Appendix P

TRANSPORTATION, DISTRIBUTION AND LOGISTICS YOUTH APPRENTICESHIP

AUTO TECHNICIAN PATHWAY BRAKE SYSTEMS (UNIT 8)

Unit 8: Auto Technician Pathway
Brake Systems

Competency

1. Assist to diagnose common brake problems

Performance Standard Condition

Competence will be demonstrated

- at the worksite
- while assisting a worksite professional

Performance Standard Criteria

Performance will be successful when learners:

- Consult with worksite professional to determine appropriate inspections and test(s) to perform based on customer concern
- Retrieve shop manuals and/or electronic retrieval systems
- Research applicable vehicle and service information, normal system operation specifications, vehicle service history, service precautions, and applicable technical service bulletins
- Assist worksite professional to complete diagnostic tests necessary to identify cause of customer concern

Learning Objectives

- Explain how friction, force, inertia, momentum, speed, power, work & torque apply to automotive brake systems
- Define basic brake requirements
- Explain the effects of weight & speed on braking & stopping distance
- Define Pascal's Law
- Explain thermal expansion of fluids, gases, & solids
- Explain energy conversion of motion changed to heat energy
- Identify the major parts of an automotive brake system
- Define the basic functions of the major parts of a brake system
- Explain pressure concerns in a brake system using hydraulic principles
- Identify external conditions that affect brake performance
- Explain common poor stopping, pulling or dragging concerns caused by problems in the hydraulic system
- Explain common causes of wheel bearing noises, wheel shimmy, and vibration
- Discuss wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system
- Cite the safety rules that should be followed when servicing brake systems

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency

2. Measure brake pedal height, travel, & free play as applicable

Performance Standard Condition

Competence will be demonstrated

- at the worksite

- Performance Standard Criteria
- **Performance will be successful when learners:**
- Obtain equipment & materials needed
- Review safety & service procedures
- Determine if the brake pedal height can be adjusted
- Determine the brake pedal free height and travel
- Pump the brake pedal with the engine off to release the vacuum in the power booster
- Place a ruler against the car floor in the line with the arc of the brake pedal travel
- Move the pedal by hand to remove any pedal free play
- Moving the pedal, measure the pedal height at the top or bottom of the pedal
- Compare to vehicle specification
- After measuring, verify adjustments needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Identify the parts of the brake pedal assembly
- Describe the operation & function of the brake pedal assembly

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency

3. Check master cylinder for leaks & proper operation

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Position the vehicle
- Inspect the housing for leaks or cracks
- Check the fluid level in the master cylinder reservoir
- Check for unequal fluid levels in the master cylinder reservoir chambers on front disc or rear drum systems
- Inspect the condition of the fluid
- Add fluid if needed
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe basic procedures for servicing a master cylinder and a brake booster
- Identify the parts of a basic master cylinder & their function
- Describe possible causes and conditions of brake fluid in the master cylinder

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency

4. Inspect brake lines, flexible hoses, & fittings

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Position the vehicle
- Inspect all brake lines, hoses & connections for leaks on the floor, under the vehicle or at the wheels
- Check the brake lines for kinks or dents
- Check the brake hoses for cuts, cracks, bulges & wear
- Inspect the backing plates for fluid & grease
- Tighten loose fittings and supports
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe the construction of brake lines
- Explain brake line flaring techniques
- Explain how to verify brake fluid leakage versus another type of fluid
- Describe the proper procedures for tightening fittings
- Identify the major parts of a typical anti-lock brake system
- Describe the operation of anti-lock brake systems
- Compare anti-lock brake design variations
- Describe the purpose and operation of traction control and stability control systems

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency
5. Bleed &/or flush brake system

Performance Standard Condition
Competence will be demonstrated
- at the worksite

Performance Standard Criteria
Performance will be successful when learners:
- Obtain equipment & materials needed
- Review safety & service procedures

BLEED- MANUAL
- Attach one end of a hose to the bleeder screw
- Place the other end submerged in a jar partially filled with clean brake fluid
- Gently have another tech depress the brake pedal
- Open the bleed screw or fitting on the caliper or wheel cylinder while watching for air bubbles in the hose
- Close the bleeder screw or fitting; tell the tech release the brake pedal
- Repeat until no more bubbles come out of the hose
- Repeat procedure on the other brake assemblies or brake line connectors if needed

BLEED- PRESSURE
- Pour enough brake fluid in the bleeder ball to reach the prescribed level
- Charge the ball with 10 to 15 psi of air pressure
- Fill the master cylinder with brake fluid
- Install the adapter and hose on the master cylinder
- Open the valve on the hose
- Attach a bleeder hose to the farthest wheel cylinder bleed screw
- Submerge the free end of the hose in a glass container halfway filled with brake fluid
- Loosen the bleed screw
- Close off the bleed screw and remove the bleeder hose when fluid coming from the submerged end of the hose is free of air bubbles
- Repeat bleeding operation on the other wheel cylinders in proper order
- Close the valve at the bleeder ball hose
- Disconnect the bleeder from the master cylinder
- Check the brake fluid level in the reservoir

FLUSH
- Pressure bleed all of the old brake fluid out of the system
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives
- Compare bleeding vs. flushing
- Describe special precautions for master cylinders with plastic reservoirs

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency

6. Remove & inspect caliper assembly

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Position the vehicle
- Remove the wheels of the caliper to be serviced
- Mark the wheels for re-insertion
- Compress caliper piston(s)
- Remove the bolts from the caliper to the steering knuckle
- Lift the caliper away from the rotor
- Hang the caliper with a cord
- Replace worn or rusted retaining hardware
- Inspect the caliper housing for leaks or cracks
- Inspect the piston & bore for pitting, nicks, scrapes
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Identify the parts & functions of the caliper assembly & calipers
- Explain the operation of drum/disk brakes and power-assist units
- Compare drum and disc brakes
- Explain how to service a disc brake assembly
- Explain how to service a drum brake assembly

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency

7. Remove, inspect & replace brake pads & retaining hardware

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Position the vehicle
- Remove the wheels of the caliper to be serviced
- Mark the wheels for re-insertion
- Compress caliper piston(s)
- Remove the bolts from the caliper to the steering knuckle
- Lift the caliper away from the rotor
- Hang the caliper with a cord
- Remove the clips (if applicable) and old pads from the caliper
- Fit the new pads into the calipers
- Compress the piston over the new brake pads in the caliper assembly with a C clamp
- Slide the caliper assemblies over the new pads
- Mount the caliper assembly
- Torque all bolts properly
- Install wheel and tighten lug nuts or bolts to specification
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe the recommended intervals for brake pad inspections
- Define the purpose & operation of the brake pads

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency

8. Reassemble, lubricate, & reinstall calipers, pads, & related hardware

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Check the caliper cylinder wall for wear, scoring, or pitting
- Check the caliper piston for wear; replace with a new piston if needed
- Inspect all hoses; replace any that are leaking or show deterioration
- Clean all the caliper parts with an approved cleaner
- Lubricate all parts liberally with clean brake fluid
- Work the new seal into the cylinder bore groove
- Compress the piston back into the caliper
- Reassemble the caliper halves using new gaskets and seals if needed
- Clean & lubricate caliper attachment hardware
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Explain the importance of lubricant on sliding surfaces
- Explain the importance of methodical bench cleaning and inspection for this procedure

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency

9. Clean, inspect, & measure rotor thickness, lateral runout, & thickness variation

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Position the vehicle
- Remove wheel and caliper assembly
- Inspect the disc surface for warpage, cracks or scoring
- Inspect the disc thickness for variation
- Measure thickness using an outside micrometer in several places around the disc
- Measure runout using a dial indicator
- Compare readings to disc specifications
- Consult with worksite professional to determine if new disc or resurfacing is indicated
- After testing, prepare for service or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Define the purpose & operation of the rotor
- Describe when a rotor should be replaced
- Define runout
- Explain how to measure disc thickness
- Discuss complications of a thin or warped disc

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency
10. Install wheel

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Position the vehicle
- Re-attach wheel
- Torque lug nuts or bolts to specification
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Identify the parts of a tire and wheel
- Describe different methods of tire construction
- Explain tire and wheel sizes
- Describe tire ratings

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency

11. Check parking brake cables & components

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Position the vehicle
- Remove the wheel
- Screw one lug to keep rotor in place
- Loosen parking brake cable at the equalizer
- Apply parking brake to determine movement
- Inspect the cables & linkages for wear, binding & corrosion
- Replace cables & linkages if needed
- Release the parking brake or engage one notch only
- Clean & lubricate the cable & linkages
- Turn the cable adjuster to remove excess slack
- Apply & release the parking brake to check for brake dragging
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe the operation of parking brakes
- Describe lubricant procedures for metal vs. plastic coated cables
- Explain what excessive heavy drag could mean
- Identify traction control/vehicle stability control system components
- Describe the operation of a regenerative braking system

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency
12. Check brake & indicator light system

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Check the indicator light system
- Use a DMM to locate electric circuit problems
- Replace the bulb if needed
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Explain the function of the DMM
- Describe how the DMM works to measure voltage, voltage drop, current flow & resistance
- Describe the purpose of the ground lead in using the DMM

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency
13. Inspect, replace wheel studs

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Position the car
- Remove wheel and caliper assembly
- Remove the rotor
- Inspect the stud for damage
- Force the old stud out with a pressing tool
- Push the new stud through
- Thread a wheel bolt on & tighten; add more bolts as the stud is pulled through the hub
- Remove the bolts
- Replace the parking cable brake, rotor, caliper assembly, and wheel
- Torque lug nuts or bolts to specification
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Compare lug nuts to lug studs to lug bolts
- Explain how studs are marked if they are left-hand threads

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency
14. Service wheel bearings & race

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Remove wheel and brake caliper
- Gently pry the bearing grease cup away from hub by turning the wheel a little each time
- Remove the cotter pin, retaining ring, and spindle nut
- Remove hub or rotor-hub assembly
- Inspect the bearing and race for scoring, flat spots, or broken rollers
- Knock the outer race from the hub
- Flip over the hub and knock out the inner race, bearing, and seal
- Pack the new inner and outer wheel bearings by either pressing grease into each roller by hand or using a bearing packer and grease gun
- Remove old grease from inside hub
- Use the wheel-bearing tool to seat inner race into hub
- Place the bearing in the race and use the tool again to seat the grease seal
- Flip over the hub and repeat for the outer race
- Pack a good amount, but do not completely fill inside the hub with grease
- Clean all excess grease from outside the hub
- Place the hub on the spindle
- Tighten the nut just enough to seat the whole assembly while spinning the hub
- Loosen the nut then re-tighten to specifications
- Pack more grease into the bearing and bearing cup
- Replace retaining ring and secure with a new cotter pin
- Gently replace the bearing grease cup being careful not to dent it
- Remove all grease from the outer surface of the hub or rotor
- Grab the top and bottom of the hub and check for play
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Explain service procedures for wheel bearings
- Identify the parts of driving and nondriving hub and wheel bearing assemblies
- Explain the purpose of greasing each roller
- Describe how to choose the drift for the wheel bearing tool
- Demonstrate the torque needed to re-tighten the nut
- Describe the dangers of over-tightening the spindle nut

Comments:

Unit 8: Auto Technician Pathway
Brake Systems

Competency

15. Remove, inspect, or replace sealed wheel bearing assembly

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Obtain equipment & materials needed
- Review safety & service procedures
- Position the vehicle
- Remove wheel
- Insert tool into caliper & rotor to prevent rotor from turning
- Remove wheel drive shaft nut
- Remove rotor
- Remove speed sensor & dust shield
- Remove wheel bearing assembly & hub retaining bolts
- Separate the wheel bearing assembly & hub from the drive axle
- Remove the wheel bearing assembly & hub
- Inspect the wheel bearing assembly & hub for damage
- Press the new hub & bearing assembly into the steering knuckle
- Re-install the steering knuckle, rotor, caliper and wheel
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe common tire, wheel, and wheel bearing problems
- Explain service procedures for wheel bearings
- Identify the parts of driving and nondriving hub and wheel bearing assemblies

Comments: