APTA STANDARDS DEVELOPMENT PROGRAM
RECOMMENDED PRACTICE
American Public Transportation Association
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APTA Bus Maintenance Training Working Group

Training Syllabus to Instruct/Prepare for the ASE Transit Bus HVAC Test

Abstract: This *Recommended Practice* provides guidelines for establishing a standardized bus maintenance training related to the ASE certification program syllabus for HVAC systems used in transit buses and coaches.

Keywords: air conditioning, Automotive Service Excellence (ASE) H7, bus, certification, heating, HVAC, training, transit, ventilation

Summary: This *Recommended Practice* allows users to instruct/prepare transit bus technicians and mechanics for the Automotive Service Excellence (ASE) H-7 Transit Bus HVAC Test and to evaluate, develop or enhance current training programs for the diagnosis, repair and maintenance of transit bus HVAC systems. Individual operating agencies should modify these guidelines to accommodate their specific equipment and mode of operation.

Scope and purpose: This *Recommended Practice* reflects the consensus of the APTA Bus Standards Program members in conjunction with transit labor organizations, including ATU and TWU, on the subject material, manuals, textbooks, test equipment, methods and procedures that have provided the best performance record based on the experiences of those present and participating in meetings of the program task forces and working groups. APTA recommends the use of this document by organizations that have a training department or that conduct training for the maintenance of transit buses; organizations that contract with others for transit bus maintenance training; and organizations that influence how training for transit bus maintenance is conducted.

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Training Syllabus to Instruct/Prepare for the ASE Transit Bus HVAC Test

1. Learning environment

For best application of this *Recommended Practice*, a combination of classroom lectures, mentoring, practical training and practice tests should be included in the training program.

2. Computer skills

Basic computer skills are now a standard for transit bus technicians. Basic skills and knowledge in the operation of a computer in a Microsoft Windows environment are essential.

3. Course descriptions and objectives

The learning objectives listed below have been developed through a labor-management committee of subject matter experts (SMEs). The Learning Objective Levels represent 100 (introductory), 200 (intermediate) and 300 (advanced) levels. Within each level, the learning objectives are organized in the recommended order of instruction. When a transit bus mechanic demonstrates proficiency in the learning objectives, he or she should be capable of attaining ASE Transit Bus Technician Certification.

- **Modules A1, A2 and A3: HVAC Systems Diagnosis, Service and Repair 101, 201, 301:** The objective of these courses is to familiarize the employee with the basics of HVAC system components and operation. Participants will receive instruction from a qualified instructor regarding basic troubleshooting and preventive maintenance procedures for HVAC systems, including the identification of defective/worn components and probable causes of failure. Emphasis is placed on determining the need for service or repair based on operating noises, or sight, odor or touch conditions. The 301-level course focuses on component and refrigerant type identification and data reader/computer usage to determine fault codes and perform system tests.
- **Module A4: Refrigerant Recovery, Recycling and Handling:** The objective of this course is to familiarize the employee with EPA and SAE "J" standards for R-22, R-134a, R-407c, and EPA approved refrigerant blends. The course covers the maintenance and verification of correct operation of certified equipment, identification and recovery of A/C system refrigerant, recycling of refrigerant, testing recycled refrigerant for non-condensable gases, and following federal and local laws for service procedures.
- **Modules B1, B2 and B3: A/C Systems 101, 201, 301:** The objective of these courses is to familiarize the employee with basics of A/C system components, operation, diagnosis and repairs to restore the A/C system to OEM specifications. Emphasis is placed on diagnosis of problems via gauges; sight, audible, odor and touch; testing; and evacuating, charging and removing contaminants from the A/C system. The 201 module focuses on compressors and clutches. Inspection, testing, diagnosis, repairs and replacements of A/C compressor and clutch components are covered to restore the A/C system to OEM specifications. Emphasis in the 301 module is placed on the evaporator,

condenser and related components, and complete restoration of the A/C system to OEM specifications.

- **Modules C1, C2 and C3: Heating and Engine Cooling Systems 101, 201, 301:** The objective of these courses is to provide the employee with a basic understanding of transit bus heating and engine cooling system components and operation. It covers troubleshooting and preventive maintenance procedures for heating and engine cooling systems including inspection, testing, diagnosis and repair of heating and engine cooling system components. Upon completion of the course, employees should understand all advanced theories and have the ability to perform all applicable testing, troubleshooting, inspection and diagnosis to restore the heating and engine cooling system to OEM specifications.
- **Modules D1 and D2: HVAC Related Controls 101, 201:** The objective of these courses is to familiarize the employee with HVAC-related control diagnosis and repair. The 101 module covers electrical systems inspection, diagnosis, testing and repair, and the 201 module covers constant/automatic temperature control systems inspection, diagnosis, testing and repair.

4. Exam requirements

The minimum acceptable grade to pass the course and all practical tests is 75 percent. Students must pass written tests with a minimum grade of 80 percent.

5. ASE test content summary

TABLE 1
Specifications for Transit HVAC Test

Content Area	Questions in Test	Percent of Test
A. Heating, Ventilation, and Air Conditioning Systems Diagnosis, Service and Repair	7	14%
B. A/C System and Component Diagnosis, Service and Repair 1. A/C System—General (10) 2. Compressor and Clutch (6) 3. Evaporator, Condenser and Related Components (6)	22	44%
C. Heating and Engine Cooling Systems Diagnosis, Service and Repair	7	14%
D. Heating, Ventilation, and Air Conditioning Operating Systems and Related Controls Diagnosis and Repair 1. Electrical Systems (6) 2. Constant/Automatic Temperature Control (6)	10	20%
E. Refrigerant Recovery, Recycling, Handling and Retrofit	4	8%
Total	**50**	**100%**

References

National Institute for Automotive Service Excellence (ASE) website. http://www.ase.com/

Abbreviations and acronyms

A/C air conditioning
AC alternating current
ASE Automotive Service Excellence
ATU Amalgamated Transit Union
DC direct current
DMM digital multimeter
EDSI Educational Data Systems, Inc.
EPA Environmental Protection Agency
HVAC heating, ventilation and air conditioning
NATSA North American Transit Service Association
OJT on-the-job training
PM preventive maintenance
PPE personal protective equipment
RPM revolutions per minute
TWU Transit Workers Union

Document history

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First published					October 1, 2010
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Second revision					

Appendix A: Transit Bus HVAC Learning Objectives

101 SAFETY, COMPLIANCE & CERTIFICATION	
Learning Objectives	**ASE Task Reference**
Demonstrate use of proper PPE for working with refrigerants	A1
Describe proper handling and labeling of refrigerant storage tanks	B1(6)

101 THEORY & UNDERSTANDING	
Learning Objectives	**ASE Task Reference**
Refer to manufacturer's specifications and codes	B2(8), D1(1), D1(6), D2(2), D2(3), D2(4), D2(6)
Demonstrate ability to reference maintenance manuals	E6, B2(3)
Demonstrate ability to identify HVAC system components	A3
Describe characteristics of different refrigerants	E2
Locate heater and defroster core components	C11
Demonstrate ability to reference recovery machine operation manuals	E1
Demonstrate ability to reference maintenance manual to determine which accessories and components are present	D2(1)
Explain the difference between recycling and recovering	E3
Explain the operation of heating systems	C1
Explain the operation of evaporator and condenser fan motors	D1(5)
Demonstrate ability to identify and use the correct containers for different refrigerants	E4

101 TOOL USAGE & DIAGNOSTICS	
Learning Objectives	**ASE Task Reference**
Demonstrate ability to use digital multimeter (DMM)	B2(1), B2(2), B2(6), B2(8), C13, C17, D1(1), D1(2), D1(3), D1(5), D2(6)
Demonstrate ability to use hand tools properly	B2(2), B2(4), B2(7)
Demonstrate basic computer skills	A4
Demonstrate ability to use basic air tools	B2(6), B2(8), C13

102 SAFETY, COMPLIANCE & CERTIFICATION	
Learning Objectives	**ASE Task Reference**
Identify safety/high-pressure protection devices	B2(1), B2(2)
Refer to EPA-required records on use of refrigerant	E4
Describe all EPA requirements for handling, labeling and storage	E4
Comply with federal and local laws concerning handling of refrigerants	E6

102 THEORY & UNDERSTANDING	
Learning Objectives	**ASE Task Reference**
Read pressure temperature charts	B2(1)
Identify color code for refrigerant tanks	B1(2)
Describe the need for the different refrigerant oil types	B1(9)
Locate and describe the purpose of HVAC control panels using schematics and manuals	D1(6)
Describe cable operation; check and replace cables as needed	D2(2), D2(3)
Explain compressor operation, hi-lo cut-out switches and other related components	B2(2)
Explain different uses of AC and DC motors	D1(5)
Explain the purpose of evaporator pressure regulators	D2(2) D2(3)
Explain evaporator and condenser operation and purpose	D1(5)
Explain the function of expansion valves, service valves, check valves	D2(2), D2(3)
Describe the process of HVAC air flow through bus	D2(4)
Explain operation of expansion valve	B3(6)
Describe refrigerant color code conventions	E4
Explain the use of vacuum pump	B1(6)
Describe the operation of the service valve	B1(6)

102 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	**ASE Task Reference**
Inspect belts for tension and wear	A1
Inspect evaporator filters	A2
Check for smooth operation of cables and linkages	C14
Demonstrate ability to cut and crimp wires	C13
Demonstrate ability to use proper coolant specifications when refilling	C8

103 SAFETY, COMPLIANCE & CERTIFICATION	
Learning Objectives	**ASE Task Reference**
Attain EPA 608 certification	B2(6), B3(5)
Attain EPA 608 Type II certification	A3

201 THEORY & UNDERSTANDING	
Learning Objectives	**ASE Task Reference**
Demonstrate ability to follow proper PM	C11
Identify gauges needed for proper refrigerant	A3
Identify and use the proper refrigerant	B1(8)
Describe defroster operation and connection to the rest of the system	D1(2)
Demonstrate ability to use manufacturer specifications for lubricant and level	B2(5)

201 TOOL USAGE & DIAGNOSTICS	
Learning Objectives	**ASE Task Reference**
Demonstrate ability to identify refrigerant types using an analyzer or static gauge	A3, B1(2)
Demonstrate use of digital thermometer to verify thermostat settings	C7, D2(2)
Demonstrate use of test kit for antifreeze to determine conditioner concentration	C3
Demonstrate ability to use spectrometer to check antifreeze level	C5

201 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	**ASE Task Reference**
Bleed air according to specifications	C8
Check air flow	B3(3), C1
Check ambient air sensors above condenser	C1
Check condition of belt and pulley	C6
Check air flow of blowers	C13
Check brackets for looseness	C5
Check brackets and clamps to ensure they are not rubbing	B3(2)
Check condenser and fittings for leaks	B3(4)
Check condenser for debris and dirt	B3(3)
Check coolant filter	C3
Check discharge line for low discharge temperature	A2, B1(4)
Check electrical connections and brushes in fan motor	B3(3)
Check evaporator and condenser fans for proper air flow	B3(3)
Check fan speed	C1, C2, C3
Check fan speed switches	C13
Check filter-drier for leaks	B3(5)
Check for bent fins	B3(3), B3(7)
Check brackets and mounting bushings	B3(7)
Check for bent cage (or squirrel cage)	B3(3)
Check for clutch cycling	A1
Check for coldwater leaks	C11
Check for compressor noise	A1
Check for moisture and/or contamination of system with sight glass and/or gauges	A2, B1(3)
Check for discharge air circulation	A2
Check for discoloration of compressor oil in sight glass and level	A2, B1(4)
Check for electrical smell or rubber burning smell	A2
Check for fan motor operation	A1
Check for foggy windows	A2
Check for frost on drier or tank	A2, B3(5)
Check for leaks	B3(7)

Learning Objectives	ASE Task Reference
Check operation of valves	B3(9)
Check for return air circulation	A2
Check for unusual noise or vibration	A1
Check fresh air damper	D2(4)
Check heater core for leaks	C2
Check hoses, lines and filters for leaks with leak detector, dirt tracks or soapy water	B1(5), B3(2)
Check inline valves for proper operation and leaks	C14
Check low-level sensor	C3
Check modulation valve for proper operation	C1
Check mounting brackets	B3(5)
Check mounting bushings	B3(4)
Check operation for low air flow	B3(7)
Check operation of high-pressure relief valve	B3(10)
Properly torque clamps	C4
Check packing for service valves	B3(9)
Check proper placement and contact of thermal bulb	B3(6)
Check proper routing of hoses	B3(2), C4
Check return lines for heat	B3(10)
Check sight glass to ensure proper oil level	B3(1)
Check suction line for frost	A2, B1(4)
Check temperature of return line	C10
Check operation of driver control switches	C13
Check that evaporator is engaging to remove moisture	C2
Check booster pump operation	C1, C12
Check the water pump drive gear	C6
Check the relief pressure of the valve	C5
Check the weep hole in the water pump	C6
Check thermostat operation	C3
Check valve solenoid function	C15
Check roof-mounted accessories for leaks	D2(4)
Clear water drains	B3(8)
Unplug drains as needed	C2
Clean evaporator core	B3(7)
Inspect compressor mounts	B2(3)
Inspect remote (feeler) bulb for proper placement and attachment	B3
Listen for bearing noise	C6
Listen for excessive noise from compressor bearing and tensioner bearing	B2(3)
Perform pressure test	C4, C5, C10

Learning Objectives	ASE Task Reference
Pressurize cooling system	C3
Remove and clean filter	B3(8)
Remove black mold from ductwork	C16
Test fan operation by turning up temperature	C9
Run system to stabilize for 15 minutes	B3(1)
Troubleshoot thermostat, connections, cables	C1
Verify bolt-on expansion valve is attached to line	A2
Visually check mountings	B3(4)
Visual inspection of oil condition and color	B2(5)
Visually check fan components	C9
Visually check hoses for leaks, fraying and “carcass strength”	C4
Visually check housing and seals	C7
Visually check radiator fins for leaks and bends	C5
Visually inspect condition of heater and defroster cores	A2, C11
Visually inspect sensors for proper connection or damage	B2(2)

202 SAFETY, COMPLIANCE & CERTIFICATION

Learning Objectives	ASE Task Reference
Demonstrate ability to safely use recycle/recovery machine	B1(2), B1(6), B2(6), B3(2), B3(5), E3

202 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Interpret micron gauge readings	B1(6)
Describe manufacturer charging procedures and specifications	B1(8)
Read and interpret schematic diagrams	B2(1), B2(6), B3(4), D1(1), D1(2), D1(6)
Describe HVAC control systems	B1(1)

202 TOOL USAGE & DIAGNOSTICS

Learning Objectives	ASE Task Reference
Demonstrate ability to use electronic sniffer	B1(5)
Demonstrate ability to use micron gauge	B1(6), B3(2), B3(5)
Demonstrate ability to use nitrogen as a drying agent	B1(6)
Demonstrate ability to use manifold gauges	B1(6), B1(8), B2(1), B2(2), B2(6), E3
Connect gauges to check pressures; test on or off bus as needed	D1(3), D1(5)
Connect manifold gauge and interpret pressures based on refrigerant used	A3, D2(1)
Install manifold gauge set	B3

Learning Objectives	ASE Task Reference
Demonstrate ability to use a purge machine	E1
Purge manifold gauge set	A3, B1(3)
Demonstrate ability to service and maintain recycle/recovery machine	B1(6)
Demonstrate ability to use a digital thermometer and pressure gauge to confirm presence of non-condensable gases	E5
Demonstrate ability to use belt tension gauge for proper belt tension adjustment	B2(3)
Demonstrate ability to use flow meters	D2(3)
Demonstrate ability to use service valves to isolate system	B2(6)
Demonstrate ability to use strobe to check fan speed	C9

202 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Demonstrate ability to check refrigerant level	B2(1), B1(3), B1(8)
Demonstrate ability to do nitrogen pressure test	B1(3)
Demonstrate ability to weigh added refrigerant	B1(8)
Demonstrate ability to align compressor pulleys with straight edge	B2(3)
Change compressor oil	B2(5)
Change evaporator core	B3(7)
Check air gap on compressor clutch	B2(4)
Check clutch mating surfaces for wear and straightness	B2(4)
Check engine temperature sensor	D1(4)
Check for compressor operation	B3(10)
Check for electrical and mechanical failures of the coolant valves	D2(3)
Check grounds	D1(1), D1(6)
Check heater control valve	D2(2), D2(3)
Check mechanical control panel assembly	D2(2), D2(3)
Check modulator valve	D1(4)
Check safety switches	D2(1)
Check the heating modulation valves	B3(10)
Check unloaders and valves	B2(6), D2(1)
Check operation of evaporator pressure regulator	B1
Connect temperature sensor to evaporator outlet	A3
Confirm operation of condenser fans	B3(10)
Confirm proper airflow through condenser	B3(10)
Connect sensors to return air duct and discharge air	A3
Connect temperature sensors	A3
Inspect hardware and adjust or replace as needed	B2(7)
Locate and test heater core sensor	A3

Learning Objectives	ASE Task Reference
Locate valves and visually check for leaks	B3(9)
Demonstrate ability to splice or solder properly	B2(2)
Demonstrate ability to use ambient air temperature to determine pressures	A3
Demonstrate ability to use R22 mixed with nitrogen gas to check for leaks	B3(2)
Perform visual/tactile inspection of pipes to check coolant valve function	D2(3)

203 TOOL USAGE & DIAGNOSTICS

Learning Objectives	ASE Task Reference
Demonstrate ability to diagnose electrical problems with clutch coil	B2(1)
Demonstrate ability to properly diagnosis condenser fan motors	B2(1)
Demonstrate ability to use digital multimeter to measure clutch coil resistance and running voltage & amperage	B2(4)

203 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Demonstrate ability to clean expansion valve filter	B1(7), B3(6)
Check electronic display panel for codes	B2(1)
Check operation of evaporator and condenser fan motors (speed, current draw, and proper air flow)	B1(1)

301 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Demonstrate ability to interpret refrigeration gauge readings	B1(8)
Describe electrical and mechanical protection devices for different manufacturers	D1(3), D1(5)

301 TOOL USAGE & DIAGNOSTICS

Learning Objectives	ASE Task Reference
Properly connect and use readers or laptop depending on manufacturer	A4, B2(1), B2(2), B2(8), D1(1), D1(4), D1(6), D2(1), D2(2), D2(5), D2(6), D2(7)
Identify HVAC fault codes	A4
Electronically diagnose solenoid operation	B3(6)
Measure for superheat	B3(6)
Perform refrigerant oil acid test and interpret results	A2

301 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Demonstrate ability to check motor RPMs	B3(3)

302 TOOL USAGE & DIAGNOSTICS	
Learning Objectives	**ASE Task Reference**
Check and interpret diagnostic codes	D2(1), D2(2), D2(5), D2(6), D2(7)
Clear fault codes	A4
Diagnose function of relay boards or control boards	D1(6)
Use laptop software to open and close valves (where electronically controlled)	D2(4)

302 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	**ASE Task Reference**
Adjust set point	A4
Adjust system parameters	A4
Interpret sensor readings and compare to specifications	B2(1)

303 THEORY & UNDERSTANDING	
Learning Objectives	**ASE Task Reference**
Explain connections/interface between HVAC and bus multiplexing	D1(2), D1(4)

303 TOOL USAGE & DIAGNOSTICS	
Learning Objectives	**ASE Task Reference**
Demonstrate ability to download program and set parameters	B1(1)
Diagnose zone heating and cooling problems	D2(4)

303 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	**ASE Task Reference**
Identify and replace faulty modules; program new modules based on local specifications	D1(1), D1(6)
Inspect and calibrate temperature sensors	B1(1)

401 TOOL USAGE & DIAGNOSTICS	
Learning Objectives	**ASE Task Reference**
Demonstrate ability to use laptop computer to diagnose auxiliary heater	C17

401 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	**ASE Task Reference**
Check for hose leaks on coolant side	C17
Check fuel pump and nozzle for proper operation	C17
Check igniter gap	C17
Check testing switch	C17
Clean heat exchanger as recommended	C17
Clean optical sensor	C17
Change fuel filter	C17

Appendix B: ASE transit bus HVAC task list

A. Heating, ventilation and air conditioning systems diagnosis, service and repair

1. Verify the need for service or repair of HVAC systems based on operating noises; determine appropriate action.
2. Verify the need of service or repair of HVAC systems based on sight, odor and touch conditions; determine appropriate action.
3. Identify HVAC system components and refrigerant type (R-22, R-134a, R-407c); conduct performance tests; determine appropriate action.
4. Use a data reader/computer to determine fault codes and perform system tests; check and adjust system parameters; clear fault codes.

B. A/C system and component diagnosis, service and repair

1. A/C system—general

1. Diagnose the cause of A/C system temperature control problems; determine needed repairs.
2. Identify A/C refrigerant type; check for contamination; determine appropriate action.
3. Diagnose the cause of A/C system problems indicated by pressure gauge readings and sight glass/moisture indicator conditions (where applicable); determine needed service or repairs.
4. Diagnose the cause of A/C system problems indicated by sight, audible, odor and touch conditions; determine needed repairs.
5. Perform A/C system leak test; determine needed repairs.
6. Evacuate A/C system using appropriate equipment.
7. Remove contaminants from the A/C system.
8. Charge A/C system with refrigerant.
9. Identify A/C system lubricant type needed for system application.

2. Compressor and clutch

1. Diagnose A/C system problems that cause protection devices (pressure, thermal and electronic) to interrupt system operation; determine needed repairs.
2. Inspect and test A/C system pressure, thermal and electronic protection devices and connections; replace as required.
3. Inspect and adjust A/C compressor drives, belts, pulleys and tensioners; replace as required.
4. Inspect, test and service A/C compressor clutch components and clutch assembly; replace as required.
5. Check and correct A/C compressor lubricant level and condition.
6. Inspect, test and replace A/C compressor.
7. Inspect and repair A/C compressor mountings and hardware; replace as required.
8. Check operation of A/C compressor unloaders; adjust as required.

3. Evaporator, condenser and related components

1. Adjust A/C system lubricant level after replacement of system components.
2. Inspect and repair A/C system hoses, lines, filters, fittings and seals; replace as required.
3. Check air flow through A/C condensers and evaporators; correct as required.
4. Inspect and test A/C system condenser and mountings; replace as required.
5. Inspect receiver and filter-drier; replace as required.
6. Inspect and test refrigerant solenoid, expansion valve(s) and evaporator pressure regulators; check placement of thermal bulb (capillary tube); replace as required.
7. Inspect and test evaporator core; replace as required.
8. Inspect, clean and repair evaporator housing and water drain; inspect and service or replace evaporator air filter.

9. Identify and inspect A/C system service valves and connections; repair as required.
10. Diagnose cause of A/C system failures that result in refrigerant loss from the high-pressure relief device.

C. Heating and engine cooling systems diagnosis, service and repair

1. Diagnose the cause of outlet air temperature control problems in the HVAC system; determine needed repairs.
2. Diagnose window fogging problems; determine needed repairs.
3. Perform engine cooling system tests for leaks, protection level, contamination, coolant level, temperature and conditioner concentration; determine needed repairs.
4. Inspect engine cooling and heating system hoses, lines and clamps; replace as required.
5. Inspect and test radiator, pressure-relief devices and coolant recovery system (surge tank); determine needed repairs.
6. Inspect water pump and drive system; determine needed repairs.
7. Inspect and test thermostats, bypasses, housings and seals; determined needed repairs.
8. Flush and refill cooling system; bleed air from system.
9. Inspect and test fan, fan drives, controls and fan shroud; repair or replace as required.
10. Inspect and test heating system coolant control valve(s) and manual shut-off valves; replace as required.
11. Inspect and flush driver's heater and/or defroster cores; replace as required.
12. Perform heating system tests to include coolant flow and operation of booster pump(s).
13. Inspect, test and diagnose heater/defroster and defogger system problems; check blowers, fans, resistors, switches, relay/modules, sensors, wiring and protection devices; repair or replace as required.
14. Inspect, test and diagnose service heating, ventilating and defrosting control panel assemblies, cables and linkages; repair or replace as required.
15. Inspect, test and diagnose heating, ventilating and defrosting control switches, hoses and solenoid valves; repair or replace as required.
16. Inspect, test and adjust heating, ventilating and defrosting ducts, filters, doors, cables, linkages, hoses and outlets; repair or replace as required.
17. Test, diagnose and service fuel-fired auxiliary heater system.

D. Heating, ventilation and air conditioning operating systems and related controls diagnosis and repair

1. Electrical systems

1. Diagnose the cause of failures in HVAC electrical control systems; determine needed repairs.
2. Inspect and test HVAC defroster blower motors, resistors, switches, relays, modules, wiring and protection devices; repair or replace as required.
3. Inspect and test HVAC compressor clutch relays, modules, wiring, sensors, switches, diodes and protection devices; repair or replace as required.
4. Inspect and test HVAC-related electronic engine control systems; determine needed repairs.
5. Inspect and test HVAC evaporator/heater and condenser fan motors, motor drivers (alternating current and direct current), relays, modules, switches, sensors, wiring and protection devices; repair or replace as required.
6. Inspect and test HVAC system electrical control panel assemblies; repair or replace as required.

2. Constant/automatic temperature control systems

1. Diagnose constant/automatic temperature control system problems; determine needed repairs.
2. Inspect and test climate control temperature sensors; repair or replace as required.
3. Inspect, test and adjust heater coolant valve and controls; repair or replace as required.
4. Inspect and test solenoids and switches; repair or replace as required.
5. Inspect and test constant/automatic temperature control panels; repair or replace as required.
6. Inspect and test constant/automatic temperature control microprocessor (climate control computer/programmer); repair or replace as required.
7. Connect data reader/computer to determine fault codes and perform system tests; check and adjust system parameters; clear fault codes.

E. Refrigerant recovery, recycling and handling

NOTE: Tasks 1 through 5 should be accomplished in accordance with published EPA and appropriate SAE J standards for R-22, R-134a, R-407c and EPA-approved refrigerant blends. Service must be performed by EPA-certified technicians.

1. Maintain and verify correct operation of certified equipment.
2. Identify and recover A/C system refrigerant.
3. Recycle refrigerant.
4. Handle, label and store refrigerant.
5. Test recycled refrigerant for non-condensable gases.
6. Follow federal and local laws for service procedures.

Appendix C: Sample curriculum

HVAC—Module A1
HVAC Systems Diagnosis, Service & Repair 101

Goal: Participants should understand the basics of HVAC system components and operation.

Objectives:
Upon completion of this course, participants should be able to:

- demonstrate safe use of hand tools and related equipment;
- identify HVAC system components;
- understand how to work safely with HVAC system and components;
- demonstrate a basic understanding of principles of operation;
- demonstrate a basic understanding of HVAC-related theory and safety practices; and
- complete EPA 608 and 608 Type II Certification Testing.

Job tasks/learning objectives/OJT checklist:
Will be tied back to Transit Training Guidelines. EDSI to complete

1. 101 and 201 Tool Usage & Diagnostics
2. 101 Theory & Understanding
3. 101 and 102 Safety, Compliance & Certification
4. 101 and 202 Theory & Understanding
5. 101 and 102 Theory & Understanding
6. 103 Safety, Compliance & Certification

Course description: Participants will receive classroom instruction in which a qualified instructor will go over the basics of HVAC system components and operation, including pertinent theory, component identification, safety issues, applicable tools/equipment and proper usage. Participants should leave the course with a basic understanding of how HVAC systems operate and relevant components to their operation.

Recommended class size: 8:1

Prerequisites (previous module and/or demonstrated experience):

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 4 hours

Target audience: All new and existing mechanics

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module A2

HVAC System Diagnosis, Service & Repair 201

Goal: Participants should understand basic troubleshooting techniques for HVAC systems through an enhanced understanding of theory and proper operation.

Objectives:
Upon completion of this course, participants should be able to:

- explain the proper function of an HVAC system at the component level;
- explain basic troubleshooting procedures of HVAC components;
- verify the need for service or repair based on operating noises; and
- verify the need for service or repair based on sight, odor and touch conditions.

Job tasks/learning objectives/OJT checklist:

1. 102 Theory & Understanding
2. 102 and 201 Procedures, Inspections & Testing
3. 201 Procedures, Inspections & Testing
4. 201 and 202 Procedures, Inspections & Testing

Course description: Participants will receive instruction from a qualified instructor regarding basic troubleshooting and preventive maintenance procedures for HVAC systems, including the identification of defective/worn components and probable causes of failure. Emphasis is placed on determining the need for service or repair based on operating noises, or sight, odor or touch conditions.

Recommended class size: 8:1

Prerequisites (previous module and/or demonstrated experience): Participants should have taken HVAC System Diagnosis, Service & Repair 101 or have equivalent experience.

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 4 hours

Target audience: Anyone successfully completing HVAC System Diagnosis, Service & Repair 101 or demonstrating equivalent knowledge/experience

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module A3

HVAC Systems Diagnosis, Service & Repair 301

Goal: Participants should be able to perform all necessary actions required to restore the HVAC system to OEM specifications.

Objectives:
Upon completion of this course, participants should be able to:

- demonstrate advanced troubleshooting/inspection procedures;
- identify HVAC system components and refrigerant types (R-22, R-134a, R-407c);
- conduct performance tests and determine appropriate actions;
- use data reader/computer to determine fault codes and perform system tests; and
- check and adjust system parameters; clear fault codes.

Job tasks/learning objectives/OJT checklist:

1. 201 Procedures, Inspections & Testing
2. 101 and 201 Theory & Understanding – 201 Tool Usage & Diagnostics
3. 201 Procedure, Inspections & Testing
4. 101, 301 and 302 Tool Usage & Diagnostics
5. 302 Tool Usage & Diagnostics – 302 Procedures, Inspections & Testing

Course description: Participants will be led by a qualified instructor through the process of restoring the HVAC system to OEM specifications. This includes instructor demonstrations and participant practice. Emphasis is placed on component and refrigerant type identification and data reader/computer usage to determine fault codes and perform system tests.

Recommended class size: 8:1

Prerequisites (previous module and/or demonstrated experience): Participants should have taken HVAC System Diagnosis, Service & Repair 201 or have equivalent experience.

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 4 hours

Target audience: Anyone successfully completing HVAC System Diagnosis, Service & Repair 201 or demonstrating equivalent knowledge/experience.

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module A4

Refrigerant Recovery, Recycling & Handling

Goal: Participants should be able to safely perform refrigerant recovery, recycling and handling in accordance with published EPA and appropriate SAE J standards.

Objectives:
Upon completion of this course, participants should be able to:

- maintain and verify correct operation of certified equipment;
- identify and recover A/C system refrigerant;
- recycle refrigerant;
- handle, label and store refrigerant;
- test recycled refrigerant for non-condensable gases;
- follow federal and local laws for service procedures; and
- perform brazing and soldering,

Job tasks/learning objectives/OJT checklist:

1. 101 and 102 Theory & Understanding – 101 Tool Usage & Diagnostics – 102 Safety, Compliance & Certification
2. 201 Theory & Understanding – 202 Safety, Compliance & Certification
3. 202 Safety, Compliance & Certification
4. 101 and 102 Safety, Compliance & Certification
5. 202 Tool Usage & Diagnostics
6. 102 Safety, Compliance & Certification
7. 202 Procedures, Inspections & Testing

Course description: Participants will be led by a qualified instructor through the process of recycling, handling and recovering refrigerant according to EPA and SAE J standards. Note: All service must be performed by EPA-certified technicians.

Recommended class size: 8:1

Prerequisites (previous module and/or demonstrated experience):

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 4 hours

Target audience:

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module B1

A/C Systems 101 (A/C System)

Goal: Participants should possess a basic understanding of transit bus A/C system components, operation, diagnosis and repair to restore A/C systems to OEM specifications.

Objectives:
Upon completion of this course, participants should be able to:

- identify A/C refrigerant type, check for contamination and determine appropriate action;
- diagnose cause of A/C system temperature control problems and determine needed repairs;
- diagnose cause of A/C system problems indicated by pressure gauge readings and sight glass/moisture indicator conditions;
- diagnose the cause of A/C system problems indicated by sight, audible, odor and touch conditions;
- perform A/C system leak test;
- evacuate A/C system using appropriate equipment;
- remove contaminants from the A/C system;
- charge A/C system with refrigerant;
- identify A/C system lubricant type needed; and
- apply recovery and refrigerant process.

Job tasks/learning objectives/OJT checklist

1. 201 Theory & Understanding – 201 Tool Usage & Diagnostics – 201 Procedure, Inspections & Testing
2. 201 Procedures, Inspections & Testing
3. 202 Tool Usage & Diagnostics
4. 201 Procedures, Inspections & Testing
5. 201 Procedures, Inspections & Testing
6. 201 and 202 Tool Usage & Diagnostics
7. 201 Procedures, Inspections & Testing – 202 Safety, Compliance & Certification
8. 103 Safety, Compliance & Certification
9. 201 Theory & Understanding
10. 202 Safety, Compliance & Certification – 202 Tool Usage & Diagnostics

Course description: Participants will receive classroom instruction in which a qualified instructor will go over the basics of A/C system components, operation, diagnosis and repairs to restore the A/C system to OEM specifications. Emphasis will be placed on diagnosis of problems via gauges; sight, audible, odor and touch; testing; and evacuating, charging and removing contaminants from the A/C system.

Recommended class size: 4:1

Prerequisites (previous module and/or demonstrated experience): 608 certification from Module A1

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: One day (8 hours) in conjunction with Module B2

Target audience: All new and existing mechanics

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module B2

A/C Systems 201 (Compressor and Clutch)

Goal: Participants should possess a basic understanding of transit bus A/C system components, operation, diagnosis and repair to restore A/C systems to OEM specifications. This module reviews more advanced diagnosis and inspection of A/C systems with regard to compressor and clutch troubleshooting and diagnosis.

Objectives:
Upon completion of this course, participants should be able to:

- diagnose and repair A/C system problems that cause protection devices (pressure, thermal and electronic) to interrupt system operation;
- inspect, test and replace A/C system pressure, thermal and electronic protection devices and connections;
- inspect, adjust and replace A/C compressor drives, belts, pulleys and tensioners;
- inspect, test, service and replace A/C compressor clutch components and clutch assembly;
- check and correct A/C compressor lubricant level and condition;
- inspect, test and replace A/C compressor;
- inspect, repair, and replace A/C compressor mountings and hardware; and
- check and adjust operation of A/C compressor unloaders.

Job tasks/learning objectives/OJT checklist

1. 201 and 202 Procedures, Inspections & Testing – 303 Tool Usage & Diagnostics
2. 201 Procedures, Inspections & Testing – 202 Tool Usage & Diagnostics
3. 202 Procedures, Inspections & Testing
4. 201 and 202 Procedures, Inspections & Testing
5. 201 and 202 Procedures, Inspections & Testing
6. 201 and 202 Procedures, Inspections & Testing
7. 201 and 202 Procedures, Inspections & Testing
8. 201 and 202 Procedures, Inspections & Testing

Course description: Participants will receive instruction from a qualified instructor regarding basic troubleshooting and preventive maintenance procedures for A/C system components with a focus on compressors and clutches. Inspection, testing, diagnosis, repair and replacement of A/C compressor and clutch components are covered to restore the A/C system to OEM specifications.

Recommended class size: 4:1

Prerequisites (previous module and/or demonstrated experience): Participants should have taken A/C Systems 101 or have equivalent experience.

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 8 to 16 hours in conjunction with Module B1

Target audience: Anyone successfully completing A/C Systems 101 or demonstrating equivalent knowledge/experience.

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module B3

A/C Systems 301(Evaporator, Condenser and Related Components)

Goal: Participants should be able to perform all necessary actions required to restore the A/C system and all related components to OEM specifications. More advanced troubleshooting procedures focused on the evaporator, condenser and related components are emphasized.

Objectives:
Upon completion of this course, participants should be able to:

- adjust A/C system lubricant level after replacement of system components;
- inspect, repair and replace A/C system hoses, lines, filters, fittings and seals;
- check and correct air flow through A/C condensers and evaporators;
- inspect, test and replace A/C system condenser and mountings;
- inspect and replace receiver and filter drier;
- inspect and test refrigerant solenoid, expansion valve(s) and evaporator pressure regulators;
- check placement of thermal bulb and replace as needed;
- inspect, test and replace evaporator core;
- inspect, clean and repair evaporator housing and water drain;
- inspect, service and replace evaporator air filter;
- identify, inspect and repair A/C system service valves and connections; and
- diagnose cause of A/C system failures that result in refrigerant loss from the high-pressure relief device.

Job tasks/learning objectives/OJT checklist

1. 201 Theory & Understanding
2. 101 and 201 Procedures, Inspections & Testing
3. 201 and 202 Procedures, Inspections & Testing
4. 201 Procedures, Inspections & Testing
5. 201 Procedures, Inspections & Testing
6. 201 and 202 Procedures, Inspections & Testing
7. 201 Procedures, Inspections & Testing
8. 202 Procedures, Inspections & Testing
9. 201 Procedures, Inspections & Testing
10. 201 Procedures, Inspections & Testing
11. 201 and 202 Procedures, Inspections & Testing
12. 201 and 202 Procedures, Inspections & Testing

Course description: Participants will be led by a qualified instructor through the process of restoring the A/C system to OEM specifications. Emphasis in this module is placed on the evaporator, condenser and related components and complete restoration of the A/C system to OEM specifications.

Recommended class size: 4:1

Prerequisites (previous module and/or demonstrated experience): Participants should have taken A/C Systems 201 or have equivalent experience and completed Brazing & Soldering from Module A4.

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: Two days or 16 hours

Target audience: Anyone successfully completing A/C Systems 201 or demonstrating equivalent knowledge/experience.

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module C1

Heating and Engine Cooling Systems 101

Goal: Participants should possess a basic understanding of transit bus heating and engine cooling system components and operation.

Objectives:
Upon completion of this course, participants should be able to:

- demonstrate safe use of hand tools and related equipment;
- understand how to work safely with heating and engine cooling system and components;
- locate heater and defroster core components;
- explain operation of heating systems;
- check for smooth operation of cables and linkages;
- demonstrate ability to cut and crimp wires; and
- demonstrate ability to use proper coolant specifications when refilling.

Job tasks/learning objectives/OJT checklist:

1. 101 Tool Usage & Diagnostics
2. 103 and 202 Safety, Compliance and Certification
3. 101 Theory & Understanding
4. 101 Theory & Understanding
5. 102 Procedures, Inspections & Testing
6. 102 Procedures, Inspections & Testing
7. 102 Procedures, Inspections & Testing

Course description: Participants will receive classroom instruction in which a qualified instructor will go over the basics of heating and engine cooling system components and operation, including pertinent physics, component identification, safety issues, applicable tools/equipment and proper usage. Participants should leave the course with a basic understanding of how the heating and cooling engine systems operate.

Recommended class size: 8:1

Prerequisites (previous module and/or demonstrated experience):

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 4 hours

Target audience: All new and existing mechanics

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module C2

Heating and Engine Cooling Systems 201

Goal: Participants should understand basic troubleshooting procedures for transit bus heating and engine cooling systems through an enhanced understanding of theory and proper operation.

Objectives:

Upon completion of this course, participants should be able to:

- diagnose the cause of outlet air temperature control problems;
- diagnose and repair window fogging problems;
- perform engine cooling system tests for leaks, protection level, contamination, coolant level, temperature and conditioner concentration;
- inspect and replace engine cooling and heating system hoses, lines and clamps;
- inspect, test and repair radiator, pressure relief devices and coolant recovery systems;
- inspect and repair water pump and drive system;
- flush and refill cooling system; bleed air from system;
- inspect, test, repair and replace fan, fan drives, controls and fan shrouds;
- inspect, test and replace heating system coolant control valves and manual shut-off valves; and
- inspect and flush driver's heater and/or defroster cores.

Job tasks/learning objectives/OJT checklist:

1. 201 Procedures, Inspections & Testing – 201, 203 and 303 Tool Usage & Diagnostics
2. 201 Procedures, Inspections & Testing
3. 201 Procedures, Inspections & Testing
4. 201 and 202 Procedures, Inspections & Testing

5. 201 Procedures, Inspections & Testing – 202 Safety, Compliance & Certification
6. 201 Procedures, Inspections & Testing
7. 201 Procedures, Inspections & Testing
8. 201 Procedures, Inspections & Testing
9. 202 Procedures, Inspections & Testing
10. 202 Procedures, Inspections & Testing

Course description: Participants will receive instruction from a qualified instructor regarding basic troubleshooting and preventive maintenance procedures for heating and engine cooling systems including inspection, testing, diagnosis and repair of heating and engine cooling system components.

Recommended class size: 4:1

Prerequisites (previous module and/or demonstrated experience): Participants should have taken Heating and Engine Cooling Systems 101 or have equivalent experience.

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 8 hours

Target audience: Anyone successfully completing Heating and Engine Cooling Systems 101 or demonstrating equivalent knowledge/experience.

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module C3

Heating and Engine Cooling Systems 301

Goal: Participants should be able to perform all necessary actions required to restore the heating and engine cooling system to OEM specifications. This includes possessing knowledge of all advanced theories and ability to perform all applicable testing, troubleshooting, inspection and diagnosis.

Objectives:
Upon completion of this course, participants should be able to:

- perform heating system tests to include coolant flow and booster pump operation;
- inspect, test and diagnose heater/defroster and defogger system problems;
- check blowers, fans, resistors, switches, relays/modules, sensors, wiring and protections devices;
- inspect, test and diagnose service heating, ventilating and defrosting control switches, hoses and solenoid valves;
- inspect, test and adjust heating, ventilating and defrosting ducts, filters, doors, cables, linkages, hoses, and outlets; and
- test, diagnose and service fuel-fired auxiliary heater system.

Job tasks/learning objectives/OJT checklist:

1. 201 and 202 Procedures, Inspections & Testing
2. 201 Theory & Understanding – 201 and 203 Procedures, Inspections & Testing
3. 201 and 202 Procedures, Inspections & Testing
4. 201 and 202 Procedures, Inspections & Testing – 301 Tool Usage & Diagnostics
5. 201 and 202 Procedures, Inspections & Testing
6. 301 Tool Usage & Diagnostics

Course description: Participants will be led by a qualified instructor through the process of restoring the heating and engine cooling system to OEM specifications. This includes instructor demonstrations and participant practice. This portion is highly interactive and should employ hands-on learning activities.

Recommended class size: 4:1

Prerequisites (previous module and/or demonstrated experience): Participants should have taken Heating and Engine Cooling 201 or have equivalent experience.

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 8 hours

Target audience: Anyone successfully completing Heating and Engine Cooling 201 or demonstrating equivalent knowledge/experience.

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module D1

HVAC Related Controls 101(Electrical Systems)

Goal: Participants should possess a basic understanding of HVAC electrical components, causes of failure and the repairs necessary to restore the electrical system to OEM specifications.

Objectives:

Upon completion of this course, participants should be able to:

- inspect, test, repair and replace HVAC defroster blower motors, resistors, switches, relays, modules, wiring and protection devices;
- inspect, test, repair or replace HVAC compressor clutch relays, modules, wiring, sensors, switches, diodes and protection devices;
- inspect, test and repair HVAC-related electronic engine control systems;
- inspect, test, repair and replace HVAC evaporator/heater and condenser fan motors, motor drivers (AC and DC), relays, modules, switches, sensors, wiring and protection devices; and
- inspect, test, repair and replace HVAC system electrical control panel assemblies.

Job tasks/learning objectives/OJT checklist:

1. 201 and 202 Procedures, Inspections & Testing
2. 201 and 202 Procedures, Inspections & Testing
3. 201 and 202 Procedures, Inspections & Testing
4. 102 Theory & Understanding – 201, 202 and 203 Procedures, Inspections & Testing
5. 203 Procedures, Inspections & Testing

Course description: Participants will receive classroom instruction in which a qualified instructor will go over HVAC electrical components, testing, inspection, repair and component replacement. Focus is placed on restoring the HVAC electrical system to OEM specifications.

Recommended class size: 4:1

Prerequisites (previous module and/or demonstrated experience):

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 4 hours

Target audience: All new and existing mechanics

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.

HVAC—Module D2

HVAC Related Controls 201(Constant/Automatic Temperature Control Systems)

Goal: Participants should possess a basic understanding of HVAC constant/automatic control system problems, diagnosis procedures and how to restore the constant/automatic temperature control system to OEM specifications.

Objectives:
Upon completion of this course, participants should be able to:

- inspect, test, repair and replace climate control temperature sensors;
- inspect, test, adjust, repair and replace heater coolant valve and controls;
- inspect, test, repair and replace solenoid and switches;
- inspect, test, repair and replace constant/automatic temperature control panels;
- inspect, test, repair and replace constant/automatic temperature control microprocessor (climate control computer/programmer);
- connect data reader/computer to determine fault codes and perform system tests; and
- check and adjust system parameters and clear fault codes.

Job tasks/learning objectives/OJT checklist:

1. 201, 202 and 203 Procedures, Inspections & Testing
2. 201, 202 and 203 Procedures, Inspections & Testing
3. 201 and 202 Procedures, Inspections & Testing – 301 Tool Usage & Diagnostics
4. 203 Procedures, Inspections & Testing
5. 301 and 302 Tool Usage & Diagnostics
6. 301 Tool Usage & Diagnostics
7. 302 Tool Usage & Diagnostics

Course description: Participants will receive classroom instruction in which a qualified instructor will go over HVAC constant/automatic temperature control systems, testing, inspection, repairs and component replacement. Focus is placed on restoring the HVAC constant/automatic temperature control system to OEM specifications.

Recommended class size: 4:1

Prerequisites (previous module and/or demonstrated experience): Participants should have taken HVAC Related Controls 101 or have equivalent experience.

Delivery method (e.g., lecture, hands-on, online, lab): Hands-on and classroom

Course duration: 4 hours

Target audience: Anyone successfully completing HVAC Related Controls 101 or demonstrating equivalent knowledge/experience.

Classroom equipment and supplies: Notepads, pens/pencils, flip chart or whiteboard (and markers), classroom, laptop, projector, highlighters, note cards and name cards

Course materials, training aids and references: Student workbook, manuals, handouts, flow charts, PowerPoint, homework assignments

Instructor:

Course developer: EDSI

Subject matter experts: Contact APTA.

Revision dates: 9/9/2010

Follow-up: Most recent revision should be sent to committee for feedback.

Instructor and course evaluation: Local course evaluation sheets should be used if present.