



CENTRAL PIEDMONT COMMUNITY COLLEGE

Course Syllabus AUT-151-10 Brake System

Syllabus Contents:

- Course Description
- Course Objectives
- Weekly Outline
- Student Evaluation
- Safety Regulations
- Tool List

Time Requirements:

- 16 Weeks
- 2 Class Hours/ Week
- 3 Lab Hours/ Week
- 3 Semester Hours Credit

Instructor: Scott Farrell

E-Mail: scott.farrell@cpcc.edu

Office: TST 137 North Campus or JH-1102 Joe Hendrick Center

Phone: 704-330-4185 North Campus or 704-330-7336 Joe Hendrick Center

Office hours: By appointment

AUT-151-10

Brake Systems

Course Description

This course covers principles of operation and types, diagnosis, service, and repair of brake systems. Topics include drum and disc brakes involving hydraulic, vacuum boost, hydra-boost, electrically powered boost, anti-lock and parking brake systems. Upon completion, students should be able to diagnosis, service, and repair various automotive braking systems.

AUT-151
Brake Systems
GENERAL CURRICULUM
Course Objectives

For every task in Brakes, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with clothing; eye protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations.

A. General Brake Systems Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction. P-1

2. Identify and interpret brake system concern; determine necessary action. P-1

3. Research applicable vehicle and service information, such as brake system operation, vehicle service history, service precautions, and technical service bulletins. P-1

4. Locate and interpret vehicle and major component identification numbers (VIN, vehicle certification labels, calibration decals). P-1

B. Hydraulic System Diagnosis and Repair

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law). P-1

2. Measure brake pedal height; determine necessary action. P-2

3. Check master cylinder for internal and external leaks and proper operation; determine necessary action. P-2

4. Remove, bench bleed, and reinstall master cylinder. P-1

5. Diagnose poor stopping, pulling or dragging concerns caused by malfunctions in the hydraulic system; determine necessary action. P-1

6. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action. P-2

7. Fabricate and/or install brake lines (double flare and ISO types); replace hoses, fittings, and supports as needed. P-2

8. Select, handle, store, and fill brake fluids to proper level. P-1

9. Inspect, test, and/or replace metering (hold-off), proportioning (balance), pressure differential, and combination valves. P-2

10. Inspect, test, and adjust height (load) sensing proportioning valve. P-3

11. Inspect, test, and/or replace components of brake warning light system. P-3

12. Bleed (manual, pressure, vacuum or surge) brake system. P-1

13. Flush hydraulic system. P-3

C. Drum Brake Diagnosis and Repair

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action. P-1

2. Remove, clean (using proper safety procedures), inspect, and measure brake drums; determine necessary action. P-1

3. Refinish brake drum. P-1
4. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble. P-1
5. Remove, inspect, and install wheel cylinders. P-2
6. Pre-adjust brake shoes and parking brake before installing brake drums or drum/hub assemblies and wheel bearings. P-1
7. Install wheel, torque lug nuts, and make final checks and adjustments. P-1

D. Disc Brake Diagnosis and Repair

1. Diagnose poor stopping, noise, [vibration](#), pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action. P-1
2. Remove caliper assembly from mountings; clean and inspect for leaks and damage to caliper housing; determine necessary action. P-1
3. Clean and inspect caliper mounting and slides for wear and damage; determine necessary action. P-1
4. Remove, clean, and inspect pads and retaining hardware; determine necessary action. P-1
5. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts. P-2
6. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks. P-1
7. Clean, inspect, and measure rotor with a dial indicator and a micrometer; follow manufacturer's recommendations in determining need to machine or replace. P-1
8. Remove and reinstall rotor. P-1
9. Refinish rotor [according to manufacturer's recommendations on vehicle](#). P-1
- ~~10.~~ [Refinish rotor off vehicle](#). P-1
- ~~11.~~ Adjust calipers equipped with an integrated parking brake system. P-3
- ~~12.~~ Install wheel, torque lug nuts, and make final checks and adjustments. P-1

E. Power Assist Units Diagnosis and Repair

1. Test pedal free travel with and without engine running; check power assist operation. P-2
2. Check vacuum supply (manifold or auxiliary pump) to vacuum-type power booster. P-2
3. Inspect the vacuum-type power booster unit for vacuum leaks; inspect the check valve for proper operation; determine necessary action. P-2
4. Inspect and test ~~hydro-boost~~ [hydraulically assisted power brake](#) system ~~and accumulator~~ for leaks and proper operation; determine necessary action. P-3
- [5. Measure and adjust master cylinder pushrod length.](#) P-3

F. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair

1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action. P-1
2. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust wheel bearings. P-1

3. Check parking brake cables and components for wear, rusting, binding, and corrosion; clean, lubricate, or replace as needed. P-2
4. Check parking brake operation; determine necessary action. P-1
5. Check operation of parking brake indicator light system. P-3
6. Check operation of brake stop light system; determine necessary action. P-1
7. Replace wheel bearing and race. P-1
8. Inspect and replace wheel studs. P-1
9. Remove and reinstall sealed wheel bearing assembly. P-2

G. Antilock Brake and Traction Control Systems

1. Identify and inspect antilock brake system (ABS) components; determine necessary action. P-1
2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel or pulsation, and noise concerns caused by the antilock brake system (ABS); determine necessary action. P-2
3. Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine necessary action. P-1
4. Depressurize high-pressure components of the antilock brake system (ABS). P-3
5. Bleed the antilock brake system's (ABS) front and rear hydraulic circuits. P-2
6. Remove and install antilock brake system (ABS) electrical/electronic and hydraulic components. P-3
7. Test, diagnose and service ABS speed sensors, toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data). P-1
8. Diagnose antilock brake system (ABS) braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.). P-3
9. Identify traction control/[vehicle stability control](#) system components. P-3

AUT-151-10
Brake Systems

Weekly Outline

Required Text: James D Halderman- Automotive Brake Systems, 5th Edition
Classroom & Shop Manuals By Clifton Owen

Week 1 Orientation, Shop and Safety Regulations
 Review Syllabus
 Reading Assignment: Chapter 1 in Classroom and Shop Manual

Week 2 Service Info, Tools and Safety

1. Personal Safety
2. Tool and Equipment Safety
3. Work Area Safety
4. Hazard Communication

Reading Assignment: Chapter 2 in Classroom Environment and HAZMAT

TEST Chapter 1 & 2

Week 3 Brake System Components and Performance Standards

1. Basic Brake System Components and Operation
2. Braking Dynamics
3. Friction
4. Hydraulics
5. Vacuum
6. ASE Certification

Reading Assignment: Chapter 3

Week 4 Brake System Principles

Reading Assignment: Chapter 4

- 1: Brake Fade
- 2: Friction
- 3: Gas Fade
- 4: Leverage

Week 5 **TEST CHAPTER 3 AND 4**

Week 5

Drum Brakes Chapter 10

1. Basic Parts and Operation
2. Brake Drum Assemblies
3. Brake Shoe Assemblies
4. Drum brake Design
5. Self-Adjuster Mechanisms

Week 6

Drum Brake Diagnosis and Service Chapter 11

1. Hardwear Kits
2. Lubrication Points

Week 7

Test Chapter 10 &11

Disc Brakes Chapter12

1. Disc Brake Design
2. Calipers
3. Brake Disc
 - a. Video on Disc Operation & Service

Week 8

Disc Brake Diagnosis and Service Chapter 13

1. Linnings
2. Types of Calipers
3. Pad wear indicators

Week 9

Test Chapter 12 &13

Brake Hydraulic Systems Chapter 5

1. Hydraulic Brake Fluid
2. Brake Pedals
3. Master Cylinder Parts
4. Dual-piston Master Cylinder
5. Split Hydraulic Systems

Week 10

Brake Fluid and Lines Chapter 7

1. Brake fluid
2. Brake lines
3. Brake tubing

Week 11

Hydraulic Valves and Switches Chapter 6

1. Brake Lines
 2. Warning Lamp Switches
 3. Metering and Proportioning Valves
- Hydraulic Line and Valve Service

Reading Assignment: Chapter 8 Classroom & Shop Manual

Week 12

TEST CHAPTER 5, 6 and 7

Parking Brake operation diagnosis and service chapter 14

1. Cable Systems
 2. Rear Drum and Disc Parking Brake Assemblies
- Parking Brake Service

Week 13

Power-brake Units operation, diagnosis and service chapter 16

1. Vacuum Power Boosters
 2. Types of Vacuum Boosters
 3. Hydraulic Power Brakes
- Power-Assist Unit Service

Reading Assignment: Chapter 9 Classroom & Shop Manual

Week 14

Test Chapter 14 and 16

Antilock Brake Systems (ABS) Components and Operation Chapter 18

1. Pressure Modulation
2. Types of Antilock Brake Systems
3. System Components
4. System Operation
 - a. Video on Antilock Brakes

Week 15

Antilock Brake Systems Chapter 19

1. Pressure Modulation
2. Types of Antilock Brake Systems
3. System Components
4. System Operation
 - a. Video on Antilock Brakes

Antilock Brake Service

Week 16

Shop Clean-up and Final Test

Test Chapter 18 and 19



CENTRAL PIEDMONT COMMUNITY COLLEGE

STUDENT GRADE POINT AVERAGE

Students will be graded according to the following grade point system.

| Grade | Point Value | Description |
|--|-------------|--------------------|
| A | 4 | Excellent |
| B | 3 | Very Good |
| C | 2 | Satisfactory |
| D | 1 | Poor |
| F | 0 | Failing |
| The following grades will not be used in computing the grade point average. | | |
| I = Incomplete | | W = Withdrawal |
| S = Satisfactory | | U = Unsatisfactory |
| AUD = Audit | | N = Never Attended |
| X = Credit by Examination | | |

- **Since this course is preparatory to entering the automotive service industry, job attitude, neatness, promptness and care of equipment will be considered part of the final grade. The final grade on these items will be determined by the instructor and based upon accepted industry standards.**

GRADING

- FOR A GRADE OF "A":**
 - Complete all written tests with an average of 93% to 100%.
 - Attend 90% of all scheduled class/lab hours.
 - Complete all lab/shop work in a manner as would be determined EXCELLENT in an actual shop.
- FOR A GRADE OF "B":**
 - Complete all written test with an average of 85% to 92%.
 - Attend 85% of all scheduled class/lab hours.
 - Complete all lab/shop work in a manner as would be determined VERY GOOD in an actual shop.
- FOR A GRADE OF "C":**
 - Complete all written tests with an average of 77% to 84%.
 - Attend 80% of scheduled class/lab hours.
 - Complete all lab/shop work in a manner as would be determined SATISFACTORY in an actual repair shop.
- FOR A GRADE OF "D":**
 - Complete all written tests with an average of 70% to 76%.
 - Attend 80% of all scheduled class/lab hours.
 - Complete all lab/shop work in a manner as would be determined POOR in an actual repair shop.



CENTRAL PIEDMONT COMMUNITY COLLEGE

Automotive Department Student Dress Code Effective August 2005

All automotive students will have and wear safety glasses at all times in shop or lab areas. Failure to adhere to safety glasses rules may result in disciplinary action.

1. All students are required to wear their dealer sponsored uniform to school each day. If a student has not been sponsored by a dealer, the student may purchase approved CPCC shirts from the school store. All shirts must be clean and tucked in. Rips and tears must be mended in a timely manner.
2. Dark colored work-style pants are recommended or Proper fitting jeans that meet the following requirements (length above the shoes, jeans above the hip with belt). No oversized jeans will be permitted. **Shorts are not allowed.** Rips and tears must be mended in a timely manner.
3. Facial jewelry of any type is **NOT** permitted. This includes ear, nose, lip, eyebrow, and cheek rings and/or studs. We also suggest that you refrain from wearing necklaces, rings, or bracelets of any kind as these items may pose a safety hazard.
4. All belts will be of the type that does not have an exposed buckle. No keys, chains or wallets hanging out of pockets.
5. Hats are permitted in the shop area only! If a hat has a brim, it must be worn with it facing forward.
6. Students must wear leather work boots or shoes with steel toes. We highly recommend oil resistant soles. No sneakers, tennis shoes, open toed shoes, or dress shoes are permitted.
7. Other appearance issues not directly covered by these rules will be considered on a case-by-case basis. CPCC staff will decide what is professional in appearance and what is not.

Any Student Not Following These Guidelines Will Be Dismissed From Class And Attendance Credit For That Day Will Not Be Given. No Excuses Will Be Considered.

- Students will bring tools required for class with them at class time.
 - **No Tools, No Lab Credit.**
- **Remember how you act and present yourself will reflect on the department and presentations to prospective employers.**



CENTRAL PIEDMONT COMMUNITY COLLEGE

Automotive Department Student Guidelines / Expectations

- No tobacco products usage is allowed inside any college building at any time.
- Eating or drinking in classrooms is with permission of instructor only; **there will be no eating or drinking in shop or lab or lab areas.**
- Students are expected to be in class on time and will be held responsible for any information covered by instructor, even if late or absent. Tests and quizzes missed may be made up only with instructor permission.
- Missed or late assignments will affect student's course grade.
- Tardiness is a problem; any student who is over 15 minutes late for a class will be counted as absent. CPCC attendance policy is in the on line student handbook.
- Students are expected to conduct themselves in a mature manner at all times. Students caught cheating, fighting, stealing, spinning tires, vandalizing or purposely damaging a vehicle or equipment will be **EXPELLED** from the automotive program. Care should be shown to college vehicles and property.
- Leaving class or shop/lab early without instructor permission will not be tolerated.
- Students are expected to come prepared for class. This means with paper, textbook, pens, pencils or other required material.
- Cell phones and pagers must be turned off during all class or lab times. Cell phones may only be used outside of the automotive buildings. Cell phones which ring during class will be subject to forfeiture or may result in student loss of privilege.
- The area in front of the main lab is not a parking area for students. The laneway must remain open for emergency vehicles. Vehicles inappropriately parked will be ticketed and towed. No parking means No Parking.
- All students are expected to clean up and put away all tools and equipment used during class or lab before leaving. Housekeeping is very important and will be part of your grade.
- Whenever you are unsure about anything ask your instructor! It is your responsibility to make sure that no physical damage occurs to any vehicle that you are working on or driving. Students are responsible for their actions!
- **Safety glasses** and student tools are mandatory in all shop/lab areas, no exceptions.
- All vehicles brought into the main lab will have a CPCC work order filled out and visible on windshield.



CENTRAL PIEDMONT COMMUNITY COLLEGE

Automotive Technology, Tool List

Safety Glasses or Goggles Mandatory in Labs

- Toolbox
- Common slotted screwdrivers, 4"x3/16, 6"x1/4, 8"x1/4
- Phillips screwdrivers number 1 and number 2
- Torx bit set T10 to T60
- Standard combination wrench set 5/16 to 1 1/4"
- Metric combination wrench set 6mm to 22mm
- 16 oz ball peen hammer
- 6" needle nose pliers
- Regular slip joint pliers
- 10 or 12" Channel Lock pliers
- 6 or 7" side cutting pliers
- Set of punches and chisels
- Feeler gauge set
- 3/8" drive socket set, including ratchet, extensions, standard and metric sockets,
 - 3/8 to 7/8 and 8mm to 17mm
- 3/8" to 1/2" socket adapter, 1/2" to 3/8" socket adapter
- 1/2" drive socket set with extensions and ratchet,
- 1/2" drive flex handle at least 18" long (breaker bar)
- 1/2" drive sockets, 7/16 to 1 1/4 and 10mm to 22mm
- 1/2" inch drive torque wrench
- Spark plug sockets 5/8" and 13/16" 3/8" drive
- Gasket scraper
- Set of Allen wrenches
- 12-volt test light
- 1/4" drive socket set, standard and metric sockets, including ratchet
- Non-sparking drift punch, brass or aluminum
- Digital Volt, Ohm and Ammeter DVOM, with Leads Example Fluke model 83

You may wish to purchase additional tools for the specific program you are enrolled in such as ASEP, BMW, T-TEN, CAP. Check with your instructor for a list.



CENTRAL PIEDMONT COMMUNITY COLLEGE

Automotive Technology Safety Regulations

- An Instructor must be present any time a class or session is working in the lab

Use of safety glasses is required/mandatory in lab areas.

- Any safety hazard will be reported to the instructor immediately. Floor will be kept clear of all liquids and tripping hazards.
- No equipment will be operated by students until they have received instruction on proper and safe operation of same equipment.
- Vehicle lifts must be secured with mechanical locks prior to working under vehicle
- Jack stands will be used when jacking up a vehicle for service.
- Brake asbestos "dust" will be controlled any time work is done which could lead to asbestos exposure.
- Floor exhaust system will be used anytime an engine is running in the lab.
- Use of tobacco is not permitted in any lab or classroom.
- Use of audio equipment is not permitted during class/lab hours.
- Students and faculty must follow OSHA rules concerning exposure to blood borne diseases.
- Proper disposal of automotive waste products, including hazardous wastes, is required.