Compressor

The first requirement of an air brake system is a way to compress air and store it in reservoirs (tanks) so that it's available for instant use.

The source of the compressed air is the compressor, which takes in air from the atmosphere and compresses (pressurizes) it. The compressed air is then pumped through an air line to a supply reservoir.

The compressor is mounted on the engine of the bus or truck. On most new engines, the compressor is mounted on the side of the engine and driven by gears. A belt, like a fan belt, drives some compressors. As long as the engine is running, the compressor will be running.

All trucks use piston-type air compressors. They may have one, two or four cylinders depending on the vehicle’s volume demands.

When air is compressed, its temperature rises. With a truck air compressor operating at a pressure of 120 p.s.i. (827 kPa), the air temperature as it leaves the compressor is over 204° C (400° F).

To prevent the compressor from overheating, two types of cooling systems are used. The most common method on heavy trucks is to circulate engine coolant through the compressor, while some compressors on lighter units may be air-cooled.

Oil lubricates the moving parts of the compressor, just like oil is used to lubricate the moving parts of a car’s engine. Oil also helps to cool the compressor. The compressor is usually lubricated from the same oil as the engine of the truck or bus, though some compressors have their own oil supply. It's important to check that there is sufficient oil supply.
Since the compressor pumps air, it needs a supply of clean air to work properly. Air from the atmosphere supplies both the truck engine and the compressor. An air filter is used to keep this supply clean. The air filter should be checked regularly to make sure it is not clogged.

A piston-type compressor operates on a similar principle to that of the intake and compression strokes of a typical car engine.

**Intake stroke**

As the piston moves down in the cylinder, it creates a lower pressure (vacuum) within the cylinder than the atmospheric pressure outside the compressor. With the inlet valve open, air is then drawn into the cylinder to fill the vacuum.
Compression stroke

When the piston reaches the bottom of the cylinder, it begins to rise. The inlet valve closes, causing the air in the cylinder to compress. As the piston nears the top of the stroke, the discharge valve opens, and the pressurized air is forced past the valve and into the discharge line leading to the reservoir.

Governor

The compressor is capable of compressing air to over 500 p.s.i. (3,448 kPa). This is far higher than is needed to operate an air brake system. Most current air brake systems operate with a maximum pressure of 125 p.s.i. (862 kPa).

There needs to be a way to stop compressing air once a certain air pressure has been reached. And, if the air pressure in the tanks drops below a certain level (such as after a series of brake applications), there needs to be a way to start compressing air again.

This is the job of the governor. When enough pressure has been built up, the governor causes the compressor to go into an “unloading” stage.

Governors are usually set to unload the compressor (stop the compressor from pumping air) when the air pressure reaches about 125 p.s.i. Although the maximum pressure on different vehicles may vary between 105 and 135 p.s.i. (724 and 931 kPa), the range between minimum and maximum pressure should be approximately 20 p.s.i. (138 kPa).

For example, if the maximum air pressure was 125 p.s.i., the governor would restart the compressor if air pressure in the reservoirs dropped to 105 p.s.i. (applying the brakes several times would likely cause the air pressure to drop to this level). At any rate, the governor must restart the compressor if the air pressure drops below 80 to 85 p.s.i. (552 to 586 kPa).
Steel tanks (known as reservoirs) are used to store the compressed air from the compressor. A safety valve on the first reservoir protects the reservoirs from being over-pressurized and bursting if the governor fails to unload the compressor. The safety valve consists of a spring-loaded ball to allow reservoir air to exhaust into the atmosphere. The valve's pressure setting is determined by the force of the spring. Safety valves are normally set to vent the excess pressure at approximately 150 p.s.i. (1,034 kPa).

If the safety valve has to relieve the pressure, the governor or compressor needs service or repair. Only a qualified mechanic should do this. The air that’s delivered from the compressor usually contains some water vapour that condenses into liquid water. This is why the supply reservoir is often called the wet tank. Most compressors also pass a small amount of oil and carbon particles. The oil and any other contaminants mix with the water, making a grey sludge.

If allowed to accumulate, this sludge would enter other components of the braking system. Too much water in the system causes trouble with valves and other parts. In winter, water in the system may freeze, causing malfunction of valves or brake chambers.

To prevent this sludge from contaminating the air valves in the system, drain valves (also known as drain cocks) are installed in all reservoirs. Draining the reservoirs can prevent this sludge build up. Most manufacturers recommend that you drain reservoirs daily.

Pressing on the brake pedal (called the foot valve treadle) applies the air brakes, just like stepping on the brake pedal applies the brakes in a car.
The treadle (pedal) of a foot valve has a springy feel that is quite different from the feel of a hydraulic brake pedal of a car. For one thing, you really don’t have to press harder on a foot valve to apply more braking force — you simply have to press it down a bit farther. If the foot valve is held in one position, the air pressure delivered to the brake system will remain constant. Releasing the foot valve allows the application air to be exhausted through the assembly’s exhaust ports to the atmosphere.

In effect, it is a foot-controlled pressure regulator. It’s the device that allows you to select any application pressure needed to make a gentle, or a very rapid stop.

A unique feature of a foot control valve is the ability to maintain the application pressure that you’ve chosen, even if there are small leaks downstream from the foot valve. You need only to maintain the treadle position and the foot valve will momentarily open, replenish any air that has been lost, and then close — all automatically.

How air brakes work

Brakes applied

In this simplified diagram, air at full system pressure is indicated by the dark shading in the line connecting the supply reservoir to the foot valve.

The driver is making a brake application. This can be seen by the light shading in the air lines connecting the foot valve to the air chambers. Arrows show the direction of air flow.

The air chambers are pressurized and the brake linings have contacted the brake drums, slowing the vehicle.
Brakes released

In this simplified diagram, the driver’s foot is off the brake pedal, allowing the brakes to release. This action has caused an exhaust port in the bottom of the foot valve to open, allowing the air that was applied to the brake chambers to escape. Note the burst of exhaust air below the foot valve.

The return springs in the air chambers have returned the pushrod assembly to the released position, and the slack adjusters and s-cams have rotated to their released position.

Brake shoe return springs (not shown) have retracted the brake linings away from the brake drums.

Dual air brake systems

Dual air brake systems have been in use since the mid-1970s.
The device that made dual systems possible is the **dual foot valve**. It’s actually two control valves operated by a single pedal. This allows the brake system to be divided into two completely independent sections. Each section has its own supply, delivery and exhaust ports.

The two sections of the dual foot valve are the **primary** and **secondary**. The primary section is located closest to the pedal, and in many systems operates the drive axle brakes. The secondary usually operates the steering axle brakes.

When the driver applies the brakes, both sections of the dual foot valve are activated. Air from the primary tank is applied to the rear axle brakes and air from the secondary tank is applied to the front axle brakes.

Most dual systems use three reservoirs: a supply reservoir and two service reservoirs, one for each section of the dual system. Each service reservoir is filled through a one-way check valve, and there are two reservoir pressure gauges, one for each service reservoir.

Even if one or the other system totally fails, the driver is able to make a controlled stop using only the foot valve, although maximum braking power will be reduced.

There are other ways of splitting a dual air brake system. However it’s divided, if one of the systems fail, the driver is still able to make a controlled stop.

Note the change in terminology for the reservoirs. The first reservoir (wet tank) is called the **supply reservoir**. The two service reservoirs are called the **primary reservoir** and **secondary reservoir**, indicating the section of the dual foot valve that they supply.

Some dual systems have the low-air warning device connected to the supply reservoir as shown, while others have two separate connections, one located on each service reservoir.

### Components of a dual air brake system

#### Supply, primary and secondary reservoirs

The compressed air from the compressor contains several contaminants including water vapour, oil mist and carbon particles. Most contaminants settle in the supply reservoir. Primary and secondary reservoirs have been added so that all the air brake components, with the exception of the governor valve, are supplied with cleaner air.

#### One-way check valve

One-way check valves allow air to flow from the supply reservoir to the primary and secondary reservoirs. As the name implies, a one-way check valve allows air to flow in one direction only.

This is so the air supply in the primary and secondary reservoirs wouldn’t flow backward and be lost if there’s a failure in the air compressor, compressor discharge line, or supply reservoir.
Reservoir pressure gauges

All air brake-equipped vehicles have at least one air pressure gauge on the instrument panel to indicate the air pressure in the service reservoir system.

Rather than having two separate reservoir gauges, many vehicles have a single gauge with two needles, indicating the pressure in the primary and secondary reservoirs.

Many vehicles also have a gauge to indicate how much air pressure is being applied when the foot valve is depressed.

The reservoir pressure gauge is mounted in the dashboard so you can monitor the status of the air brake system while driving and during a pre-trip inspection.

Low-air warning device

All vehicles equipped with air brakes must have a warning device to indicate if the air pressure in the system drops to a dangerous level. This could occur if there’s an air leak, or if you apply the brakes repeatedly and have used up the air supply more rapidly than the compressor can replenish it.

The low-air warning device must come on when air pressure drops below 60 p.s.i. (414 kPa).