Section 6



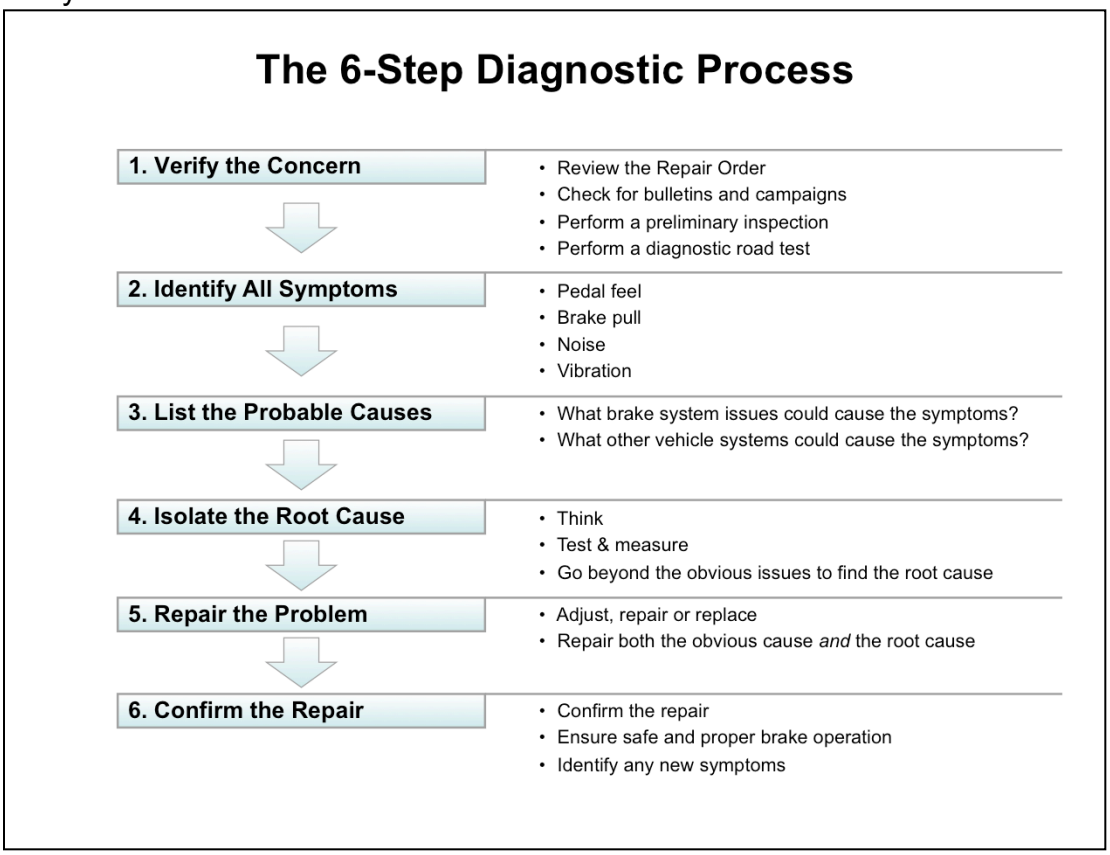
Brake Diagnosis

Section 6 Topics

This section covers Toyota's six-step diagnostic process, and describes how to apply that process to common brake concerns related to basic braking components.

Once you've completed this section you should be able to:

- Perform a preliminary inspection to determine the condition and safety of a vehicle prior to a diagnostic road test.
- Conduct a diagnostic road test to verify the concern and identify the symptoms.
- Use those symptoms to isolate the root causes of common brake concerns.
- Repair common brake concerns.
- Perform a confirmation road test to confirm that the concern has been resolved and the vehicle is ready for delivery to the customer.



The 6-Step Diagnostic Process

No matter what system you are working on, the 6-Step Diagnostic Process helps avoid wasted time, unnecessary parts replacement and the risk of not fixing the customer's original concern.

1. Verify the Concern
   - Review the Repair Order and check for bulletins & campaigns.
   - Perform a preliminary inspection.
   - Perform a diagnostic road test.

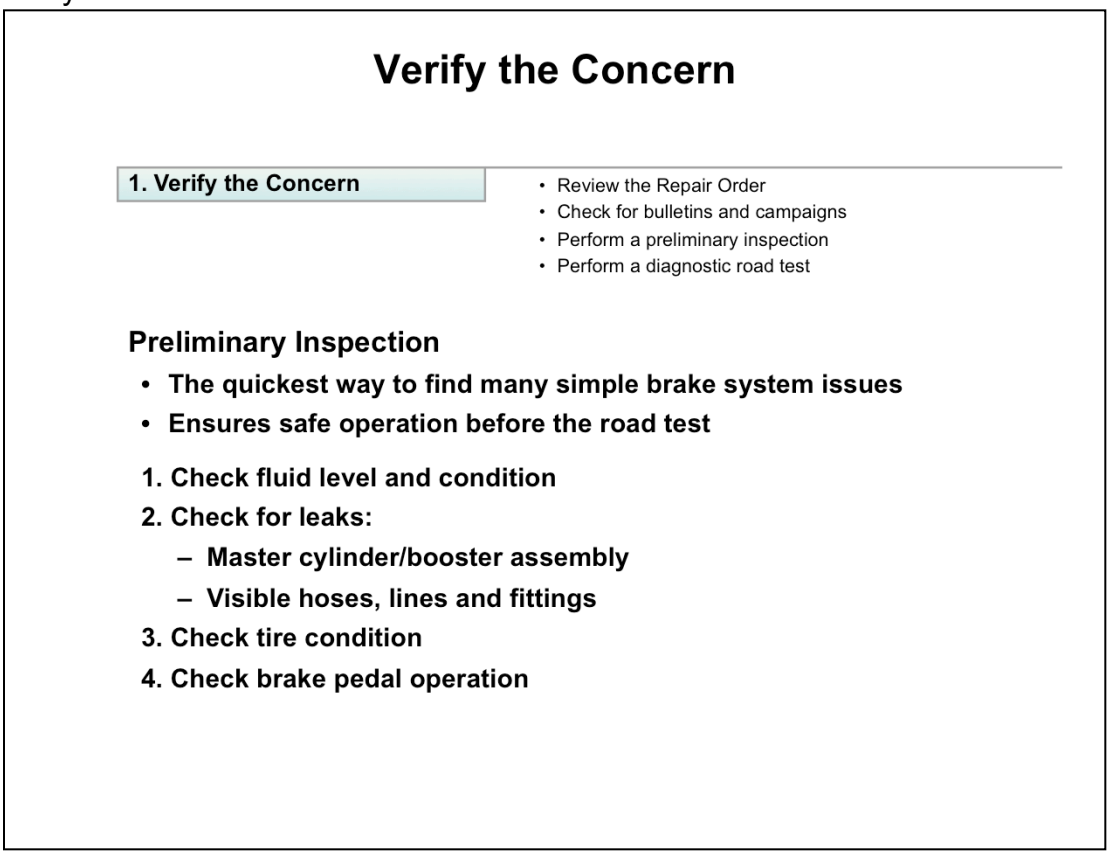
2. Identify All Symptoms
   - Common braking symptoms include pedal feel, brake pull, noise and vibration.

3. List The Probable Causes
   - Ask yourself what should be happening, and what issues could cause the symptoms you're experiencing.

4. Isolate the Root Cause
   - Think first, then test and measure.
   - Go beyond the obvious issues to find the root cause.

5. Repair the Problem
   - Adjust, repair or replace components as needed.
   - To prevent comebacks, repair both the obvious cause *and* the root cause.

6. Confirm the Repair
   - Perform a confirmation road test to confirm the repair and ensure safe and operation.
   - Identify any new symptoms.



Verify the Concern

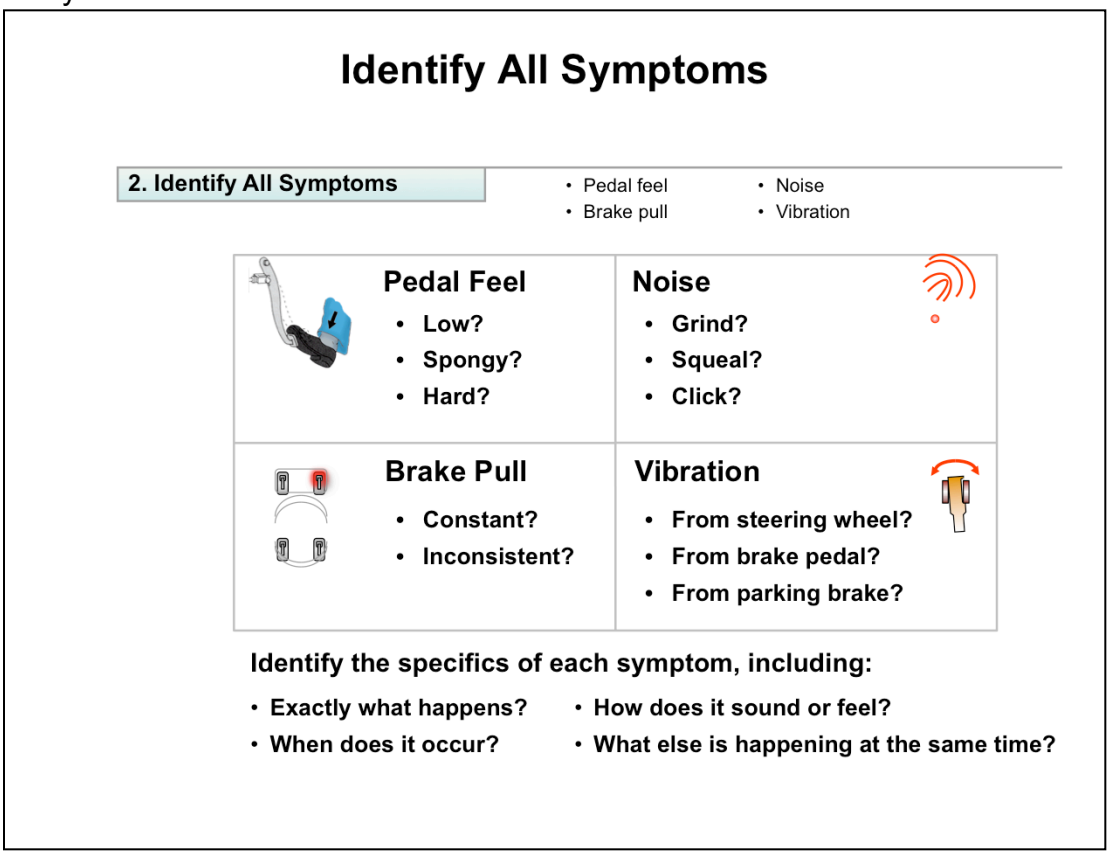
Carefully reviewing the Repair Order and checking for bulletins and campaigns are crucial steps in making sure you keep your customer's vehicle operating safely. And your diagnostic road test is vital to make sure you understand the concern that brought the customer into the dealership.

But there's one step in the process of verifying the concern that is sometimes overlooked, yet can easily save you time and ensure your safety when conducting a road test: the Preliminary Inspection.

Preliminary Inspection

A simple preliminary inspection is the quickest way to uncover many brake system issues. It can also help you find safety-related issues before you even move the vehicle. Before any road test you should always:

1. Check fluid level and condition (clean, fresh contaminant free fluid at the level specified in the repair manual)
2. Check for leaks at the master cylinder and brake booster assembly and at any visible hoses, lines and fittings.
3. Check tire condition
4. Check brake pedal operation



Identify All Symptoms

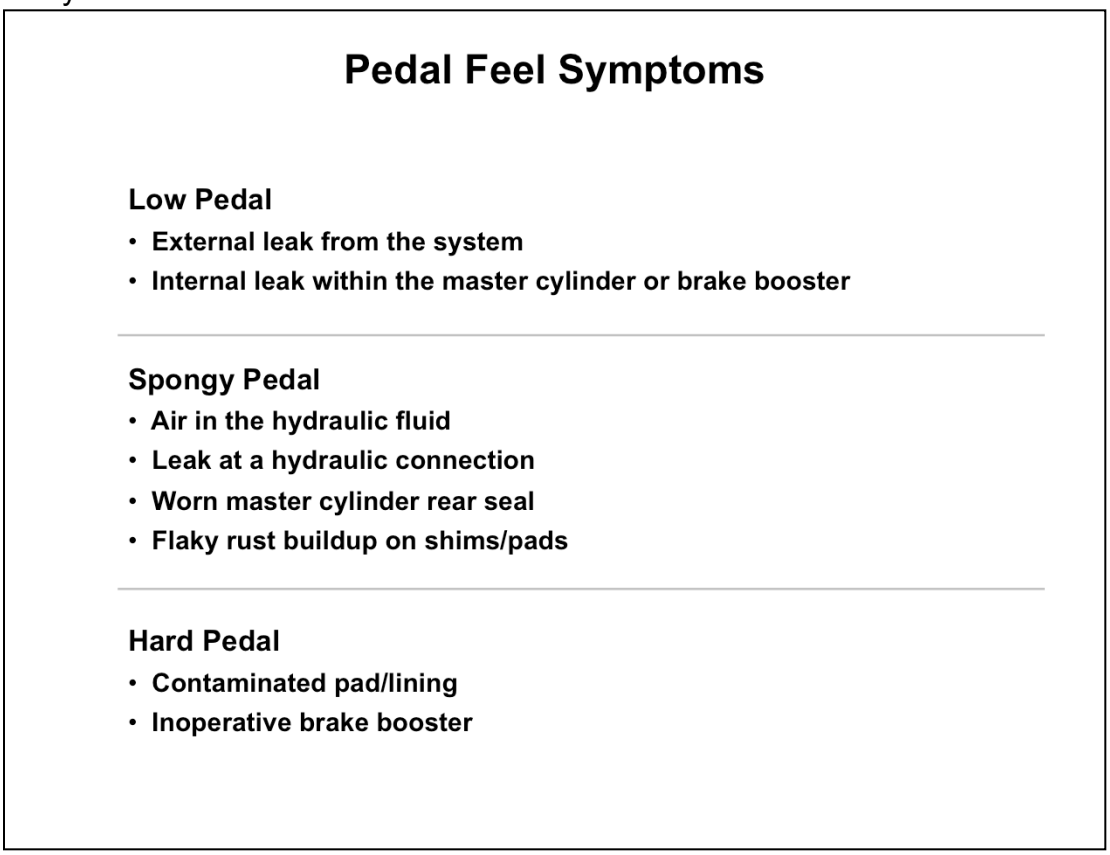
Hydraulic brake systems can create a variety of symptoms, but most of them fall into these categories:

- Pedal Feel
  - Low
  - Spongy
  - Hard
- Brake Pull
  - Constant pull
  - Inconsistent pull
- Noise
  - Grind
  - Squeal
  - Click
- Vibration
  - From the steering wheel
  - From the brake pedal
  - When the parking brake is applied and when it is not

Before you analyze the problem, identify all symptoms in detail. Pay attention to the symptoms the customer reported, and also to things they might not have noticed. Ask yourself:

- Exactly what happens?
- How does it sound or feel?
- When does it occur?
- What else is happening at the same time?

The answers to these questions will provide the information you need to support a solid diagnostic conclusion.



Pedal Feel Symptoms

Common pedal feel symptoms include:

Low Pedal (very little resistance), which can be cause by:

- External leak from system.
- Internal leak within master cylinder or brake booster.

Spongy Pedal, which can be caused by:

- Air in the hydraulic fluid
- Leak at hydraulic connection
- Worn master cylinder rear seal
- Flaky rust buildup on shims/pads

Hard Pedal (large effort for poor braking), which can be caused by:

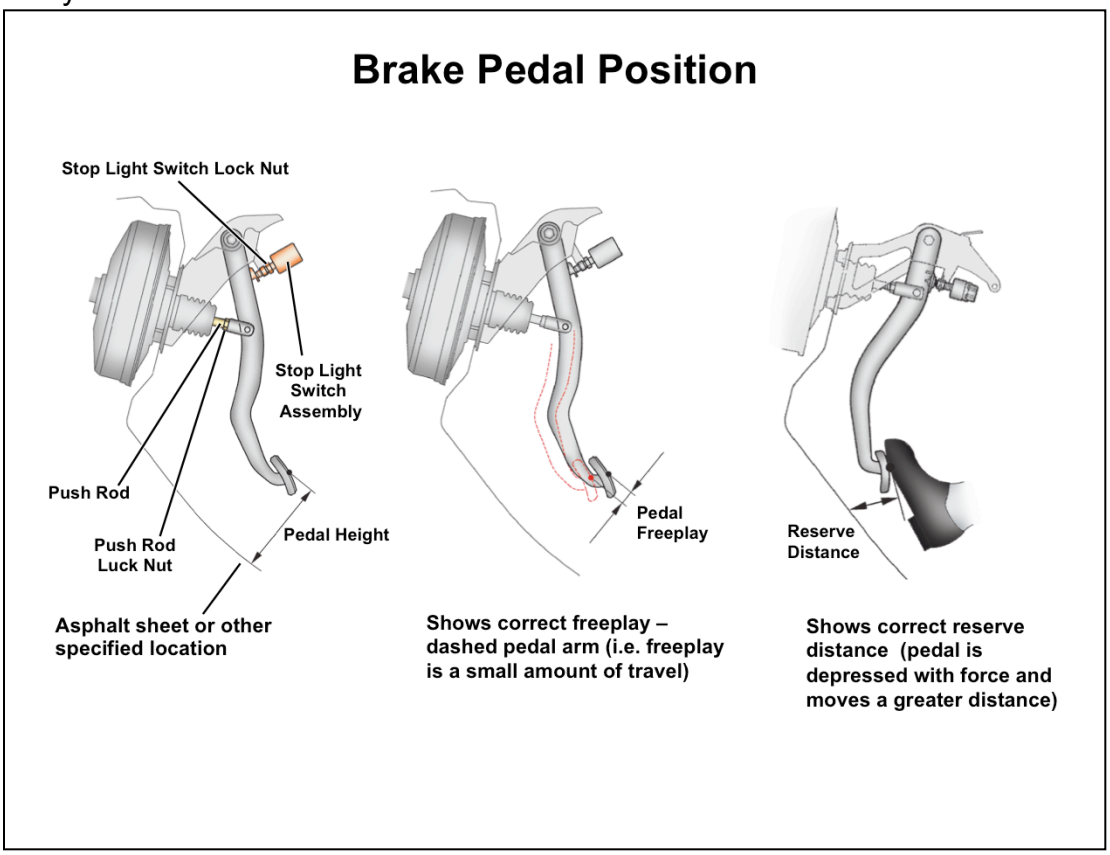
- Contaminated pad/lining
- Inoperative brake booster

NOTES

Obviously, it's impossible to see a leak inside the master cylinder. But if the pedal has the same 'spongy' feel that an external leak would have yet no external leak is present, fluid is probably leaking between chambers inside the master cylinder.

A flaky rust buildup on the shims/pads (which can be caused by exposure to road salt) can also create a 'spongy' pedal feel. But rust buildup causes a different feel than a hydraulic leak. You can rule out rust build up by:

- Paying close attention to the pedal feel
- Inspecting the shims/pads



Brake Pedal Position

Brake pedal position checks include:

Pedal Height

Brake pedal height is measured from the asphalt sheet to the top of pedal pad, and is adjusted using the push rod and clevis. Pedal height must be measured prior to reserve distance and free play.

NOTE

Push rod adjustment may be limited by the position of the stop light switch.

Free-Play

Free-play is measured from top of the pedal in its at-rest position to the top of the pedal where pedal pressure begins. For improved accuracy, bleed off booster vacuum before measuring free-play.

Reserve Distance

Reserve distance is measured from the top of the brake pedal to the asphalt sheet (or other specified location) with brake pedal fully depressed and engine running.

Low reserve distance may be caused by:

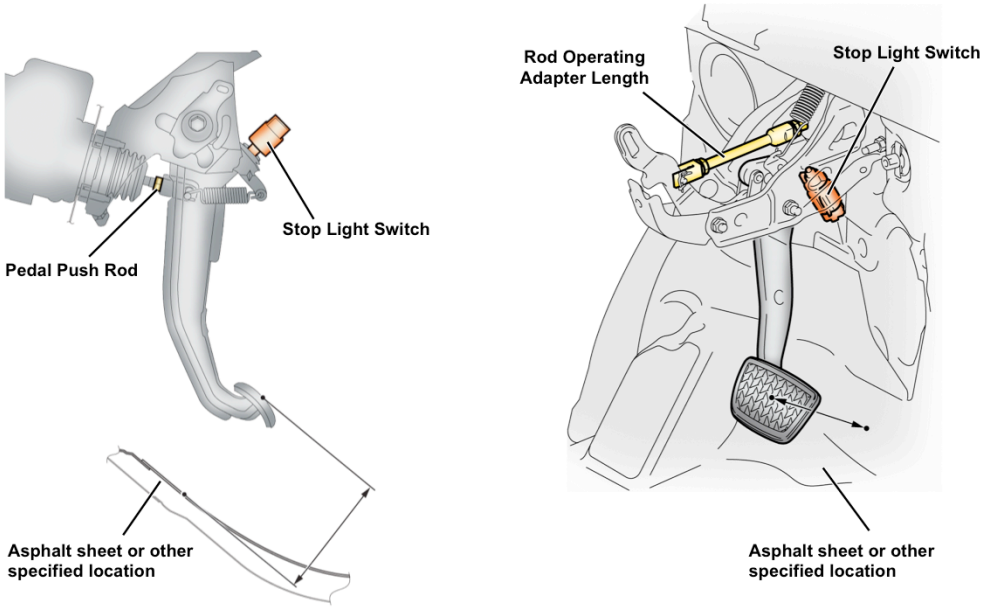
- Air in hydraulic system
- Rotor run-out
- Automatic adjusters not working correctly
- Loose wheel bearings

If pedal reserve is insufficient, the brakes may be slightly applied even when the pedal is not depressed, overheating the brake system and causing premature wear.

Stop Light Switch

Check stop light switch for proper clearance and adjust as needed. **Note**: Stop light switch adjustment may be affected by push rod adjustment.

Brake Pedal Reserve Adjustment



Brake Pedal Reserve Adjustment

Reserve distance is measured from the top of the brake pedal to the asphalt sheet (or front floor footrest, #2 dash panel insulator pad, or other specified location) with brake pedal fully depressed and engine running.

Low reserve distance may be caused by:

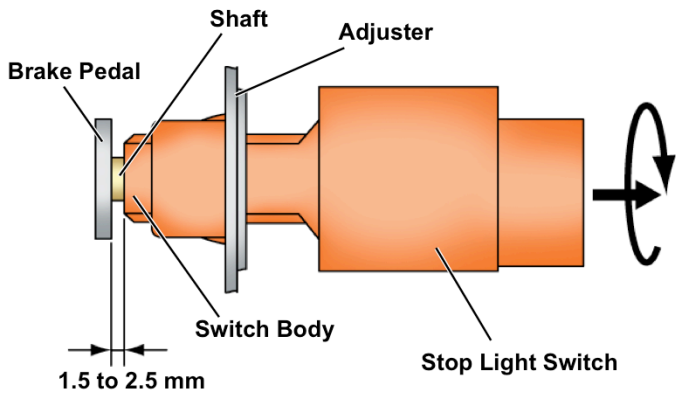
- Air in hydraulic system
- Rotor run-out
- Automatic adjusters not working correctly
- Loose wheel bearings

If pedal reserve is insufficient, the brakes may be slightly applied even when the pedal is not depressed, overheating the brake system and causing premature wear.

Note that adjustment of reserve distance is performed by two different methods on Toyota vehicles. Adjustment is either at the pedal push rod or at the rod operating adaptor depending on model.

Stop Light Switch Adjustment

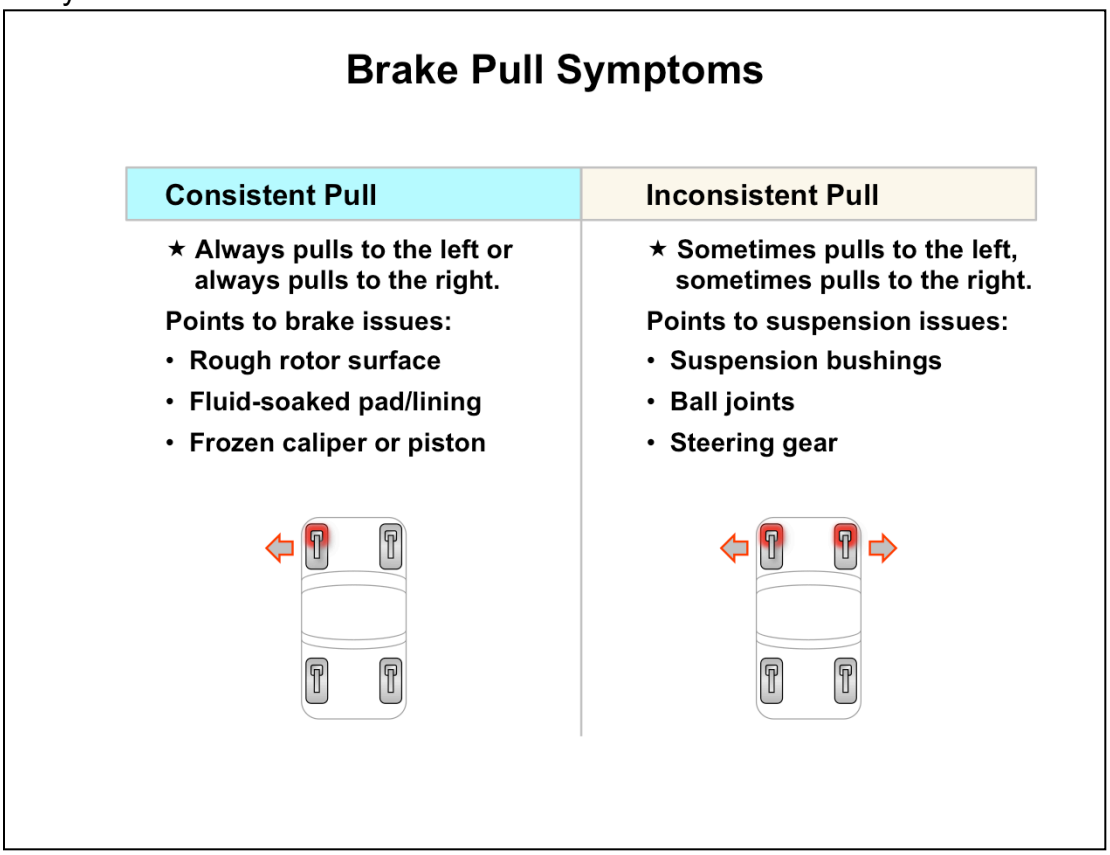
Example:



Service Tip: Stop light switch adjustment is a critical element of cruise control operation, always set it to repair manual specifications.

Stop Light Switch Adjustment

Check stop light switch for proper clearance and adjust as needed. **Note**: Stop light switch adjustment may be affected by push rod adjustment. Stop lamp adjustment is critical element of cruise control operation.



Brake Pull Symptoms

When diagnosing pull issues, it is helpful to separate vehicle pull from brake pull. Vehicle pull results from an imbalance from side to side. Your diagnosis should 1st rule out chassis pull issues such as alignment problems, worn/ damaged components (e.g. strut bushings), tire issues or uneven tire pressure.

Brake pull symptoms can be consistent or inconsistent. A consistent pull where the vehicle always pulls to the left or always pulls to the right when the brake is applied are typically caused by a brake system issue. Specific causes can be:

- Stuck piston (front or rear)
- Fluid-soaked pad/lining (front or rear)
- Frozen piston (front or rear)
- Scored disc (front or rear, excessively rough rotor surface)
- Cracked or distorted pad (front or rear, make sure to inspect shims and pad backing plate for excessive rust)
- Seized caliper (make sure to inspect slide condition)

An inconsistent pull, where the vehicle sometimes pulls to the left and sometimes to the right, typically indicates a suspension issue. Common causes include; suspension bushings, ball joints, steering gear issues, changes to wheel offset or excessive tire width.

Noise Symptoms

Grinding Noise ★ Occurs at all times during braking. • Cracked or distorted pad/lining • Rough rotor or drum surface	**Squealing Noise** ★ Occurs at all times during braking. • Damaged, missing, or incorrectly installed anti-squeal shims/springs • Scored rotor surface
Grinding Noise ★ Occurs just before vehicle stops. • Dirty or glazed pad/lining	**Squealing Noise** ★ Occurs just before vehicle stops. • Fluid-soaked pad/lining
Grinding Noise ★ Occurs only during 1st few stops. • Corroded rotor	**Clicking Noise** ★ Can be during braking or at all times. • Loose or damaged brackets, clips support plates, etc.

Service Tip: Becoming familiar with all service information is an important part of a brake service professional. In addition to the Repair Manual, other information; such as Quick Training Guide QT512A, can help resolve a concern.

Noise Symptoms

When listing noise symptoms, notice the character of the noise and when the noise occurs:

A consistent ‘grinding’ noise that occurs at all times during braking:

- Cracked or distorted pad/lining
- Rough rotor or drum surface

A consistent ‘squealing’ noise that occurs at all times during braking:

- Damaged, missing, or incorrectly installed anti-squeal shims/springs
- Scored rotor surface

A ‘grinding’ noise that only occurs just before the vehicle stops:

- Dirty or glazed pad/lining

A ‘squealing’ noise that only occurs just before the vehicle stops:

- Fluid-soaked pad/lining

A ‘grinding’ noise that only occurs during the 1st few stops each day:

- Corroded rotor

A ‘clicking’ noise (can be during braking or at all times):

- Loose or damaged brackets, clips support plates, etc,

NOTE A ‘groaning’ noise while creeping forward with light brake pedal effort is normal and does not affect braking. Slightly increasing or decreasing pedal effort will eliminate the noise.

Vibration Symptoms

Where	When
Vibration in steering wheel: • Front brakes • Front wheel assembly • Front tires **Vibration in brake pedal:** • Disc runout or lack of parallelism • Drum brakes out-of-round	**During coast down from 50-20:** • Driveshaft **Service brakes and parking brake:** • Rear brakes * **Service brakes but *not* parking brake:** • Front brakes * * Parking brake tests are only effective on vehicles with rear drum brakes.

Vibration Symptoms

When listing vibration symptoms, notice where the vibration is felt most strongly.

- If the vibration is very noticeable in the steering wheel, it is probably being created in the front brakes, front wheel assembly or front tires.
- If the vibration is very noticeable in the brake pedal, it is probably related to rotor runout, lack of parallelism or drum brakes that are out-of-round.

It is also very important to notice when the vibration occurs:

- If the vibration occurs during coast down from 50-20 mph when the brakes are not applied the vibration is likely related to a driveshaft issue such as excess driveshaft runout, excess pinion runout or incorrect differential pinion angle.

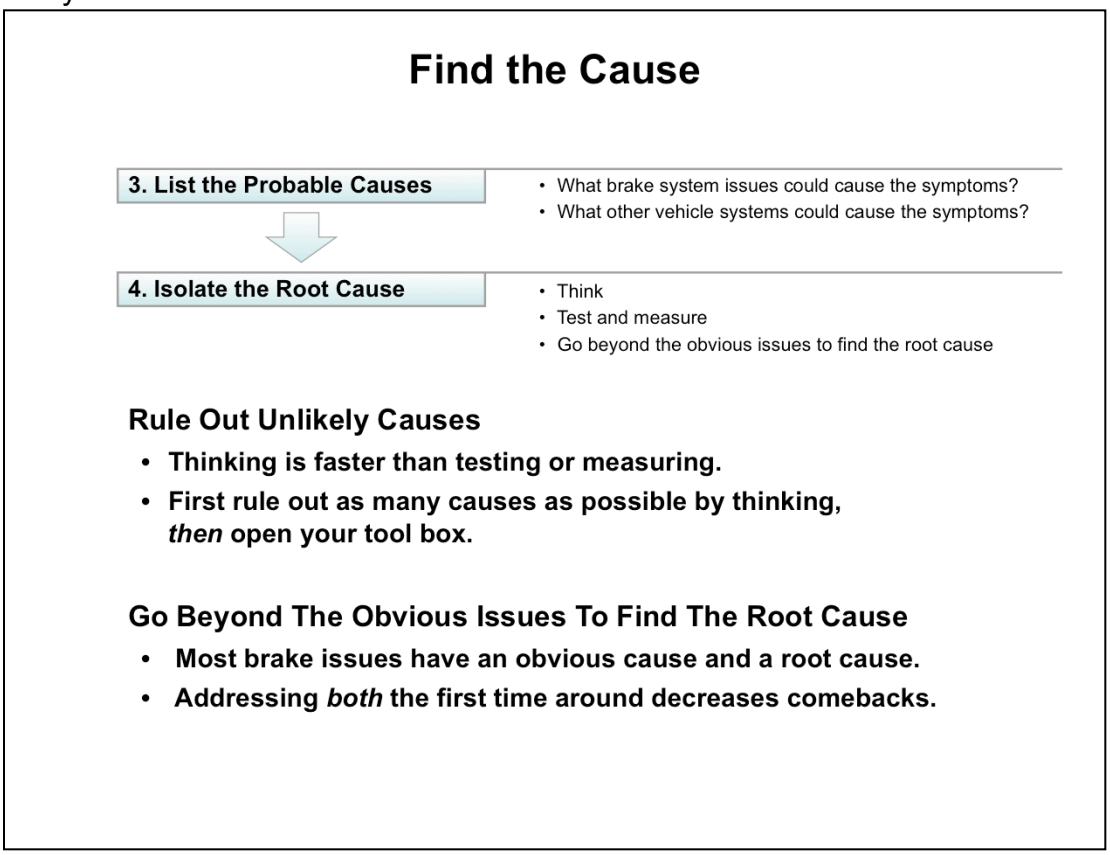
On vehicles with rear drum brakes:

- If the vibration occurs with the service brakes but not with the parking brake, the vibration is probably coming from the front brakes.
- In the vibration occurs with the service brakes and the parking brake, the vibration is probably coming from the rear brake.

NOTES

This does not apply to vehicles with rear disc brakes, because the parking brake is separate from the service brake.

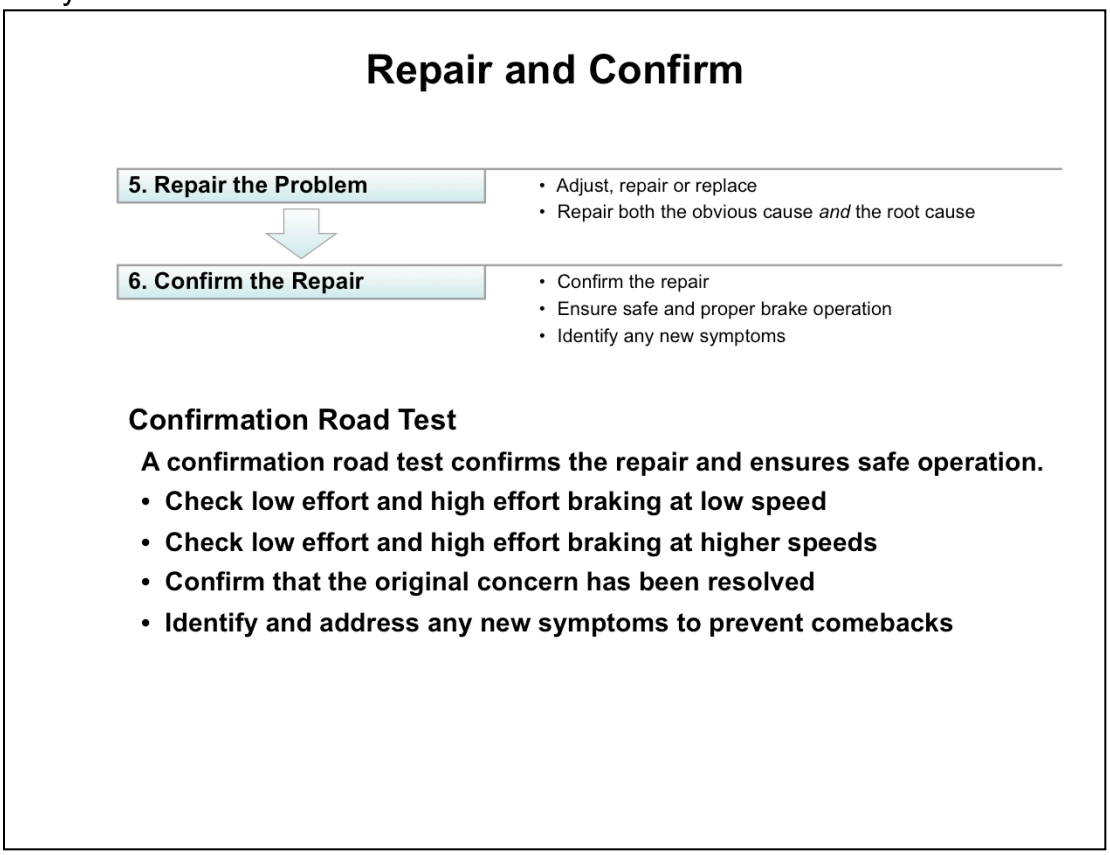
Parking brake operation tests are not recommended for vehicles that use a ratcheting pedal operating lever.



Find the Cause

Once you've identified all the symptoms in detail, it's time to list the probable causes, then rule out the less likely causes one at a time. Eventually, you'll be left with the real cause (or causes) of the concern.

Most brake issues have at least two causes: an obvious cause (such as a thickness variation in the rotor) and a root cause (such as the rotor misalignment that caused the thickness variation to begin with). So always take time to think beyond the obvious and find the root cause of every problem. That little bit of time up front can save you a lot of time later by preventing comebacks.



Repair and Confirm

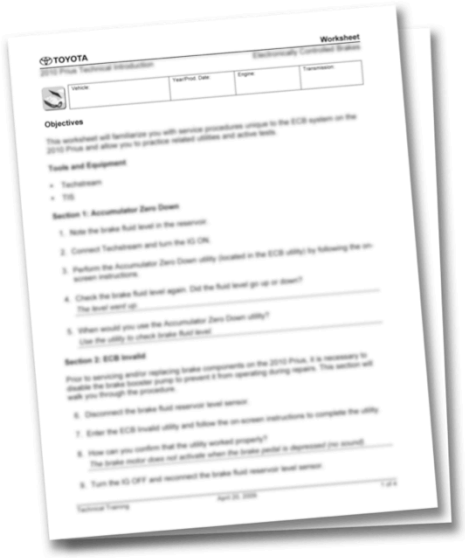
Once you've isolated the obvious and root causes of the concern, its time to repair the problem. Specific repair procedures for each component can be found in the section of this course dedicated to that component.

When your repair work is complete, perform a confirmation road test to confirm the repair and ensure safe and proper operation before returning the vehicle to the customer. During your confirmation road test you should:

- Check low effort and high effort braking at low speed
- Check low effort and high effort braking at higher speeds
- Confirm that the original concern has been resolved
- Identify and address any new symptoms to prevent comebacks

Brake Diagnosis Worksheet

- **Worksheets:**
  - **Brake Pedal Measurement**


TOYOTA Worksheet
2010 Prius Technical Introduction Electronically Controlled Brakes
Vehicle | Year/Prod. Date | Engine | Transmission
Objectives
This worksheet will familiarize you with service procedures unique to the ECB system on the 2010 Prius and allow you to practice related utilities and active tests.
Tools and Equipment
• Techstream
• TIS
Section 1: Accumulator Zero Down
1. Note the brake fluid level in the reservoir.
2. Connect Techstream and turn the IG ON.
3. Perform the Accumulator Zero Down utility (located in the ECB utility) by following the on-screen instructions.
4. Check the brake fluid level again. Did the fluid level go up or down?
The level went up.
5. When would you use the Accumulator Zero Down utility?
Use the utility to check brake fluid level.
Section 2: ECB Invalid
Prior to servicing and/or replacing brake components on the 2010 Prius, it is necessary to disable the brake booster pump to prevent it from operating during repairs. This section will walk you through the procedure.
6. Disconnect the brake fluid reservoir level sensor.
7. Enter the ECB Invalid utility and follow the on-screen instructions to complete the utility.
8. How can you confirm that the utility worked properly?
The brake motor does not activate when the brake pedal is depressed (no sound).
9. Turn the IG OFF and reconnect the brake fluid reservoir level sensor.
Technical Training April 20, 2009 1 of 4

Notes: