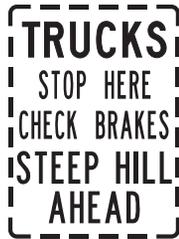


**fast fact**

Your company may have a maintenance crew to keep vehicles safely running.

But one person is ultimately responsible to ensure that the brakes are operating properly before the vehicle is moved. That person is the driver.

**fast fact**

You may be fined as much as \$2,000 if you're operating a vehicle with brakes that are defective. This includes excessive brake chamber pushrod stroke.

A typical s-cam brake. The brake is shown in the released position.

**What you'll learn**

After reading this chapter you'll be able to:

- explain why air brake adjustment needs to be regularly checked
- explain how to measure air brake chamber pushrod travel and how to adjust air brakes.

**Brake adjustment — it's critical**

The most important part of any braking system is the foundation brakes. If these are not in correct working order and properly adjusted, the best designed air brake system won't be able to safely stop the vehicle.

Brake failures and runaways that result in crashes are almost never caused by an air system failure. The absence of routine brake maintenance or the driver failing to check brakes on a daily basis is a much more common factor.

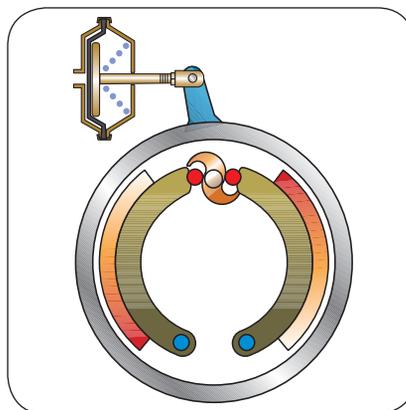
Daily pre- and post-trip inspections — including checking and adjusting brakes — are mandatory. The driver may be held responsible if the brakes are incorrectly adjusted or not working properly.

**Brake adjustment — it's the law**

Federal and provincial laws require that you check manual and automatic slack adjusters daily, during the pre-trip inspection. It's up to you, the professional driver, to ensure your vehicle has safe, correctly adjusted brakes.

You're also required by law to check your brakes before driving down steep grades that are posted with regulatory signs.

You can't always crawl underneath your vehicle to measure air brake chamber pushrod travel, but there are devices available to help you visually check for brake adjustment.

**S-cam brake — released**

### definition

**Slack adjustment** means adjusting the brakes to keep air chamber pushrod travel within tolerance to ensure that the brakes are effective.

**Pushrod travel** means the distance the pushrod extends from the air brake chamber when the brakes are applied.

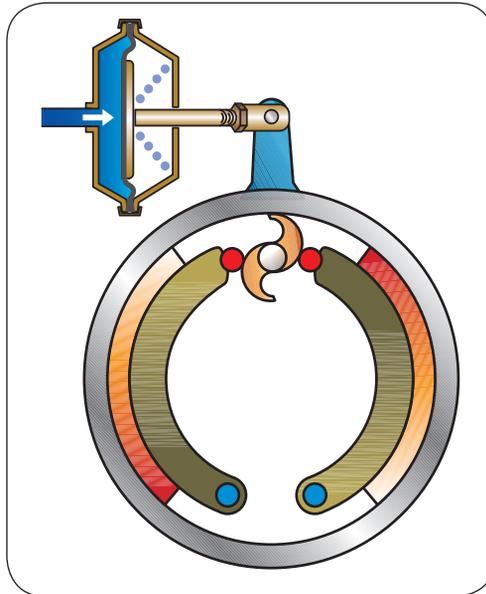
### fast fact

When correctly adjusted, the running clearance between the brake lining and drum is only a few thousandths of an inch — hardly thicker than three sheets of paper.

A typical s-cam brake. The brake is shown in the applied position.

The most common type of air brake chamber used on trucks and trailers is the Type 30. These chambers have a maximum available stroke of 2½ inches (65 mm). A long stroke Type 30 is designated Type 30LS, and has a maximum available stroke of three inches.

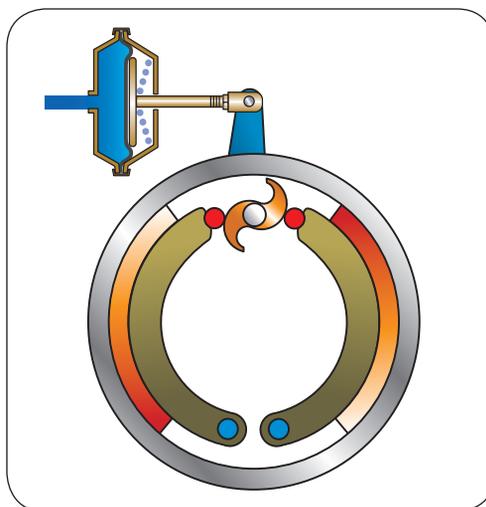
### S-cam brake — applied



In this diagram, the brakes have been applied and the brake linings have contacted the brake drum. The brake chamber has stroked less than half of its maximum stroke, indicating that the brake is in correct adjustment.

### S-cam brake — incorrectly adjusted and cold brake drum

In this diagram, the brakes are applied and the linings have contacted the brake drum.



### driving tip

Check air brake chamber pushrod travel at least daily.

Each brake on an axle should be adjusted to have a similar amount of pushrod travel — that is, the pushrod travel of the left brake should be similar to the pushrod travel of the right brake on the axle.

This brake chamber pushrod has excessive travel, but may work as long as the brake drum is cool. But it won't stay cool for long!

**fast fact**

Once you learn how, manual slack adjusters are easy to adjust.

Air-brake-equipped vehicles rarely “lose” their brakes. If the brakes don’t work properly, it’s likely because the brake system hasn’t been well maintained and the driver has failed to regularly check brake pushrod travel.

Now that the brake drum is hot, the brake linings will no longer contact the drum. The brake chamber has bottomed out.

**warning!**

Even incorrectly adjusted brakes may seem to work when brakes are lightly applied.

This could result in a dangerous brake system under moderate to heavy braking, or on a downgrade.

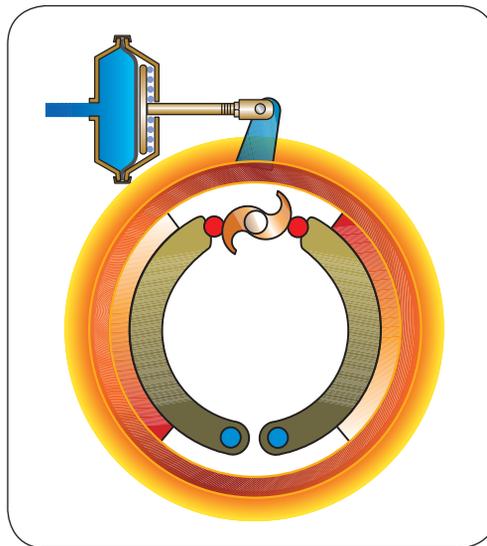
**driving tip**

Always block the wheels before checking any brakes.

Turn the engine off so that you can also listen for any air leaks.

Note that the brake chamber has stroked more than half of its maximum, which means that this air brake chamber pushrod has excessive travel and the brakes need adjustment.

When the brake drum is cool and with normal brake application pressure, the brake will seem to be effective, so it’s easy to be lulled into a false sense of security.

**S-cam brake — incorrectly adjusted and hot brake drum**

This diagram shows the same brake after a few brake applications.

Cast iron brake drums expand when heated, causing the air chamber to stroke further as the temperature rises.

If an unforeseen event required the driver to make a sudden stop, the brake chamber could **bottom out**, and braking power would be greatly reduced.

On long downgrades, the expansion of hot brake drums can cause a total loss of braking and result in a runaway.

**Checking and adjusting s-cam brakes — manual slack adjuster**

Drivers seldom have the luxury of the use of a pit and hydraulic jacks so that brake adjustment can be done with wheels off the ground.

But, brakes can still be adjusted very accurately with the wheels on the ground using one of the following methods.

Be sure that the vehicle is safely parked with the wheels blocked. The air system should be at full pressure and the spring parking brakes released.

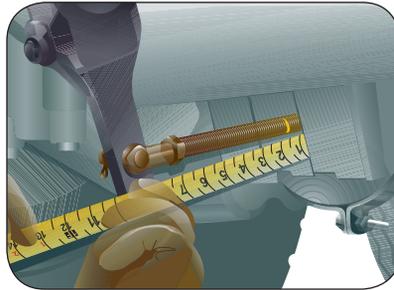
Turn the engine off so that you can listen for air leaks.

There are two methods of checking for correct adjustment, but the measurements that indicate the need for adjustment are different.

## Applied stroke method (service brake application)

The **applied stroke** method is the method used by roadside inspectors, and is also a method recommended by commercial fleet maintenance supervisors.

Unless you have a device to apply and hold the service brakes on, this method requires two people — one to apply the brakes and one to measure travel.



Checking the pushrod stroke by applying the brakes.

### driving tip

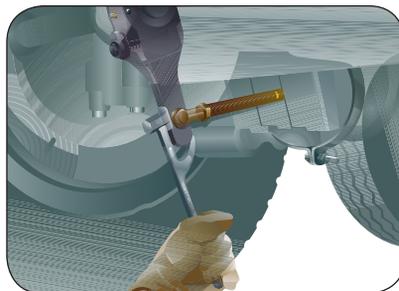
While checking air brakes look for other brake component wear and excessive play including:

- s-cam bushing wear
- s-cam spline wear
- slack adjuster play (worn gear)
- clevis pin wear.

1. With the brakes released, reservoir pressure at least 100 p.s.i. (690 kPa), and the engine off, either:
  - a) make a mark on the pushrod where it exits the brake chamber or
  - b) measure the pushrod length from the clevis pin to the face of the brake chamber.
2. Apply and hold a full brake application of 90 to 100 p.s.i. (620 – 690 kPa).
3. With the brakes applied, either:
  - a) measure the distance between the mark on the pushrod and face of the brake chamber or
  - b) re-measure the pushrod length from the clevis pin to the face of the brake chamber.

The distance between the mark on the pushrod and the face of the brake chamber, or the difference between the two pushrod length measurements from the clevis pin to the face of the brake chamber, is called the applied stroke (1 inch to 1½ inches — 25 to 38 mm is a good range). If this distance is more than 1¼ of an inch (45 mm), the brakes need adjustment.

## Pry method of free stroke measurement



Using a brake tool to measure brake chamber pushrod free stroke.

To begin, make sure system air pressure is over 100 p.s.i. (690 kPa) and all parking brakes are released.

1. Push against the pushrod to ensure that it's fully retracted into the brake chamber. Then make a mark on the pushrod where it exits the brake chamber.

### driving tip

Make sure you have the proper equipment to check the brakes. You'll need:

- a flashlight to inspect components
- chalk or other marker, and a ruler or other marking device, to check pushrod free stroke
- a tool to pry on the air brake chamber pushrod to check for free stroke
- a wrench to adjust manual slack adjusters.

You should also wear sturdy clothing, a hard hat and eye protection.

If the red marking on the pushrod (at the chamber face) is visible, it indicates that the brake is dangerously out of adjustment and it needs **immediate** attention.

### driving tip

While checking air brakes look for other brake component wear and excessive play including:

- s-cam bushing wear
- s-cam spline wear
- slack adjuster play (worn gear)
- clevis pin wear.

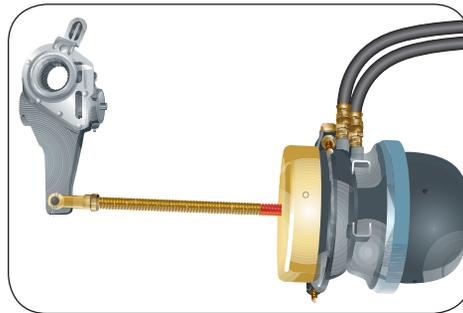
2. Pull the pushrod out from the brake chamber, using a tool like a pry bar for leverage.
3. Measure the distance between the chalk mark and the face of the brake chamber.

The distance between the mark on the pushrod and the face of the brake chamber is called the free stroke ( $\frac{1}{2}$  to  $\frac{3}{4}$  of an inch — 12 to 20 mm is a good range). If this distance is more than  $\frac{3}{4}$  of an inch (20 mm), the brakes need adjustment.

### Brake adjustment indicators

New air brake chamber pushrods have a marking (usually red) to indicate when brake adjustment must be done immediately. If the pushrod travel becomes excessive, the marking will show.

Don't wait until the red marking is exposed before adjusting the brakes.

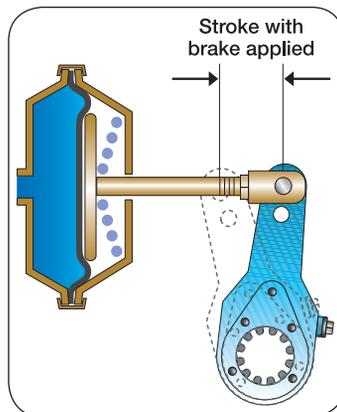


### Brake adjustment — manual slack adjuster

With a typical Type 30 clamp type air chamber, you **must** adjust the brakes if pushrod travel is:

- more than  $\frac{3}{4}$  of an inch (20 mm) using the pry method of free stroke measurement, or
- more than  $1\frac{3}{4}$  of an inch (45 mm) using the brake application — applied stroke measurement method.

Note that these are maximum measurements. You should adjust the brakes if your measurements approach these limits.



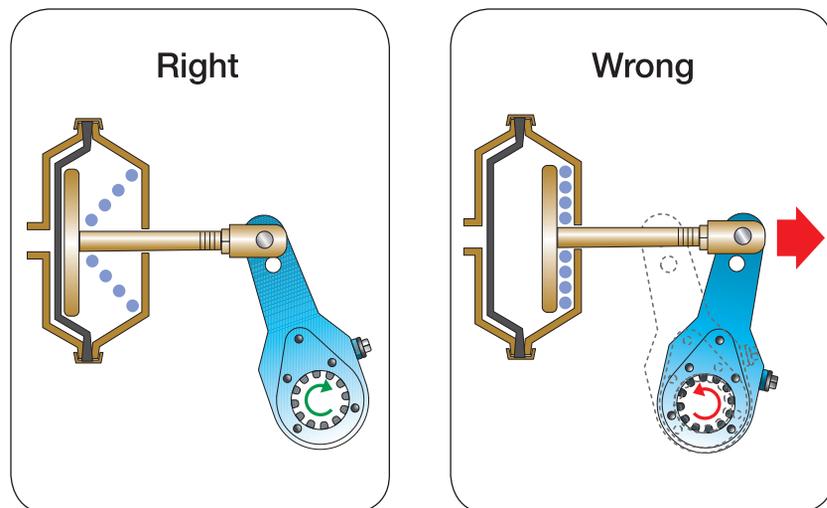
## Adjustment

Most manual slack adjusters have a spring-loaded locking sleeve that must be pressed in and held so the adjusting bolt can be turned.

Depending upon the orientation of the slack adjuster, you may need to turn the adjusting bolt clockwise or counter-clockwise. There are two indicators to watch for to ensure that you're tightening and not loosening the slack adjustment.

With a wrench of the proper size, usually a  $\frac{9}{16}$  inch, depress the locking sleeve and turn the adjusting bolt while watching the end of the camshaft. The camshaft will rotate slightly as the bolt is being turned. If you're turning in the right direction, the cam will rotate in the same direction that it would if the brakes were being applied, as shown by the arrow on the cam end in the diagram below.

If the pushrod goes into the chamber, this indicates that the previous slack adjustment was done incorrectly.



If the slack adjuster is pulling the pushrod out of the chamber when you turn the adjusting bolt, **stop**. The adjusting bolt is being turned in the **wrong** direction.

The pushrod and the slack adjuster arm should **never** move in or out while turning the adjusting bolt.

If the pushrod goes into the chamber, this indicates that the previous slack adjustment was done incorrectly.

Once you know the proper direction, continue turning until solid resistance is met. This indicates that the brake linings have contacted the brake drum.

If the brake has no dust shields, or if you can see the brake shoes and linings through an inspection slot, you can visually verify that the linings have contacted the drum.

Backing off the adjusting bolt about  $\frac{1}{3}$  of a turn should establish correct running clearance between the lining and drum. Be sure the locking sleeve re-engages the bolt so that the adjustment will not back off.

**driving tip**

Have an adjusting wrench at hand when checking the brakes so that you can make a brake adjustment if required.

**fast fact**

Automatic slack adjusters still need to be regularly checked to ensure that correct adjustment is being maintained.

**warning!**

It's dangerous to manually adjust automatic slack adjusters.

Repeated adjustment can mask other problems and may lead to brake failure.

**warning!**

Automatic slack adjusters should only be adjusted or repaired by a qualified mechanic.

Follow the manufacturer's instructions in carrying out any adjustment.

It's common, especially on tandem axle units, for the adjusting bolts on one axle to adjust in one direction, while the other axle requires an opposite turn. It's not uncommon to find that the brakes on one or the other axle have been mistakenly backed off, creating a serious safety hazard.

After adjusting, verify that there's enough clearance by re-measuring the free stroke.

## S-cam brakes — automatic slack adjuster

All commercial trucks and trailers with air brakes have been manufactured with automatic slack adjusters since 1996. Automatic slack adjusters adjust themselves during normal brake applications made in day-to-day driving.

Automatic slack adjusters are able to maintain brake stroke more reliably than manual slack adjusters. But, automatic slack adjusters must still be checked as part of a pre-trip inspection.

Once properly installed, automatic slack adjusters shouldn't need manual adjustment. If an automatic slack adjuster strokes beyond the maximum allowed, this usually indicates that there are other brake problems that need to be repaired by a qualified brake service mechanic.

Manual adjustment of automatic slack adjusters is dangerous because it gives a false sense of security about the effectiveness of the braking system. A manual adjustment may temporarily shorten the stroke, but the automatic slack will soon re-set to its designed stroke.

**Repeated manual adjustment can cause undue wear on the internal components of the slack adjuster and possibly lead to early failure.**

Manufacturers generally recommend that automatic slack adjusters be checked by a mechanic at every chassis lubrication interval, every 40,000 km, or every three months, whichever comes first.

The National Safety Code of Canada as well as American and Mexican laws require a daily check of brake adjustment as part of a pre-trip inspection. As well, in certain mountainous areas of North America, signs are posted requiring trucks to stop and check brakes before proceeding down long grades. These brake checks are required regardless of whether manual or automatic slack adjusters are used.

If a pushrod stroke is excessive during one of these checks, the automatic slack adjuster has either failed, been incorrectly installed, or there is a problem within the foundation brake.

## Checking and adjusting automatic slack adjusters

Most manufacturers of automatic slack adjusters specify that pushrod stroke be checked by making a 90 to 100 p.s.i. (620 to 690 kPa) application. If you have no application pressure gauge, turn the engine off and pump the reservoir pressure down to between 90 and 100 p.s.i. (620 to 690 kPa) — then make a full application.

### driving tip

It's strongly recommended that you get the service data books for the make of automatic slack adjusters that you are using.

They contain all the information needed to keep them operating properly, including lubrication requirements, initial setup, inspection and testing. They're available where truck parts are sold.

### warning!

It's dangerous to manually adjust automatic slack adjusters.

The adjustment procedures shown here are for use in emergencies as a last resort where qualified brake personnel can't attend, such as driving the vehicle to a service depot.

Remember — as the driver, you're responsible for the condition of the vehicle you're operating — including the brakes.

Pushrod strokes with automatic slack adjusters are usually slightly longer than with well-adjusted manual slack adjusters. With a typical Type 30 clamp type air chamber and an automatic slack adjuster, the brakes need repair if pushrod measurements are:

- more than  $\frac{3}{4}$  of an inch (20 mm) using the pry method of free stroke measurement, or
- more than two inches (50 mm) using the brake application — applied stroke method.



Four types of automatic slack adjusters.

If a pushrod stroke is excessive, the automatic slack adjuster has either failed, been incorrectly installed, or there is a problem within the foundation brake.

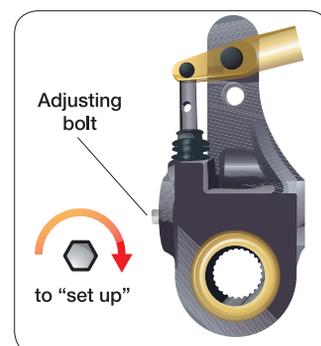
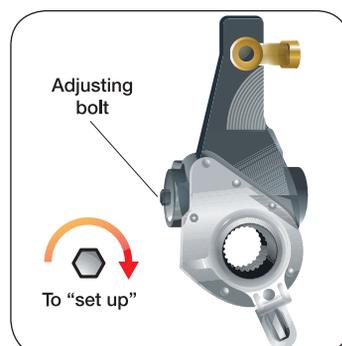
#### THE FOLLOWING ARE EMERGENCY PROCEDURES ONLY. A REPAIR OR REPLACEMENT MUST BE MADE AS SOON AS POSSIBLE.

Be sure that the vehicle is safely parked with the wheels blocked. The air system should be at full pressure and the spring parking brakes released.

If you make an emergency adjustment of an automatic slack adjuster, be sure to record it on your daily post-trip inspection report. After adjusting, verify that there is sufficient clearance by re-measuring the free stroke.

#### Slack adjusters with hexagonal adjusting bolts

If the slack adjuster has a hexagonal (six-sided) adjusting bolt, the brakes may be set up by turning the adjusting bolt in a **clockwise** direction until the lining contacts the drum. Backing off the adjusting bolt by  $\frac{1}{2}$  a turn should restore running clearance. Backing off may take considerable force and you may hear or feel ratcheting. This is normal.



These two types of automatic slack adjusters both have hexagonal adjusting bolts.

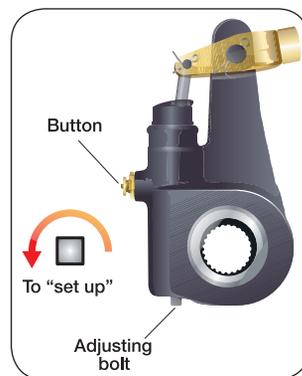
**fast fact**

There's no reliable substitute for physically checking brake adjustment.

**Slack adjusters with square adjusting bolts**

If the slack adjuster has a square adjusting bolt located at the bottom end of the body, **don't try** adjusting until a spring-loaded pawl that meshes with internal teeth is disengaged. These units have a  $\frac{3}{4}$  inch hexagonal (hex) cap located on the slack adjuster body. Some of these hex caps are equipped with a round "button" that can be pried up approximately  $\frac{1}{32}$  of an inch (.75 mm) and held, using a screwdriver. On units that don't have the button, the hex cap, spring and pawl must be removed. With the spring and pawl disengaged, you can do the adjustment.

These brakes must be set up with a **counter-clockwise** turn until the lining contacts the drum. Turning the adjusting bolt  $\frac{1}{2}$  a turn clockwise will restore running clearance. Release the button or re-install the spring and pawl if you removed them.



This type of slack adjuster has a square adjusting bolt.

**Air brake adjustment myths**

There's some misinformation about air brakes that you may hear. These myths could be dangerous, if you believe them.

*Myth #1:*

Brake adjustment can be checked from the cab by making a full brake application and checking for an initial pressure drop of between 8 to 12 p.s.i. (55.2 to 82.8 kPa). The assumption is that as the brake chambers stroke further and further, that more air volume will be required, and this should show up on the reservoir gauges.

**Fact #1:**

**Modern trucks have very large air reservoirs, and even if all the brakes had excess pushrod travel, the pressure drop would not reach the 8 to 12 p.s.i. (55.2 to 82.8 kPa) range. Also, most truck reservoir gauges don't have fine enough markings to accurately estimate such pressure changes.**

*Myth #2:*

A 90-degree angle between the centre of the slack adjuster arm and the chamber pushrod with the brakes applied is a good indication that the brake is adjusted correctly.

**Fact #2:**

**The 90-degree angle is more dependent on the length of the chamber pushrod than on brake adjustment. Also, to prevent interference between the slack adjuster and suspension parts, some manufacturers will vary the angle up to plus or minus 10 degrees.**

*Myth #3:*

A clockwise turn of the adjusting bolt on a manual slack adjuster will set up the brakes.

**Fact #3:**

**Depending on the orientation of the slack adjuster on the brake assembly, the correct direction to set up the brakes may be clockwise, or counter-clockwise. On vehicles with tandem axles, it's common to find that one axle sets up with a clockwise turn, while the other requires a reverse direction.**

*Myth #4:*

As long as the parking brake control valve is open and the trailer supply valve is open (charged), spring brakes are off and slack adjustment can be checked.

**Fact #4:**

**Some parking brake control valves and trailer supply valves will remain in the open position with as little as 20 p.s.i. (138 kPa) system air pressure. Yet the spring brakes may be partially or fully applied. For this reason, make sure system air pressure is at least 90 to 100 p.s.i. (620 to 690 kPa) and all parking brakes are released before checking brake adjustment.**

*Myth #5:*

Replacing automatic slack adjusters with manual slack adjusters better ensures that the brakes are kept properly adjusted.

**Fact #5:**

**Automatic slack adjusters, as the name implies, automatically adjust for brake wear as the brakes are used. Manual slack adjusters don't adjust for brake wear until they are manually adjusted. A Transport Canada study showed that vehicles with manual slack adjusters were put out-of-service at a rate 150 per cent higher than those with automatic slack adjusters, because there's a higher probability that a brake with a manual slack adjuster would be out of adjustment.**

**Under B.C. Commercial Vehicle Safety and Enforcement rules, it's illegal to retrofit manual slack adjusters on a vehicle manufactured with automatic slack adjusters.**

### Review questions

1. Why's it so critical to check slack adjustment?
2. Who's ultimately responsible for the brakes on a vehicle?
3. What's the fine for operating a commercial vehicle with improperly adjusted brakes?
4. What are the dangers of operating a vehicle where the pushrod travel is barely within tolerance when the brake drums are cold?
5. What items should you carry to measure and adjust slack adjusters?
6. What's the first thing you should do when preparing to measure slack adjustment?
7. How much pressure should you apply to the foot valve when measuring slack adjustment using the applied stroke method?
8. How do you know you're turning the adjusting bolt in the correct direction when adjusting a slack adjuster?
9. What's an advantage of automatic slack adjusters?