Appendix S

TRANSPORTATION, DISTRIBUTION AND LOGISTICS
YOUTH APPRENTICESHIP

AUTO TECHNICIAN PATHWAY
ENGINE PERFORMANCE & REPAIR (UNIT 11)

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

1. Assist to diagnose common engine performance 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 the basic function of the major parts of an automotive engine
- Identify the major parts of a typical automotive engine
- Describe the four-stroke cycle
- Define common engine terms
- Compare types of engine systems such as gasoline, diesel, hybrid, etc.
- Describe the design and construction of an engine cylinder head
- Explain umbrella and O-ring type oil seals
- Explain the purpose of valve spring shims, rotators, stem caps, and spring shields
- Explain hydraulic and mechanical lifters
- Describe different types of rocker arm assemblies
- Explain the construction of engine bearings
- Cite the safety rules that should be followed when servicing engine systems
- List the most common engine performance problems
- Describe the symptoms for common engine performance problems
- Explain typical causes of engine performance problems
- Discuss common problems relating to abnormal engine noise or vibration concerns, unusual exhaust color, odor, and sound, and fuel, & ignition concerns
- Describe common driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems)
- Describe the function and use of a thermometer, pyrometer, manometer
- Describe the function and use of an oscilloscope or GMM to diagnose engine concerns
- Explain why a structured approach to engine diagnosis is essential
- Identify the major parts of a hybrid drive system
- Explain the construction and operation of hybrid drive assemblies

- Explain the principles of operation of energy storage devices such as capacitors and different battery types
- List the safety measures that must be followed when working on high-voltage hybrid drive systems
- Identify the most common problems that occur in a hybrid vehicle drive system
- Describe future technology developments in hybrid motor vehicles including new cell technologies

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

2. Inspect engine assembly for fuel, oil, coolant, & other leaks

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
- Start the vehicle
- Inspect engine for external problems such as leaks, part damage, contaminated oil
- Smell fluid from leaks
- Listen for unusual noises
- Increase engine speed while listening & watching
- Listen carefully to abnormal engine noises using a stethoscope or other listening device
- Consult worksite professional to determine further tests, inspections or repairs
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe coolant in oil appearance and possible causes
- Describe the appearance and possible causes of oil in coolant, engine oil leaks, external coolant leaks, engine blowby, engine vacuum leaks, engine exhaust leaks, & engine smoking
- Describe basic problem colors of exhaust smoke
- Describe basic problem colors of diesel exhaust smoke
- Describe how to use a stethoscope or listening device to pinpoint & interpret engine noises

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

3. Perform cranking & running compression tests

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 all spark plugs
- Block open the throttle
- Disable the ignition system
- Disable the electronic fuel injection if applicable
- Screw the compression gauge into one of the spark plug holes
- Crank the engine to rotate about 4-6 compression strokes
- Record gauge readings
- Repeat for each cylinder
- Repeat while engine is running
- Compare gauge readings to specifications
- Consult worksite professional to determine further tests, inspections or repairs
- After testing, prepare for service or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe engine size measurements based on bore, stroke, displacement, and number of cylinders
- Explain engine compression ratio and how it affects engine performance
- Explain engine torque and horsepower ratings
- Describe the different methods used to measure and rate engine performance
- Explain volumetric efficiency, thermal efficiency, mechanical efficiency, and total engine efficiency
- Cite safe practices when making engine performance measurements
- Explain the purpose & procedure of the compression test
- Compare compression testing for gasoline versus diesel engines
- Describe the use and purpose of a compression gauge
- Explain when an engine compression test is indicated

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

4. Perform cylinder leakage test

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 crankcase filler cap
- Remove radiator filler cap
- Ensure radiator is filled to prescribed level
- Locate TDC using a whistle tester adaptor on the tester in the cylinder spark plug hole
- Rotate engine until cylinder to be tested is at TDC
- Remove whistle and connect leak tester
- Check cylinder leakage tester reading
- Look for air leaking noise or air bubbles
- Consult worksite professional to determine further tests, inspections or repairs
- Unblock the throttle valve
- Reconnect the ignition system
- Reinstall the spark plugs and air filter
- After testing, prepare for service or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Explain the purpose & procedure of the cylinder leakage test
- Describe the use and purpose of a cylinder leakage tester
- Explain the use of the whistle adaptor on the leakage tester
- Explain when a cylinder leakage test is indicated

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

5. Perform cooling system pressure tests; check coolant condition; inspect & test radiator, pressure cap, coolant recovery tanks, & hoses

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 the radiator cap once the engine is sufficiently cooled
- Check the coolant's condition and color
- Visually inspect the cooling system for leaks, loose or missing fan belts, low coolant level, abnormal water pump noises, coolant in the oil, combustion leakage into the coolant
- Determine the coolant's freezing point using a coolant hydrometer
- Look down the radiator neck while the engine is running up to operating temperature to observe circulation
- Check thermostat if circulation is poor
- Connect a cooling system pressure tester to the radiator fill neck
- Pump the pressure tester until the pressure reaches the release pressure marked on the cap
- Leave the tester connected and watch for leaks
- Check for signs of heater core leaks on the ground under the engine
- Check for leaks at the pump drive shaft
- Check for leaks at all hose fittings, gaskets, and engine freeze (core) plugs
- Tighten, repair or replace parts as needed
- After testing, prepare for service or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Summarize the functions of a cooling system
- Explain the operation and construction of major cooling system components
- Compare cooling system design variations
- Explain the importance of antifreeze
- List common cooling system problems and their symptoms
- Describe the most common causes of system leakage, overheating, and overcooling
- Perform a combustion leak test and a system pressure test
- Describe safe working practices to use when testing, maintaining, or repairing a cooling system

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

6. Retrieve, record diagnostic trouble codes, OBD monitor status & freeze frame data

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
- Verify malfunction indicator light trouble codes using the scan tool
- Obtain the appropriate scan tool and program cartridge for the vehicle, system and/or date
- Locate the data link connector (DLC) in the vehicle
- Attach the scan tool cable into the DLC; use an adaptor if needed
- Connect the scan tool to battery power if needed
- Follow the prompts to access the trouble codes
- Consult the trouble code chart or scan tool code conversion
- Consult worksite professional to determine further tests, inspections or repairs
- Erase diagnostic trouble codes when applicable

Learning Objectives

- Discuss the purpose and operation of on-board diagnostic systems
- Explain the use of scan tools to simplify reading of trouble codes
- Compare OBD I and OBD II system capabilities and procedures
- Locate the data link connector on most makes and models of cars
- Activate on-board diagnostics and read trouble codes with and without a scan tool
- Describe how to use a trouble code chart in a service manual or code conversion by a scan tool
- Describe the importance of running all OBDII monitors for repair verification

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

7. Inspect, test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, & circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO)

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
- Connect the oscilloscope to the circuit or output signal
- Set the scope to read the pattern desired
- Evaluate the scope patterns displayed
- Inspect the waveform for abnormal shapes
- Consult reference patterns to determine normal waveforms
- Consult worksite professional to determine further tests, inspections or repairs
- After testing, prepare for or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe the input, processing, and output sections of a basic computer system
- Explain input sensor and output device classifications and operation
- Summarize computer system signal classifications
- Sketch a block diagram for a computer system
- Summarize where computers, control modules, sensors, and actuators are typically located
- Summarize the flow of data through a computer
- Explain how a computer uses sensor inputs to determine correct outputs
- Explain the principles of an oscilloscope
- Summarize how to use waveforms to analyze the operation of sensors, actuators, ECU outputs, and other electrical-electronic devices
- Evaluate ignition system waveforms
- Summarize how to use an engine analyzer

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

8. Inspect, test fuel pumps & pump control systems for pressure, regulation & volume

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
- Visually inspect for restricted fuel filters, kinked fuel lines or hoses, intake air leaks, and low engine compression

PUMP PRESSURE

- Connect pressure gauge to output line or test fitting on fuel pump
- For mechanical fuel pumps, start engine & idle at specified rpm
- For electric fuel pumps, activate supply voltage to pump motor or start engine
- Compare pressure readings to specification
- If pressure is not within specification, isolate fuel pressure regulator from the pump by pinching the fuel hose going to the fuel return line OR taking the regulator out of the system

FUEL REGULATION

- Connect pressure gauge to fuel pressure test fitting on fuel rail
- Start the engine
- Note reading
- Compare pressure to specification

PUMP VOLUME

- Route output line from fuel pump into a graduated cylinder
- Clip line into cylinder for control of flow
- Start engine & idle at specified speed
- Allow fuel to pour into container for prescribed amount of time
- Close off valve and shut off engine
- Compare volume output to specification
- Consult worksite professional to determine further tests, inspections or repairs
- After testing, prepare for or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Define the major parts of a fuel supply system
- Explain the relationship between engine performance and fuel economy
- Describe the operation of mechanical and electric fuel pumps
- Describe the construction and action of air filters
- Explain the tests used to diagnose problems with fuel pumps, fuel filters, and fuel lines
- State safety rules for working on fuel supply systems

- Explain common causes of hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

9. Inspect, test fuel injectors

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
- Verify fuel pressure

TBI

- Remove the air cleaner
- Crank or start engine
- Observe fuel spray pattern in the throttle body
- Test power to injector solenoid

EFI MULTIPORT

- Start engine
- Listen to each injector with a listening device/stethoscope
- Test the injector solenoid, wiring harness and control module circuits
- Perform noid light tests to check feed circuit

BALANCE TEST

- Connect pressure gauge to test fitting on fuel rail
- Close valve for measuring fuel volume on fuel gauge assembly
- Connect balance tester wiring to injector in question & to battery
- Turn on ignition to pressure system, then turn off
- Press injector balance tester button & watch pressure drop
- Record drop in pressure
- Repeat on other fuel injectors
- Compare pressure drop readings between injectors
- Consult worksite professional to determine further tests, inspections or repairs
- After testing, prepare for service or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- List some of the possible advantages of gasoline injection
- Describe the classifications of gasoline injection
- Explain the operation of electronic multiport gasoline injection
- Summarize the operation of air flow sensing, hydraulic-mechanical (continuous), and pressure-sensing gasoline injection systems
- Compare the various types of gasoline injection systems
- Discuss typical gasoline injection system problems
- Explain the operating principles of a diesel injection system
- Summarize the differences between gasoline and diesel engines

- Explain OBD II testing features used on late model fuel injection systems
- Cite safety rules for injection system service
- Describe procedure to perform noid light test
- Explain purpose & procedure for injector balance test

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

10. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s) & heat shield(s)

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 vehicle
- Use a light to closely inspect the exhaust system components for leaks, rust, and loose connections
- Focus attention on muffler, pipe connections, gaskets and pipe bends
- After testing, prepare for service or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Explain the relationship between engine performance and exhaust emission
- Explain the construction and design of intake and exhaust manifolds
- Describe the basic parts of an exhaust system
- Explain the most common reasons for exhaust system failures
- Describe the appearance of exhaust leaks on components
- Compare exhaust system design differences
- Explain the fundamental parts of a turbocharging system
- Summarize the construction and operation of a supercharging system
- Cite safety procedures for working on exhaust systems

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

11. Perform exhaust system back-pressure test

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 an oxygen sensor located before the catalytic converter
- Install a pressure gauge into the sensor hole
- Start the engine
- Read the pressure gauge at idle and at higher speeds
- Compare pressure reading to specification
- Isolate exhaust system restriction by disconnecting the parts one at a time until the back pressure drops
- After testing, prepare for service or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Explain the purpose and procedures of the back-pressure test
- List common causes of catalytic converter problems
- Describe the pressure readings which indicate exhaust system restriction

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

12. Inspect, test, replace components of the EGR system including EGR tubing, exhaust passages, vacuum pressure controls, filters & hoses

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
- Inspect passages, hoses, tubing and filters for clogs, damage. Leaks and wear
- Replace as needed

VACUUM EGR VALVES

- Warm engine to operating temperature
- Increase engine speed to 2000-3000 rpm quickly using the accelerate linkage by hand
- Inspect valve stem movement
- Test EGR valve by connecting hand vacuum pump to EGR valve at idle
- Apply vacuum to pump, engine should stall or miss
- If not, remove and clean valve or replace

ELECTRONIC EGR VALVES

- Use scan tool to isolate trouble codes
- Test electronic EGR valves according to manual
- To pinpoint test a digital EGR connect scope to wires goint to valve
- Check scope waveform
- If no voltage, check for electrical connection
- Consult with worksite professional for valve replacement
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Define the fundamental terms relating to automotive emission control systems
- Explain the sources of air pollution
- Identify sources and causes of CO, CO_2, Hydrocarbon, & nitrogen oxide emissions
- Identify types of gasoline and their effect on performance and emissions
- Describe the function of the carburetor to meet the engine's fuel mixture requirements
- Explain emissions inspections tests
- Describe the operating principles of emission control systems
- Compare design differences in emission control systems
- Identify the components that act as outputs to control air/fuel ratios & emission control systems
- Explain how a computer or engine control module can be used to operate emission control systems

- Summarize how OBD II systems use multiple oxygen sensors to check air-fuel mixture and catalytic converter efficiency
- Explain the purpose of the EGR in conjunction with the ECM
- List common causes of EGR system malfunctions

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

13. Remove, replace timing belt; verify correct camshaft timing

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
- Set the number 1 cylinder to TDC
- Remove the timing belt cover & timing belt
- Line up timing marks on the camshaft and crankshaft sprockets
- Slip the belt over the sprockets
- Move the tensioner into the belt to hold the belt on its sprockets
- Adjust belt tension to specification
- Install timing belt cover
- 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 and operation of a camshaft
- Compare the three types of camshaft drives
- Explain the construction of a timing gear, timing chain, and timing belt assembly
- Explain the importance of regular timing belt maintenance
- Cite safety procedures to follow when servicing engine front ends

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

14. Inspect, test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, & fan control devices

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
- Inspect fan for bent blades, cracks, and other problems; replace fan if damaged
- Inspect the fan clutch for excessive play or oil leakage
- Start the engine to test the thermostatic fan clutch
- Observe the action of the fan clutch; if locked, replace fan clutch
- Observe electric cooling fan when engine is warm
- If fan does not function properly, check fuse, electrical connections, relay, and supply voltage to the fan motor
- Replace fan motor if it fails to operate with voltage applied
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- List common engine fan problems and their symptoms
- Describe safe working practices to use when testing, maintaining, or repairing a cooling system.
- Explain the basic function and construction of each major part of a typical heating and air conditioning system
- Summarize the operation and interaction of heating, ventilation, and air conditioning systems
- Explain the principles of refrigeration
- Identify how to recover A/C system refrigerant
- Explain how refrigerant is recycled and stored

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

15. Install gaskets, seals, & sealers as required

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
- Inspect for leaks prior to disassembly
- Clean old gaskets carefully
- Match holes and sealing surfaces perfectly
- Apply appropriate sealer type
- Align and hand screw all bolts
- Tighten all fasteners in steps
- Use crisscross tightening pattern to specified torque
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Identify commonly used automotive fasteners
- Summarize safety rules relating to fasteners, gaskets, seals, and sealants
- Explain the reason for tightening the bolts a little at a time in a crisscross pattern

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

16. Perform oil pressure tests

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 oil level
- Install pressure gauge into the hole for the oil sending unit or one of the line sto the oil cooler
- Run the engine at specified speed for testing
- Read the pressure gauge and compare to specification
- If the oil pressure indicator is implicated, test electrical connection, circuit wiring and gauge
- Consult worksite professional to determine further tests, inspections or repairs
- After testing, prepare for service or cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- List common lubrication system problems and symptoms
- Describe common causes of low oil pressure
- Describe common causes of high oil pressure

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

17. Inspect, replace engine cooling & heater system hoses

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
- Inspect hoses visually for swelling, cracks, and leaks
- Check for hardened hoses by hand
- Flex or bend the hoses, watch for surface cracks
- Replace hoses if problems
- Loosen hose clamps
- Twist and pull hose from fittings
- Clean metal hose fittings
- Seal fittings if corroded or pitted
- Slide on new hose and clamp
- Fit the hose clamps over the hose fittings
- Tighten the clamp and check for leaks
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Discuss common problems and wear for cooling and heating hoses
- Explain common problems associated with worn cooling & heating system hoses

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

18. Inspect, test, replace thermostat housing, gasket, & seal

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
- Observe the coolant through the opening in the radiator neck as the engine warms
- Use a temperature probe to touch the thermostat outlet hose
- Unscrew bolts holding thermostat housing to engine
- Tap housing free
- Lift off housing and thermostat
- Scrape old gasket material off housing
- Check for gaps between housing and sealing surface
- File or sand surface flat if warped
- Remove thermostat and test in water on a hot plate
- Replace thermostat if it does not open at correct temperature
- Install new thermostat centered in housing with pellet toward inside of engine
- Position new gasket with approved sealer
- Torque thermostat 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 common problems associated with the thermostat
- Explain procedures for replacing a rubber thermostat housing seal instead of a gasket
- List precautions to take with combined plastic housings

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

19. Inspect, remove, replace water pump

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

INSPECT

- Wiggle the fan or pump pulley up and down to check for worn pump bearings
- Warm engine and then shut off
- Squeeze top of radiator hose while another technician restarts the engine to check for pump operation
- Observe coolant in radiator with engine at operating temperature

REMOVE

- Unbolt all brackets and components (air conditioning compressor, power steering pump, alternator, etc)
- Unscrew ALL bolts holding pump to engine
- Lightly tap pump housing to free pump
- Scrape off old gasket or sealer material

REPLACE

- Install water pump gasket using approved sealer
- Work o-ring seal into bottom of groove if applicable
- Fit pump onto the engine straight into place
- Start all bolts be hand
- Check all bolt lengths are the same
- Torque all fasteners a little at a time in a pattern
- Install the other components
- Tighten pulley properly
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe common problems associated with the water pump

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

20. Remove, replace radiator

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
- Cool radiator
- INSPECT
- Inspect the outside for debris
- Inspect radiator shroud for breaks
- Spray water from back of radiator to push debris out the front
- Inspect radiator cap and filler neck for cracks, tears, nick or dents
- Have neck repaired as needed
- REMOVE
- Place catch pan under radiators petcock
- Drain radiator
- Disconnect hoses, oil cooler lines, and wires to sensors and fans
- Remove brackets or bolts to remove radiator from its mounting
- REPLACE
- Ensure rubber mounts are in place in their brackets
- Carefully lower radiator into place without hitting and damaging it
- Connect all hoses, lines and wires
- After servicing, verify service and make adjustments as needed, cleanup work area, return tools to proper location, complete appropriate documentation

Learning Objectives

- Describe common problems associated with the radiator

Comments:

Unit 11: Auto Technician Pathway
Engine Performance & Repair

Competency

21. Inspect, service, replace shafts, yokes, boots, & CV joints

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

SHAFT

- Scribe mark each component
- Clamp the shaft in a vise
- Inspect, clean, grease and re-assemble as needed

CV JOINT SERVICE

- Place the half shaft in a vise
- Cut through the swage rings without damaging the outer race
- Compress the seal on the halfshaft and away from the CV joint outer race
- Wipe away grease from the CV joint face
- Spread the halfshaft retaining snap rings apart
- Pull the CV joint from the halfshaft
- Discard the old seal
- Place the brass drift against the cage
- Tap gently on the brass drift to tilt the cage
- Remove the first ball when the cage tilts
- Repeat to remove all of the balls
- Pivot the cage and align the cage windows with the lands of the outer race
- Lift out the cage and the inner race
- Remove the inner race from the cage
- Thoroughly degrease all CV joint parts
- Check outer CV joint assembly for wear, cracks, or other damage; replace damaged parts
- Clean halfshaft bar
- Lightly grease inner & outer race grooves
- Reassembly
- Insert inner race into cage
- Align inner race lands with cage windows
- Insert cage & inner race into outer race
- Place brass drift against cage
- Tap gently on brass drift to tilt cage; install first ball when cage tilts; reinstall all balls
- Pack CV joint seal & assembly with grease
- Place new small swag clamp onto CV joint seal
- Place large retaining clamp on seal
- Position CV joint small end into joint seal groove on halfshaft bar

- Position outboard end of halfshaft assembly
- Align seal, halfshaft bar, swage clamp
- Place retaining snap ring into CV joint inner race
- Slide CV joint onto halfshaft bar
- Slide large diameter of CV joint seal with retaining ring in place over outside of CV joint outer race
- Position lip of CV join seal into groove of CV joint outer race
- Remove excess air
- Secure large retaining clamp & toque 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 and describe the parts of a modern drive shaft assembly
- Explain the functions of a drive shaft
- Describe the different types of universal joints
- List the different types of drivelines
- Describe the most common drive shaft problem
- List the basic parts of an automotive clutch
- Explain the operation of a clutch
- Describe gear operating principles
- Explain the fundamental operation of a manual transmission
- Identify the basic components of an automatic transmission
- Describe the function and operation of the major parts of an automatic transmission
- Explain how an automatic transmission shifts gears
- Identify the major parts of a rear drive axle assembly
- List the functions of a rear axle assembly
- Describe the operation of a differential
- Compare different types of axles
- Identify the major parts of a transaxle assembly
- Explain the operation of a manual transaxle
- Explain the operation of an automatic transaxle
- Identify the parts of constant velocity drive axles
- Compare design differences in CV-joints

Comments: