

## Consider Keeping a Chamber Stroke Measurement Record

Many fleets and owner-operators have found success in preventing violations by tracking brake chamber stroke measurements at each wheel-end as part of their periodic maintenance programs. This involves recording pushrod stroke each time it is measured. See *Table 2*.

For example, consider a truck-tractor with Type 24L chambers on the steer axle and Type 30LS on the drive axles. Stroke limits in the regulation for Type 24L and Type 30LS are 2 inches and 2 1/2 inches, respectively.

The table below shows pushrod stroke measurements recorded on three occasions. Note the circled entries show one brake at the regulatory limit (it will need service soon) and another exceeding the regulatory limit (it is a violation and must be serviced). This table can be expanded to account for all axles in a vehicle or combination.

Table 2

| Chamber Size:            |               | Type 24L | Type 24L | Type 30LS | Type 30LS | Type 30LS | Type 30LS |
|--------------------------|---------------|----------|----------|-----------|-----------|-----------|-----------|
| Regulation Stroke Limit: |               | 2"       | 2"       | 2 1/2"    | 2 1/2"    | 2 1/2"    | 2 1/2"    |
| Date                     | Odometer      | L Steer  | R Steer  | LF Drive  | RF Drive  | LR Drive  | RR Drive  |
| 7/6                      | 235,643 miles | 1 1/2"   | 1 1/2"   | 1 1/4"    | 1 3/4"    | 1 1/2"    | 1"        |
| 7/26                     | 243,355 miles | 1 1/2"   | 1 3/4"   | 1 1/4"    | 1 3/4"    | 2 1/4"    | 1 1/4"    |
| 8/18                     | 250,221 miles | 1 1/2"   | 2"       | 1 1/2"    | 1 3/4"    | 2 3/4"    | 1 1/4"    |
|                          |               |          |          |           |           |           |           |
|                          |               |          |          |           |           |           |           |
|                          |               |          |          |           |           |           |           |



The Commercial Vehicle Safety Alliance (CVSA) is a nonprofit association comprised of local, state, provincial, territorial and federal commercial motor vehicle safety officials and industry representatives. The Alliance aims to prevent commercial motor vehicle crashes, injuries and fatalities and believes that collaboration between government and industry improves road safety and saves lives. Our mission is to improve commercial motor vehicle safety and enforcement by providing guidance, education and advocacy for enforcement and industry across North America. For more information, visit [www.cvsa.org](http://www.cvsa.org).

## Air Brake Pushrod Stroke Why is it so important?



© Commercial Vehicle Safety Alliance All rights reserved.

## Regulation Stroke Limits for Clamp-Type Brake Chambers

1. In a safe location, chock the wheels and release the spring brakes.
2. Bring the air pressure to 90 to 100 psi (620 to 690 kPa), then turn off the engine.
3. Identify the size and type of each brake chamber. See *Table 1*.
4. Scribe the pushrods.
5. Fully apply and hold the brakes.
6. Measure the pushrod stroke.
7. Confirm the pushrod stroke is within regulatory limits. Do not use rated stroke. See *Table 1*.

Use this table to determine the stroke limit in the regulation corresponding to the chamber size and type (standard or long stroke design) for each brake on the vehicle.

Table 1

| TYPE SIZE | CHAMBER MARKING               | SAE J2899 MARKING | OUTSIDE DIAMETER  | MANUFACTURER RATED STROKE | REGULATION STROKE LIMIT |
|-----------|-------------------------------|-------------------|-------------------|---------------------------|-------------------------|
| 6         | None                          | A                 | 4 1/2" (115 mm)   | 1 1/2" (38 mm)            | 1 1/4" (32 mm)          |
| 9         | None                          | B                 | 5 1/4" (133 mm)   | 1 3/4" (44 mm)            | 1 3/8" (35 mm)          |
| 12        | None                          | B                 | 5 11/16" (144 mm) | 1 3/4" (44 mm)            | 1 3/8" (35 mm)          |
| 16        | None                          | D                 | 6 3/8" (162 mm)   | 2 1/4" (57 mm)            | 1 3/4" (45 mm)          |
| 16LS      | 'L' and Stroke Tag            | E                 | 6 3/8" (162 mm)   | 2 1/2" (64 mm)            | 2" (51 mm)              |
| 20        | None                          | D                 | 6 25/32" (172 mm) | 2 1/4" (57 mm)            | 1 3/4" (45 mm)          |
| 20LS      | 'L' and Stroke Tag            | E                 | 6 25/32" (172 mm) | 2 1/2" (64 mm)            | 2" (51 mm)              |
| 20LS3     | Square Ports, Tag and Marking | F                 | 6 25/32" (172 mm) | 3" (76 mm)                | 2 1/2" (64 mm)          |
| 24        | None                          | D                 | 7 7/32" (183 mm)  | 2 1/4" (57 mm)            | 1 3/4" (45 mm)          |
| 24L       | 'L' and Stroke Tag            | E                 | 7 7/32" (183 mm)  | 2 1/2" (64 mm)            | 2" (51 mm)              |
| 24LS      | Square Ports, Tag and Marking | F                 | 7 7/32" (183 mm)  | 3" (76 mm)                | 2 1/2" (64 mm)          |
| 30        | None                          | E                 | 8 3/32" (205 mm)  | 2 1/2" (64 mm)            | 2" (51 mm)              |
| 30        | 'DD3' (Bus/Motorcoach)        | N/A               | 8 1/8" (206 mm)   | 2 3/4" (70 mm)            | 2 1/4" (57 mm)          |
| 30LS      | Square Ports, Tag and Marking | F                 | 8 3/32" (205 mm)  | 3" (76 mm)                | 2 1/2" (64 mm)          |
| 36        | None                          | F                 | 9" (228 mm)       | 3" (76 mm)                | 2 1/2" (64 mm)          |

NOTES:

- (1) Manufacturer's rated stroke, which is sometimes marked on chambers, should **never** be used as the adjustment limit. Brakes should be adjusted so pushrod travel does not exceed the respective stroke limit in the regulation.
- (2) A drum brake with new linings that have not yet fully seated to the drum has the potential to exceed the stroke limit in the regulation upon a full brake application of 90 to 100 psi (620 to 690 kPa). Drum brakes with new linings should be checked regularly.
- (3) SAE J2899 is a new alphanumeric marking option first implemented on some products in 2018.

# Air Brake Pushrod Stroke

The brake system on a commercial motor vehicle must work well every time, under all conditions. If not, the driver's life and the lives of others are at risk.

To stop effectively in every braking situation, all components in the air brake system, including the foundation brakes, must be properly installed, adjusted and maintained by qualified technicians. Stroke limits specified by Canadian and U.S. regulations help maintenance technicians and enforcement personnel inspect and identify brakes that may not be properly adjusting.

During day-to-day driving, a driver cannot tell how well the brakes will work during an extreme braking maneuver. The most effective way to confirm that S-cam drum brakes are within regulatory limits is to measure pushrod stroke. Pushrod stroke is the length in inches or millimeters that the pushrod travels when the brake is fully applied. If the pushrod stroke is beyond the limit in the regulation, the foundation brake may no longer be able to provide full braking force and the brake may need servicing.

Brake system violations represent the most common reason commercial motor vehicles are placed out of service during roadside inspections. When pushrod stroke exceeds the regulatory limit, a violation exists and something may be wrong in the foundation brake system or with the slack adjuster.

By following manufacturers' recommended foundation brake maintenance intervals (for lubrication, lining replacement, wear tolerances, etc.), regularly measuring the pushrod stroke and proactively addressing issues, crash risk can be mitigated, safety ratings may improve, and the chances of a violation or out-of-service order can be reduced.



## What is a brake chamber pushrod stroke violation?

A brake violation occurs when the brake chamber pushrod stroke exceeds the stroke limits set by regulations.

Keeping a brake chamber pushrod within regulatory stroke limits ensures there is sufficient pushrod travel to apply full force to the foundation brake under all operating conditions. The limits are based on the size of the brake chamber and whether the chamber is a standard or long-stroke design. See *Table 1*.

Pushrod stroke that exceeds regulatory limits not only violates federal, state, provincial and/or territorial regulations but, more importantly, it results in a decline in the braking force – eventually to zero – provided by the foundation brake, which will increase the distance it takes to stop the vehicle.

Vehicles manufactured in the U.S. after Oct. 20, 1994, or in Canada after May 31, 1996, must be equipped with self-adjusting brake adjusters (SABAs) to automatically account for normal brake system wear. Manual brake adjusters are only permitted on legacy vehicles manufactured prior to the dates above and must be regularly adjusted by hand.

The use of SABAs has helped to significantly reduce the rate of out-of-service brake violations. However, even with properly working SABAs, abnormal/excessive wear or broken components can result in excessive pushrod stroke and must be properly serviced.

## How to correctly measure the brake chamber stroke

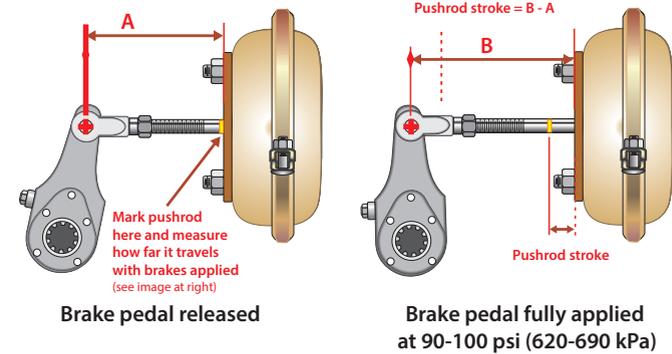
To measure chamber pushrod stroke, you will need a ruler, chalk, flashlight, eye protection, pencil and paper. You will also need another person to apply the service brakes. The procedure is as follows:

**Step One** – Ensure the vehicle is in a safe location and make sure the wheels are properly chocked to prevent rolling. Release the spring brakes. Confirm your dash gauge indicates 90 to 100 psi (620 to 690 kPa) supply pressure in the air brake system reservoirs. Then, shut off the engine. **Note:** Supply reservoir pressure exceeding 110 psi (758 kPa) will result in incorrect pushrod stroke assessments.

**Step Two** – Visit each brake and confirm it is in the normal released position with nothing wrong or out of place. Mark each pushrod to establish a reference starting location. This should be level with where the pushrod exits the brake chamber or the chamber mounting bracket. Note where the pushrod mark started and where it ends up, then measure the difference in the next step. See *Figure 1*.

**Step Three** – Have the other person press and hold the service brakes (pushing the brake pedal all the way down until it stops) while you measure and record the distance each pushrod mark moved (or "stroked").

Figure 1



**Note:** It is normal for pressure to drop slightly as brakes are applied. If multiple brake applications cause the pressure to drop below 90 psi (620 kPa), pause the procedure to rebuild reservoir pressure to 90 to 100 psi (620 to 690 kPa), then resume with the engine off.

**Step Four** – Compare your recorded pushrod stroke values with the stroke limits in the regulation for your brake chambers. See *Table 1*. If any chamber stroke measurement is near, at or beyond the prescribed regulatory stroke limit for your chamber type or size, the foundation brake, brake chamber, SABA, drum and wheel-end need to be inspected in more detail and serviced as soon as possible. If any pushrod stroke measurement exceeds the prescribed stroke limit, a violation exists. Any vehicle or combination of vehicles with 20% or more of the wheel ends containing brake violations is out of service per the CVSA North American Standard Out-of-Service Criteria.

## What about free-stroke and slack?

Measuring chamber free-stroke or chamber pushrod slack, which is the distance you can pull the brake chamber pushrod by hand using a bar or lever without applying air pressure to the chamber, does not confirm a brake is working properly under all conditions. Chamber free-stroke longer than 3/8" to 3/4" (10 to 20 mm) may indicate a more serious issue. However, shorter free-stroke does not confirm proper brake chamber stroke.

## How can brake chamber stroke indicators help you?

Checking the stroke typically means getting under the vehicle to take measurements before and during a brake application. Brake chamber stroke indicators can be installed to help identify when the stroke reaches or exceeds regulatory limits. Stroke indicators can provide a visual aid to make stroke assessment easier, possibly without needing to go under the vehicle. It is recommended, however, that the previously mentioned four-step procedure be completed on a regular schedule.

## What to do when the brake chamber stroke violates the regulations

When brake chamber pushrod stroke exceeds the regulatory stroke limit, what you do about it depends on whether your vehicle is equipped with manual or self-adjusting brake adjusters.

- **Self-adjusting brake adjusters** – SABAs should not be manually adjusted; they will do so automatically. If a chamber with a SABA has excessive stroke, there is a problem with the foundation brake, the drum, the SABA itself or other components. The entire wheel end (chamber, SABA, drum, hub and other hardware) should be inspected and serviced by an authorized brake technician as soon as possible. A manual readjustment may temporarily improve the stroke length, but it can cause damage and does not fix the underlying problem. The stroke violation may return within a few brake applications and, most importantly, stopping ability may be significantly impaired.
- **Manual brake adjusters** – Manual brake adjusters, permitted on older vehicles, must be readjusted by a qualified individual on a regular basis. If regulations require the vehicle to be equipped with SABAs based on its date of manufacture, installing and using a manual brake adjuster in place of the self-adjusting one is a violation.

## Notes about self-adjusting brake adjusters

When SABAs exceed the regulation limit, consider the following before adjusting the brakes:

- Drivers may be legally prohibited from adjusting SABAs in some jurisdictions.
- The motor carrier may prohibit the driver from adjusting SABAs.
- Do not readjust a SABA unless you have been specially trained to do so.
- Manually adjusting a SABA improperly can damage it. The manufacturer's instructions must be precisely followed.
- The brake chamber will return to the excessive stroke condition until the cause of the problem is repaired. Excessive stroke can return quickly, even in just a few brake applications.
- If the driver readjusts the brake chamber stroke, he or she must continue to monitor the brake chamber stroke and report any excessive stroke problems to the motor carrier or service provider.
- Be sure that any technician hired to correct an excessive brake chamber stroke is qualified and will fix the underlying cause.
- If a brake chamber with SABAs exhibits excessive stroke, some of the contributing causes could include worn or seized clevis pin connections, worn S-cam bushings, cracked chamber bracket or cam tube welds, worn rollers, cracked drums, worn linings, worn drums and/or loose mounting hardware. A trained brake technician should diagnose and correct the underlying problem(s).