Class 5 to 7 Truck and Bus Hydraulic Brake System

Diagnostic Guide

1st Edition
Important Service Notes

The information in this publication was current at the time of printing. The information presented in this publication is subject to change without notice or liability.

The information contained in this publication is intended for use by properly trained and equipped professional technicians. It is NOT for the “Do It Yourselfer”

Failure to follow safety and repair procedures can result in personal injury, or damage to vehicles, components and equipment.

![WARNING]

Failure to follow all the safety and vehicle repair procedures either contained in this manual, in the chassis and vehicle manufacturer’s repair manuals or in accordance with other accepted methods can result in personal injury, death, or damage to components, vehicles, or personal property.

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Preface

Purpose Of This Diagnostic Guide

The purpose of this diagnostic guide is to assist Class 5 to 7 hydraulic brake repair technicians to more accurately and quickly diagnose the most likely causes of a customer's brake related complaint.

This diagnostic guide is NOT a repair instruction, but only a guide. When the probable cause of a customer's complaint is established, the repair procedure must be done in accordance with the instructions in the vehicle manufacturer's service manual.

Using This Diagnostic Guide

The brake technician must be able to understand the customer's complaints and description of the symptoms well enough to match them to one (or more) of the categories listed in the Table of Contents. Most customer complaints and symptoms on the vehicle can be matched to these categories. Each category has a corresponding flow chart that will lead the brake technician to the most likely cause of the customer's complaints and vehicle symptoms. Several of the flow chart paths end with a comment box that also includes a number. Brake technicians can use this number to document why a Bosch manufactured part was replaced.

IMPORTANT REMINDER: The first step in diagnosing any customer complaint is to confirm the customer's complaint and determine which category applies.

The flow charts show which diagnostic steps need to be taken. The brake technician must have the necessary skills needed to perform each step. The flow charts are structured to guide the brake technician to take the quickest and easiest steps first. Often, these first, simple steps will be enough to determine what repair needs to be made.

WARNING

After completion of all diagnostic steps, the brake technician must remember to tighten any tube nuts, fittings, bolts, screws, bleeder screws, etc., that were loosened as part of the diagnostic procedure.

In all cases, the vehicle manufacturer's service manual must be used for any repair instructions.

Brake system warning lights and buzzers are unique to the vehicle manufacturer. The Brake Warning Light and Buzzer Do Not Shut Off flow chart offered in this guide is generic and may not apply to all vehicles. The vehicle manufacturer's service manual must be consulted in order to determine the proper function of these warning devices.

Exclusions

The ABS portion of the hydraulic brake system is not addressed in detail in this guide since the ABS hardware and software are unique to the specific vehicle manufacturer. Any diagnosis or repair needs to be done in accordance with the vehicle manufacturer's ABS service manual.
Hydraulic Brake System Diagram

Figure 1. Brake System Components

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Schematic of Typical Electrical System

Figure 2. Schematic of Typical Electrical System

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Brake Warning Light and Buzzer
Do Not Shut Off

TIP

The light and buzzer come on together, typically in response to signals from the parking brake switch, booster flow switch, master cylinder fluid level indicator switch, the master cylinder differential pressure switch or booster backup pump (See Figure 2).

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Booster Backup Pump Runs Continuously

TIP

The booster backup pump can run only if the relay is closed. The relay will be closed only if:
1) the flow switch is closed and there is power to the coil, or
2) the relay is stuck closed.

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NOTE: Use appropriate brake component or vehicle manufacturer’s service manual for all repair work.
Booster Backup Pump Does Not Run

TIP

The booster backup pump will not run if there is no voltage to the motor or if the motor is damaged (e.g., burned out or jammed).

A no-voltage condition can occur because:
1) Battery is dead
2) Relay is stuck
3) Wires are broken (battery to motor circuit or ignition switch / brake light switch to booster flow switch circuit)
4) Booster flow switch is not closed to ground

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Brake Pedal Continues to Fall With Steady Foot Force

**TIP**

If the brake pedal does NOT fall with steady foot pressure but feels spongy, soft or springy, the problem is probably caused by air trapped in the brake fluid system. Start by bleeding the brake system at the caliper furthest from the master cylinder and work from the back to the front of the vehicle.

**NOTE:** Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Brake Pedal Feels Very Hard

TIP

The most common reasons for a very hard brake pedal are:
1) Insufficient flow or pressure from the power steering pump
2) The ABS hydraulic unit is blocking the flow of brake fluid to the calipers

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Potential Master Cylinder and Booster Leak Points

**Figure 3.** Potential Master Cylinder and Booster Leak Points

*NOTE:* Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Leakage

TIP

Most external leakage is easy to detect by wetness and/or appearance of fluid drops. However, slight dampness (no drops or wetness) may not indicate a leak.

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Leakage (continued)

TIP

Brake fluid mixes with water.
Power steering fluid floats on water.

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Leakage (continued)

From previous page

Is booster flow switch leaking?

No

Is leak at booster inlet port?

No

Is leak at booster backup pump?

No

Is leak at the interface between the booster housing and the backup pump? Or, if an adapter is present, between the adapter and the housing or the adapter and the pump?

16 The problem is probably with the booster.

Clean and examine all sealing surfaces and seal grooves at backup pump, booster housing, and adapter.

15 The problem is probably with the backup pump.

Yes

The problem is probably with the booster inlet fitting O-ring seal.

14 The problem is probably with the flow switch O-ring seal.

Yes

Are surfaces and grooves flat and free of damage?

Yes

18 The problem is probably with the seals.

No

17 The problem is probably with the damaged component.

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Brake Drag

TIP  Possible Causes of Brake Drag:
1) Booster does not return
2) Brake pedal does not return
3) Brake hoses and tubes collapsed or kinked
4) Master cylinder does not return
5) ABS traps pressure
6) Brake caliper does not release

- With engine OFF, measure location of the pedal from the floor
- Start engine and measure if pedal dropped to a new position
- Shut OFF engine and measure if pedal returned to original position

Did pedal drop about 1/2” when engine started?

No

Yes

Two people will be needed for this step.
- Apply and release brakes, then quickly loosen bleed screw at the suspected caliper(s).
- The bleed screw must be loosened quickly, in case trapped pressure at the caliper bleeds down before the bleed screw is loosened.
- Does fluid spurt out under pressure?
- Tighten bleed screw to manufacturer’s recommended torque.

- Remove caliper and shoe pads
- For rear axle, disconnect axle from hub
- Does rotor spin freely

No

Yes

The problem is probably with bearing pre-load.
Caliper assembly is probably dragging.

- Remove filler cap from the master cylinder
- Look at the diaphragm, inside the cap
- Is the diaphragm swollen (See Figure 4)

No

Yes

Master cylinder has been contaminated with the wrong fluid.
- Replace all of the following: master cylinder, all calipers, ABS hydraulic unit, and all rubber hoses.
- Flush the steel brake tubes with clean brake fluid prior to installing new brake components.

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NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Brake Drag (continued)

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Brake Drag (continued)

TIP

Prior to moving master cylinder 1/8 inch away from booster, loosen two diagonally opposed nuts that hold the master cylinder to the booster, by 1/8 inch. Have a power tool ready to loosen the remaining two nuts after the brakes have been applied and released.

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Two people will be needed to do this step.
- Apply and release brakes, then quickly loosen primary brake line tube nut at the master cylinder.
- The tube nut must be loosened quickly in case trapped pressure at the master cylinder bleeds down before the tube nut is loosened.

Does fluid spurt out under pressure at the brake line tube nut?

No

- Tighten brake line tube nut to manufacturer’s recommended torque
- Apply and release brakes, then quickly loosen secondary brake line tube nut
- Retighten tube nut

Yes

Two people will be needed for this step.
- Tighten tube nuts to manufacturer’s recommended torque.
- Apply and release brakes.
- Shut-off engine.
- After releasing brakes, quickly loosen the four nuts (see TIP) holding the master cylinder to booster, by 1/8 inch.
- Quickly pull master cylinder away from booster, and quickly loosen primary brake line tube nut.
- All of these steps must be done quickly in case trapped pressure at the master cylinder bleeds down before the tube nut is loosened.

The problem is probably with the ABS.

Does fluid spurt out under pressure at the brake line tube nut?

No

Yes

Continued on next page

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Brake Drag (continued)

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Does fluid spurt out under pressure at the tube nut?

No

- The problem is probably with the booster or pedal linkage
- Retighten tube nut
- Retighten 4 nuts to 34 to 41 Nm

Yes

22 The problem is probably with the master cylinder.

Apply and release brakes, then quickly do the following:
- Remove pin that holds the pedal rod to the pedal arm.
- Open primary tube nut at master cylinder.
- These steps must be done quickly in case trapped pressure in the master cylinder bleeds down before the tube nut is loosened.

Does fluid spurt out under pressure at the tube nut?

No

- Retighten the tube nut
- The problem is probably with the pedal linkage

Yes

23 - Retighten the tube nut
- The problem is probably with the booster

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Master Cylinder Cap Diaphragms

Diaphragm swollen due to exposure to mineral oil (power steering fluid, automatic transmission fluid, motor oil, etc.)

Normal diaphragm

Figure 4. Comparison: Swollen vs. Normal Diaphragm

NOTE: Use appropriate brake component or vehicle manufacturer's service manual for all repair work.
Low Shoe Pad Life or Uneven Shoe Pad Wear

TIP

Shoe pad life can vary greatly due to many factors including vehicle type, vocation (e.g., rollback tow truck, box truck, bus, etc.), terrain, urban vs. rural use, and driver style. Therefore, no guidelines can be provided for the mileage that should be obtained.

- **Verify condition that shoe pads are wearing abnormally (excessive inner vs. outer shoe pad wear).**
- **Are brakes dragging?**
  - **No**
    - **Do brakes show signs of heat exposure?**
      - **No**
        - For low brake operating temperature conditions, see service manual for appropriate alternate replacement shoe pads.
      - **Yes**
        - Condition is probably related to the duty cycle (usage) or the driver’s braking habits.
  - **Yes**
    - See **Brake Drag** section.

**NOTE:** Use appropriate brake component or vehicle manufacturer's service manual for all repair work.