

## Test procedures for air brake systems

### Purpose

To advise Heavy Vehicle Authorised Inspection Station (HVAIS) examiners of the procedures to be used for the inspection and testing of compressed air brake systems on heavy vehicles.

### Introduction

The procedures described in this bulletin are to be used for the inspection and testing of compressed air brake systems on heavy vehicles. The procedures also apply to vehicles equipped with vacuum operated brakes (ie air pressure also means vacuum in this instance).

Before carrying out these test procedures note the following:

- Some bogie-drive vehicles may be fitted with differential interlocks or power dividers which are permanently engaged. Caution must be used when testing these axle groups on brake roller testers as drive will be transmitted to the axle which is not turning. This will cause the vehicle to climb out of the rollers unless that axle is jacked clear of the ground.
- Use wheel chocks where testing is not on a brake roller tester, to prevent the vehicle from moving in the event of brake release or failure. Always select suitable level ground.
- The vehicle should be operated by the vehicle owner (or their representative) during these tests.
- Observe any manufacturer's shut-down instructions before switching off the engine (eg idle engine for five minutes to prevent turbo charger damage).
- Suitable fittings may be required to exhaust air from self-sealing air line connectors.

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**For:** • HVAIS Proprietors and Examiners

**Cc:** • Engineering Signatories • RTA Inspectors Vehicle Regulation • RTA Registry Service Managers

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# Section I. Pre-ADR 35 heavy vehicles

equipped with single or dual circuit compressed air brake systems

## **BRAKE SYSTEM REQUIREMENTS**

### **1. Drain valve**

A manual or automatic drain valve must be fitted at the lowest point of each air brake reservoir in the system.

### **2. Pressure warning device**

Each vehicle must be equipped with a low air pressure (or low vacuum) warning device that provides the driver with an audible or visible warning that the vehicle manufacturer's minimum safe working brake air pressure or vacuum has been reached.

This device can be either a buzzer, a red warning light, a flag, or a gauge (marked to instantly show a minimum safe operating pressure).

Where a single brake power unit is used (ie in some air/hydraulic or vacuum systems) an audible warning device must be fitted.

When these devices first activate, there must remain sufficient air pressure or vacuum to provide for two full applications of the service brake.

### **3. Tractor protection system**

Every motor vehicle which is equipped to tow a trailer must be provided with a tractor protection system designed to protect its air brake system in the event of inadvertent separation from its trailer.

The tractor protection device must prevent the towing vehicle's brake system air pressure from falling below the manufacturer's minimum requirement (if known) or 300 kPa (45 psi).

This device must provide an audible or visible warning to the driver that it has activated.

Note: In some vehicles, this warning device may also function as the low air pressure warning device.

### **4. Air system charging time**

The time taken to charge the air system from empty to 80% of the governor cut-out pressure must not exceed 5 minutes.

Vehicles with vacuum operated brakes must be capable of charging their systems after being fully depleted, from buzzer 'ON' to buzzer 'OFF' in 30 seconds and from buzzer 'ON' to normal operating level in 60 seconds.

## **BRAKE TEST PROCEDURE**

### **I. Generally inspect all of the vehicle's brake equipment including drums/discs, brake hoses and chambers, slack adjusters and actuators, relay valves, tanks, pipes and fittings, etc.**

- Check that components are secured and are not deteriorated, worn or damaged.
- Check for over-travel of slack adjusters during brake application.
- Check the condition of compressor hoses/fittings, drive belt & pulley (if fitted).
- Check for the presence of the compressor air filter.
- Check for the presence of visible brake failure indicators and ensure they are operational.

**2. Have the driver start the engine and build up sufficient air pressure so that the low air warning device is off.**

- Then, have the driver apply the service brakes several times until this device activates.
- Note the pressure at which this occurs.

**3. Have the driver build the air back up until maximum air pressure is reached (ie to the governor cut-out point).**

The maximum pressure reached must not exceed the manufacturer's allowable maximum operating pressure limit (if known), or 650 kPa.

- Note this pressure limit as it is required later.
- Once this pressure has been reached, have the driver switch off the engine (the ignition may need to be returned to the 'ON' position for the gauges to operate).
- Observe any manufacturer's shut down instructions before switching off the engine (eg idle engine for five minutes to prevent turbo charger damage).

**4. Check service brake operation.**

- Ensure that the parking brake control is in the 'OFF' position.
- For truck/trailer combinations equipped with hand controls, ensure that the brake proportioning device is in the 'FULL-ON' position.
- Have the operator apply the service brake and hold the pedal depressed.
- Check that the brakes operate on all wheels by observing movement of 'slack adjusters' or in the case of wedge brakes, by gripping the air line and feeling for a pulse in the line when the brakes are applied (take care not to damage the line during this operation).
- Listen for any leaks (other than the normal exhausting of valves) and watch for any drop in air pressure while the service brake is applied.

A maximum drop of more than 20 kPa (plus 5 kPa for each attached trailer) is unacceptable.

- Ensure that the actuators release immediately the brake pedal is released.

**5. Have the driver release and fully apply the service brake another four times.**

The air pressure must not drop below half of the maximum level achieved in step 3.

**6. Have the driver continue to apply and release the service brake pedal to completely drain air pressure.**

Spring brakes which apply at this stage must only operate after the low pressure warning device actuates (see step 2).

Once activated, the spring brakes must be capable of being released at least twice by application of the spring brake release control.

This spring brake release control must be located within reach of the driver when seated in the normal driving position.

**7. Instead of spring brakes, some vehicles may be fitted with parking lock actuators.**

(see Section 3 – Brake components).

These actuators must be provided with a separate source of air, protected from the service brake system. This air source is to provide emergency braking in the event of total air pressure loss in the service brake system.

To check this function, the emergency brake must apply and release when all service brake pressure is depleted.

Ensure that this system functions while the vehicle is stationary before carrying out the emergency brake test.

**8. Have the driver re-start the engine and build up air to the maximum limit (see previous item 3).**

The engine may run at maximum speed for this test.

The time to charge the system from zero to 80% of this maximum limit must not exceed five minutes.

For vacuum operated systems, the time taken to charge the system must not exceed 30 seconds from buzzer 'ON' to buzzer 'OFF' and must not exceed 60 seconds from buzzer 'OFF' to the normal operating limit.

**9. Carry out a service brake performance test.**

- Have the driver build up maximum air pressure (if necessary), then either:
  - Accelerate the vehicle to 35 km/h and apply the service brake – the vehicle must stop in 16.5 metres, or
  - Accelerate the vehicle to any speed and apply the service brake – an average deceleration of 2.8 m/s<sup>2</sup> (or 29%g) must be achieved.

For truck/trailer combinations the proportioning device might need to be adjusted.

**10. Carry out a parking brake performance test.**

- Have the driver apply the parking brake (this might also be the emergency brake).
- Ensure that the parking brake operates by trying to move the vehicle under light throttle while the parking brakes are applied.

The parking brake control must remain in the 'ON' position when applied.

- If the parking brake fails, immediately apply the service brake.

**11. Carry out an emergency brake performance test.**

- Have the driver apply the emergency brake control (this might also be the parking brake control) and watch that the relevant brake chambers work.
- Have the driver build up maximum air pressure (if necessary), then either:
  - Accelerate the vehicle to 35 km/h and apply the emergency brake – the vehicle must stop in 40.5 metres, or
  - Accelerate the vehicle to any speed and apply the emergency brake – an average deceleration of 1.1 m/s<sup>2</sup> (or 12%g) must be achieved.
- If the emergency brake fails, immediately apply the service brake.

**12. For a truck/trailer combination, ensure that the tractor protection valve is in the normal operating position and that the vehicle is at full air pressure.**

- Disconnect the trailer air lines and allow air to exhaust (suitable fittings may be required).
- Ensure that the truck's service brakes will still operate.
- Check that the trailer breakaway system has actuated by attempting to move the truck/trailer combination under light throttle.

The air brakes on any trailer or semi-trailer must not apply together with the spring brakes by operation of the one control.

If any spring brakes are fitted to the prime mover they must not operate until after the low air warning device has activated (ie 300 kPa) and the tractor protection device operates.

## Section 2. ADR 35 or ADR 35/00 heavy vehicles equipped with compressed air brake systems

### **BRAKE SYSTEM REQUIREMENTS**

#### **1. Drain valve**

A manual or automatic drain valve must be fitted at the lowest point of each air brake reservoir in the system.

#### **2. Air pressure gauges**

Each vehicle must be equipped with air pressure gauges that show air pressure in each sub-circuit of the brake system.

Dual circuit vehicles with a single gauge (having a separate needle for each sub-circuit) satisfy this requirement.

Single circuit vehicles are only required to have one gauge.

#### **3. Pressure warning device**

Each vehicle must be equipped with a low air pressure (or low vacuum) warning device which provides the driver with a visible warning that the vehicle manufacturer's minimum safe working brake air pressure or vacuum has been reached.

This device can be either a red warning light, a flag or a gauge (marked to instantly show a minimum safe operating pressure).

This device should operate before the pressure drops below 400 kPa (60 psi) in either sub-circuit.

Where a single brake power unit is used (ie in some air/hydraulic or vacuum systems), an audible warning device must also be fitted.

When these devices first activate, there must remain sufficient air pressure or vacuum to provide for two full applications of the service brake.

#### **4. Braking system**

These vehicles must be equipped with a service brake (or primary) system, a secondary brake system and a park brake system.

The service brake provides the main braking force for the vehicle and may have either a single circuit or a dual (split) circuit system.

The secondary brake system provides supplementary vehicle braking in the event of a failure in the service brake system.

The park brake is designed only to retain the vehicle in a stationary position and not to provide any deceleration forces.

#### **5. Tractor protection system**

Every motor vehicle which is equipped to tow a trailer must be provided with a tractor protection system designed to protect its air brake system in the event of inadvertent separation from its trailer.

The tractor protection device must prevent the towing vehicle's brake system air pressure from falling below 300 kPa (45 psi) or the manufacturer's minimum if known.

This device must provide an audible or visible warning to the driver that it has activated.

## 6. Air system charging time

The time taken to charge the air system from empty to 80% of the governor cut out pressure must not exceed 5 minutes.

Vehicles with vacuum operated brakes must be capable of charging their systems after being fully depleted, from buzzer 'ON' to buzzer 'OFF' in 30 seconds and from buzzer 'ON' to normal operating level in 60 seconds.

## **BRAKE TEST PROCEDURE**

### **1. Generally inspect all of the vehicle's brake equipment including drums/discs, brake hoses & chambers, slack adjusters & actuators, relay valves, tanks, pipes & fittings etc.**

- Check that components are secured and are not deteriorated, worn or damaged.
- Check for over-travel of slack adjusters during brake application.
- Check the condition of compressor hoses/fittings, drive belt & pulley (if fitted).
- Check for the presence of the compressor air filter.
- Check for the presence of visible brake failure indicators and ensure they are operational.
- Identify the service brake system, the secondary brake system & the park brake system. This information will be useful later in this procedure.

### **2. Have the driver start the engine and build up sufficient air pressure so that the low air warning device is off.**

- Then, have the driver apply the service brakes several times until this device activates.
- Note the pressure at which this occurs.

### **3. Have the driver build the air back up until maximum air pressure is reached (ie to the governor cut-out point).**

This must not exceed the manufacturer's maximum operating pressure limit (if known), or 1120 kPa (160 psi).

- Note this pressure limit as it is required later.
- Once this pressure has been reached, have the driver switch off the engine (the ignition may need to be returned to the 'ON' position for the gauges to operate).
- Observe any manufacturer's shut-down instructions before switching off the engine (eg idle engine for five minutes to prevent turbo charger damage).

### **4. Check service brake operation.**

- Ensure that the parking brake control is in the 'OFF' position.
- For truck/trailer combinations equipped with hand controls, ensure that the brake proportioning device is in the full 'ON' position.
- Have the operator apply the service brake and hold the pedal depressed.
- Check that the brakes operate on all wheels and that the actuators release immediately the brake pedal is released.
- Listen for any leaks (other than the normal exhausting of valves) and watch for any drop in air pressure while the service brake is applied.
- A maximum drop of more than 20 kPa (plus 5 kPa for each attached trailer) is unacceptable.

**5. Have the driver release and fully apply the service brake pedal another four times.**

The air pressure in either of the sub-circuits must not fall below half of the maximum system pressure (see step 3).

**6. Then, have the driver continue to deplete the air by applying the service brake pedal until zero pressure is obtained in both sub-circuits.**

Spring brakes which apply at this stage must only operate after the low pressure warning device actuates (see step 2).

The spring brake release control must be located within reach of the driver when seated in the normal driving position.

**7. Have the driver re-start the engine and build up air to the maximum limit (see step 3).**

The engine may run at maximum speed for this test.

The time to charge the system from zero to 80% of this maximum limit must not exceed five minutes.

For a vacuum operated system, the time taken to charge the system must not exceed 30 seconds from buzzer 'ON' to buzzer 'OFF' and must not exceed 60 seconds from buzzer 'OFF' back to the normal operating limit.

**8. Have the driver stop the engine (see previous note) and ensure all brakes have been released.**

- Drain one sub-circuit of the service brake system.  
The presence of oil or fuel in brake reservoirs indicates a faulty or damaged compressor and is a reason for rejection.
- Watch the air pressure gauge(s) to ensure that pressure in only one sub-circuit is draining. The other sub-circuit must not drain.
- Once the circuit is fully drained close the drain valve. The spring brakes should not apply during this operation. However, please note:
  - That ADR 35/-- and ECE R13 both require brake tests to be conducted with the engine running.
  - For certain vehicles spring brakes may apply if the engine is not running and the service brake circuit has been fully depleted of air.
  - In a single circuit service brake system, energy to hold the spring brakes off is supplied by a separate dedicated reservoir.
  - In a dual circuit service brake system, spring brakes are normally held off by residual line pressure. Repeated applications of the service brake will cause the spring brakes to apply, which is acceptable.
- Regardless of whether the spring brakes apply have the driver depress and hold the service brake pedal. Examine the service brake chambers and components connected to the charged circuit to see that they continue to operate correctly by:
  - Observing movement of slack adjustors, or
  - Feeling for expansion in the air line (take care not to damage the line during this operation), or
  - Feeling the brake chamber to detect the application of the service brake through the movement of internal components (take care to avoid components that may move), or
  - Detecting if pressurised air exits the pressure test connection valve, which is located at either the inlet to or in the body of the brake chamber. Remove the protective cover and depress the top of the pressure test connection valve, air will be released when the service brakes are applied. Note the pressure test connection valve is only mandatory for vehicles manufactured after 1 July 1998.
- Ensure the drain valve is closed and have the driver re-start the engine and build up air to the maximum pressure. If the spring brakes have applied, determine if the spring brakes release.

**9. For dual circuit service brake systems, repeat Step 8 for the other sub-circuit.**

**10. Carry out a service brake performance test.**

- Have the driver build up maximum air pressure (if necessary), then either:
  - Accelerate the vehicle to 35 km/h and apply the service brake - the vehicle must stop in 16.5 metres, or
  - Accelerate the vehicle to any speed and apply the service brake - an average deceleration of  $2.8\text{m/s}^2$  (or 29%g) must be achieved.

For a truck/trailer combination the proportioning device might need to be adjusted.

**11. Carry out a parking brake performance test.**

- Have the driver apply the parking brake.
- Ensure that the parking brake operates by checking that the vehicle is prevented from moving under light throttle while the parking brakes are applied.

The parking brake control must remain in the 'ON' position when applied.

**12. For a truck/trailer combination, ensure that the tractor protection valve is in the normal operating position and that the vehicle is at full air pressure.**

- Disconnect the trailer air lines and allow air to exhaust (suitable fittings may be required).
- Check that the trailer break-away system has actuated by attempting to move the vehicle under light throttle.

If any spring brakes are fitted to the prime mover they must not operate until after the low air warning device has activated (ie 300 kPa) and the tractor protection device operates.

# Section 3. Brake components

Figures 1 – 3 show the internal mechanisms of some typical brake components.

FIGURE 1: TYPICAL POWER BRAKE CHAMBER

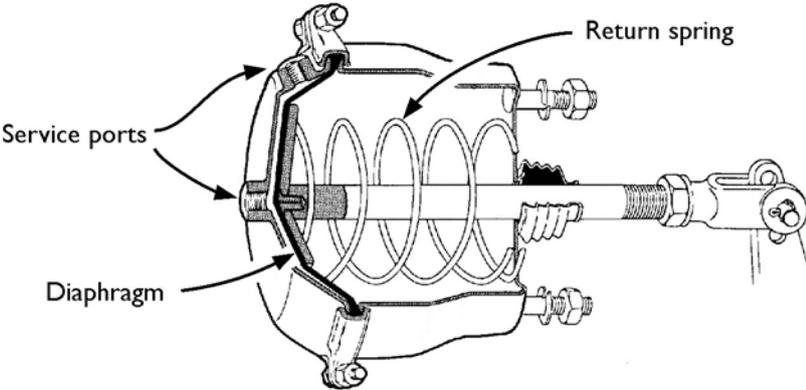


FIGURE 2: TYPICAL SPRING BRAKE CHAMBER

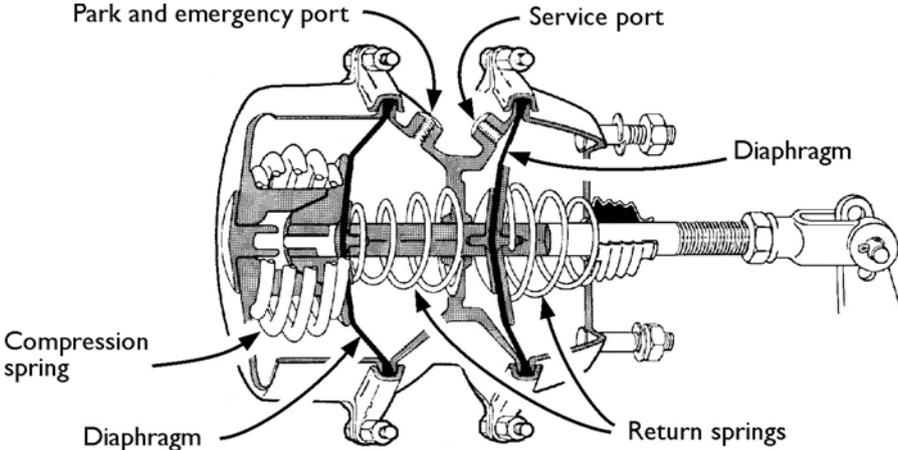


FIGURE 3: TYPICAL PARK-LOCK SAFETY ACTUATOR

