

*The braking system on a commercial vehicle is one of the most important safety systems, as well as one of the most misunderstood.*

The braking system is one of the most important safety systems on a commercial vehicle. Without a properly functioning brake system, the lives of the driver and the motoring public are in danger. While it is one of the most important systems, it is also one of the most misunderstood.

Air brakes use compressed air to make the brakes function. In an air brake system, air is stored under pressure and then delivered upon demand to the brake chambers located at each wheel or set of wheels. The function of the brake chamber is to convert air pressure into mechanical movement. The increase in pressure in the brake chamber displaces a rubber diaphragm that extends a steel push rod. This push rod ultimately activates the brakes. The foundation brakes, through friction, then act to slow and eventually stop the wheels.

*What elements compose an air brake system?*

The air brake system is composed of three major subsystems:

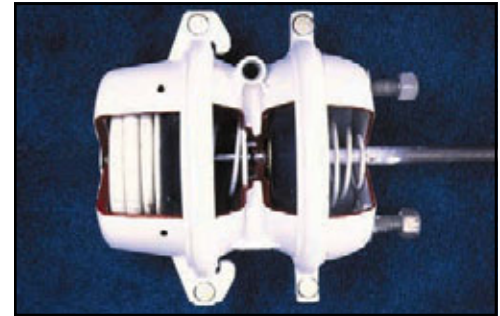
- Components that maintain a supply of compressed air,
- Valves that direct and control the flow of compressed air, and
- Mechanical parts that transfer the energy of the compressed air into the mechanical force and motion necessary to stop or slow the vehicle.

*Why are there two airlines going to the trailer?*

The tractor's air brake system is connected to the trailer's system by two airlines at the back of the cab. All air brake systems have to comply with Federal Motor Vehicle Safety Standards which require a dual circuit brake system. In the event of a leak or failure, emergency braking function is maintained.

The blue line (also called the service or control line) is used to send a pressure signal to the trailer brake valve to open and allow compressed air from the trailer air reservoir tanks to activate the trailer brakes.

The red line (also called the supply or emergency line) allows compressed air produced by the air compressor on the engine, to fill the trailer air reservoir tanks. In addition, the compressed air from the red hose is used to keep the spring brakes from activating. The spring brake is simply a large spring incorporated into the brake chamber.



*Cut-away view of a brake chamber with the spring brake.*

*What happens if one of the trailer airlines gets cut or becomes disconnected?*

In an emergency where the red (supply) air line pressure drops below about 35 psi (pounds per square inch), the tractor protection valve is activated which closes off the air supply to the trailer. The lack of air pressure activates the spring brakes on the trailer thereby stopping the vehicle. Tractors and trailers equipped with air brakes have at least one axle equipped with spring brakes; on a tractor, it must be a non-steer axle.

If the blue (service) line gets disconnected, there will be no indication to the driver that he has a problem until he steps on the brake pedal (foot valve). When he does, he will realize that he is losing air every time he pushes the foot valve. The driver can maintain air pressure in the tractor brakes for a short time by using them sparingly as he brings his vehicle to a controlled stop. If necessary, the driver can manually pull out the tractor protection valve causing the spring brakes to lock up the trailer wheels.

*What is a slack adjuster?*

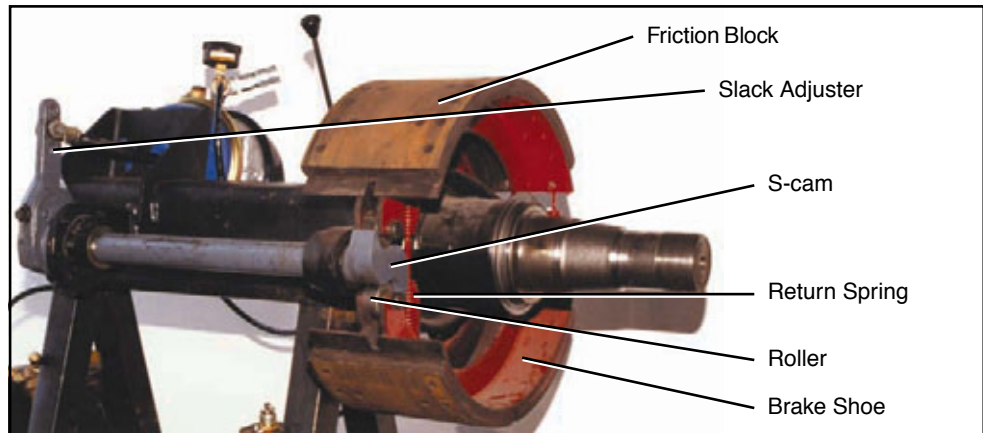
The slack adjuster is found at the end of a push rod that is, in turn, attached to the brake chamber. Proper adjustment of the slack adjuster is very important because the slack adjuster is responsible for adjusting the space or "slack" between the brake

*Ruhl Forensic, Inc.'s staff provide expertise in: mechanical and electrical engineering, collision investigation and vehicle dynamics, biomechanics and human factors, heavy vehicle driving and mechanical systems, federal regulations and compliance, fleet safety, traffic engineering, construction zone safety, OSHA, graphic visualization, and other areas.*

*Our experts provide a continuum of service from initial on-site investigations through research, testing and reconstruction to courtroom testimony and presentation graphics and visualization.*

*We offer quick response to your investigation needs 24 hours a day. Contact us by calling 1-800-355-7800, 1-800-235-2808, or 1-800-278-4095.*

*Please feel free to call us with any questions that you may have and we will direct you to the appropriate individual within our firm.*



*A common s-cam foundation brake is shown. When the driver steps on the treadle valve, the s-cam will rotate while pushing outward on the two rollers. This outward movement expands the brake shoes and pushes the friction blocks against the inside of the rotating brake drum. This produces friction and heat causing a retarding force on the brake drum and thus slows down the rotation of the attached wheel.*

shoes and the brake drum. Properly adjusted slack adjusters are essential to ensure the safe stopping ability of the vehicle and to comply with Federal Motor Carrier Safety Regulations (FMCSR).

*How often should the amount of slack be checked?*

Checking the slack in the brake mechanism is a part of a pre-trip inspection. A driver is required to complete a pre-trip inspection, a systematic check of the tractor-trailer's parts and systems, before every trip and/or at the start of the day, as required under FMCSR 392.7. There are both self-adjusting and manual slack adjusters.

*Do self-adjusting (automatic) slack adjusters need to be inspected during the pre-trip inspection?*

Yes. Every slack adjuster, whether manual or self adjusting, must be inspected as part of the pre-trip. A large number of out of service violations for out-of-adjustment brakes are for self-adjusting slack adjusters.

*What is brake lag?*

Brake lag is the time required for air to pass through the air brake system before

braking actually begins. It is important to include brake lag when calculating stopping distances for air-braked vehicles.

As you can see, an air brake system is quite different from the hydraulic system found in the typical automobile. It is imperative that the people investigating and reconstructing accidents involving air brakes have a thorough knowledge of the system and an understanding of its impact on a reconstruction. The staff of Ruhl Forensic is knowledgeable in the workings of the air brake system and understands its implications in accident scenarios.

For more information on this topic contact, Ruhl Forensic staff at [ruhl@ruhl.com](mailto:ruhl@ruhl.com), or by calling the Champaign, IL office at (800) 355-7800, the Scottsdale, AZ office at (800) 235-2808 or the Chicago, IL office at (800) 278-4095.

A much more in-depth discussion of air brakes and other topics involving the systems and operation of a commercial vehicle can be found in the Ruhl Forensic publication, *Truck and Trucking Handbook: A Primer* which is available for purchase through the Champaign, IL office or on the web at [www.ruhl.com](http://www.ruhl.com).