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 and 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 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.

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 and 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 and vehicle manufacturer’s service manual for all repair work.
Potential Master Cylinder and Booster Leak Points

RESERVOIR TO BODY INTERFACE

FLOW SWITCH SEAL

BOOSTER OUTLET PORT

INTLET PORT SEAL

MASTER CYLINDER OUTLET PORTS

BOOSTER TO MASTER CYLINDER INTERFACE

BOOSTER HOUSING TO BACKUP PUMP INTERFACE

Figure 3. Potential Master Cylinder and Booster Leak Points

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

Uneven lining wear or rapid lining wear is often mistaken as stuck calipers. More probable root causes are incorrect linings, excessive brake duty, or incorrect repairs when last serviced. See back of lining for lining type.

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

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**UNEVEN OR HIGH RATE OF WEAR**

Correct lining?
- If less than 26K GVW, in most cases should be HX-402
- If 26K GVW or greater, in most cases should be HX-7A1

Note: These identifications may be found imprinted on the back of each shoe.

**No**
- Apply correct lining per manufacturer’s recommendation

**Yes**
- See Over Heated Brakes section
Over Heated Brakes

Typical over heated brake signs and symptoms may include brake lining odor, steering wheel pull, or blued rotors.

Uneven lining wear or rapid lining wear is often mistaken as stuck calipers. More probable root causes are incorrect linings, excessive brake duty, or incorrect repairs when last serviced. (See page 8 Low Shoe Pad Life or Uneven Shoe Pad Wear.)

Possible causes of over heated brakes:
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.
7) There are two different guide pins that connect the anchor plate to the caliper. Verify proper assembly per manufacturer’s recommended procedure.
8) Improper brake operation may be due to caliper interference with adjacent truck components as the caliper moves inboard, as linings wear. Verify that there is no interference.

NOTE: Use appropriate brake component and vehicle manufacturer’s service manual for all repair work.
NOTE: Use appropriate brake component and vehicle manufacturer’s service manual for all repair work.

Over Heated Brakes (continued)

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

No

- 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

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

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

No

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 bleeder screw is loosened
- Does the fluid spurt out under pressure?
- Tighten bleed screw to manufacturer’s recommended torque

Yes

The problem is probably with the power steering pump

The problem is probably with the booster, master cylinder or ABS

Continued  
on  
next page

Continued  
on  
page 12
NOTE: Use appropriate brake component and vehicle manufacturer’s service manual for all repair work.
Over Heated Brakes (continued)

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 an air ratchet ready to loosen the remaining two nuts quickly after the brakes have been applied and released.

**From page 10 or 11**

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?

- 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

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 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

Continued on next page

NOTE: Use appropriate brake component and vehicle manufacturer’s service manual for all repair work.
NOTE: Use appropriate brake component and vehicle manufacturer’s service manual for all repair work.

Over Heated Brakes (continued)

Does fluid spurt out under pressure at the tube nut?

No

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

Yes

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

- Retighten the tube nut
- The problem is probably with the booster
Figure 4. Comparison: Normal vs. Swollen Diaphragm

NOTE: Use appropriate brake component and vehicle manufacturer’s service manual for all repair work.
Leakage

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 and vehicle manufacturer’s service manual for all repair work.

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**Flowchart:**

- **Is the leak at the booster, master cylinder, ABS hydraulic unit, brake caliper, or tubes and hoses?**
  - **Caliper**
    - Is leak at the brake hose tube fitting?
      - No
        - Tighten tube fitting to manufacturer’s recommended torque
          - Does it still leak?
            - Yes
              - Replace tube seat or fitting. Tighten to manufacturer’s recommended torque.
                - Does it still leak?
                  - Yes
                    - The problem is probably with the caliper
                  - No
                    - Complete
            - No
              - The problem is probably with the caliper
        - Yes
          - Tighten bleed screw to manufacturer’s recommended torque
            - Does it still leak?
              - Yes
                - Replace tube seat or bleed screw. Tighten to manufacturer’s recommended torque.
                  - Does it still leak?
                    - Yes
                      - Complete
                    - No
                      - The problem is probably with the caliper
            - No
              - Complete
  - **ABS**
    - See ABS or vehicle manufacturer’s service manual

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Continued on next page
Leakage (continued)

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

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

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.
3) Binding pedal linkage - the brake pedal (lever) must be aligned side to side throughout full pedal travel, such that the booster pedal rod is aligned with the booster centerline to prevent linkage binding. With the pedal rod in the released position, the pin that attaches the booster pedal rod to the brake pedal (lever) should rotate freely by hand. Optimal performance occurs when the booster pedal rod articulates at the smallest angle possible.

- Check for proper power steering pump flow and pressure
- If the steering wheel cannot be rotated rapidly, or if flow is measured and found to be low, the problem is probably with the power steering pump

With engine OFF, does brake pedal feel very hard?

No

Yes

Does the backup pump run?

No

Yes

See Booster Back-up Pump Does Not Run section

Does the booster backup pump sound like it slows down when pushing harder on the pedal?

No

Yes

The problem is probably with the booster backup pump

The problem is probably with the ABS

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

If no external leakage, the problem is due to bypassing fluid, either inside the master cylinder or inside the ABS hydraulic unit.

Is there visible brake fluid leakage from:
- master cylinder?
- ABS hydraulic unit?
- disc brake calipers (watch for expanding piston boots)?
- tubes, hoses, or connections?

No

Is ABS light on?

No

A Snap-on master cylinder pressure test kit (P/N SVT 750) may be used to determine if the master cylinder can build and hold pressure. Does the master cylinder leak down? The master cylinder outlet port sizes are 9/16-18 UNF-2B on the primary and 1/2-20 UNF 2B on the secondary in most cases. An alternative to the test kit is to plug the master cylinder outlet ports. Apply steady foot force to the brake pedal. Does pedal continue to fall?

No

Yes

The problem is probably due to bypass of brake fluid inside master cylinder.

Yes

A Snap-on master cylinder pressure test kit (P/N SVT 750) may be used to determine if the master cylinder can build and hold pressure. Does the master cylinder leak down? The master cylinder outlet port sizes are 9/16-18 UNF-2B on the primary and 1/2-20 UNF 2B on the secondary in most cases. An alternative to the test kit is to plug the master cylinder outlet ports. Apply steady foot force to the brake pedal. Does pedal continue to fall?

No

Yes

The problem is probably due to bypass of brake fluid inside master cylinder.

See Leakage section.

Brake Pedal Feels Spongy, Soft or Springy

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 and vehicle manufacturer’s service manual for all repair work.
Booster Backup Pump Does Not Run

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 and vehicle manufacturer’s service manual for all repair work.
Booster Backup Pump Runs Continuously

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.

Is ignition key ON while condition exists?

No

Are brake lights OFF?

No

The problem is probably with the brake light switch

Yes

Is there voltage to the relay coil?

No

The problem is probably with the booster backup pump relay

Yes

The problem is probably with the ignition switch

Is engine running?

No

Normal condition

Yes

Unplug connector from flow switch

Is booster backup pump still running?

No

The problem is probably with the booster backup pump relay

Yes

Check for proper power steering pump flow by rapidly rotating the steering wheel (the alternative is to measure the fluid flow)

Does steering wheel rotate normally? Is flow OK?

No

The problem is probably with the power steering pump

Yes

The problem is probably with the booster flow switch

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

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 and vehicle manufacturer’s service manual for all repair work.