Brakes

Air Brake Types

Air brakes use compressed air to make the brakes work and must be well maintained and used correctly. The air brake system consists of three braking systems combined:

— The **service brake** system applies and releases the brakes when you use the brake pedal during normal driving.

— The **parking brake** system applies and releases the parking brakes when you use the parking brake control.

— The **emergency brake** system uses parts of the service and parking brake systems to stop the vehicle in the event of a brake system failure.

**NOTE:** A vehicle’s air brake system must contain the following which will be checked during the pre-trip inspection test:

— Air gauges.

— Air compressor cut-in and cut-out.

— Low pressure warning devices.

**NOTE:** A full service brake application must deliver to all brake chambers not less than 90 percent of the air reservoir pressure remaining with the brakes applied.

Air Compressor, Governor, Storage Tanks, Air Drier & Purge Valve

The **air compressor** pumps air into the air storage tanks (reservoirs). The air compressor is connected to the engine through gears or a V-belt. The compressor may be air cooled or may be cooled by the engine cooling system.

The **governor** controls when the air compressor will pump air into the air storage tanks. When air tank pressure rises to the “cutout” level (no higher than 130 lbs. per square inch, or “PSI.”), the governor stops the compressor from pumping air. When the tank pressure falls to the “cut-in” pressure (no lower than 100 PSI.), the governor allows the compressor to start pumping again.

**Air storage tanks** are used to hold compressed air. The tanks will hold enough air to allow the brakes to be used several times even if the compressor stops working. A one-way check valve is located between the compressor and the first reservoir. The check valve keeps air from going out if the air compressor develops a leak. Compressed air usually has some water and some compressor oil in it. This is bad for the air brake system. For example, the water can freeze in cold weather and cause brake failure. The
water, oil, etc., tends to collect in the bottom of the air tank. Each air tank is equipped with a drain valve in the bottom. Most, current apparatus are equipped with an air drier and purge valve.

With an air drier, compressed air is passed through a pressure vessel with two "towers" filled with a media such as activated alumina, silica gel, molecular sieve or other desiccant material. This desiccant material attracts the water from the compressed air via adsorption. As the water clings to the desiccant, the desiccant "bed" becomes saturated. Once this cycle completes some compressed air from the system is used to "purge" the saturated desiccant bed by simply blowing the water that has adhered to the desiccant off.

The brakes are applied by pushing down the brake pedal (also called the foot valve or treadle valve). The harder you push down on the pedal, the more air pressure is applied from the storage tanks into the brake chambers. Letting up on the brake pedal exhausts the air pressure from the brake chambers and releases the brakes. The air pressure used to apply the brakes must be built up in the reservoirs by the compressor. Pressing and releasing the pedal (fanning) can unnecessarily let air out faster than the compressor can replace it. If the pressure gets too low, the brakes will not work.

When the brake pedal is depressed, two forces push back against the pedal. One force comes from a spring in the valve. The second force comes from the air pressure going to the brake chambers. This lets the operator feel how much air pressure is being applied to the brake chambers. This "feel" does not tell how much force is being applied to the brakes because that depends on brake adjustment.

Drum brakes (foundation brakes) may be used at each wheel. The most common type is the S-cam drum brake.

**S-Cam Or Drum Brakes**

When you push the brake pedal, air is let into each brake chamber. Air pressure pushes the rod out, moving the slack adjuster, thus twisting the brake cam shaft. This turns the S-cam. The S-cam forces the brake shoes away from one another and presses them against the inside of the brake drum. When the brake pedal is released, the S-cam rotates back and a spring pulls the brake shoes away from the drum, letting the wheels roll freely again. Most of the brush units utilize drum brakes.

**Disc Brakes**

In air-operated disc brakes, air pressure acts on a brake chamber and slack adjuster, like S-cam brakes. But instead of the S-cam, a “power shaft” is used. The pressure of the
Brakes chamber on the slack adjuster turns the power screw. The power shaft clamps the disc or rotor between the brake lining pads of a caliper, similar to a large C-clamp.

**Gauges**

All air-braked vehicles have an air supply pressure gauge connected to the air tank. With a dual air brake system, there is a gauge for each half of the system or, sometimes, a single gauge with two needles. These gauges tell you how much air pressure is in the air tanks.

The application pressure gauge shows how much air pressure you are applying to the brakes (some vehicles do not have this gauge). When going down steep grades, if increased brake pressure to hold the same speed is required it may mean the brakes are fading due to excess heat buildup. The need for increased pressure can also be caused by brakes out of adjustment, air leaks, or mechanical problems.

A low air pressure warning device is required on vehicles with air brakes. A warning light and buzzer which you can see must come on when the air supply pressure drops below 60 PSI.

**Spring Brakes**

Escondido Fire Department vehicles that use air pressure to apply the service brakes are equipped with emergency brakes and parking brakes. The parking brake must be held on by mechanical force (because air pressure can eventually leak away). Spring brakes are usually used to meet the emergency and parking brake requirements. When driving, powerful springs are held back by air pressure. If the air pressure is removed, the springs put on the brakes. A parking brake control in the cab allows the driver to let the air out of the spring brakes. This lets the springs put on the brakes. A leak in the air brake system will generally cause the springs to put on the brakes.

The spring brakes will come fully on when air pressure drops to a range of 20 to 45 p.s.i. Do not wait for the brakes to come on automatically. When the low air pressures warning
light and buzzer first come on, bring the vehicle to a safe stop right away while you can still control the brakes.

The braking power of spring brakes depends on the brakes being in adjustment. If the brakes are not adjusted, neither the regular brakes nor the emergency/parking brakes will work correctly.

The parking brakes are applied using a diamond shaped, yellow, push-pull control knob. Pull the knob out to set the parking brakes (spring brakes), and push it in to release them. Use the parking brakes whenever you park.

**Measuring Slack Adjusters**

Some air brake systems in our fleet require measuring the distance between the push rod and the brake can. Other systems are enclosed and are measured by Fleet Services. When required it is completed every Tuesday by the Engineer to ensure a 90 degree angle or less between the slack adjuster and the push rod. Once the angle is over 90 degrees it must be adjusted by shops. The distance of push rod travel is 2" - 2 ½" depending on the size of the brake can but the key is 90 degrees or less when the brake pedal is applied. The measurement is important to maintain the strength of the brake pads against the rotor. If out of adjustment, braking power will be affected and may influence the unit’s ability to come to a quick stop.

Using safety glasses and hearing protection:

— Chock in front of and behind one set of rear duals.
— Release the brakes by depressing the parking brake knob
— Measure the distance from the surface of the can to the clevis pin on the push rod
— Have someone depress the brakes and re-measure
— Subtract the released measurement from the depressed.
— Record that figure. Generally it should be 2” or less.
— If over two consult with the Captain

The driver operator/engineer must determine whether measurement is required for the unit assigned to.

**Summary**

All this information is not meant to confuse but to give a broad summary of selected mechanical principles of brake operation. If you don't understand how something works, it can be very difficult to repair or to detect what is broken. Fleet Services, Motive Department does most of the repairs. Fleet Services has much more detailed service manuals on apparatus, engines, and other accessories.
DOT/DMV COMMERCIAL AIR BRAKE TEST PROCEDURE

Here is what is expected to be completed, in this order, when performing a Commercial Vehicle walk-around test

**Step #1**
Test the LOW PRESSURE WARNING SIGNAL by executing the following steps:
1. With the engine off supply electrical power to all gages by turning the ignition on only.
2. Slowly fan down the brakes pausing in between each fan in order to wait for the buzzer/light to come on.
3. Continue to do this until the low air-warning buzzer and light come on completely, this should happen between 75 & 55 psi.
4. When this happens record an exact air pressure reading from both the primary and secondary air gauges.

**Step #2**
Check that the spring brakes come on automatically by performing the following steps:
1. Chock the wheels.
2. Release all parking brakes and shut the engine off.
3. Pump the brake.
4. Air supply valve knob should pop out when the air pressure falls to the manufacturer’s specifications (usually in a range between 45 to 20 psi).

**Step #3**
After completing step #2 start the engine in order to perform step #3 which is CHECKING THE AIR COMPRESSOR GOVERNOR CUT-OUT PRESSURE. Execute the following steps:
1. Run the engine running at a faster than normal idle in order to build up the air pressure faster.
2. While doing this watch the pressure gauges closely.
3. Give an exact air pressure reading from both the primary and secondary air gauges.
   **The Governor should cut-out no more than 130 psi.**

*SPECIAL NOTE: ONCE COMPLETED WITH STEP #3, CONTINUE TO RUN THE VEHICLE UNTIL YOU HEAR THE GOVERNOR CUT-OUT AND BOTH AIR PRESSURE GAUGES HAVE STOPPED MOVING.*
Step #4
Now check the AIR COMPRESSOR GOVERNOR CUT-IN PRESSURE, this is done by executing the following steps:
(1) With the engine still running from Step #3, Begin to slowly fan the brakes down.
(2) Watch both air pressure gauges closely to see if the needles start to move up in-between each fanning of the brakes.
(3) When the needle in the primary air pressure gauge begins to move this is your governor cut-in pressure.
(4) Give an exact air pressure reading from both primary and secondary air gauges.
** The Governor cut-in level should be no lower than 100psi.**

Step #5
Now perform the APPLIED BRAKE CHECK, this is done by executing the following steps:
(1) Push in the park brake knob to release the Apparatus parking brakes.
(2) Watch both air pressure gauges until both needles have settled and are no longer moving.
(3) Apply full steady pressure on the foot brake pedal and again watch both air pressure gauges.
(4) Once both air pressure gauge needles have stopped moving/ settled give an exact air-pressure reading from both my primary and secondary gauges.
(5) Continue to hold fill-steady pressure on the brake pedal for 1 minute (which you will time with a watch).
(6) After 1 minute, and prior to releasing the foot pedal give an exact air-pressure reading from both the primary and secondary gauges. You should not have lost more than 3psi for a single vehicle.
(7) Set the Apparatus parking brakes and release the foot pedal brake.

AIR BRAKE TEST PROCEDURES AND PRE TRIP INSPECTION MAY VARY DEPENDING ON LOCATION AND STATE REQUIREMENT AND OR UPDATES IN LAWS OR PROCEDURES.