A dual air tractor system for towing a trailer.

**Note** — Depending on the air brake system configuration used, the hand control valve may be supplied from blended air, or from primary or secondary reservoir pressure.

To avoid confusion, the air supply source to the hand valve is not shown in this diagram or in the diagrams on the next two pages.

Dual air tractor-trailer system — foot valve applied

This diagram shows only the two service reservoirs, the dual foot valve, and the components that are added to a tractor with a dual air system so that it can safely tow a trailer with air brakes.

The components added are a trailer air supply valve, tractor protection valve, hand control valve, and a pair of two-way check valves.

Two-way check valves are installed so that whichever brake is applied — foot valve or hand valve — a control signal will be sent to the trailer.

The driver is making a foot valve application. The tractor front and rear brakes are being applied, and a control signal is being sent to the trailer through both of the two-way check valves.

Note that in most dual systems, the parking brake control valve (yellow button) is interlocked with the trailer supply valve (red button) so that applying the parking brake control valve causes all of the parking brakes on both the tractor and trailer to apply.

Some tractors are equipped with three dashboard control valves — the parking brake control valve (yellow button), the trailer supply valve (red button), plus a tractor parking brake valve with a round blue button that can control the **tractor parking brakes** independently of the trailer brakes.
Dual tractor-trailer system — primary air system failure

This diagram shows a tractor with a dual air system where there has been a failure in the primary air system on the tractor. The low-air warning would have alerted the driver to the problem and a glance at the reservoir gauges would confirm that only one part of the dual air system had been lost.

The driver is making a foot valve application, causing the tractor front brakes to apply. Application air from the secondary foot valve is also passing through both of the two-way check valves, to the trailer control line, signalling the trailer brakes to apply.

If the secondary system had failed, a foot valve application would apply the rear tractor brakes, directing air through both of the two-way check valves to signal the trailer brakes to apply.

The same motor vehicle safety standards that require automatic shutoff of the air supply to the trailer — in the event that the pressure in the tractor air system is lowered to between 20 and 45 p.s.i. (138 and 310 kPa) — apply equally to tractors with dual air systems.

Because the trailer supply valve is now supplied with “blended air” from a two-way check valve, the automatic shutoff will not occur until the service reservoir with the highest pressure is lowered to between 20 and 45 p.s.i. (138 and 310 kPa).

The automatic shutoff requirement should be checked as part of a pre-trip inspection. If it doesn’t function properly, the vehicle must be placed out of service until it is repaired.

Despite the ruptured air line from the primary reservoir, the driver can still make a controlled stop.

A peace officer may place a trailer out of service if the trailer brakes don’t apply when the trailer air supply valve is closed.
This diagram shows how the tractor protection valve and the trailer air supply valve act together to protect the tractor air supply from being depleted to an unsafe level if the trailer separates, causing the connecting lines to rupture. The sudden loss of air through the broken trailer supply line has caused the trailer air supply valve to shut off automatically.

The driver is making a foot valve application, causing the tractor service brakes to apply. The application pressure is also passing through both of the two-way check valves to the tractor protection valve.

Because there is no pressure in the supply line to the trailer, the tractor protection valve has closed the passage to the trailer control line. No application air can be wasted through that broken line.

If the control line separates, nothing will happen until the trailer brakes are applied. When that happens, the tractor protection system will activate to protect the tractor air supply.

When no trailer is connected, the trailer air supply valve will be in the closed position. This allows the tractor to be driven bobtail so that no air will be lost through the disconnected glad hand couplers.

**Other types of foundation brakes**

Here are the three other types of foundation brakes found on air-braked vehicles:

- wedge brakes
- air disc brakes
- air-over-hydraulic brakes.
Wedge brakes

This type of brake uses one or two small air chambers with wedge-shaped pushrods. Wedge brakes are usually found only on steering axles.

When the brakes are applied, air pressure in the brake chamber pushes the wedge part of the pushrod between two rollers, forcing the brake linings out to contact the brake drum.

Most wedge brakes have internal automatic adjusters. Checking proper adjustment requires that inspection hole covers in the backing plate be removed so that brake linings movement can be checked while the brakes are applied and released. If either linings move more than $\frac{1}{16}$ of an inch, or a total of $\frac{1}{8}$ of an inch for both linings, the automatic adjusters have failed.

Unlike conventional s-cam braking systems, drivers can’t easily check the wedge brake adjustment of a wedge brake.

Adjustment and repairs to wedge brakes should only be done by a qualified mechanic.

Air disc brakes

This type of brake uses a rotor, or disc, that’s mounted to the wheel hub and rotates with the wheel. Two brake pads are located on either side of the rotor. When applied, the brake pads are pressed against the rotor. This action is similar to that of a large “C” clamp.
There are a number of different linkages used between the air chamber and the operating mechanism. This illustration only shows one type, but the principle of the others is similar.

Most air disc brakes feature an internal automatic brake adjustment mechanism to adjust for brake pad wear. Chamber stroke limits are the same as for automatic slack adjusters.

Unlike conventional s-cam braking systems, drivers can’t easily check the adjustment of an air disc brake.

Make sure adjustment and repairs to air disc brakes are only done by a qualified mechanic.

**Air-over-hydraulic brakes**

Air-over-hydraulic brakes are often found on middleweight trucks and buses. This type of braking system combines the features of an air brake system and a hydraulic braking system.

Hydraulic foundation brakes offer several advantages on commercial vehicles of this size, including light weight, compact size and proven automatic adjusting mechanisms.

Most middleweight commercial vehicles of this size were once powered by gasoline engines, which supplied a source of engine vacuum so that vacuum boosters for the hydraulic brakes could be used. The now-common diesel engine doesn’t supply a usable vacuum, so a partial air brake system has been adopted.

An air-over-hydraulic braking system (above) consists of a compressor, governor, air storage tanks, foot valve and two air-over-hydraulic pressure intensifiers. The system may also include spring parking brakes. Like a full air brake system, typical air-over-hydraulic braking systems use a standard air pressure of around 125 p.s.i. (862 kPa).
A standard dual air foot valve is used. Pressing on the foot valve directs air pressure to the air-actuated side of the hydraulic pressure intensifiers, causing the hydraulic-actuated side of the intensifiers to direct hydraulic pressure to the foundation brakes. In other words, air pressure actuates the braking action, but hydraulic pressure delivers the braking force to the foundation brakes to stop the vehicle.

To provide a parking brake, many air-over-hydraulic braking systems have a parking brake chamber attached to the foundation brake.

The parking brake is controlled by the same dashboard-mounted parking brake control valve used on vehicles with full air brake systems. Applying the parking brake control valve on the dashboard applies the spring in the parking brake chamber, which forces a wedge between the brake shoes to apply the brakes. Releasing the parking brake control valve directs air pressure to the parking brake chamber to contract the wedge and spring.

Like a full air brake system, if there were a serious air leak in an air-over-hydraulic system, eventually the brakes would stop functioning properly. For this reason, drivers need to know and understand how the system works, and check air pressure gauges frequently.

Other air brake system components

Here are other components commonly found in air brake systems.

Air dryers

Air dryers are optional devices that are installed in the compressor discharge line between the compressor and the first reservoir. They’re designed to remove any water vapour, oil mist and carbon particles from the air before it’s delivered to the first reservoir.

The warm, moist air from the compressor enters the dryer where a certain amount of the water vapour condenses on cool metallic surfaces. The air then passes through a filter that removes any oil and through another filter that removes the remaining water vapour. From there the clean air passes through an internal one-way check valve, and onto the first reservoir.

When the reservoir has come up to full pressure, a purge port in the bottom of the air dryer will open. The collected contaminants are ejected along with a sudden burst of air.

At the same time, a certain amount of clean air is allowed to flow back through the filters. This reverse flush effect cleans both filters in readiness for the next compression cycle. The purge port remains open until the compressor resumes pumping.

Some air dryers are equipped with an electric heating element to prevent freezing in cold weather.

In systems with an air dryer, the safety valve is often installed at the air dryer rather than at the supply reservoir.