

# Automotive Technology 6<sup>th</sup> Edition

## Chapter 106 DISC BRAKE DIAGNOSIS & SERVICE

### Opening Your Class

KEY ELEMENT	EXAMPLES
<b>Introduce Content</b>	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
<b>Motivate Learners</b>	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
<b>State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.</b>	Explain learning objectives to students as listed below: <ol style="list-style-type: none"> <li>1. Discuss how to diagnose problems with disc brakes.</li> <li>2. Describe how to inspect, disassemble, and service disc brake calipers.</li> <li>3. Explain disc brake squeal correction.</li> <li>4. State the symptoms of a faulty disc brake.</li> </ol>
<b>Establish the Mood or Climate</b>	Provide a <i><b>WELCOME</b></i> , Avoid put downs and bad jokes.
<b>Complete Essentials</b>	Restrooms, breaks, registration, tests, etc.
<b>Clarify and Establish Knowledge Base</b>	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

**NOTE: Lesson plan is based on 6<sup>th</sup> Edition Chapter Images found on Jim's web site @ [www.jameshalderman.com](http://www.jameshalderman.com)**

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**NOTE: You can use Chapter Images or possibly Power Point files:**

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## Chapter 106 Disc Brake Diagnosis & SVC

### 1. SLIDE 1 CH106 DISC BRAKE DIAGNOSIS & SERVICE

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[Rotor Thickness Variation & Brake Pedal Pulsation \(View\) \(Download\)](#)

**DISCUSSION: Ask students to discuss procedure for diagnosing disc brake problems.**

### **EXPLAIN TECH TIP: *Let the Owner Drive***

**When verifying customer complaint, ask owner or driver of vehicle to drive. Often, problem is best discovered if vehicle is being driven exactly the same way as complaint first occurred. For example, the technician may brake harder or softer than the driver so the problem may not be detected.**

### **DISCUSS FREQUENTLY ASKED QUESTION:**

**To verify customer complaint, ask customer to drive vehicle while you ride along on a test drive to make sure vehicle is operated in same manner in which problem occurs**

2. **SLIDE 2 EXPLAIN** Figure 106-1 Minimum thickness for various types of disc brake pads. Pad wear sensors often make a “chirping” sound when the vehicle is

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## Chapter 106 Disc Brake Diagnosis & SVC

moving if the pads are worn. Do not confuse that noise for a defective wheel bearing or other fault.

3. **SLIDE 3 EXPLAIN Figure 106-2** This cracked disc brake pad must be replaced even though it is thicker than minimum allowed by vehicle manufacturer and the wear sensor was not close to the rotor.

**EXPLAIN TECH TIP: *Bleed and Squirt Test*** If you suspect a brake is not being fully released, simply loosen the bleeder valve. If brake fluid squirts out under pressure, then brake is being kept applied. Look for a defective flexible brake hose. If the vehicle is off the ground, the wheels should be able to be rotated with brakes off. If a wheel is difficult or hard to turn by hand and is easy to turn after opening bleeder valve, then there is a brake fluid **The electronic sensor in a brake pad that operates the wear indicator is easily broken when removing the pads.**

4. **SLIDE 4 EXPLAIN FIGURE 106-3** brake pad display used by shops to help customers visualize measurements taken when their brakes were inspected.
5. **SLIDE 5 EXPLAIN FIGURE 106-4** Most disc brake calipers have a brake inspection opening. For a thorough inspection, however, caliper should be removed and entire braking system thoroughly inspected. This inspection opening does allow use of a brake pad thickness gauge so that pad thickness can be documented on the work order.

**DEMONSTRATION:** Show students how to do the bleed and squirt test to determine if a brake is being completely released.

**DISCUSSION:** discuss the process of visually inspecting disc brakes. What should they do beyond checking the thickness of the lining?

6. **SLIDE 6 EXPLAIN Figure 106-5 (a)** Both rear- and forward-mounted calipers have the bleeder valve at the top. Some calipers will fit on the wrong side of the vehicle, yet not be able to be bled correctly because the bleeder valve would point down, allowing trapped air to

## ICONS



## Chapter 106 Disc Brake Diagnosis & SVC

remain inside the caliper bore. If both calipers are being removed at the same time, mark them “left” and “right.”

7. **SLIDE 7 EXPLAIN Figure 106-6** Many manufacturers recommend removing  $\frac{1}{2}$  of brake fluid from master cylinder before servicing disc brakes. Use a squeeze bulb and dispose of used brake fluid properly.
8. **SLIDE 8 EXPLAIN Figure 106-7** Most OEMS recommend that bleeder valve be opened and brake fluid forced into a container rather than back into master cylinder reservoir. This helps prevent contaminated brake fluid from being forced into the master cylinder where the dirt and contamination could cause problems.
9. **SLIDE 9 EXPLAIN Figure 106-8** Many calipers use a hollow “banjo bolt” to retain flexible brake line to caliper housing. Fitting is usually round like a banjo. The copper washers should always be replaced and not reused.
10. **SLIDE 10 EXPLAIN Figure 106-9** Caliper retaining bolts are often called guide pins. Guide pins are used to retain the caliper to the steering knuckle. These pins also slide through metal bushings and rubber O-rings.
11. **SLIDE 11 EXPLAIN Figure 106-10** If caliper is not being removed, it must be supported properly so that weight of caliper is not pulling on flexible rubber brake line. A suitable piece of wire, such as a coat hanger
12. **SLIDE 12 EXPLAIN Figure 106-11** wooden block or a folded shop cloth helps prevent damage when caliper pistons are removed. Use extreme care when removing a caliper piston using compressed air. The pressure applied can force the piston out of the caliper with tremendous force. Always follow service information instructions.
13. **SLIDE 13 EXPLAIN Figure 106-12** After piston is removed from the caliper housing, the dust boot can often be removed using a straight blade screwdriver.
14. **SLIDE 14 EXPLAIN Figure 106-13** Phenolic (plastic) pistons should be carefully inspected.
15. **SLIDE 15 EXPLAIN Figure 106-14** If there are any surface flaws such as rust pits on piston, it should be replaced.

**DISCUSS CASE STUDY: *Three Brake Jobs in 40,000 Miles*** tech was asked to replace front disc brake pads on Pontiac Grand Am because sensors were touching rotors and making

## ICONS

## Chapter 106 Disc Brake Diagnosis & SVC

squealing sound. This was the 3<sup>rd</sup> time that front brakes needed to be replaced. Previous repairs had been limited to replacement of front disc brake pads only. When the caliper was removed and pads inspected, it was discovered that a part of one pad had broken and a piece of the lining was missing. • **SEE FIGURE 106-15.** Then technician spotted something at rear of vehicle that told whole story—a trailer hitch.

Owner confirmed that heavy jet ski was towed in hilly terrain. Tech recommended overhauling front disc brake calipers to prevent possibility of front pads dragging. Tech also recommended inspection of rear brakes. The rear brakes were glazed and out of adjustment. Technician received permission to replace rear brakes, replace both front calipers, and install quality disc brake pads. When customer returned, technician advised customer to use a lower gear in transmission on long downhill roads to help keep brakes from overheating and failing prematurely.

### Summary

- **Complaint**—front calipers needed replacement more often than expected.
- **Cause**—front calipers were not retracting rear brakes were not working
- **Correction**—Front calipers were replaced and rear brakes were serviced. Plus the owner was advised to use the gear selector when descending long grades to reduce load on brakes.

16. **SLIDE 16 EXPLAIN** FIGURE 106-15 These pads were found to be cracked and a section was missing



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DEMO

DEMO



## Chapter 106 Disc Brake Diagnosis & SVC

**DEMONSTRATION: Show example of a phenolic caliper piston, and discuss the initial problems associated with them and how these problems were resolved. Show students an example of steel caliper pistons, and discuss the benefits and drawbacks of steel versus phenolic caliper pistons.**

**DEMONSTRATION: Show how to get caliper piston into a caliper that needs dust boot installed before piston. Use low air pressure through brake line hole. Place piston on top of dust boot. Air pressure will expand dust boot out just far enough for you to sneak piston between top lip of seal. Another way to install piston into seal is to work your fingers in between the seal and the piston and pull seal around piston as you apply light pressure down on the piston**

17. **SLIDE 17 EXPLAIN Figure 106-16** Removing the square-cut O-ring seal from the caliper bore. Use a wooden or plastic tool to prevent damage to seal groove.
18. **SLIDE 18 EXPLAIN Figure 106-17** Some OEMs recommend cleaning the inside of the caliper bore using a honing tool as shown. Even though the caliper piston does not contact the inside of this bore, removing any surface rust or corrosion is important to prevent future problems. If the honing process cannot remove any pits or scored areas, the caliper should be replaced.
19. **SLIDE 19 EXPLAIN Figure 106-18** Installing a new piston seal. Never reuse old rubber parts. A caliper overhaul kit includes just two items: the square-cut piston seal O-ring and dust boot.
20. **SLIDE 20 EXPLAIN Figure 106-19** Brake assembly fluid or clean brake fluid from a sealed container can be used to lubricate the caliper seal and caliper pistons before assembly.
21. **SLIDE 21 EXPLAIN Figure 106-20** Installing caliper piston. Many calipers require that dust boot be installed in groove of piston and/or caliper before installing piston.
22. **SLIDE 22 EXPLAIN Figure 106-21** Installing a piston into a caliper. Sometimes a C-clamp is needed to install the piston. Both the piston and the piston seal should be coated in clean brake fluid before assembly.

## ICONS

## Chapter 106 Disc Brake Diagnosis & SVC

23. **SLIDE 23 EXPLAIN Figure 106-22** Seating the dust boot into the caliper housing using a special plastic seating tool.
24. **SLIDE 24 EXPLAIN Figure 106-23** All rubber bushings should be lubricated with silicone brake grease for proper operation.
25. **SLIDE 25 EXPLAIN Figure 106-24 (a)** Using a screwdriver to force the outboard pad into proper position before bending the retaining tabs.
26. **SLIDE 26 EXPLAIN Figure 106-24 (b)** Use two hammers to bend the tab where it extends through the hole in the caliper body.
27. **SLIDE 27 EXPLAIN Figure 106-25** Often, a hammer is necessary to bend the retainer flange to make certain that the pads fit tightly to the caliper. If the pads are loose, a “click” may be heard every time the brakes are depressed. This click occurs when the pad(s) move and then hit the caliper or caliper mount. If the pads are loose, a clicking noise may be heard while driving over rough road surfaces.



**HANDS-ON TASK:** Have students carry out the steps to remove disc brake calipers. Have students inspect the calipers they have removed, and select students to report their observations to the class.

**EXPLAIN TECH TIP:** Using “Loaded Calipers” Saves Time. Many technicians find that disassembly, cleaning, and rebuilding calipers can take a lot of time. Often bleeder valve breaks off or caliper piston is too corroded to reuse. This means that technician has to get a replacement piston, caliper overhaul kit (piston seal and boot), plus replacement friction pads and hardware kit. To save time (and sometimes money), many technicians are simply replacing the old used calipers with “loaded calipers.” Loaded calipers are remanufactured calipers that include (come loaded with) the correct replacement friction pads and all the necessary hardware. • SEE FIGURE 106-26.

28. **SLIDE 28 EXPLAIN FIGURE 106-26** A loaded caliper includes all hardware and shims with the correct pads all in one convenient package, ready to install on the vehicle



## ICONS

## Chapter 106 Disc Brake Diagnosis & SVC



29. **SLIDE 29 EXPLAIN Figure 106-27** Floating calipers must be able to slide during normal operation. Therefore, there must be clearance between the caliper and the caliper mounting pads (abutments). Too little clearance will prevent the caliper from sliding and too much clearance will cause the caliper to make a clunking noise when the brakes are applied.
30. **SLIDE 30 EXPLAIN Figure 106-28** Using an air-powered sanding disc to clean the caliper mount pads.
31. **SLIDE 31 EXPLAIN Figure 106-29** Determine which face of the special tool best fits the holes or slots in the piston. Sometimes needle-nose pliers can be used to rotate the piston back into the caliper bore.
32. **SLIDE 32 EXPLAIN Figure 106-30** Note twisted flexible brake line

**EXPLAIN TECH TIP: Always Double-Check Your Work. Whenever reassembling brakes, it is easy to twist flexible brake hose as shown in • FIGURE 106-30. To prevent possible brake hose failure and possibly an accident, always double-check that ribs on brake hose are straight. The ribs allow technician to easily spot if hose has been twisted.**

33. **SLIDE 33 EXPLAIN Figure 106-30** Note twisted flexible brake line

**DEMONSTRATION: Show the students the proper way to remove a brake pad that has an electronic wear sensor. Show students how to check an electronic sensor for proper installation with a continuity tester**

**DEMONSTRATION: Show caliper abutments on a disc brake, and discuss the issues caused by too much clearance between the abutment and the caliper. What causes this and what are the symptoms? Ask student to identify possible repairs It may take several tries to get retaining tabs tight on out board pad. They must be tight to point where you have to force them on by hand.**

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QUESTION

## Chapter 106 Disc Brake Diagnosis & SVC

**DISCUSS CHART 106-1 causes of brake noise can have many reasons and corrections.**

34. **SLIDE 34 EXPLAIN** Figure 102-31 For best braking performance, purchase replacement disc brake pads that include all clips and shims specified by the vehicle manufacturer. Some pads even come with a package of the specified grease to use on the shims to reduce the possibility of brake noise.
35. **SLIDE 35 EXPLAIN** Figure 102-32 Notice beveled pads. The shape of pad helps reduce brake noise.

### **EXPLAIN TECH TIP: Increasing Pad Life**

**Many vehicles seem to wear out front disc brakes more often than normal. Stop-and-go city-type driving is often cause. Driving style, such as rapid stops, also causes a lot of wear to occur. Tech can take some actions to increase brake pad life that are easier than having to cure driver's habits.**

**These steps include the following:**

1. **Make sure the rear brakes are properly adjusted and working correctly. If the rear brakes are not functioning, all of the braking is accomplished by the front brakes alone.**

**NOTE: Remind the driver to apply the parking brake regularly to help maintain proper rear brake clearance on the rear brakes.**

2. **Use factory brake pads or premium brake pads from a known manufacturer. Tests performed by OEMS show that many aftermarket replacement brake pads fail to deliver original equipment brake pad life.**

**DISCUSSION: Ask students to discuss how to test newly installed brake pads prior to a test drive and why this is an important first step. Ask students to talk about the causes of disc brake squeal. How can you tell the difference between the sound of a thin-lining warning sensor and other problems associated with operating disc brakes? Ask students to discuss the process of bedding-in, or burnishing, replacement brake pads to break them in. What is OEM recommendation for pads**

## ICONS



## Chapter 106 Disc Brake Diagnosis & SVC

with which they are working? Is this typically appropriate for new brakes today?

**DEMONSTRATION:** Show students an example of **Anti-Squeal Shims** and discuss how they work. Ask students to discuss ways to prevent disc brake squeal. Talk about how and where to apply grease to disc brakes to reduce brake noise. Ask students to discuss how to machine brake rotors to reduce brake noise. How does changing the brake pad lining and shape help diminish brake noise? **Always purchase replacement disc brake pads that include all the clips, shims, and lubricant specified by the OEM**

**DISCUSSION:** Ask students to discuss possible causes of dragging brakes. Ask students to talk about why front disc brakes might be very sensitive to light application of the brakes. Ask students to discuss why rear drum brakes might skid during hard application of the brakes

**DEMONSTRATION:** Show students how to use a brake pressure tester to diagnose an imbalance between the left- and right-side brakes.

**DEMONSTRATION:** Show how to torque a wheel using a torque stick and to double check with a torque wrench when the car is on the ground.

**EXPLAIN TECH TIP:** ***Screwdriver Trick.*** A low brake pedal on GM vehicles equipped with rear disc brakes is a common customer complaint. Often reason is a lack of self-adjustment that should occur whenever brake pedal (or parking brake) is released. During brake release, the pressure is removed from caliper piston and the spring inside caliper piston is free to adjust. Often this self-adjustment does not occur and a low brake pedal results. A common trick that is used on the vehicle assembly line is to use a screwdriver to hold piston against rotor while an assistant releases the brake pedal. • **SEE FIGURE 106-33.** As brake pedal is released, adjusting screw inside caliper piston is

## ICONS

## Chapter 106 Disc Brake Diagnosis & SVC

free to move. Sometimes, it may be necessary to tap on caliper itself with a deadblow hammer to free adjusting screw. Repeat process as necessary until proper brake pedal height returns. If this method does not work, replace caliper assembly. In summary, recall these steps:

**STEP 1** Have an assistant depress brake pedal.

**STEP 2** Using a screwdriver through hole in top of caliper, hold the piston against the rotor.

**NOTE:** Be careful not to damage dust boot.

**STEP 3** While still holding the piston against the rotor, have assistant release the brake pedal. The adjusting screw adjusts when brake pedal is released and a slight vibration or sound will be noticed as brake is released. This vibration or sound is created by the self-adjusting mechanism inside caliper piston taking up the excess clearance.

**STEP 4** Repeat as necessary until normal brake pedal



36. SLIDE 36 **EXPLAIN** FIGURE 102-33 screwdriver blade is used to keep the piston applied to allow self-adjustment to occur when the brake pedal is released.

37. SLIDE 37 **EXPLAIN** FIGURE 102-34A brake pressure tester.



**EXPLAIN TECH TIP: Pressure Testing Can Help Find Problems.** A stuck caliper or caliper slide is often difficult to see or diagnose as a problem because the movement of broken pads is so little. Using a pressure gauge between caliper piston and rotor (inboard) or between rotor and caliper (outboard) can tell technician if there is a difference between left and right side brakes. • **SEE FIGURE 106-34.**



37. SLIDE 37 **EXPLAIN** FIGURE 102-34A brake pressure tester.

38. SLIDE 38 **EXPLAIN** FIGURE 102-34B The small “pads” can be placed between the caliper piston and the rotor to check for applied pressure and inserted between the caliper and the rotor on the outside of the rotor to test the pressure—the pressure should be the same if the caliper is able to slide on its pins or slides.

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## Chapter 106 Disc Brake Diagnosis & SVC

### 39. SLIDES 39-56 OPTIONAL EXPLAIN DISC BRAKE SERVICE

#### ON-VEHICLE ASE EDUCATION TASK D1:

Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging, or pulsation concerns; determine needed action.

#### ON-VEHICLE ASE EDUCATION TASK D2:

Remove and clean caliper assembly; inspect for leaks, damage, and wear; determine needed action

#### ON-VEHICLE ASE EDUCATION TASK D3:

Inspect caliper mounting and slides/pins for proper operation, wear, and damage; determine needed action.

#### ON-VEHICLE ASE EDUCATION TASK D4:

Remove, inspect, and/or replace brake pads and retaining hardware; determine needed action.

#### ON-VEHICLE ASE EDUCATION TASK D5:

Lubricate and reinstall caliper, brake pads, and related hardware; seat brake pads; inspect for leaks.

#### ON-VEHICLE ASE EDUCATION TASK D10:

Retract and re-adjust caliper piston on an integrated parking brake system.

#### ON-VEHICLE ASE EDUCATION TASK D11:

Check brake pad wear indicator; determine needed action.

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## Chapter 106 Disc Brake Diagnosis & SVC

### ON-VEHICLE ASE EDUCATION TASK D12:

**Describe importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations..**

**SEARCH INTERNET: Automotive disc brake designs have a long history dating back to Frederick William Lanchester's patent in 1902. Have students collaborate on a report covering early history of disc brake designs—from 1949 Crosley Hotshot to 1963 Studebaker Avanti.**