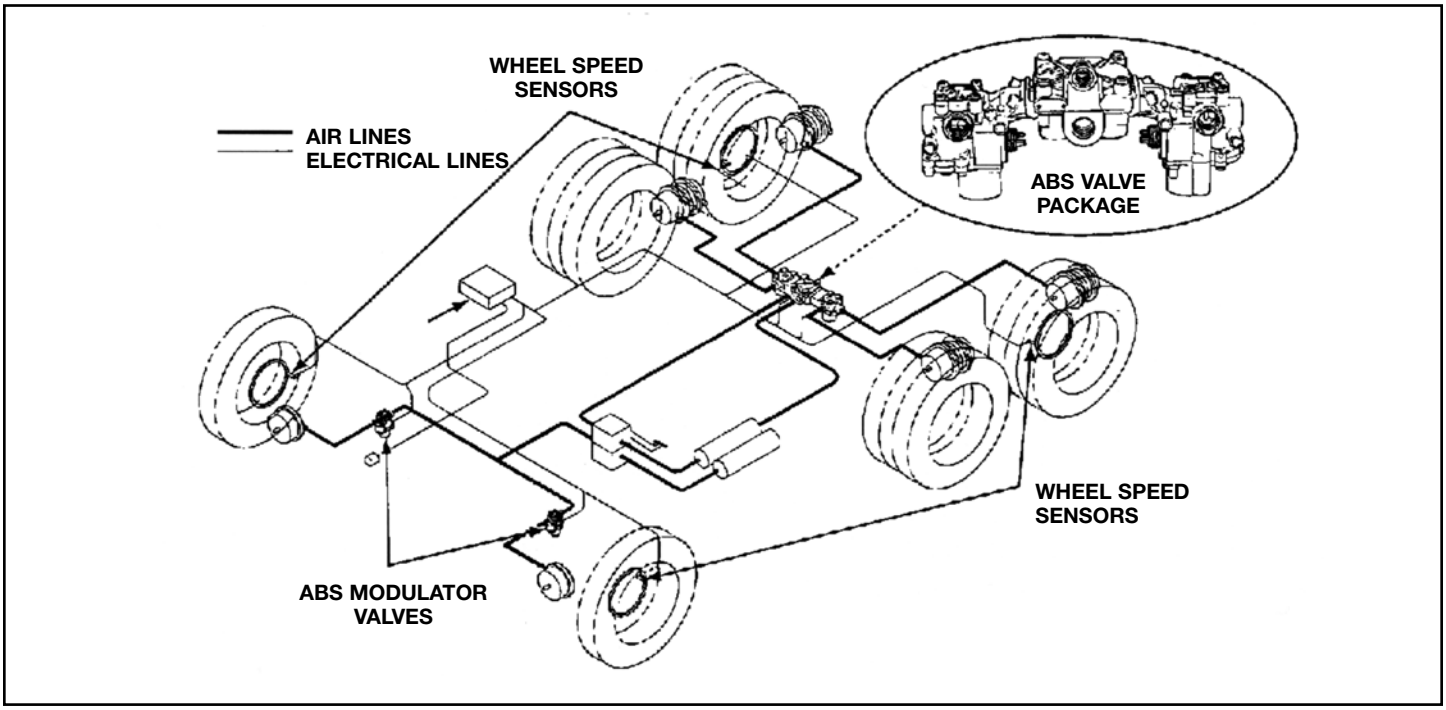



*Illustration of Anti-Lock Brake System*

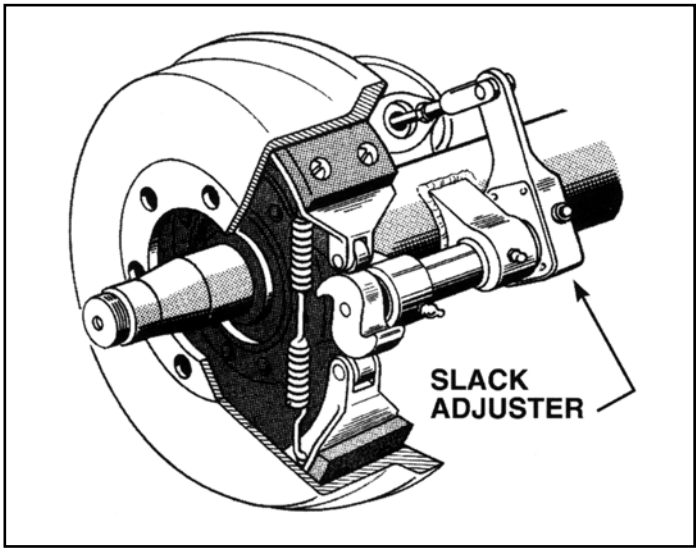
The ECU is cab mounted. The fuses, relays and diagnostic test button are also mounted inside the cab; the location varies with the truck model.

The benefits of ABS include the following:

- **Prevention of wheel lock-up:** ABS helps prevent wheel lock-up during emergency braking on slippery or uneven traction surfaces.
- **Enhanced control:** ABS greatly enhances vehicle stability during braking and allows improved steering control when the brakes must be applied in a curve.
- **Reduced tire wear:** ABS can help reduce tire wear and flat-spotting.
- **Accident reduction:** ABS can reduce the number of reportable accidents and thereby possibly have an impact on insurance costs.
- **Resale:** ABS may contribute to increased resale value of the vehicle.
- **Insurance discounts:** Most insurance companies offer discounts for trucks that are ABS-equipped.

## Slack Adjusters

Automatic slack adjusters (brake adjusters) are standard on all Peterbilt vehicles. They do exactly what their name suggests: they automatically adjust the brakes nearly every time they are applied or released. They accomplish this by using a worm gear and ratcheting mechanism to keep pushrod travel where it will allow optimal performance and ensure that the brakes will remain effective throughout their lining life. The adjusters form the interface between the brake's actuating mechanism and the pushrod from the brake chamber.




*Slack Adjuster*

## Wheel Seals

Wheel seals encapsulate the bearing lubricant that allows the wheels to spin freely around the axle spindle. Oil bath seals contain a liquid lubricant and are the type most often found on heavy-duty vehicles.