



APTA BTS-BMT-RP-011-16

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APTA Bus Maintenance Training
Working Group

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

Abstract: This *Recommended Practice* provides guidelines for establishing a standardized bus maintenance training program related to the ASE certification syllabus for the Electronic Diesel Engine Diagnosis Specialist Test (L2) from a transit bus maintenance perspective.

Keywords: Automotive Service Excellence (ASE) L2, bus, certification, electronics, medium/heavy vehicle, training, transit

Summary: This *Recommended Practice* provides transit bus maintenance training and transit bus maintenance departments with typical information to evaluate, develop or enhance current training programs for the diagnosis, repair and maintenance of transit bus brake systems. In addition, this document allows departments to instruct/prepare transit bus technicians and mechanics for the H8 National Automotive Service Excellence (ASE) Medium/Heavy Vehicle Electronic Diesel Engine Diagnosis Specialist Test. 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 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 and how preventive maintenance inspections and repairs are scheduled.

This document represents a common viewpoint of those parties concerned with its provisions, namely operating/planning agencies, manufacturers, consultants, engineers and general interest groups. The application of any standards, recommended practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of a transit system's operations. In those cases, the government regulations take precedence over this standard. The North American Transit Service Association and its parent organization APTA recognize that for certain applications, the standards or practices, as implemented by individual agencies, may be either more or less restrictive than those given in this document.

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Table of Contents

Participants	iii
1. Learning environment	1
2. Computer skills	1
3. Course learning objectives	1
4. Exam requirements	2
5. ASE test content summary	2
References.....	3
Abbreviations and acronyms.....	3
Document history.....	3
Appendix A: Electronic diesel engine diagnosis learning objectives	4
Appendix B: ASE medium/heavy vehicle electronic diesel engine diagnosis specialist test task list..	14
Appendix C: Sample curriculum	16

List of Figures and Tables

Table 1 Specifications for Medium/Heavy Vehicle Electronic Diesel Engine Diagnosis Specialist Test.....	2
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Participants

The American Public Transportation Association greatly appreciates the contributions of the **Bus Maintenance Training Working Group**, which provided the primary effort in the drafting of this document.

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Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist 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 computers in a Windows environment are essential.

3. Course learning 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). 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 passing the ASE Medium/Heavy Vehicle Electronic Diesel Engine Diagnosis Specialist Test.

- **Module I: General Inspection and Diagnosis:** The objective of these courses is to provide the employee with knowledge and hands-on practice of proper procedures for inspecting and diagnosing transit bus diesel engines, including verifying complaints, utilizing service information and diagnostic tools, and practicing troubleshooting techniques to determine the root cause of problems.
- **Module II: Electronic Engine Controls Diagnosis:** The objective of these courses is to provide the employee with knowledge and hands-on practice of proper procedures for inspecting and diagnosing transit bus diesel engine electronic diagnostic controls and using electronic diagnostic controls to identify and repair problems. Determining appropriate procedures, performing tests and evaluating data will be emphasized.
- **Module III: Air Induction and Exhaust Systems Diagnosis:** The objective of these courses is to provide the employee with knowledge and hands-on practice of proper procedures for inspecting and diagnosing transit bus diesel engine air induction and exhaust problems, including problems caused by engine brakes, exhaust brakes, back-pressure devices and wastegates. Determining appropriate procedures, performing tests and evaluating data will be emphasized.
- **Module IV: Fuel System Diagnosis:** The objective of these courses is to provide the employee with knowledge and hands-on practice of proper procedures for inspecting and diagnosing transit bus diesel fuel system problems. Determining appropriate procedures, performing tests and evaluating data will be emphasized. Specific fuel injection systems, such as E1 electronic unit injector (EUI), E2 pump line nozzle – electronic (PLN-E), E3 hydraulic electronic unit injector (HEUI) and E4 common rail (CR) should be taught as needed based on local fleet makeup, but are not part of the ASE exam.

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 Medium/Heavy Vehicle Electronic Diesel Engine Diagnosis Specialist Test

Content Area	Questions in Test	Percent of Test
A. General Inspection and Diagnosis	4	9%
B. Electronic Engine Controls Diagnosis	27	60%
C. Air Induction and Exhaust Systems Diagnosis	6	13%
D. Fuel Systems Diagnosis	9	18%
Total	45	100%

Please see Appendix B for the full list of ASE course tasks that should be covered during the training course.

NOTE: Source for test structure data: ASE website, 10/19/2012.

References

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

Abbreviations and acronyms

ASE	Automotive Service Excellence
ATU	Amalgamated Transit Union
CR	common rail
ECM	electronic control module
ECU	electronic control unit
EDSI	Educational Data Systems Inc.
EUI	electronic unit injector
FMI	failure mode identifier
HEUI	hydraulic electronic unit injector
NATSA	North American Transportation Services Association
OEM	original equipment manufacturer
OJT	on-the-job training
PID	parameter identifier
PLN-E	pump line nozzle – electronic
PMI	preventive maintenance inspection
RPM	revolutions per minute
SID	subsystem identifier
TLC	Transportation Learning Center
TWU	Transit Workers Union
WIF	water in fuel
DPF	diesel particulate filter

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	CEO Approval	Policy & Planning Approval	Publish Date
First published	May 15, 2013	July 7, 2016	Sept. 6, 2016	Sept. 30, 2016	Oct. 6, 2016
First revision					
Second revision					

Appendix A: Electronic diesel engine diagnosis learning objectives

101 SAFETY	
Learning Objectives	ASE Task Reference
Demonstrate use of personal protective equipment (PPE)	E4(1)

101 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate knowledge of basic computer skills	A1, E1(3), E2(3), E3(3), E4(3)
Demonstrate ability to refer to service manuals, bulletins and wiring diagrams	A1, B11, C2, C7, D8, E1(3), E1(7), E2(3), E2(7), E3(3), E3(7), E4(3), E4(7)
Demonstrate ability to refer to manufacturer's website	A1, E1(3), E2(3), E3(3), E4(3)
Specify and describe basic electrical principles	E1(4), E1(6), E2(4), E2(6), E3(4), E3(6), E4(4), E4(6)
Demonstrate knowledge of voltages and pressure in common rail system	E4(1)
Explain how engine RPM is a factor in troubleshooting	A3
Explain the purpose of warning lights	A6
Explain the importance of conducting all diagnostic tests according to manufacturer's specifications	All

101 TOOL USAGE	
Learning Objectives	ASE Task Reference
Demonstrate use of infrared temperature gauge	A5

101 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Inspect air filter	A7
Check battery voltage	A9, E1(8), E2(8), E3(8), E4(8)
Check belts	A5
Check condition of exhaust and opacity	A4, A8, C4,
Check fill tube valve	D1
Check fluid level and condition	A6, A9, E1(8), E2(8), E3(8), E4(8)
Check for broken spring	E1(2), E1(5), E3(1), E3(2), E3(5)
Check for damaged fin blades on both sides of turbocharger	C5
Check for debris in oil pan	E1(8), E2(8), E3(8), E4(8)
Check for external broken spring	E1(1)
Check for external fuel leaks	D1, D4
Check for external leaks at cooler	A9
Check for fan operation	A5
Check for leaks in cooler	E1(8), E2(8), E3(8), E4(8)

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

Learning Objectives	ASE Task Reference
Check for leaks in hoses	A5
Check for loose clamps	C1
Check for low coolant	B9
Check for oil and/or dirt contamination	C1
Check for poor acceleration or low power going up grade	C4, D5, D7
Check for rough idle and running	D7
Check for seized or binding components	A9, E1(8), E2(8), E3(8), E4(8)
Check fuel filters	D1, E4(9)
Check fuel line condition	D1
Check fuel line isolators	D1
Check fuel temperature	D2
Check function of pump drive gear	E2(1)
Check hoses and clamps for holes and audible leaks	A7
Check induction pipe condition and for oil, debris and/or water	A7
Check oil level, pressure and condition	A3, A6, B9, E3(2), E3(5)
Check oil temperature	A6
Check for correct tire size	A9, E1(8), E2(8), E3(8), E4(8)
Check transmission operating temperature	A9(9), E1(8), E2(8), E3(8)
Check WIF (water-in-fuel) sensor	D2
Inspect turbocharger, muffler, pipe and rubber boots for damage (cracks, holes, crushing)	C1
Demonstrate ability to listen for unusual engine noises	A9, D7, E1(8), E2(8), E3(8)
Inspect for soot or fluid leaks in engine compartment	C5
Demonstrate ability to measure fuel temperature	D5
Demonstrate ability to record specific repair work according to agency guidelines	A11, B11, C7 , D8, E1(11), E2(11), E3(11)
Take engine oil sample for analysis	A6
Verify operator complaint	E1(8), E1(10), E2(8), E2(10), E3(8), E3(10), E4(10)
Visually inspect pipes and routing for cracks and leaks	A8
Visually inspect wiring harnesses	A6
Visually inspect exhaust components for signs of leakage	A4
Visually inspect fuel injectors	D7
Visually inspect fuel system	E4(1)
Visually inspect vehicle indicators	A2, E1(8), E2(8), E3(8), E4(8)

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

102 SAFETY	
Learning Objectives	ASE Task Reference
Demonstrate ability to follow proper safety precautions	E2(2)

102 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check fuel for oil contamination	E1(9), E2(9), E3(9), E4(9)
Check coolant levels for concentration	A5
Check for coolant in oil/fuel	A5
Check for noise (e.g., hole in pressure hoses/blown-out gasket causes a high-pitched whistle)	C4
Listen for noise in turbocharger, muffler, exhaust pipe	C5
Check particulate filter	C5
Open fuel lines at each injector	E2(2)

103 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Describe cooling system principles	A5
Describe lubrication system principles	A6

103 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for air in fuel	D4, D5
Check for debris on magnetic drain plug	A9
Check for overheating	A5
Inspect air vent	D1
Inspect fuel tank condition and mounting	D1
Demonstrate ability to refer to manual for fuel flow diagrams	D1
Demonstrate ability to refer to manual for min/max turbo boost (40-45), vacuum pressure specs	C3
Demonstrate ability to use site glass	D6

201 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate knowledge of fault codes (PID, SID, FMI)	A1, A2, A3, A6, A7, A9, B2, B4, C3, D3, E1(1), E1(2), E1(3), E1(4), E1(5), E1(6), E1(8), E2(3), E2(4), E2(6), E2(8), E3(1), E3(2), E3(3), E3(4), E3(5), E3(6), E3(8), E4(1), E4(2), E4(3), E4(4), E4(5), E4(6), E4(8), E4(10), E4(11)
Demonstrate knowledge of terrain of bus route (duty cycle) for troubleshooting	A9, E1(8), E2(8), E3(8), E4(8)

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

201 TOOL USAGE	
Learning Objectives	ASE Task Reference
Compare electronic gauge readings with mechanical gauge readings	B4
Compare sensor readings with mechanical gauge or test equipment	A3
Demonstrate ability to use digital multimeter to check actuators within specifications	C6
Demonstrate ability to use a digital multimeter	A1, A3, B1, B6, C2, E1(4), E1(6), E1(7), E2(2), E2(4), E2(6), E2(7), E3(3), E3(4), E3(6), E3(7), E4(4), E4(6), E4(7)

201 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check coolant level and condition	E1(8), E2(8), E3(8), E4(8)
Check for filter restriction	D2
Check for oil contamination	A6
Check for proper restricted fitting	E1(2), E1(5), E1(9), E3(2), E3(5), E3(9), E4(2)
Ensure that proper sensor is installed	B1
Check for wear in differential	A9, E1(8), E2(8), E3(8), E4(8)
Check to ensure that electrical parameters of engine sensors are within tolerances	A3
Inspect check valves	D1
Listen for abnormal noise	E4(8)
Operate engine to verify complaint	A2
Perform flow test	D6
Perform fuel sight glass test procedure to check for air in fuel	D1
Visually inspect fuel for color, debris, water and air	D6
Perform fuel system pressure test	D1
Reset diesel particulate filter (DPF) monitor codes	C5
Review and describe vehicle history/identify potential causes of repeated failures	B11, C7, D8
Road-test vehicle to verify operator complaint	A10, C2, E1(8), E2(8), E3(8), E4(8)
Test operation of coolant system	A5
Demonstrate ability to use schematics and bulletins for diagnosing problems	B5
Verify speedometer calibration	A9, E1(8), E2(8), E3(8), E4(8)

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

202 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Explain the meaning of exhaust smoke colors and color strength	A4
Explain fault code troubleshooting (PID, SID, FMI)	B5
Explain symptom-based troubleshooting	E1(8), E2(8), E3(8), E4(8)

202 TOOL USAGE	
Learning Objectives	ASE Task Reference
Check gauge accuracy	D3
Check pressures with hydraulic gauges	E1(8), E2(8), E3(8), E4(8)
Check sensor accuracy with known good mechanical gauges or digital multimeter	C3
Perform slack tube/manometer test	A8, C2
Demonstrate ability to use handheld diagnostic data reader	A1, A2, A3, A6, A7, A9, B2, B4, B5, E1(3), E1(4), E1(6), E1(8), E2(3), E2(4), E2(6), E2(8), E3(3), E3(4), E3(6), E3(8), E4(8)
Demonstrate ability to use gauges to check fuel pressure and lift pump pressure	E4(1), E4(2), E4(5)
Demonstrate ability to use manual and electric pressure gauges	C3, D6, E1(4), E1(9), E2(9), E3(9), E4(9)
Demonstrate ability to use proper connector tools	E1(4), E1(6), E2(4), E2(6), E3(4), E3(6), E4(4), E4(6)
Demonstrate ability to use proper test probes for connectors	E1(4), E1(6), E2(4), E2(6), E3(4), E3(6), E4(4), E4(6)
Demonstrate use of laptop to read turbo boost pressure	C2

202 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check operation of air intake sensors	A7
Check for air restriction	A7
Check electronic control module/unit (ECM/ECU) history	A5, A6, A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11),
Check operation of engine temperature sensors	B9
Check exhaust back-pressure, sensor or reading (if equipped)	C6
Check fan operation/charged air based on temperature	A7
Check filter change history	D3
Check for engine miss	D7
Check vehicle history for fleetwide problems	A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11)
Check for fuel in oil	D5
Check for leaks in charged air cooler	C4
Check for new manufacturer tech bulletins	E1(11), E2(11), E3(11), E4(11)
Check for restricted fuel filter	D5
Check for wear on axle	A9, E1(8), E2(8), E3(8), E4(8)

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

Learning Objectives	ASE Task Reference
Check fuel pressure	D4, D5, E1(1), E1(2), E1(5), E3(1), E3(2), E3(5)
Check fuel pressure sensor	D3
Check fueling/filter/inspection history	D2
Check grid heater (intake manifold heater)	A7
Check history of low-power complaints	E1(10), E2(10), E3(10), E4(10)
Check (injector) electrical connections	E1(2), E1(5), E3(2), E3(5), E4(2), E4(5)
Check minimum cranking speed	E1(2), E1(5), E3(2), E3(5), E4(2), E4(5)
Check minimum supply voltage during engine cranking	E1(2), E1(5), E3(2), E3(5), E4(2), E4(5)
Check oil consumption history	A6
Check response time	E1(2), E1(5), E3(2), E3(5)
Check transmission shifting points at specific engine RPM	A9, E1(8), E2(8), E3(8), E4(8)
Check sensors and wiring	A6, A9, E1(8), E2(8), E3(8), E4(8)
Check solenoids and relays	E1(8), E2(8), E3(8), E4(8)
Check test sensors	E2(2)
Check that sensors are operating within manufacturer's specifications	B9
Check wiring at fuel pump	D4
Check wiring on lift pump	D4
Check wiring on all engine sensors	B1
Compare injector calibration code on component to code on ECM/ECU	E1(1), E1(2), E1(5), E3(1), E3(2), E3(5)
Examine conditions at time of fault code (history of use)	A6
Interpret sensor test results	B7
Perform air inlet restriction test; interpret results	C1
Perform back-pressure test	C5
Perform cylinder cutout test	A3, E1(1), E1(2), E1(5), E1(10), E2(10), E3(1), E3(2), E3(5), E3(10), E4(5)
Perform cylinder performance test	A3
Perform engine injector cutout test	D7
Perform exhaust restriction test	A8
Perform exhaust system back-pressure test; interpret results	C1
Perform mechanical fuel pressure test	D4
Perform stall test	A8, A9, C4, C5
Perform turbo boost pressure test and interpret results	A7, C1
Review and explain vehicle history	A3, A5, A6, A8, A10, A11, B5, D7, E1(1), E1(2), E1(5), E1(11), E2(11), E3(1), E3(2), E3(5), E3(11), E4(1), E4(2), E4(3), E4(5), E4(11)
Simulate conditions of failure	A5, E1(8), E2(8), E3(8)
Test for restrictions in fuel supply	E1(9), E2(9), E3(9), E4(9)

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

Learning Objectives	ASE Task Reference
Test for voltage, amps, ohms and grounds	B6
Test sensors	A8
Verify horsepower and torque rating of engine	A10
Verify throttle operation	A10
Visually/audibly/tactilely inspect components	A3

203 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Describe non-electronic performance tests (air restriction, fuel/oil pressure, fuel levels)	B10
Demonstrate ability to read and interpret schematics	A1, B6, B7, B8, E1(3), E2(3), E4(3), E4(4), E4(6)
Explain and follow fault code troubleshooting steps	E1(8), E2(8), E3(8), E4(8)

203 TOOL USAGE

Learning Objectives	ASE Task Reference
Demonstrate ability to run fuel system software test	E1(5), E3(5), E4(5)
Demonstrate ability to use laptop to check fuel rail pressure	E4(1), E4(2), E4(5)
Demonstrate ability to use laptop to monitor fuel rate being delivered by engine request	D2
Demonstrate ability to use laptop to record road test	A6
Demonstrate ability to use computer and engine diagnostic software package	A1, A2, A3, A6, A7, A9, B4, B5, B7, B8, C4, D2, D6, D7, E1(1), E1(2), E1(3), E1(5), E1(8), E1(9), E2(3), E2(5), E2(8), E2(9), E3(1), E3(2), E3(3), E3(5), E3(8), E3(9), E4(1), E4(2), E4(3), E4(5), E4(8), E4(9), E2(3), E2(5), E4(10), E4(11)
Demonstrate ability to use proper connection cables and data link adapters	E1(4), E1(6), E2(4), E2(6), E3(4), E3(6), E4(4), E4(6)
Demonstrate ability to use laptop for recording and taking snapshots	B2
Describe use of proper electrical connector, pins and crimping technique	B1, B6
Demonstrate ability to use regulated air hose	C6
Demonstrate ability to verify proper reading with diagnostic software	E1(4), E1(6), E2(4), E2(6), E3(4), E3(6), E4(4), E4(6)

203 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Explain and check for proper actuator function	C6
Check charged air cooler	A7
Check cylinder balance	E4(2)
Check for blockage in cooling system	A5

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

Learning Objectives	ASE Task Reference
Check for blockage in radiator/thermostat	A5
Check for clogged line	D5
Check for exhaust emissions in coolant	A5
Check for internal leaks in cooler (coolant contamination)	A9
Check for return/pickup line obstructions	E1(2), E1(5), E3(2), E3(5), E4(5), E4(2), E4(9)
Check for sensor or wire damage caused by fluid leak, vibration or improper placement	B1
Check for suction leaks (cracked fuel fittings)	E1(2), E1(5), E1(9), E2(9), E3(2), E3(5), E3(9), E4(2), E4(5), E4(9)
Check injector timing	E1(1), E1(2), E1(5), E3(1), E3(2), E3(5)
Check oil analysis for silicone level	A7
Check oil pump (main pressure)	A9, E1(8), E2(8), E3(8)
Check programmed acceleration and performance settings	A10
Check programmed fuel and air intake settings	A10
Check programmed shift ratios	A10
Check retarder operation	A5
Check solenoids and relays	A9
Check speed sensors	A9, E1(8), E2(8), E3(8), E4(8)
Check transmission operating temperature	E4(8)
Check wiring harnesses for opens, shorts and pin tension	A6, A8
Check wiring to ECM/sensors/actuators	B4
Configure communication parameters	E4(4), E4(6)
Demonstrate ability to force actuator on or off using software	E1(6), E2(6), E3(6), E4(6)
Perform cylinder cutout test	E4(1), E4(2), E4(10)
Perform spill (drain) back test	E1(9), E2(9), E3(9), E4(9)
Perform pressure checks (clutch)	A9
Verify that injector calibration codes are correct	D7

301 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Demonstrate use of fault codes in troubleshooting	A2

301 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Check for ECM problems (multiple codes, multiple counts, fault code relationships)	B4
Check for exhaust/intake restriction and exhaust condition	A3
Inspect diesel particulate filter	A8
Troubleshoot multiplex communication network	B10
Visually inspect for exhaust contaminants	A4

302 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Describe the purpose of oil analysis (history and current)	A6

302 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Check for correct fuel/lift pump/accumulator pressure	D2
Check for defective parts	E1(11), E2(11), E3(11), E4(11)

303 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Explain fault and no-fault troubleshooting	B3, B4, B9
Describe the process of using a laptop to extract data	B2, B3
Explain symptom-based troubleshooting	A2

303 TOOL USAGE

Learning Objectives	ASE Task Reference
Demonstrate ability to use breakout cables, box/harness	B6, B7, B8, B10, E1(4), E1(6), E1(7), E2(4), E2(6), E2(7), E3(4), E3(6), E3(7), E4(4), E4(6), E4(7)

303 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Check ABS/traction control operation	A10
Check coolant flow	A5
Check for internal fuel leak	D5
Check for return/pickup line obstructions	E1(9), E2(9), E3(9)
Check for software revisions/updates of monitoring system	A8
Check high-pressure oil system	E3(2), E3(5)
Check network communication between components	A10
Check operation of HEUI pump	E3(8)
Inspect camshaft/rollers for wear	E1(2), E1(5), E3(2), E3(5), E4(5), E4(2)

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

Learning Objectives	ASE Task Reference
Explain diagnosis of OEM network (CAN) communication problems	B10
Perform dyno test	C2
Identify a modified system	D1
Discern if problem is OEM (bus side) or engine side	B9

403 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Interpret click test results	B8
Demonstrate ability to use laptop for click test	D1, D4

Appendix B: ASE medium/heavy vehicle electronic diesel engine diagnosis specialist test task list

A. General diesel engine diagnosis

1. Locate and utilize relevant service information, vehicle information and diagnostic tools.
2. Verify operational complaint.
3. Determine if problem is electrical/electronic or engine mechanical.
4. Evaluate engine mechanical condition based on visual inspection of exhaust output.
5. Diagnose performance complaints caused by cooling system problems.
6. Diagnose performance complaints caused by engine lubrication system problems.
7. Evaluate integrity of air induction system.
8. Evaluate integrity of exhaust system.
9. Diagnose performance complaints caused by problems or modifications to the transmission, drive axle ratio, or by incorrect tire specifications.
10. Diagnose performance complaints caused by vehicle operation and configuration.
11. Determine the root cause of current, multiple and repeated failures.

B. Electronic diesel engine controls diagnosis

1. Inspect and test for missing, modified or damaged engine control components and programmed parameters (factory and customer).
2. Interpret diagnostic scan tool data to determine program parameters (factory and customer) and engine control system condition.
3. Establish relative importance and accuracy of displayed data.
4. Determine whether the control system problem is electrical/electronic or mechanical.
5. Determine appropriate electronic engine control diagnostic procedures based on vehicle data and operational complaint, and utilize relevant service information and diagnostic tools.
6. Perform digital multimeter tests on circuits.
7. Test input sensors/circuits using displayed data.
8. Test output actuators/circuits using displayed data.
9. Test and confirm operation of electrical/electronic circuits not displayed on diagnostic tools.
10. Diagnose performance complaints caused by non-engine electronic control system problems.
11. Determine the root cause of current, multiple and repeated failures.

C. Diesel engine air induction and exhaust diagnosis

1. Inspect and test for missing, modified or damaged components.
2. Determine appropriate air induction and exhaust system diagnostic procedures based on vehicle data and operational complaint, and utilize relevant service information and diagnostic tools.
3. Establish relative importance and accuracy of displayed data.
4. Diagnose performance complaints caused by air induction system problems.
5. Diagnose performance complaints caused by exhaust system problems.
6. Diagnose performance complaints caused by engine brakes, exhaust brakes, back-pressure devices, and mechanically and electronically actuated wastegates.
7. Determine the root cause of current, multiple and repeated failures.

D. Diesel fuel systems diagnosis

1. Inspect and test for missing, modified or damaged components.
2. Determine appropriate fuel system diagnostic procedures based on available vehicle data and operational complaint, and utilize relevant service information and diagnostic tools.
3. Establish relative importance and accuracy of displayed data.

4. Determine whether the fuel system problem is electrical/electronic or mechanical.
5. Diagnose performance complaints caused by fuel system problems.
6. Test and/or analyze fuel, fuel system pressure, temperature and delivery rates.
7. Determine the need for fuel injector performance testing.
8. Determine the root cause of current, multiple and repeated failures.

E. Specific fuel systems diagnosis

NOTE: Each task in this section applies to the following types of fuel injection systems: E1 electronic unit injector (EUI), E2 pump line nozzle – electronic (PLN-E), E3 hydraulic electronic unit injector (HEUI) and E4 common rail (CR).

1. Inspect and test for missing, modified or damaged engine control components and programmed parameters.
2. Determine whether the fuel control system problem is electrical/electronic or mechanical.
3. Research system operation, and determine appropriate electronic engine control/fuel system control diagnostic procedures based on vehicle data, operational complaint and service information.
4. Test input sensors/circuits using displayed data.
5. Test fuel control system operation.
6. Test output actuators/circuits using displayed data.
7. Test and confirm operation of electrical/electronic circuits not displayed on diagnostic tools.
8. Diagnose performance complaints caused by non-engine electronic control system problems.
9. Test and/or analyze fuel, fuel system pressure, fuel supply, fuel return, temperature and delivery rates to diagnose performance complaints.
10. Determine the need for fuel injector performance testing.
11. Determine the root cause of current, multiple and repeated component failures.

Appendix C: Sample curriculum

Electronic Diesel Engine Diagnosis

Module I: General Inspection and Diagnosis

Goal: Participants should understand the operation of engine systems and how to successfully perform preventive maintenance and inspections on these systems.

Objectives:

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

- demonstrate an understanding of basic electrical/electronic theory;
- identify and demonstrate theory, purpose, and procedures for engine assembly and disassembly;
- demonstrate an understanding of the basic operation of the engine and specific features;
- identify instrument cluster warning lights and determine action;
- develop the ability to check fluid levels, determining the kinds of fluids needed and top off;
- demonstrate an understanding of onboard diagnostics;
- identify, locate and diagnose the engine sensors/components; and
- utilize testing tools and perform circuit tests.

Course description: Participants will receive classroom instruction in which a qualified instructor will present general inspection and operations of electronic diesel engines. Component identification, safety issues, applicable tools/equipment, proper usage and best practices for diagnosis are emphasized. Participants should leave the course with a strong understanding of diesel engine operations and diagnosis.

Recommended class size: 8:1

Prerequisites (previous module and/or demonstrated experience): Equivalent knowledge to Cummins Virtual College Basic Electrical Theory and Troubleshooting (BETT), and INSITE Qualification

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

Course duration: 2-5 days

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, PowerPoint, homework assignment

- The agency's particular engine model: Cummins Virtual College (Virtual Classroom Training, Written Assessment and Virtual Hands-on Assessment)

Course developer: Brian Lester, EDSI

Subject matter experts: John Burke, TWU Local 100; John Schiavone, Transportation Learning Center; Mark Dalton, King County Transit

Revision dates: 5/15/13

Follow-up: To be determined based on ASE revision schedule

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

Job tasks/learning objectives/OJT checklist: These are the concrete tasks that can be performed to apply the knowledge taught in this course and reinforce the content of the General Inspection and Diagnosis section of the ASE L-2 Exam.

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

101 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Demonstrate knowledge of basic computer skills	A1, E1(3), E2(3), E3(3), E4(3)
Demonstrate ability to refer to service manuals, bulletins and wiring diagrams	A1, B11, C2, C7, D8, E1(3), E1(7), E2(3), E2(7), E3(3), E3(7), E4(3), E4(7)
Demonstrate ability to refer to manufacturer's website	A1, E1(3), E2(3), E3(3), E4(3)
Explain how engine RPM is a factor in troubleshooting	A3
Explain the purpose of warning lights	A6
Explain the importance of conducting all diagnostic tests according to manufacturer's specifications	All

101 TOOL USAGE

Learning Objectives	ASE Task Reference
Demonstrate use of infrared temp gauge	A5

101 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Inspect air filter	A7
Check battery voltage	A9, E1(8), E2(8), E3(8), E4(8)
Check belts	A5
Check condition of exhaust and opacity	A4, A8, C4,
Check fluid level and condition	A6, A9, E1(8), E2(8), E3(8), E4(8)
Check for external leaks at cooler	A9
Check for fan operation	A5
Check for leaks in hoses	A5
Check for seized or binding components	A9, E1(8), E2(8), E3(8), E4(8)
Check hoses and clamps for holes and audible leaks	A7
Check induction pipe condition and for oil, debris and/or water	A7
Check oil level, pressure and condition	A3, A6, B9, E3(2), E3(5)
Check oil temperature	A6
Check for correct tire size	A9, E1(8), E2(8), E3(8), E4(8)
Check transmission operating temperature	A9(9), E1(8), E2(8), E3(8)
Demonstrate ability to listen for unusual engine noises	A9, D7, E1(8), E2(8), E3(8)
Demonstrate ability to record specific repair work according to agency guidelines	A11, B11, C7, D8, E1(11), E2(11), E3(11)
Take engine oil sample for analysis	A6
Visually inspect pipes and routing for cracks and leaks	A8
Visually inspect wiring harnesses	A6
Visually inspect exhaust components for signs of leakage	A4
Visually inspect vehicle indicators	A2, E1(8), E2(8), E3(8), E4(8)

102 SAFETY

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

102 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check coolant levels for concentration	A5
Check for coolant in oil/fuel	A5

103 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Describe cooling system principles	A5
Describe lubrication system principles	A6

103 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for debris on magnetic drain plug	A9
Check for overheating	A5

201 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate knowledge of fault codes (PID, SID, FMI)	A1, A2, A3, A6, A7, A9, B2, B4, C3, D3,
Demonstrate knowledge of terrain of bus route (duty cycle) for troubleshooting	A9, E1(8), E2(8), E3(8), E4(8)

201 TOOL USAGE	
Learning Objectives	ASE Task Reference
Compare sensor readings with mechanical gauge or test equipment	A3
Demonstrate ability to use a digital multimeter	A1, A3, B1, B6, C2, E1(4), E1(6), E1(7), E2(2), E2(4), E2(6), E2(7), E3(3), E3(4), E3(6), E3(7), E4(4), E4(6), E4(7)

201 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for oil contamination	A6
Check for wear in differential	A9, E1(8), E2(8), E3(8), E4(8)
Check to ensure that electrical parameters of engine sensors are within tolerances	A3
Road-test vehicle to verify operator complaint	A10, C2, E1(8), E2(8), E3(8), E4(8)
Test operation of coolant system	A5
Verify speedometer calibration	A9, E1(8), E2(8), E3(8), E4(8)

202 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Explain the meaning of exhaust smoke colors and color strength	A4

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Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

202 TOOL USAGE	
Learning Objectives	ASE Task Reference
Perform slack tube/manometer test	A8, C2
Demonstrate ability to use handheld diagnostic data reader	A1, A2, A3, A6, A7, A9, B2, B4, B5, E1(3), E1(4), E1(6), E1(8), E2(3), E2(4), E2(6), E2(8), E3(3), E3(4), E3(6), E3(8), E4(8)

202 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check operation of air intake sensors	A7
Check for air restriction	A7
Check electronic control module/unit (ECM/ECU) history	A5, A6, A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11),
Check fan operation/charged air based on temperature	A7
Check vehicle history for fleetwide problems	A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11)
Check for wear on axle	A9, E1(8), E2(8), E3(8), E4(8)
Check grid heater (intake manifold heater)	A7
Check oil consumption history	A6
Check transmission shifting points at specific engine RPM	A9, E1(8), E2(8), E3(8), E4(8)
Check sensors and wiring	A6, A9, E1(8), E2(8), E3(8), E4(8)
Examine conditions at time of fault code (history of use)	A6
Perform cylinder cutout test	A3, E1(1), E1(2), E1(5), E1(10), E2(10), E3(1), E3(2), E3(5), E3(10), E4(5)
Perform cylinder performance test	A3
Perform exhaust restriction test	A8
Perform stall test	A8, A9, C4, C5
Perform turbo boost pressure test and interpret results	A7, C1
Review and explain vehicle history	A3, A5, A6, A8, A10, A11, B5, D7, E1(1), E1(2), E1(5), E1(11), E2(11), E3(1), E3(2), E3(5), E3(11), E4(1), E4(2), E4(3), E4(5), E4(11)
Simulate conditions of failure	A5, E1(8), E2(8), E3(8)
Test sensors	A8
Verify horsepower and torque rating of engine	A10
Verify throttle operation	A10
Visually/audibly/tactilely inspect components	A3

203 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate ability to read and interpret schematics	A1, B6, B7, B8, E1(3), E2(3), E4(3), E4(4), E4(6)

203 TOOL USAGE	
Learning Objectives	ASE Task Reference
Demonstrate ability to use laptop to record road test	A6
Demonstrate ability to use computer and engine diagnostic software package	A1, A2, A3, A6, A7, A9, B4, B5, B7, B8, C4, D2, D6, D7

203 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Check charged air cooler	A7
Check for blockage in cooling system	A5
Check for blockage in radiator/thermostat	A5
Check for exhaust emissions in coolant	A5
Check for internal leaks in cooler (coolant contamination)	A9
Check oil analysis for silicone level	A7
Check oil pump (main pressure)	A9, E1(8), E2(8), E3(8)
Check programmed acceleration and performance settings	A10
Check programmed fuel and air intake settings	A10
Check programmed shift ratios	A10
Check retarder operation	A5
Check solenoids and relays	A9
Check speed sensors	A9, E1(8), E2(8), E3(8), E4(8)
Check wiring harnesses for opens, shorts and pin tension	A6, A8
Perform pressure checks (clutch)	A9

301 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Demonstrate use of fault codes in troubleshooting	A2

301 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Check for exhaust/intake restriction and exhaust condition	A3
Inspect diesel particulate filter	A8
Visually inspect for exhaust contaminants	A4

302 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Describe the purpose of oil analysis (history and current)	A6

302 PROCEDURES, INSPECTIONS & TESTING

303 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Explain symptom-based troubleshooting	A2

303 TOOL USAGE

303 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check ABS/traction control operation	A10
Check coolant flow	A5
Check for software revisions/updates of monitoring system	A8
Check network communication between components	A10

Electronic Diesel Engine Diagnostics

Module II: Controls Diagnosis

Goal: Participants should understand the operation of engine systems and how to successfully perform preventive maintenance and inspections on these systems.

Objectives:

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

- demonstrate an understanding of basic electrical theory;
- demonstrate understanding of computerized engine control systems;
- diagnose and repair computerized engine controls;
- service computerized engine control systems; and
- demonstrate understanding of sensors and actuators as they pertain to engine control systems.

Course description: Participants will receive classroom instruction in which a qualified instructor will present diagnosis of controls and using electronic controls to make diagnostic determinations. Use of test equipment, proper usage of tests and best practices for diagnosis are emphasized. Participants should leave the course with a strong understanding of diesel engine electronic controls.

Recommended class size: 8:1

Prerequisites (previous module and/or demonstrated experience): Equivalent knowledge to Cummins Virtual College Basic Electrical Theory and Troubleshooting (BETT), and INSITE Qualification

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

Course duration: 2-5 days

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, PowerPoint, homework assignment

- The agency’s particular engine model: Cummins Virtual College (Virtual Classroom Training, Written Assessment and Virtual Hands-on Assessment)

Course developer: Brian Lester, EDSI

Subject matter experts: Mark Dalton, King County Metro; Mike Joyce, Metro Transit Minneapolis-St. Paul

Revision dates: 5/15/13

Follow-up: To be determined based on ASE revision schedule

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

Job tasks/learning objectives/OJT checklist: These are the concrete tasks that can be performed to apply the knowledge taught in this course and reinforce the content of the Controls Diagnosis section of the ASE L-2 Exam:

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

101 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate ability to refer to service manuals, bulletins and wiring diagrams	A1, B11, C2, C7, D8, E1(3), E1(7), E2(3), E2(7), E3(3), E3(7), E4(3), E4(7)
Explain the importance of conducting all diagnostic tests according to manufacturer's specifications	All

101 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for low coolant	B9
Check oil level, pressure and condition	A3, A6, B9, E3(2), E3(5)
Demonstrate ability to listen for unusual engine noises	A9, D7, E1(8), E2(8), E3(8)
Demonstrate ability to record specific repair work according to agency guidelines	A11, B11, C7, D8, E1(11), E2(11), E3(11)

201 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate knowledge of fault codes (PID, SID, FMI)	A1, A2, A3, A6, A7, A9, B2, B4, C3, D3,

201 TOOL USAGE	
Learning Objectives	ASE Task Reference
Compare electronic gauge readings with mechanical gauge readings	B4
Demonstrate ability to use a digital multimeter	A1, A3, B1, B6, C2, E1(4), E1(6), E1(7), E2(2), E2(4), E2(6), E2(7), E3(3), E3(4), E3(6), E3(7), E4(4), E4(6), E4(7)

201 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Ensure that proper sensor is installed	B1
Operate engine to verify complaint	A2
Review and describe vehicle history/identify potential causes of repeated failures	B11, C7, D8
Demonstrate ability to use schematics and bulletins for diagnosing problems	B5

202 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Explain fault code troubleshooting (PID, SID, FMI)	B5

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

202 TOOL USAGE	
Learning Objectives	ASE Task Reference
Demonstrate ability to use handheld diagnostic data reader	A1, A2, A3, A6, A7, A9, B2, B4, B5, E1(3), E1(4), E1(6), E1(8), E2(3), E2(4), E2(6), E2(8), E3(3), E3(4), E3(6), E3(8), E4(8)

202 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check electronic control module/unit (ECM/ECU) history	A5, A6, A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11),
Check operation of engine temperature sensors	B9
Check vehicle history for fleetwide problems	A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11)
Check that sensors are operating within manufacturer's specifications	B9
Check wiring on all engine sensors	B1
Interpret sensor test results	B7
Review and explain vehicle history	A3, A5, A6, A8, A10, A11, B5, D7, E1(1), E1(2), E1(5), E1(11), E2(11), E3(1), E3(2), E3(5), E3(11), E4(1), E4(2), E4(3), E4(5), E4(11)
Test for voltage, amps, ohms and grounds	B6

203 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Describe non-electronic performance tests (air restriction, fuel/oil pressure, fuel levels)	B10
Demonstrate ability to read and interpret schematics	A1, B6, B7, B8, E1(3), E2(3), E4(3), E4(4), E4(6)

203 TOOL USAGE	
Learning Objectives	ASE Task Reference
Demonstrate ability to use laptop to monitor fuel rate being delivered by engine request	D2
Demonstrate ability to use computer and engine diagnostic software package	A1, A2, A3, A6, A7, A9, B4, B5, B7, B8, C4, D2, D6, D7
Demonstrate ability to use laptop for recording and taking snapshots	B2
Describe use of proper electrical connector, pins and crimping technique	B1, B6

203 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for sensor or wire damage caused by fluid leak, vibration, improper placement	B1
Check wiring to ECM/sensors/actuators	B4

301 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for ECM problems (multiple codes, multiple counts, fault code relationships)	B4
Troubleshoot multiplex communication network	B10

303 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Explain fault and no-fault troubleshooting	B3, B4, B9
Describe the process of using a laptop to extract data	B2, B3

303 TOOL USAGE	
Learning Objectives	ASE Task Reference
Demonstrate ability to use breakout cables, box/harness	B6, B7, B8, B10, E1(4), E1(6), E1(7), E2(4), E2(6), E2(7), E3(4), E3(6), E3(7), E4(4), E4(6), E4(7)

303 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Explain diagnosis of OEM network (CAN) communication problems	B10
Discern if problem is OEM (bus side) or engine side	B9

403 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Interpret click test results	B8

Electronic Diesel Engine Diagnosis

Module III: Intake and Exhaust Systems Diagnosis

Goal: Participants should understand the operation of engine systems and how to successfully perform preventive maintenance and inspections on these systems.

Objectives:

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

- demonstrate an understanding of basic electrical theory;
- diagnose and repair complex engine performance and emissions systems; and
- measure engine performance.

Course description: Participants will receive classroom instruction in which a qualified instructor will go over the theory of intake and exhaust systems and their diagnosis in an electronically controlled diesel engine. Component identification, safety issues, applicable tools/equipment, proper usage and best practices for observation and documentation are emphasized. Participants should leave the course with a basic understanding of how to inspect and maintain engine intake and exhaust systems.

Recommended class size: 8:1

Prerequisites (previous module and/or demonstrated experience): Equivalent knowledge to Cummins Virtual College Basic Electrical Theory and Troubleshooting (BETT), and INSITE Qualification

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

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

Course duration: 2-5 days

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, PowerPoint, homework assignment

- The agency’s particular engine model: Cummins Virtual College (Virtual Classroom Training, Written Assessment and Virtual Hands-on Assessment)

Course developer: Brian Lester, EDSI

Subject matter experts: Mark Dalton, King County Metro; Mike Joyce, Metro Transit Minneapolis-St. Paul

Revision dates: 2/5/13

Follow-up: To be determined based on ASE revision schedule

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

Job tasks/learning objectives/OJT checklist: These are the concrete tasks that can be performed to apply the knowledge taught in this course and reinforce the content of the Intake and Exhaust Systems Diagnosis section of the ASE L-2 Exam:

101 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate ability to refer to service manuals, bulletins and wiring diagrams	A1, B11, C2, C7, D8, E1(3), E1(7), E2(3), E2(7), E3(3), E3(7), E4(3), E4(7)
Explain the importance of conducting all diagnostic tests according to manufacturer’s specifications	All
101 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check condition of exhaust and opacity	A4, A8, C4,
Check for damaged fin blades on both sides of turbocharger	C5
Check for loose clamps	C1
Check for oil and/or dirt contamination	C1
Check for poor acceleration or low power going up grade	C4, D5, D7
Inspect turbocharger, muffler, pipe, rubber boots for damage (cracks, holes, crushing)	C1
Inspect for soot or fluid leaks in engine compartment	C5
Demonstrate ability to record specific repair work according to agency guidelines	A11, B11, C7 , D8, E1(11), E2(11), E3(11)

102 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Check for noise (e.g., hole in pressure hoses/blown-out gasket causes a high-pitched whistle)	C4
Listen for noise in turbocharger, muffler, exhaust pipe	C5
Check particulate filter	C5

103 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Demonstrate ability to refer to manual for min/max turbo boost (40-45), vacuum pressure specs	C3

201 THEORY & UNDERSTANDING

Learning Objectives	ASE Task Reference
Demonstrate knowledge of fault codes (PID, SID, FMI)	A1, A2, A3, A6, A7, A9, B2, B4, C3, D3,

201 TOOL USAGE

Learning Objectives	ASE Task Reference
Demonstrate ability to use digital multimeter to check actuators within specifications	C6
Demonstrate ability to use a digital multimeter	A1, A3, B1, B6, C2, E1(4), E1(6), E1(7), E2(2), E2(4), E2(6), E2(7), E3(3), E3(4), E3(6), E3(7), E4(4), E4(6), E4(7)

201 PROCEDURES, INSPECTIONS & TESTING

Learning Objectives	ASE Task Reference
Reset diesel particulate filter (DPF) monitor codes	C5
Review and describe vehicle history/identify potential causes of repeated failures	B11, C7, D8
Road-test vehicle to verify operator complaint	A10, C2, E1(8), E2(8), E3(8), E4(8)

202 TOOL USAGE

Learning Objectives	ASE Task Reference
Check sensor accuracy with known good mechanical gauges or digital multimeter	C3
Perform slack tube/manometer test	A8, C2
Demonstrate ability to use manual and electric pressure gauges	C3, D6, E1(4), E1(9), E2(9), E3(9),E4(9)
Demonstrate use of laptop to read turbo boost pressure	C2

202 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check electronic control module/unit (ECM/ECU) history	A5, A6, A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11),
Check exhaust backpressure, sensor or reading (if equipped)	C6
Check vehicle history for fleetwide problems	A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11)
Check for leaks in charged air cooler	C4
Perform air inlet restriction test; interpret results	C1
Perform back-pressure test	C5
Perform exhaust system backpressure test; interpret results	C1
Perform stall test	A8, A9, C4, C5
Perform turbo boost pressure test and interpret results	A7, C1

203 TOOL USAGE	
Learning Objectives	ASE Task Reference
Demonstrate ability to use computer and engine diagnostic software package	A1, A2, A3, A6, A7, A9, B4, B5, B7, B8, C4, D2, D6, D7
Demonstrate ability to use regulated air hose	C6

203 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Explain and check for proper actuator function	C6

303 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Perform dyno test	C2

Electronic Diesel Engine Diagnosis

Module IV: Fuel System Diagnosis

Goal: Participants should understand the operation of engine systems and how to successfully perform preventive maintenance and inspections on these systems.

Objectives:

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

- demonstrate an understanding of basic electrical theory;
- demonstrate understanding of fuel injection systems;
- explain fuel and electronic management;
- diagnose and repair fuel injection systems; and
- describe the purpose of injectors, filters and pumps as major components in a fuel system.

Course description: Participants will receive classroom instruction in which a qualified instructor will go over the theory of fuel systems and their diagnosis in an electronically controlled diesel engine. Component identification, safety issues, applicable tools/equipment, proper usage and best practices for observation and documentation are emphasized. Participants should leave the course with a basic understanding of how to

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

inspect and maintain engine fuel systems. Specific fuel injection systems, such as E1 electronic unit injector (EUI), E2 pump line nozzle – electronic (PLN-E), E3 hydraulic electronic unit injector (HEUI) and E4 common rail (CR) should be taught as needed based on local fleet makeup, but are not part of the ASE exam.

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: 2-5 days

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, PowerPoint, homework assignment

- The agency’s particular engine model: Cummins Virtual College (Virtual Classroom Training, Written Assessment and Virtual Hands-on Assessment)

Course developer: Brian Lester, EDSI

Subject matter experts: Mark Dalton, King County Metro; Mike Joyce, Metro Transit Minneapolis-St. Paul

Revision dates: 5/15/13

Follow-up: To be determined based on ASE revision schedule

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

Job tasks/learning objectives/OJT checklist: These are the concrete tasks that can be performed to apply the knowledge taught in this course and reinforce the content of the Fuel Systems Diagnosis section of the ASE L-2 Exam:

101 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate ability to refer to service manuals, bulletins and wiring diagrams	A1, B11, C2, C7, D8, E1(3), E1(7), E2(3), E2(7), E3(3), E3(7), E4(3), E4(7)
Explain the importance of conducting all diagnostic tests according to manufacturer’s specifications	All

101 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check fill tube valve	D1
Check for external fuel leaks	D1, D4
Check for poor acceleration or low power going up grade	C4, D5, D7
Check for rough idle and running	D7
Check fuel filters	D1, E4(9)
Check fuel line condition	D1
Check fuel line isolators	D1
Check fuel temperature	D2
Check water-in-fuel (WIF) sensor	D2
Demonstrate ability to measure fuel temperature	D5
Demonstrate ability to record specific repair work according to agency guidelines	A11, B11, C7 , D8, E1(11), E2(11), E3(11)
Visually inspect fuel injectors	D7

103 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for air in fuel	D4, D5
Inspect air vent	D1
Inspect fuel tank condition and mounting	D1
Demonstrate ability to refer to manual for fuel flow diagrams	D1
Demonstrate ability to use site glass	D6

201 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate knowledge of fault codes (PID, SID, FMI)	A1, A2, A3, A6, A7, A9, B2, B4, C3, D3,

201 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for filter restriction	D2
Inspect check valves	D1
Perform flow test	D6
Perform fuel sight glass test procedure to check for air in fuel	D1
Visually inspect fuel for color, debris, water and air	D6
Perform fuel system pressure test	D1
Review and describe vehicle history/identify potential causes of repeated failures	B11, C7, D8

APTA BTS-BMT-RP-011-16

Training Syllabus to Instruct/Prepare for the ASE Electronic Diesel Engine Diagnosis Specialist Test

202 TOOL USAGE	
Learning Objectives	ASE Task Reference
Check gauge accuracy	D3
Demonstrate ability to use manual and electric pressure gauges	C3, D6, E1(4), E1(9), E2(9), E3(9),E4(9)

202 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check electronic control module/unit (ECM/ECU) history	A5, A6, A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11),
Check filter change history	D3
Check for engine miss	D7
Check vehicle history for fleetwide problems	A11, B11, C7, D8, E1(11), E2(11), E3(11), E4(11)
Check for fuel in oil	D5
Check for restricted fuel filter	D5
Check fuel pressure	D4, D5, E1(1), E1(2), E1(5), E3(1), E3(2), E3(5)
Check fuel pressure sensor	D3
Check fueling/filter/inspection history	D2
Check wiring at fuel pump	D4
Check wiring on lift pump	D4
Perform engine injector cutout test	D7
Perform mechanical fuel pressure test	D4
Review and explain vehicle history	A3, A5, A6, A8, A10, A11, B5, D7, E1(1), E1(2), E1(5), E1(11), E2(11), E3(1), E3(2), E3(5), E3(11), E4(1), E4(2), E4(3), E4(5), E4(11)

203 TOOL USAGE	
Learning Objectives	ASE Task Reference
Demonstrate ability to use computer and engine diagnostic software package	A1, A2, A3, A6, A7, A9, B4, B5, B7, B8, C4, D2, D6, D7

203 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for clogged line	D5
Verify that injector calibration codes are correct	D7

302 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for correct fuel/lift pump/accumulator pressure	D2

303 PROCEDURES, INSPECTIONS & TESTING	
Learning Objectives	ASE Task Reference
Check for internal fuel leak	D5
Identify a modified system	D1

403 THEORY & UNDERSTANDING	
Learning Objectives	ASE Task Reference
Demonstrate ability to use laptop for click test	D1, D4