

AUT 151 (A5) BRAKE SYSTEMS

COURSE DESCRIPTION:

Prerequisites: None

Corequisites: None

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, and anti-lock, parking brake systems and emerging brake systems technologies. Upon completion, students should be able to diagnose, service, and repair various automotive braking systems. Course Hours Per Week: Class Hours 2; Lab Hours 3; Semester Hours Credit 3.

Safety Disclaimer

Automotive work presents many hazards. A moment's carelessness can cause injury to oneself or to others. Such mishaps can occur quickly due, in part, to the nature of the industrial tools used in automotive work. The weight of automobiles and the equipment used to fix them can even cause fatal injuries. Therefore, great care must always be taken in checking out equipment before use, and in using that equipment to work on automobiles.

As we work to insure the safety of everyone in the DTCC automotive lab, it is the instructor's responsibility to introduce students to equipment and to advise them on its safe operation. Those health and safety procedures are also presented in each textbook for each course in the automotive program. **Students are responsible for mastery of that safety information.** DTCC holds each student in every class responsible for reading and applying all of the information regarding personal and public safety and personal and public health in the required text.

While working in the DTCC automotive lab, safety glasses must be worn by everyone. However, safety glasses are only one small requirement so that students remain injury free. All safety recommendations in the text book and from the instructor must be followed. A student with any questions about a safety procedure should immediately ask an instructor for clarification.

Any student using equipment in the automotive lab must be responsible for using that equipment in a safe manner. Durham Technical Community College holds each student in automotive classes responsible for acting to ensure a safe environment and to ensure both the student's own safety and the safety of his classmates.

LEARNING OUTCOMES:

Upon completion of this course the student will be able to:

- a. Test, diagnose, and repair poor stopping caused by hydraulic system and components.
- b. Diagnose hydraulic system for internal and external leaks and make repairs.
- c. Measure and adjust brakes and master cylinder pushrod length.
- d. Bench bleed master cylinder.
- e. Flush/bleed brake system using proper procedures.
- f. Diagnose/service wheel brake mechanism.
- g. Inspect, test, replace or adjust load or height sensing type proportional valves.

- h. Inspect, test, and replace brake warning light system(s) and wiring.
- i. Select, handle, and adjust brake fluid level.
- j. Use a micrometer to measure rotor and drums for minimum/maximum specifications.
- k. Machine rotor and drum
- l. Install brake pad/shoes and brake hardware.
- m. Reinstall wheel, torque lug nuts, and make final checks and adjustments.
- n. Check vacuum supply/power booster operation service as needed.
- o. Inspect, test, and service hydro-boost system and accumulator.
- p. Diagnose, adjust, and replace wheel bearings and grease seal.
- q. Test, adjust, service or replace parking brake system components.
- r. Check operation of antilock brakes systems (ABS).
- s. Diagnose anti-lock brake system electronic controls and components using diagnostic trouble codes.
- t. Adjust and repair antilock brakes systems (ABS) to manufacturer recommendations.

OUTLINE OF INSTRUCTION:

- I. Basic Fundamentals
 - A Hydraulic System
 - 1) Pressure requirements
 - 2) Dual and diagonally split systems
 - B Master and Wheel Cylinders
 - C Drum Brakes
 - D Disc Brakes (Single Piston Floating and Sliding Caliper Design)
 - 1) Advantages
 - 2) Adjustment
 - 3) Special tools
 - 4) Four wheel disc system
 - 5) Multiple piston calipers
 - E Power Brakes
 - F Brake Service Philosophy
 - 1) Should Drums and Rotors on the Same Axle Be Turned the Same Size?
 - 2) How Should Lining Be Broken In?
 - 3) What Constitutes a Complete Brake Job?
 - 4) What Lining Material is Best?
 - 5) How Should Backing Plates and Brake Parts Be Cleaned?
 - G Basic Troubleshooting
- II. Hydraulic Control Devices
 - A Master Cylinder (Tandem)
 - 1) Operation
 - 2) Construction (position of parts)
 - 3) Nomenclature of parts
 - 4) Reconditioning procedures (include cleaning and inspection)
 - 5) Push rod adjustment (effects)
 - 6) Bench bleeding and installation
 - 7) Failure diagnosis
 - 8) Leakage (internal and external)
 - B Step Bore Master Cylinder
 - C Quick Take-up Master Cylinder
 - D Proportioning Valve
 - 1) Purpose
 - 2) Symptoms if defective

- 3) Height sensing type
- 4) Dual proportioning valves
- 5) Electronically controlled
- 6) Servicing
- E Metering Valve
 - 1) Purpose
 - 2) Must be open when pressure tank bleeding
 - 3) Symptoms if defective
 - 4) Hold open tools
- F Pressure Differential Switch
 - 1) Operation
 - 2) Centering
 - 3) Testing the dash lamp
 - 4) Testing the warning light switch
- G Residual Valve
 - 1) Purpose
 - 2) Drum brakes only
- H Combination Valve
 - 1) Inspect and test
 - 2) By-pass
 - 3) Two-function type
 - 4) Three-function type
 - 5) Servicing
- I Wheel Cylinders
 - 1) Nomenclature
 - 2) Inspection
 - 3) Reconditioning
 - 4) Purpose of expanders
- J Brake Fluids
 - 1) Boiling points
 - 2) Water contamination
 - 3) Silicone type
 - 4) Changing fluid
 - 5) Handling and storage
- K Hydraulic Tubing, Fittings, and Hoses (Copper Gaskets and Flare Nut Wrenches and Tools)
 - 1) Double flare
 - 2) ISO flare
- L Anti-Lock Components
 - 1) Accumulator
 - 2) Dump valve
 - 3) Isolation valve
 - 4) Controller
 - 5) Speed sensor/tone wheel
 - 6) Power supply
 - 7) Circuit protection
 - 8) Reset switch
 - 9) Warning lights
- M Pressure Test System by Applying Force to Pedal
 - 1) Hold for 15 seconds
 - 2) Inspect for leaks

III. System Service

- A Bendix Type Brake
 - 1) Common
 - 2) Servo-action
 - 3) Nomenclature of parts (self-adjusting type)
 - 4) Construction (position of parts)
 - 5) Adjustment
 - 6) Anchor pin location
- B Leading/Trailing Shoe Type Brake
 - 1) Nomenclature of parts
 - 2) Construction
 - 3) Adjustment
 - 4) Anchor pin location
- C Drum Removal, Inspection, and Reconditioning
 - 1) Bell-mouthing
 - 2) Taper
 - 3) Out-of-round
 - 4) Machining
 - a. Chatter band
 - b. Reasons for poor finish
 - c. Composite rotor set-up
 - 5) Hard spots
 - 6) Scoring
 - 7) Oversize limits (machining and discard)
 - 8) Drum micrometer
 - 9) Removing drum front hub
 - 10) Swedged studs
 - 11) Front wheel bearings (RWD and FWD)
 - a. Service
 - b. Diagnosis/repair
 - c. Adjustment
 - d. Seal installation
- D Rotor Inspection and Use of Tools
 - 1) Runout (including the hub surface)
 - 2) Parallelism
 - 3) Thickness minimum (machining and discard)
 - 4) Ra finish
 - 5) Flatness
 - 6) Machine on lathe (include swirl finish)
 - 7) Importance of torqueing lug nuts when installing
 - 8) Rotor balance
 - 9) Rotor ventilation
 - 10) Scoring limits
- E Brake Shoes
 - 1) Inspection
 - a. Lining wear limits
 - b. Shoe damage
 - 2) Arcing (rarely done today)
 - a. Purpose
 - b. Oversize lining
 - c. Pre-arc'd lining when purchasing shoes
 - 3) Primary and secondary shoes

- 4) Lubricate shoe support pads (ledges)
- 5) Replacement procedures (including use of brake shoe setting gauge)

F Brake Bleeding Procedures

- 1) Pressure tank
 - a. Diaphragm type
 - b. Advantages
- 2) Manual bleeding
- 3) Pressure bleeding
- 4) Surge bleeding
- 5) Vacuum bleeding
- 6) Bleeder screw location
- 7) Bleeding sequences
- 8) Flushing

G Wheel Cylinders and Calipers

- 1) Inspection
- 2) Reconditioning procedures and use of tools
- 3) Caliper design
 - a. Fixed
 - b. Floating
 - c. Aluminum
 - d. Rear wheel types
 - e. Low drag
 - f. Phenolic pistons
 - g. Integral parking brake
- 4) Rubber parts and mounting hardware
- 5) Rebuilding (including use of assembly lubricant)

H Disc Brake Pads

- 1) Inspection
- 2) Removal (including caliper dismount)
- 3) Replacement procedures/break-in
 - a. Drain fluid
 - b. Clean and lubricate component parts
 - c. Torque caliper
- 4) Edge coding (including semi metallic material)

I Parking Brake

- 1) Nomenclature
- 2) Adjustment/cable replacement
- 3) Test light circuit
- 4) Lubrication

J Stop Light and/or TCC/Cruise Control

- 1) Operational check
- 2) Servicing

IV. Power Brakes

- A Vacuum Suspended
- B Atmospheric Suspended
- C Integral, Pedal Assist, and Multiplier Types
- D Testing/Diagnosis
 - 1) Vacuum supply
 - 2) Loss of fluid
 - 3) Hard pedal
 - 4) Rough idle with brake pedal depressed

- 5) Hidden brake fluid loss
- 6) Brake drag test
- 7) Air tightness test
- 8) Vacuum system test
- E Push Rod Adjustment
- F Purpose of Check Valve
- G Hydro-Boost System
 - 1) Basic test
 - 2) Accumulator test
 - 3) Seal leaks
 - 4) Troubleshooting
 - 5) Bleeding procedure
- H Electric Motor Type

V. Brake Problem/Diagnosis

- A Vibration
 - 1) Chatter
 - 2) Pedal Pulsation
 - 3) Vibration When Braking
- B Noise
 - 1) Squeals
 - 2) Wheel Bearing Noise
 - 3) Grinding Noise
 - 4) Clicking Noise
- C Hydraulic
 - 1) Spongy Pedal
 - 2) Rising Pedal (Stop Light Stays On)
 - 3) Low Pedal
 - 4) Pedal Sinks Slowly to Floor with Pressure Applied
 - 5) Loss of Pedal on Rough Roads
 - 6) Poor Stopping
 - 7) Fade
- D Electrical/Electronic
 - 1) Scan Tool Diagnostics
 - 2) Amber Warning Lamp
 - 3) Red Brake Warning Light
 - 4) No Stop Lights
- E Mechanical
 - 1) Pulling to One Side
 - 2) Grabbing
 - 3) Wheel and Axle Seal Leakage
 - 4) Dragging
 - 5) Fluid Leaks
 - 6) Failure to Self-Adjust
 - 7) Hard Pedal
 - 8) Wheel Lock-Up
 - 9) Dive (Front End Dips Excessively)
 - 10) Sensitive Brakes

VI. Anti-Lock Braking Systems

- A Theory of Operation/Nomenclature of Parts
- B Precautions
- C Operational Checks/Scan Tool Data
- D Testing (Including Pulling Trouble Codes)
- E Clearing Codes
- F Using DVOM for Checks

VII. New Brake Systems Technologies

REQUIRED TEXTBOOKS AND MATERIALS:

To be announced by instructor.

NATEF:

This course fulfills 80 of the 105 hours required by **NATEF** for A5. See COE 111.