Braking Systems: ASE Certification Series

Introduction
This Instructor’s Guide provides information to help you get the most out of the Braking Systems ASE Certification Series, a three-part program that grounds students in the primary areas of automotive braking systems diagnosis and repair, required not only to pass the Automotive Service Excellence tests, but also to be among the best skilled and savvy technicians in the business.

Learning Objectives
After viewing the program, students will be able to:

- Recognize the types, function, and components of braking systems.
- Identify and assess vehicular brake problems.
- Use appropriate diagnostic tools and strategies to respectively determine and fix problematic components of automobiles’ braking systems.
- Prepare sufficiently for ASE A5 Certification Exam.
Program Summary

When it comes to automotive professionalism and a concern for customer safety, nothing is more important than high-quality brake repair work. Use this three-part series to give auto-shop students and service trainees their best shot at acing the ASE A5 test, along with real-world capabilities in diagnosing and solving a variety of braking system problems.

National Standards

For educational standards, please refer to the accompanying ASE/NATEF task correlation check-lists, as well as the ‘educational standards’ link at http://ffh.films.com/search.aspx?q=Braking+Systems%3A++ASE+Certification+Series

Main Topics

Topic 1: Brake Fundamentals
This segment introduces the different types of brakes and their components, as well as explains brake systems’ basic operating theory.

Topic 2: ABS
This section explores antilock brake systems (ABS) and Traction Control (TCS), which represent the most important safety enhancement for the automobile in decades.

Topic 3: Flaring
Explored here is technique for replacing a section of brake line tubing. John and Chase demo a double flare and an ISO bubble flare, as well as show how to bend and install a brake line.

Topic 4: Master Cylinders
John and Chase demonstrate the method for bench bleeding, filling and bench bleeding a master cylinder before installation to remove trapped air.

Topic 5: Valves and Bleeding
As discovered in this segment, there are a series of valves with important functions that play a major role in brake dynamics. John and Chase also introduce several strategies for diagnosing problems with these valves.

Topic 6: Power Assist
As discovered in this piece, power assist is a type of braking system that reduces the braking effort required at the pedal. Chase and John talk about different components of power assist, such as vacuum power boosters and hydraulic power brakes, as well as offer tech tips, professional theory and diagnosing.
**Topic 7: Disc Brakes**
This segment explores the operation of disk brakes, as well as disc brake service and diagnostics.

**Topic 8: Drum Brakes**
Here, John and Chase cover the cover operation of drum brakes, along with drum brake service and diagnostics.

**Fast Facts**

- Brakes turn kinetic energy into heat energy. Friction and pressure dissipate the heat.

- Not only do the brakes have to stop the vehicle, they have to stop it with the momentum going forward. This is known as brake dynamics or the weight transfer of a vehicle during braking.

- A 200 horsepower engine is capable of accelerating a car from 0 to 60 in 10 seconds. For brake systems, that means the same car must stop it from 60 to 0 in 1/5 the time.

- Of the three types of brake pads—organic, metallic, and ceramic—ceramic brake pads are the best for heat transfer.

- Anti-lock brakes are not new: In 1947, B-47 bombers used them; in 1970, semi trucks got them; automobiles acquired ABS in 1985.

- ABS is an enhancement to the base brakes. Base brakes must be in top condition for the ABS to work properly.

- Brake tubes must withstand an internal pressure of 8000 PSI. Brake hoses must withstand 4000 PSI for two minutes without rupturing.

- Brake dynamics is the weight transfer of a vehicle during braking. When the foot hits the pedal, the vehicle stops, but the momentum throws the weight forward.

- Normal engine vacuum should be between 16 inches of mercury to 22 inches of mercury.

- A good visual inspection of a car can help a technician diagnose up to 40% of a car's problems.
• Fixing a disc brake is not just about backyard mechanics. It’s about being immersed in the theory of coefficient of friction, and knowing the different caliper designs and how they move. This knowledge ensures that automotive technicians provide customers with the very best brake job.

• Drum brakes usually only do about 30% of a car’s stopping.

• A wheel speed sensor generates its own voltage because it’s an AC generator.

**Vocabulary Terms**

**atmospheric suspended booster:** A booster power chamber with atmospheric pressure on both sides of its diaphragm when the brakes are not applied.

**anti-lock brake system (ABS):** Prevents wheel lockup and skidding during panic stops or while braking on slick or wet surfaces; reduces stopping distances under such circumstances, improves vehicle stability and safety, and allows the driver to retain a certain amount of steering control in an emergency situation.

**bench bleeding:** A procedure used to bleed the air from a new or rebuilt master cylinder before installation in a vehicle.

**bore cylinder:** The internal surface of a cylindrical volume used to retain and seal a moving piston and ring assembly.

**brake fade:** The reduction in stopping power that can occur after repeated or sustained application of the brakes, especially in high load or high-speed conditions.

**brake booster:** Located between the brake pedal and the master cylinder to increase the force applied to the pistons in the master cylinder.

**brake lathe:** Metal lathe (that has only the spindle, and the item to be machined is suspended vertically) designed to turn automobile brake drums and rotors.

**brake line:** A special type of high-pressure steel tubing that carries the fluid from the master cylinder to the wheel brakes.

**brake lining:** A high-friction material attached to the brake pad or brake shoe.

**brake shoes:** The components in a drum brake that support the linings.
**brake switch:** A switch connected to the brake wire that enables the turning of the brake lights on or off.

**bubble flare (ISO):** Tool used to create International Organization for Standardization (ISO)–compliant flares on the ends of tubing.

**caliper:** The component in a disc brake that applies the hydraulic force to press the brake pads against the rotor.

**chamfer:** Grinding a secondary flat surface on a corner; creating a beveled edge.

**check valve:** A one-way, in-line spring-loaded ball or piston valve that permits flow of liquids or gases in one direction only and closes to prevent passage in the opposite direction.

**coefficient of friction:** The ratio of force required to move or stop one surface, with a given perpendicular force applied to it, as it drags across another surface. Or, the slippage of the pad as it clamps down on the rotor.

**compensating port:** A small hole in a brake master cylinder to permit fluid to return to the reservoir.

**disc brake:** A type of brake that uses a flat disc or rotor rather than a drum for the friction surface.

**double flare:** The folded-over end of flared tubing necessary with steel brake lines.

**drum brakes:** Brakes that use hydraulic pressure to force curved brake shoes against the inner walls of a hollow metal drum attached to each wheel.

**duo servo:** A brake design that provides servo action regardless of which way the drum is turning (forward or reverse).

**electronic brake control module (EBCM):** Controls the system functions and detects failures.

**electro-hydraulic modulator:** A solenoid-operated valve and electric pump mechanism for cycling pressure to each wheel brake cylinder.

**fixed caliper:** A type of caliper that is rigidly mounted over the rotor, and has either two or four opposing pistons to squeeze the pads against the rotor.

**floating caliper:** Moves in and out relative to the rotor and have one or two pistons only on the inboard side of the rotor. This piston pushes the entire caliper when the brakes are applied, creating friction from the brake pads on both sides of the rotor.
glycol: A sweet but poisonous syrupy liquid used as an antifreeze and solvent.

hydro booster: A master cylinder containing a separate hydraulic chamber and spool valve operated by power steering fluid.

hygroscopic: Readily taking up and retaining moisture.

kinetic energy: The mechanical energy possessed by a body due to its motion.

lateral acceleration sensor: A detection device that signals the electronic control unit when the vehicle is being subjected to high g-force from a turn.

leading-trailing drum brake: One shoe that is “leading”, moving with the direction of rotation of the drum and thus exhibiting a self-applying, or self-servo effect. The other shoe is “trailing”, moving against the direction of rotation, being thrown off the friction surface of the drum and not retarding the drum quite so effectively.

master cylinder: The component in the hydraulic brake system that converts the force exerted on the brake pedal by the driver into hydraulic pressure that applies the brakes.

micrometer: A unit of measurement of thickness equal to one thousandth of a millimeter.

Pascal’s law (principle): States that when there is an increase in pressure at any point in a confined fluid, there is an equal increase at every other point in the container.

potentiometer: Instrument for measuring or controlling by sensing small changes in electrical resistance.

power assisted: A description of a feature that would normally require a lot of human force, but the engine’s hydraulic or vacuum pressure helps to multiply the human effort.

power brakes: A conventional hydraulic brake system that uses engine vacuum to operate a vacuum power piston, the power piston applies pressure to the brake pedal, or in some cases, directly to the master cylinder piston.

return spring: A spring that is attached to a lever so that when the lever is moved in one direction, the spring forces it back.

rotor: The disc that provides the friction surface in a disc brake. Pads rub against both sides of the rotor to generate friction.
silicone: A silicon compound with a high resistance to heat, water, and chemicals, and with good insulating and lubricating properties; used in oils, polishes, sealants, etc.

sliding caliper: The caliper slides on machined ways and is retained by keys or spring plates.

speed sensor: A detection device that measures the speed of a wheel or drive axle and sends the information in the form of an analog voltage signal to the electronic control unit.

steering angle sensor: Used to measure the overall steering angle during the movement of steering wheel.

tandem booster: A vacuum power booster that uses two diaphragms to increase brake application force.

throttle position sensor (TPS): A detection device that provides information on the position of the throttle actuation system.

traction control: An enhancement of an existing ABS system that prevents wheel spin while accelerating on wet or slick surfaces.

vacuum booster: The vacuum diaphragm unit in a power brake system that multiplies the force exerted on the brake pedal to the master cylinder.

wheel cylinders: The component in a drum brake that forces the shoes out against the drums.

Pre-Program Discussion Questions

1. When thinking of brake function, diagnostics, and repair, what tasks come to mind? Essentially: What is involved in making sure a vehicle’s brake system functions properly?
2. What are some of the tools an automotive service technician uses to diagnose brake problems?
3. What is an anti-lock brake system?
4. How might a technician’s service on a car’s braking system be addressed in the automotive industry’s code of ethics?
Post-Program Discussion Questions

1. What is the difference between a bubble flare and a double flare? How does each one affect the braking system?
2. What is the value of the ABS to the automobile and its driver?
3. Describe the importance of bleeding and how that occurs for different parts of the braking system.
4. What is the difference between a disc and drum brake in terms of operation, diagnostics, and service?
5. Aside from technical knowledge, what other qualities do automotive repair technicians require? How does customer service fit into a technician’s role?

Student Activities

Individual

- Create drawings or written scenarios featuring specific brake problems, based on performance and repair issues the ASE certification film series highlights. Rotate the drawings among classmates who identify the problem, determine the possible causes, and recommend ways to repair it.

- Select an area of brake performance and repair that you want to know more about. Visit at least two automotive repair businesses to observe how different technicians address the same brake issue. Compare and contrast methods to decide on and test an approach that you would use to tackle the brake performance issue.

- Create a step-by-step repair guide for one of the items in the film (disc or drum brake, bench bleeding). Include visuals for each step. Invite peers to test the guide out as they work on tasks in the shop.

Group

- Log onto http://podcastradioamerica.com/The_Corner_Mechanic.html to listen to one or more of the brake podcasts that The Corner Mechanic produces. As a group, storyboard or outline a brake-focused podcast, perhaps focusing on maintenance or repair tips. If time allows, record the podcast for peers who are also preparing for the ASE A5 certification exam.
• The Motorist Assurance Program (MAP) (http://www.motorist.org/) sponsors the annual Brake Safety Awareness Week during which participating MAP facilities offer inspections, educate vehicle owners regarding key undercar systems, provide complimentary automotive troubleshooting materials and answer consumers’ preventative maintenance questions. Assume the roles of members of the Brake Safety Awareness Week’s planning committee charged with the task of adding a technician component to the weeklong event. The primary goal would be to provide tips to technicians that strengthen their brake diagnostic and repair skills in order to better serve customers. Design promotional materials focused on a particular area of brakes that encourage technicians to hone up on their skills toward greater professional competency. For example, a poster that reminds technicians what to do to discover what is wrong with a car’s anti-lock brake system.

• Create a set of flashcards for quizzing peers (and helping them review) on their brake knowledge. One side has a question; the flip side has the response. For an example, see http://quizlet.com/8725379/unit-one-automotive-brake-systems-flash-cards/; and http://quizlet.com/8841605/automotive-service-excellence-ase-brake-system-flash-cards/.

Internet


• If you’ve never tuned into “Car Talk,” listen to a few segments—http://www.cartalk.com/. As a fun interactive way to review brake topics (and study for the certification exam), partner with a peer to form an automotive repair “radio” show. Have others in the class “phone” in a brake problem (drawn from the film) that you and your peer help to solve.
Assessment Questions

Q1. Two technicians are discussing brake physics. Technician A says brake dynamics is an important factor to consider when performing a brake job. Technician B says you want a high coefficient of friction when performing a brake job. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q2. Two technicians are discussing drum brakes. Technician A says the anchor is located on top of a duo-servo brake system. Technician B says the anchor is located on the bottom of a leading trailing brake system. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q3. Two technicians are discussing disc brake systems. Technician A says a hubbed rotor will house the bearing and races. Technician B says a hubless rotor has no bearings. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q4. Two technicians are discussing diagnosis of anti-lock braking systems. Technician A says scan tools can be used to retrieve trouble codes. Technician B says the amber anti-lock brake system light will illuminate when a trouble code is set. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q5. Two technicians are discussing traction control systems. Technician A says the computer uses yaw sensors and lateral acceleration sensors to read the physical forces on the vehicle. Technician B says during a traction control situation the computer can shut off injectors. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B
Q6. Technician A says brake lines are made out of copper. Technician B says all brake lines come in the exact shape and form for every application. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q7. Brake lines are being discussed. Technician A says it is a good idea to practice flaring before performing it on a vehicle. Technician B says use the old brake line as a template when bending the new one. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q8. A metering valve is being discussed. Technician A says metering valves are located in the rear lines. Technician B says metering valves help with brake dynamics. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q9. Two technicians are discussing a proportioning valve. Technician A says a proportioning valve limits the fluid to the rear brakes during light brake application. Technician B says the proportioning valve limits fluid to the rear brakes during heavy brake application. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q10. Two technicians are diagnosing vacuum brake boosters. Technician A says no vacuum to the booster would result in hard braking effort. Technician B says a diaphragm leak in the booster would result in hard braking effort. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B
Q11. Two technicians are discussing a hydro-boost system. Technician A says all hydro-boosters use brake fluid to operate. Technician B says an accumulator stores extra fluid in case of engine failure. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q12. Two technicians are discussing power assist diagnosis. Technician A says when testing a vacuum booster, press the pedal several times, hold steady foot pressure, start the car and the pedal should drop slightly. Technician B says when testing a hydro-boost unit, press the pedal several times, hold steady foot pressure, start the car and the pedal should drop slightly. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q13. Technician A says most front disc brake systems perform 20% of the braking. Technician B says disc brake jobs involve pad replacement only. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q14. Thickness variation / parallelism is being discussed. Technician A says measure the rotor in eight places using a micrometer. Technician B says excessive thickness variation parallelism will result in pedal pulsation. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q15. Lateral run-out is being discussed. Technician A says measure lateral run-out with a micrometer. Technician B says measure lateral run-out with a dial indicator. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B
Q16. Technician A says always start with a good visual inspection when diagnosing drum brakes. Technician B says fluid leaking around the drum brakes may either be brake fluid or axle fluid. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q17. Technician A says it is necessary to disassemble both sides before cutting your drums. Technician B says disassemble only one side and use the other side as a template. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B

Q18. Technician A says servicing and adjusting rear brakes will not affect pedal height. Technician B says always test drive the vehicle prior to returning it to the customer. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both Technician A and Technician B
   d. Neither Technician A nor Technician B
Assessment Questions Answer Key

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A1. C

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A5. C

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A6. D

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A10. C

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A12. C

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A13. D

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A18. B

Additional Resources Available Online
Automobile Brakes: A Short Course on How They Work
http://www.familycar.com/brakes.htm

Automotive Recyclers Association
http://www.a-r-a.org/

Automotive Service Association
http://www.asashop.org/

Car Craft
http://www.carcraft.com

Car Talk
http://www.cartalk.com/

Clear Mechanic
http://clearmechanic.com/

How Anti-Lock Brakes Work
http://auto.howstuffworks.com/auto-parts/brakes/brake-types/anti-lock-brake.htm

How Brakes Work
http://auto.howstuffworks.com/auto-parts/brakes/brake-types/brake.htm

National Highway Traffic Administration
http://www.nhtsa.gov/

National Institute for Automotive Service Excellence
https://www.ase.com/

Motorist Assurance Program
http://www.motorist.org/

Tomorrow’s Technician
http://tomorrowstechnician.com/

Additional Resources at www.filmsmediagroup.com
Automotive Computer Systems

- Preview clip online at www.films.com
- Correlates to all National CTE Organizational Standards (including the provisions of the Perkins Act)

As any automotive technician understands, the world of car technology is now fully computerized. This series provides a basic working knowledge of automotive computer systems and the ins and outs of OBD-II diagnostics. Students will absorb lessons in computer system operation, trouble codes, scan tools, and repair procedures. Ford, GM, Chrysler, and other makes are discussed, while hybrid engine technology is also addressed. Videos can stand alone or as a series for both beginning automotive students and more advanced classes. Viewable/printable instructor’s guides are available online. A Shopware Production. (4-part series, 14-30 minutes each)

Item: 24743
Copyright date: © 2008
DVD (Chaptered) ISBN 978-1-4213-8059-9

Brake System Service

- Preview clip online at www.films.com
- Correlates to National CTE Organizational Standards (including the provisions of the Perkins Act)

Brake system service is not only a major aspect of automotive education—it’s a matter of life or death. This program covers all phases of brake service, outlining diagnostic methods for system malfunctions as well as how-to sections on servicing master cylinders, boosters, and disc and drum brakes. Viewers are shown every step, from differentiating between lever and rod type adjustors…to drum measurement…to machining disc brake rotors…to the best way to force new fluid into a replaced master cylinder. The program includes extensive safety tips and helpful reminders like test-driving a car before returning it to the customer, while on-screen graphics clarify key points. A viewable/printable instructor’s guide is included. A Shopware Production. (27 minutes)

Item: 24822
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DVD (Chaptered) ISBN 978-1-4213-9885-3

Brake Systems
Braking Systems
ASE Certification Series

In order to properly inspect and repair a car’s brakes, students need to understand brake components. This program illustrates typical brake systems, demonstrating the parts and principles involved with detailed live action footage and animated diagrams. Covering the basics of hydraulic force and its applications, the program looks at the master cylinder, bushings, push rod, brake pedal, wheel cylinder, and all other essentials. Different systems are clearly explained, with a section on drum brakes and another on disc brakes. Students will gain a solid understanding of how friction is applied to brake shoes in drum brake systems, and how the brake pad, piston, and spinning rotor function in disc brakes. A viewable/printable instructor’s guide is included. A Shopware Production.

(21 minutes)

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DVD (Chaptered) ISBN 978-1-4213-9886-0

Career Opportunities in the Automotive Industry

One in seven Americans is employed in some capacity by the automotive industry, and the number of cars and other vehicles on our roads is rising steadily. A fun and exciting business, this field offers a wide array of career options for the automobile enthusiast. From pit crew mechanic to restoration expert, from mechanical engineer to parts distribution director, from RV specialist to exotic car museum director, Career Opportunities in the Automotive Industry thoroughly explores this vast and popular profession. Providing clear, easily accessible information about a wide range of careers in the field, this reference gives comprehensive descriptions of 70 different jobs. The book is divided into six areas that represent the branches of the industry—racing, sales, transportation, repair/restoration, design/production, and other automotive careers. Career Opportunities in the Automotive Industry also offers extensive appendices of associations, certified training programs and two-year schools, major car racing schools, and bibliographies of books and periodicals. Ferguson Publishing. © 2005
Making cars stop is just as important as making them go. This Shoptalk program outlines the procedures that technicians need to know in order to troubleshoot and service today's brake systems. Precise techniques are clearly demonstrated step-by-step, while concise graphics provide helpful summaries of key points. Each procedure has been carefully selected from the National Institute for Automotive Service Excellence task list on brake systems.

ASE Tasks Covered in This Program:
• Diagnosing master cylinder problems and replacing brake lines
• Replacing the master cylinder
• Pressure bleeding the hydraulic system
• Troubleshooting drum brakes
• Rebuilding a disc brake caliper
• Inspecting brake rotors
• Torquing wheel lugs
• Checking booster operation (pedal travel)
• Servicing the parking brake and anti-lock brakes

Not available in Canada. Not available for preview. (24 minutes)

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