R.T.C.C.

Diesel Technology Program 2011-2012

Instructor Chuck Lyman

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Randolph Technical Career Center
17 Forest Street
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Program Syllabus

Program: Diesel Technology Embedded Credit: Science
Instructor: Mr. Lyman

Program Description:

The Diesel Technology program provides juniors and seniors an opportunity to learn real-life skills while learning Diesel Technology theory and completing applied technical projects. Led by an instructor who is ASE Master Certified in Truck, Auto, Service Consulting and Parts Specialist, the program begins with students learning a variety of methods. These include repair, service and maintenance of diesel engines in a variety of forms: automobiles, agricultural & construction equipment, trucks, and buses. Students have the opportunity to work with customers, suppliers and other professionals.

The program culminates with students completing an intensive individualized project that tests the student's knowledge and learning of real-world methodologies. Our students work on leadership skills through their involvement with The National FFA organization. Other opportunities for eligible students may include: earning a Commercial Driver's License (CDL), taking a college class through the Vermont State Colleges and experiencing job cooperative opportunities. From welding to rebuilds, students thrive in their ability to work in our custom equipped shop.

Course Expectations, Projects, and Grading Protocol

During the course of the year students will engage in a variety of graded projects, tests and quizzes. A daily grade is assigned via a 1 –10 scale and is based on student performance in the class. This daily grade is then calculated into a weekly grade. Students should expect a minimum of one test or quiz weekly.

Students will also receive feedback as to their performance in relation to state-approved occupational skill competencies.

Projects will include work on RTCC vehicles as well as those of local businesses. Students have the opportunity to work on individual projects with the prior approval of instructor if the project fits the objectives of the course.

Grading protocol is as follows:

Project/Assignment	Percentage of Grade
Homework	25%
Vocabulary	25%
Test	25%
Quality of work in the shop, appearance, practical application of attitude, initiative, responsibility and accountability	25%
Total	100%

DIESEL TECHNOLOGY
PROGRAM OF STUDY

Recommended courses and activities:
Sophomore with a standing of a "C" in all classes.

English	Meeting all requirements for current grade level with reading comprehension and writing ability being key areas.
Science	A sound foundation in basic science
Mathematics	Meeting all requirements for current grade level, Math connections II or equivalent, recommending Algebra 1 and Geometry
History	Meeting all requirements for current grade level
Art	Meeting all requirements for current grade level
Physical Ed	Meeting all requirements for current grade level

Recommended but not required: any type of mechanical class or mechanical drawing class (CAD).

Articulation agreements:
Vermont Technical College
Ohio Technical College
University of Northwestern Ohio (being pursued)*
White Mountain Community College (being pursued)
Universal Technical Institute (being pursued)*
* Pending NATEF certification

Post-Secondary Opportunities: Our students have gone on to;
Vermont Technical College
Ohio Technical College
University of Northwestern Ohio
White Mountain Community College
Advanced Welding Institute
SUNY Cobleskill

Other Colleges/Universities or Training Programs:
Wyoming Tech
Universal Technical Institute

Industry-Recognized Certifications:
State Inspection (being pursued)
Cummins Virtual College (being pursued)
Haldex Brakes (being pursued)

Occupations:
Diesel Truck Technician
Heavy Equipment Technician
Trailer Repair Technician
Truck Driver
Heavy Equipment Operator
Welder/Fabricator
Auto Technician
Diesel Hybrid Technician
Service Writer
Shop Forman
Parts Specialist
Farm Machinery Technician
Parts failure analysis

Students are employed at:
State of Vermont Maintenance garage
State of Vermont Highway department
Brookside Customs
Napa (Randolph Auto Supply)
Green Mountain Pipeline Services
A&L Machine and Welding
Hendy Brothers
Bond Auto Parts
DMS Machining & Fabrication
Lucky's Trailer Sales

Program Certifications:
National Automotive Technicians Education Foundation (NATEF) (being pursued)

11-12 SCHEDULE
SECOND YEAR

WEEK	MHDTE
1. Aug.29-SEPT.2	ORIENTATION, HANDOUT BOOKS, JOURNALS, NOTEBOOKS, GET TO KNOW EACH OTHER,
2. SEPT. 6-9	MHDTE 1 INTRODUCTION
3. SEPT. 12-16	MHDTE 2 HAND AND SHOP TOOLS
4. SEPT. 19-23	MHDTE 3 PERSONAL AND SAFETY AWARENESS
5. SEPT. 26-SEPT.30	MHDTE 4 ENGINE BASICS
6. OCT. 3-7	MHDTE 6 POWER
7. OCT. 10-14	MHDTE 7 ENGINE POWERTRAIN COMPONENTS
8. OCT. 17-21	MHDTE 8 ENGINE FEEDBACK ASSEMBLY
9. OCT. 24-28	MHDTE 9 ENGINE HOUSING COMPONENTS
10.OCT.31-NOV.4	MHDTE 10 ENGINE LUBRICATION SYSTEMS
11. NOV. 7-10	MHDTE 11 ENGINE COOLING SYSTEMS
12. NOV. 14-18	MHDTE 12 ENGINE BREATHING
13. NOV. 21-22	CLEAN SHOP AND PREPARE FOR VACATION, WELDING
14. NOV. 28-DEC. 2	MHDTE 13 ENGINE RETARDERS
15. DEC. 5-9	MHDTE 14 ENGINE REMOVAL, DISASSEMBLY, CLEANING, INSPECTION AND REASSEMBLY
16. DEC. 12-16	MHDTE 15 DIESEL ENGINE RUN-IN AND PERFORMANCE TESTING
17. DEC. 19-21	CLEAN SHOP AND PREPARE FOR VACATION, HYDRAULICS
18. JAN. 3-6	MHDTE 16 CHEMISTRY AND COMBUSTION
19. JAN. 9-13	MHDTE 17 DIESEL FUEL CHARACTERISTICS
20. JAN. 17-20	MHDTE 18 FUEL SUBSYSTEMS
21. JAN. 23-27	MHDTE 19 OVERVIEW OF DIESEL FUEL INJECTION BASICS, MHDTE 20 INJECTOR NOZZLES
22. JAN. 30-FEB.3	MHDTE 27 BIODIESEL, ALTERNATE FUELS, AND HYBRID DRIVES

WEEK	MHDTE
23. FEB. 6-10	MHDTE 28 FAILURE ANALYSIS
24. FEB. 13-17	MHDTE 29 REVIEW OF ELECTRICAL AND ELECTRONIC FUNDAMENTALS
25. FEB. 20-24	MHDTE 30 &31 INTRODUCTION TO COMPUTERS, NETWORKING AND COMMUNICATIONS IN THE TRUCKING INDUSTRY, CLEAN SHOP FOR VACATION
26. MAR. 7-9	MHDTE 32 VEHICLE COMPUTER SYSTEMS
27. MAR. 12-16	MHDTE 33 ESTs AND SISs
28. MAR. 19-23	MHDTE 34 ELECTRICAL WIRING, CONNECTOR, AND TERMINAL REPAIR
29. MAR. 26-30	MHDTE 35 MULTIPLEXING
30. APR. 2-6	MHDTE 36&37 BOSCH ELECTRONIC DISTRIBUTER SYSTEMS, MACK V-MAC I AND II
31. APR. 9-13	MHDTE 38 DETROIT DIESEL ELCTRONIC CONTROLS (DDEC) FOR EUI SYSTEMS
32. APR. 16-20	MHDTE 39 CATERPILLAR ADEM MEUI SYSTEMS CLEAN SHOP FOR VACATION
33. APR. 30-MAY4	MHDTE 41 CUMMINS CELECT PLUS
34. MAY 7-11	MHDTE 42 BOSCH EUP ON MERCEDES-BENZ AND MACK E-TECH
35. MAY 14-18	MHDTE 43 CATERPILLAR AND NAVISTAR HEUI
36. MAY 21-25	MHDTE 44 CUMMINS HPI-TP
37. MAY 29-JUNE 1	MHDTE 45 CUMMINS CAPS
38. JUNE 4-8	CLEAN SHOP FOR END OF YEAR, TOOL INVENTORY,
39. JUNE 11	MOVIES, COOKIES AND MILK

FIELD TRIPS ARE SUBJECT TO CHANGE

LESSON DESCRIPTION

Aligned to Vermont's Framework of Standards

MHDTE 1: Introduction

In this lesson the student will describe the overall objective of this textbook, define the role of the trucking industry in North America, describe some of the recent technological advances that have changed trucks in the past decade, outline the role of the contemporary truck technician, understand the role that the truck technician is expected to play in the delivery of customer service, outline popular customer service trends in the truck OEM industry, describe the qualifications required to practice as a truck or bus technician, list some of the professional associations to which truck technicians may belong and identify some of the benefits of each, and define engines by displacement..

Vermont's Framework of Standards:

3.14 3.10 3.11 3.12

MHDTE 2: Hand and Shop Tools

In this lesson the students will identify the hand tools commonly used by truck technicians and describe their function, categorize the various types of wrenches used in shop practice, describe the precision measuring tools used by engine and fuel system technician, outline the operating principles of a standard micrometer and name the components, identify different types of torque wrenches, calculate torque specification compensation when a linear extension is used, read a standard micrometer, outline the operating principles of a metric micrometer and name the components, read a metric micrometer, understand how a dial indicator is used, define TIR and how it is determined, understand how a dial bore gauge operates, outline the procedure for setting up a dial bore gauge, perform accurate measurements using a dial bore gauge, describe some typical shop hoisting equipment and its application.

Vermont's Framework of Standards:

3.3 7.18

MHDTE 3: Personal and Safety Awareness

In this lesson the student will identify the basic personal safety equipment required in a truck service environment, outline the importance of wearing the appropriate clothing and footwear on the shop floor, explain the importance of using eye protection in the shop environment, describe two methods used to protect hearing, understand how to lift heavy objects in the safest manner and the importance of using power lift equipment whenever possible, explain the function of OSHA, identify the four categories of fire and the fire extinguisher required to put them out, explain the legislation pertaining to an employee's Right To Know, interpret the acronyms WHMIS and MSDS, interpret the emergency and first aid and fire suppression techniques, explain the safety requirements of handling

oxyacetylene gases and heating, cutting, and welding processes, describe the safety devices used on oxygen and acetylene cylinders, and list the federal agencies responsible for administering hazardous waste disposal and shop and personal safety in the United States and Canada.

Vermont's Framework of Standards:

3.4 7.18

MHDTE 4: Engine Basics

In this lesson the students will define the terms that describe basic engine operation, outline the roles played by each subsystem in the engine, describe the seven subcircuits the engine has been divided into for study purposes, calculate engine displacement using the appropriate formula, outline the differences among square, undersquare, and oversquare engines, apply the term mean effective pressure to an engine operating cycle, identify the difference between a naturally aspirated and manifold boosted engine, explain the term volumetric efficiency and apply it to cylinder breathing efficiencies, state how Boyle's and Charles's law apply to engine operation, describe how friction and inertia factors affect engine operation, explain how the heat energy of a fuel is converted to kinetic energy, define rejected heat and explain the thermal efficiency factors in a diesel engine, outline in detail the diesel four-stroke cycle, outline in detail the diesel two-stroke cycle, outline in detail the Otto four-stroke cycle, explain why it is desirable for any engine to produce peak cylinder pressure at 10 to 20 degrees ATDC on the power stroke during and speed or load phase of operation, define the term scavenging and apply it to both the diesel four-stroke and two-stroke cycle, and outline the basic characteristics of a diesel fuel.

Vermont's Framework of Standards:

3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 6: Power

In this lesson the student will understand the language of power as it applies to a truck diesel engine, define the term torque and power and describe what is required to produce each in an engine, construct the formulae required to calculate power equations, calculate brake power using actual engine data, interpret a simple fuel map, convert BHP to kW, calculate indicated power using PLANC formula, define the term brake specific fuel consumption (bsfc) and relate to a truck diesel engine fuel map, interpret OEM torque and power graphs and check their mathematical accuracy, understand how load is expressed as percentage of power output, interpret the term B-life in relation to power output, relate engine brake power to the actual power requirements of a highway rig and its load.

Vermont's Framework of Standards:

3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 7: ENGINE POWERTRAIN COMPONENTS

In this lesson the student will identify the engine powertrain components, define the role of the piston assembly in the engine powertrain, identify trunk and articulating pistons and list their advantages and disadvantages, describe the characteristics of Monotherm pistons and identify the reasons they are becoming the piston of choice by engine OEMs, outline the advantages of the Mexican hat, open combustion chamber design in modern direct-injected, low-emissions diesel engines, diagnose some typical piston failures and determine the causes, explain how piston rings act to lubricate the cylinder walls and seal the cylinder, identify some commonly used diesel engine piston rings and outline the conditions that enable rings to seal most efficiently, classify piston wrist pins by type, describe the role of connecting rods and outline the stresses they are subject to, identify common crankshaft throw arrangements and match to the appropriate cylinder block configurations, outline the forces a crankshaft is subject to under normal operation, describe the materials, manufacturing, and surface hardening processes of typical heavy-duty crankshafts, identify some typical crankshaft failures and their causes, evaluate crankshaft condition visually, by precision measuring and electromagnetic flux inspection, describe some common crankshaft reconditioning practices, outline the procedure for an in-chassis, rod and bearing rollover, measure friction bearing clearance using plastigage, define the term hydrodynamic suspension, outline the roles played by the harmonic balancer and flywheel assemblies, describe the principle of operation of a viscous-type harmonic balancer, perform a ring gear removal and replacement of a flywheel, outline the steps required to recondition a flat or pot type, heavy-duty flywheel.

Vermont's Framework of Standards:

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MHDTE 8: ENGINE FEEDBACK ASSEMBLY

In this lesson the student will identify the engine feedback assembly components, describe the role of the engine timing geartrain in managing engine functions, describe the procedure required to time an engine geartrain, define the role of the camshaft in a typical diesel engine, interpret the terminology used to describe camshaft geometry, inspect a camshaft for wear and damage, selecting the appropriate tools, outline the procedure required to remove and replace a set of block camshaft bearings, identify the role valve train components play in running an engine, list the types of tappet/cam follower used in diesel engines, inspect a set of push tubes or rods and evaluate their serviceability, describe the role of the rocker assembly in the engine feedback assembly, define the role of cylinder head valves and interpret the terminology used to describe them, outline the procedure required to recondition a set of cylinder head valves, identify valve margin and other critical wear/ machining tolerances, describe how valve rotators operate, define the role of valve seat inserts and outline the servicing procedure, perform a valve lash adjustment on a diesel engine using OEM specifications, perform basic failure analysis on diesel engine cylinder valves, outline the consequences of either too much or too little valve lash, create a valve polar diagram.

Vermont's Framework of Standards:
3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 9: ENGINE HOUSING COMPONENTS

In this lesson the student will identify the components classified as engine housing components, identify the types of cylinder block used in current truck diesel engines, outline the procedure required to inspect a cylinder block, measure an engine block to specifications using service literature, identify the types of cylinder liners used in diesel engines, explain the procedure required to remove dry, wet, and midstop liners, describe the process required to remove a seized dry from a block bore, perform selective fitting of a set of dry liners to a cylinder block, explain how cavitation erosion occurs on wet liners, identify the types of cylinder heads used in truck diesel engines, describe the component parts of a cylinder head, define component creep and gasket yield, explain the procedure required to measure, test, and recondition a cylinder head, describe the role of the intake and exhaust manifolds, describe the function of the oil pan in the engine, determine the types of oil pan failures that may be repairable by welding.

Vermont's Framework of Standards:
3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 10: ENGINE LUBRICATION SYSTEMS

In this lesson the student will outline the function of the main components in a typical diesel engine lubrication circuit, list the properties of heavy-duty engine oils, including API CJ-4 category lube, define the term hydrodynamic suspension and describe how this principle is used in a typical diesel engine, interpret the terminology used to classify lubrication oil, interpret API classifications and SAE viscosity grades, list some of the properties and ingredients of synthetic oils, identify the components used in a diesel engine lubricating system, replace and properly calibrate a lube oil dipstick, describe the two types of oil pumps commonly used on diesel engines and outline the operating principles of each, perform the measuring procedures required to determine the serviceability of an oil pump, describe the operation of an oil pressure regulating valve, define the term positive filtration, outline the differences between full flow and bypass flow, service a set of oil filters, outline the role of an oil cooler in the lubrication circuit, test and oil cooler core using vacuum or pressure testing, identify the methods used to measure oil pressure in current diesel engines, outline the procedure for taking an engine oil sample for analysis, and interpret the results of a laboratory oil analysis.

Vermont's Framework of Standards:
3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 11: Engine Cooling Systems

In this lesson the student will describe the cooling system components and their principle of operation, define the terms conduction, convection and radiation, identify the three types of coolant used in current highway diesel engines and the relative merits and disadvantages of each, outline the properties of a heavy-duty antifreeze and supplemental cooling additive package, calculate the boil and freeze points of a coolant mixture, mix coolant using the correct proportions of water, antifreeze and SCAs, perform standard SCA tests and measure antifreeze protection, recognize the degree to which coolant system scaling can insulate and outline the steps required to eliminate it, list the performance and economic advantages claimed for extended life coolant, outline the causes of wet liner cavitation and the steps required to minimize it, describe the process required to repair radiator, test the operation of a radiator cap, list the different types of thermostats in use and describe their principle of operation, describe the role of the coolant pump, describe the process required to recondition a coolant pump, define the role of the coolant filters and their servicing requirements, list the types of temperature gauges used in highway diesel engines, describe how a coolant level warning indicator operates, define the roles played by the shutters and engine fan in managing engine temperatures, outline the operation of an actively pressurized cooling systems (APCS), diagnose basic cooling system malfunctions.

Vermont's Framework of Standards:

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MHDTE 12: Engine Breathing

In this lesson the student will identify the intake and exhaust system components, describe how intake air is routed to the engine's cylinders and exhaust gases are routed out the tailpipe, define the term positive filtration, outline the operating principle of an air precleaner, service a dry, positive air cleaner, perform an inlet restriction test, outline the operation of a Roots blower on a two-stroke cycle engine, identify the subcomponents of a truck diesel engine turbocharger, outline the operating principles of an exhaust gas-driven, centrifugal turbocharger, explain how a compounded turbocharger functions, troubleshoot common turbocharger problems and perform some basic failure analysis, define the role of a charge air cooler and the relative efficiencies of each type, test a charge air heat exchanger for leaks, relate valve configurations and seat angles to breathing efficiency and cylinder gas dynamics, describe how a pulse-type exhaust manifold can boost turbocharger efficiency, outline the function of a pyrometer on a truck diesel engine, describe the role of the exhaust silencer and its operating principles, comprehend the nature of sound dynamics and how combustion noise is minimized in an engine, understand some basic exhaust gas emissions chemistry, describe the operation of a diesel engine catalytic converter and EGR system.

Vermont's Framework of Standards:

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MHDTE 13: Engine Retarders

In this lesson the student will identify some of the different types of engine brakes used on highway diesel engines, describe the operating principles of each type of engine brake and the relative advantages and disadvantages of each, outline the control mechanisms used to manage each type of retarder system, interpret the electrical schematics used in the electronic and electrical controls of engine brakes, interpret a schematic representation of the hydraulic circuit of a typical internal engine compression brake, describe how the hydraulic actuation of internal engine compression brakes is managed and timed, outline the operating principles of some nonproprietary (Jacobs) and proprietary (Caterpillar) internal engine compression brakes, explain how a progressive, multicylinder engine braking is managed, describe the operation of a Mercedes-Benz constant throttle valve (CTV) brake, describe the pneumatic controls used to manage external engine compression brakes and engine-mounted hydraulic retarders, explain how a Volvo EPG engine brake functions, outline the differences in automatic and manual control of the Caterpillar BrakeSaver.

Vermont's Framework of Standards:

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MHDTE 14: Engine Removal, Disassembly, Cleaning, Inspection and Reassembly Guidelines

In this lesson the student will describe the procedure required to remove an engine from a typical truck chassis, disassemble an engine for reconditioning, outline the process of cleaning and inspecting engine components, understand the importance of systematically tagging components and connectors, describe some of the key reconditioning procedures, develop good inspection and failure analysis habits, evaluate components for repair or replacement, describe the procedure required to reassemble a diesel engine, and outline some of the reassembly steps that require special attention or precautions.

Vermont's Framework of Standards:

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MHDTE 15: Diesel Engine Run-in and Performance Testing

In this lesson the student will outline the basics of power analysis and dynamometer testing, outline the OEM requirements of engine run-in after rebuild, describe the process required to check out both the engine and vehicle before a chassis dynamometer test, outline personal and equipment safety while operating an engine or chassis dynamometer, interpret the data on a dynamometer profile, describe how a heavy-duty truck is installed in a chassis dynamometer, test bed, outline the objectives of a chassis dynamometer performance and engine run-in tests, and describe how to road test with a newly rebuilt diesel engine.

Vermont's Framework of Standards:

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MHDTE 16: Chemistry and Combustion

In this chapter the student will understand basic chemistry and its application to fuel systems, define elements, mixtures and compound, describe a simple chemical reaction and chemical bonding, outline the structure of an atom, define the states of matter and the conditions that predetermine them, describe the properties of common elements, mixtures and compounds, outline the dynamics of combustion in an engine cylinder, define the conditions required for a stoichiometric reaction, calculate air-fuel ratio, describe the stages of combustion in a diesel engine cylinder, and describe the dynamics of detonation.

Vermont's Framework of Standards:

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MHDTE 17: Diesel Fuel Characteristics

In this chapter the student will define the terms used to describe diesel fuel, describe how the cetane number of a diesel fuel is determined, outline the minimum requirements of a highway diesel fuel, state what constitutes low- and ultra-low sulfur (ULS) diesel fuel, identify the consequences of running post-2007 engines with anything but ULS, calculate how much ignition accelerator is required to restore original CN value, determine the calorific or heating value of a fuel, understand some of the problems associated with storing fuel, identify degraded diesel fuel, explain the effects of contaminated or degraded fuel on a typical fuel subsystem, explain how cloud point specs affect cold weather engine performance and outline the contents of a typical aftermarket diesel fuel conditioner.

Vermont's Framework of Standards:

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MHDTE 18: Fuel Subsystems

In this lesson the student will identify fuel subsystem components on a truck or bus chassis, describe the components used in a diesel engine fuel subsystem, define the functions of internal and external fuel tank components, troubleshoot a fuel sending unit, define the role of primary and secondary fuel filters, service primary and secondary fuel filters, describe the three ways water can be suspended in fuel, explain how a water separator functions, service a water separator, define the principles of operation of a transfer or charge pump, prime a fuel subsystem, test the low-pressure side of the fuel subsystem for inlet restriction, test the charge side of the fuel subsystem for charging pressure and identify some typical sensors used in diesel fuel subsystems.

Vermont's Framework of Standards:

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MHDTE 19: Overview of Diesel Fuel Injection Basics

In this lesson the student will understand the objectives of a fuel management system, interpret the contents of later chapters dealing with hydromechanical and electronic engine management, define timing and explain the need to vary it for optimum performance and emissions, define metering and its application in a fuel system, explain atomization and the droplet sizings required for a direct-injected diesel engine, describe the factors that determine emitted droplet sizing, explain the overall objectives of an engine fuel system, describe the relationship between cylinder pressure and crank throw to crank axis angle and relate how the fuel system manages engine cylinder pressures.

Vermont's Framework of Standards:

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MHDTE 20: Injector Nozzles

In this lesson the student will identify the subcomponents of a nozzle assembly, describe the injector nozzle's role in system pressure management, identify four types of injector nozzles, describe the hydraulic principles of operation of poppet, multi-orifice, electrohydraulic and piezoelectric nozzles, define nozzle differential ratio, describe a valve closes orifice (VCO) nozzle, explain the difference between a low- and high spring injector, bench (pop) test a hydraulic injector nozzle, disassemble, ultrasonically bath and reassemble an injector, test a nozzle for forward leakage, test nozzle back leakage, set injector nozzle opening pressure (NOP), evaluate the serviceability of a hydraulic injector nozzle.

Vermont's Framework of Standards:

3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 28: Failure Analysis

In this lesson the student will organize the evidence produced by an engine failure, identify the facts associated with an engine failure, analyze the facts to produce findings, distinguish consequential damage from root cause(s), organize the findings to define the root cause of the failure, communicate findings to a work order, develop a repair strategy that prevents a recurrence, interpret B-life and identify how the terms B10, B50 and Bx are used by engine OEMs, analyze failure on some failed engine components, including pistons, rings, rod and main friction bearings, cylinder sleeves/liners, crankshafts, valvetrains, turbochargers and injectors.

Vermont's Framework of Standards:

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MHDTE 29: Review of Electrical and Electronic Fundamentals

In this lesson the student will describe atomic structure, outline the properties of conductors, insulators and semiconductors, describe the characteristics of static electricity, define what is meant by the conventional and electron theories of current flow, describe the relationship between electricity and magnetism, define what is meant by an electrical circuit and terms voltage, resistance and current flow, perform simple electrical circuit calculations using Ohm's law, identify the characteristics of DC and AC, describe some of the sources of electricity and how current flow can be generated in an electrical circuit, apply Ohm's law to series, parallel and series-parallel circuits, describe Kirchhoff's first and second laws and calculate voltage drop in circuit components, define the terms capacitance and identify some types of capacitors used in electrical circuits, define the operating principles of coils and transformers, describe some types of electrical waveforms and their application in electronic circuits, define the term pulse width modulation, describe some types of semiconductors used in truck electronics and define the properties of N- and P-type semiconductors, outline the operating principles and applications of diodes and transistors, describe the optical spectrum and some commonly used optical components, explain what is meant by an integrated circuit, define the role of AND, OR, NOR and NOT gates in electronic circuits, interpret a truth table, explain why the binary numeric system is used in computer electronics, define the terms bits and bytes and describe how data can be transmitted using electronic circuits

Vermont's Framework of Standards:

3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 30: Introduction to computers

In this lesson the student will outline a brief history of computers from the abacus to the present day, describe the hardware components in a basic computer system, outline the operating principles of the key components of a typical PC system, describe the different types of data retention media and their appropriate application, differentiate between magnetically retained, electronically retained and optically encoded data, outline the four stages of a computer processing cycle, describe the role played by the CPU in the processing cycle, define the role of the system clock in synchronizing processing activity, identify common PC peripherals and their role in the system, outline the role played by computers and their impact of the trucking industry.

Vermont's Framework of Standards:

3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.2

MHDTE 31: Networking and Communications in the Trucking Industry

In this lesson the student will define the terms networking and telecommunications, understand the basics of modern communications systems, identify the hardware required to enable handshake connections between a PC and a computer network system, demonstrate a basic understanding of the internet and its capabilities, describe the technology and hardware that enable a telephone to operate, outline what is required to enable telecommunications voice and data transactions, outline the transmission media used by the telecommunications industry, describe how a telecommunications satellite functions in a geosynchronous orbit, list some of the ways in which the trucking industry uses communications technology, describe how GPS adapts trilateration geometry to geographically locate vehicles and differentiate between GPS and telecom satellite communications.

Vermont's Framework of Standards:

3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 32: Vehicle Computer Systems

In this lesson the student will understand the language of computerized truck engine management systems, describe the circuit layout of an electronically managed truck engine, identify the differences between partial authority and full authority electronic engine management, outline the stages of a computer processing cycle, describe the data retention media used in vehicle ECMs, describe the role played by the various memory components in a truck ECM, identify the command and monitoring input circuits on a vehicle electronic system, define the principles of operation of thermistors, variable capacitance sensors, hall-effect sensors, potentiometers, induction pulse generators and piezoresistive sensors, describe how an ECM processes inputs and uses programmed data to generate outputs, identify current computer-controlled engines by OEM and engine series, define the role played by the injector driver unit in a typical full authority engine management system, differentiate between customer and proprietary data reprogramming and describe the processes used to reprogram a truck engine ECM with proprietary data.

Vermont's Framework of Standards:

3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 33: ESTs and SISs

In this lesson the student will define the acronyms EST and SIS, identify the different types of EST in current usage and the levels of access and programming capability of each, spec out a DMM that suits your objectives of the shop floor, perform some basic electrical circuit diagnosis using a DMM, test some everyday input circuit components such as thermistors and potentiometers, identify and describe the functional capabilities of different types of handheld ESTs, update Prolink reader-programmer cartridges by replacing PROM chip(s) and data cards, define the objectives of a snapshot test, outline the importance of completing each step when performing sequential troubleshooting testing of electronic circuits, connect a PC to a chassis data bus using the correct communications adapter (CA), outline the procedure required to perform reprogramming of an ECM with customer and proprietary data, interpret MIDs, PIDs, and FMIs and identify some of the new 2007 FMIs, explain why OBDII and EMD will be implemented as a requirement for highway diesel engines.

Vermont's Framework of Standards:

3.10 7.10 7.11 7.12 7.17 7.16 7.19 1.21

MHDTE 34: Electrical Wiring, Connector and Terminal Repair

In this lesson the student will identify SAE standard wiring colors and codes as outlined by SAE J2191 and TMC RP146, interpret SAE standard wiring codes, identify the Weather Pack-type and Deutsch-type terminals and connectors, assemble sealed connectors using the correct methods and crimping tools, disassemble sealed connectors without damaging components, splice wires where necessary in circuits where the practice is permitted, identify standard circuit protection devices, including fuses, cycling and noncycling circuit breakers, explain how a standard SAE relay functions and interpret the terminal assignments using both older and new SAE codes, identify some common circuit schematic symbols, navigate a basic wiring schematic and diagnose simple circuit malfunctions.

Vermont's Framework of Standards:

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MHDTE 35: Multiplexing

In this lesson the student will describe a typical truck data bus, list the key data bus hardware components, define the word multiplexing, describe how multiplexing can make data exchange more efficient, outline how a J1939/CAN 2.0 data bus functions, access J1587/1708 and J1939 data buses using a data connector, explain how a "smart" ladder switch operates, list the seven essential fields that make up a data frame on a truck data bus transaction, explain how FETs are used as relays to effect data bus outcomes, access a message identifier on a truck chassis data bus with multiple networked electronic systems, outline the procedure required to access a fault mode indicator (FMI) using electronic service tools.

Vermont's Framework of Standards:

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MHDTE 36: Bosch Electronic Distributor Systems

In this lesson the student will identify Bosch electronically controlled rotary distributor pump systems, describe the Bosch fuel subsystems that supply electronically controlled, rotary distributor systems, trace fuel flow routing from tank to injector on electronically controlled, rotary distributor pump fueled diesel engines, identify Bosch electronic diesel control (EDC) system components used to manage its rotary distributor pump injection systems.

Vermont's Framework of Standards:

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MHDTE 37: Mack V-MAC I and II

In this lesson the student will define the acronym V-MAC, describe the layout used by Mack Trucks in its V-MAC chassis management system, describe how Mack Trucks and Bosch adapted an inline, port-helix metering injection pump for computerized management and control, distinguish between the V-MAC I and V-MAC II systems, define the function of the V-MAC ECU and the ECU software and the input and output circuits, identify the two Bosch injection pumps used on V-MAC I and II management systems, outline the function of the Bosch rack actuator housing, identify the subcomponents contained within the rack actuator housing, describe the operating principles of the rack actuator housing subcomponents, describe how Mack Econovance operates, perform customer data programming of a V-MAC ECM, outline the procedures for reprogramming a V-MAC ECM with proprietary (Mack Trucks) data, describe the Copilot Driver Data Display option on V-MAC II, and outline the procedure required to diagnose Mack Trucks V-MAC electronics.

Vermont's Framework of Standards:

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MHDTE 38: Detroit Diesel Electronic Controls (DDEC) for EUI Systems

In this lesson the student will describe how DDEC electronics have evolved since their introduction through to DDEC V1, identify the Detroit Diesel engine families currently using DDEC, including those not using EUI fuel systems, outline the system layout of past and current DDEC EUI systems, describe the main subsystems and components in the DDEC electronic management system, outline the components and functions of the DDEC fuel subsystem, understand the principles of operation of a DDEC ECM and its output drivers, list the primary inputs to the DDEC ECM, and categorize them as command and monitoring sensors, identify the different generations of DDEC EUIs, including N2,N3 and E3 injectors, outline the operating principles of DDEC two- and four-terminal EUIs, describe the importance of programming EUI calibration data to the ECM, define the terms pilot injection and multipulse injection and their application to managing combustion, explain injector response time (IRT), describe the governing options that may be programmed to DDEC-managed engines, Time N2, N3and E3 DDC EUIs, outline the basics of DDEC system diagnosis and troubleshooting, explain the application of DDC ProDriver and ProManager, list the parameters that require calibration programming to DDEC electronics.

Vermont's Framework of Standards:

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MHDTE 39: Caterpillar ADEM MEUI Systems

In this lesson the student will describe the system layout and the primary components in a Caterpillar full authority, MEUI electronic management system, define the acronyms ADEM and ACERT, identify current and earlier Caterpillar trick engines that use MEUI fueling, identify some of the features of ACERT engine management used in current Caterpillar engines, outline the role the four primary subsystems play in managing an MEUI-fueled engine, describe the operating principles of two- and four-terminal MEUIs, define the role of input circuit components, describe how the ECM manages MEUI duty cycle to control engine fueling, outline some of the factors that govern the ECM fueling and engine management algorithm, perform some basic troubleshooting on ADEM MEUI-fueled engines, describe how <SMART> programming has replaced hard limits with soft parameters to optimize system operation, identify the ESTs required to read ADEM electronic systems, perform some basic troubleshooting using Caterpillar's Electronic Technician or ET, use Caterpillar's Service Information System or SIS, describe flash memory and programming, and access the data recording features used by ADEM and VECTRO.

Vermont's Framework of Standards:

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MHDTE 41: Cummins Celect Plus

In this lesson the student will identify the Cummins engines that use the Celect full authority electronic management system, outline the system layout of a Cummins Celect system, describe the subcomponents used on a Celect-managed engine, outline the components and the purpose of the Celect fuel subsystem, understand the principles of operation of the Celect system, identify the primary inputs to the Celect ECM, describe the operating principles of a Celect injector, describe some of the governing options available in the Celect ECM, identify the ESTs and PC software used to diagnose and program the Celect system, identify customer and Cummins data programming options for Celect, outline the procedure required to troubleshoot and diagnose electronic problems on Celect.

Vermont's Framework of Standards:

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MHDTE 42: Bosch EUP on Mercedes-Benz and Mack E-Tech

In this lesson the student will define the acronym EUP, explain the differences between full authority EUP and EUI diesel engine management, outline the system layouts on Mack Trucks E-Tech and Mercedes-Benz engines, describe the principles of operation of the EUP, identify the critical differences between the Mack Trucks and Mercedes-Benz EUP systems, describe how a EUP converts charging pressure fuel to injection pressure values, identify the similarities between EUP fueled engines and those using EUI systems, and Explain how Mercedes-Benz adapted the EUP fuel system to meet 2007 emissions standards with its MBE-900 and MBE-4000 engine families.

Vermont's Framework of Standards:

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MHDTE 43: Caterpillar and Navistar HEUI

In this lesson the student will describe the HEUI system layout and the primary components, outline the role of the four primary HEUI subsystems, describe the operating principles of injection pressure regulator (IRP), describe the operating principles and subcomponents of Caterpillar manufactured HEUI injector units, outline the operating principles of 2004 Siemens manufactured HEUI injector units, define the role played by the ECM input circuit and the factors that govern ECM processing logic, describe how the ECM switches output devices to control engine fueling and manage combustion, describe the role of the consolidated engine controller, perform basic electronic troubleshooting on an HEUI system, outline the procedures required to perform proprietary data reprogramming of an ECM, and perform customer data programming using an EST.

Vermont's Framework of Standards:

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MHDTE 44: Cummins HPI-TP

In this lesson the student will identify the engine family using the HPI-TP fuel system, outline the changes required by ISX for 2004, 2007 and 2010 EPA emissions, describe the HPI-TP fuel subsystem, trace fuel flow routing from tank to injector in an HPI-TP fueled engine, recognize the components of an IFSM module, describe the operation of timing and metering actuators, understand the operating principles of the HPI-TP system and outline some of the features of an ISX engine.

Vermont's Framework of Standards:

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MHDTE 45: Cummins CAPS

In this lesson the student will identify the engines that use the CAPS fuel system, describe the CAPS fuel subsystem, trace fuel flow routing from the tank to injector in a CAPS-fueled engine, identify the components used in a CAPS fuel pump, understand the operating principles of the CAPS system, and perform some simple repairs on the CAPS modular pump.

Vermont's Framework of Standards:

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MHDTE 46: Common Rail Systems

In this lesson the student will identify common rail (CR) diesel fuel systems, identify some of the diesel engines currently using common rail diesel fuel injection, outline the fuel subsystems in a typical CR system, trace fuel flow routing from tank to injector on common rail, diesel-fueled engines, describe the electronic management circuit components used in common rail fuel systems, describe the operation of the inline and radial piston pumps used to achieve sufficient flow to produce rail and injection pressures in a typical CR system, understand how rail pressures are managed in electronically managed, common rail diesel fuel system, outline the operation of an electrohydraulic injector, identify some of the characteristics of different OEM common rail diesel fuel injection systems and describe the operation of a fuel amplified common rail (FACR) system.

Vermont's Framework of Standards:

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MHDTE 47: Emissions

In this lesson the students will define the origin of the word “smog”, define photochemical smog and describe the conditions required to create it, describe the role that vehicle emissions play in the formation of smog, describe how ozone is formed at ground level, identify the compounds exhausted in engine end gases and identify those that are classified as noxious, identify some EPA and CARB emissions test required for diesel engine certification, outline the operating principles of C-EGR, oxidation catalytic converters, reduction catalytic converters and diesel particulate filters, explain the effect fuel injection timing can have on diesel engine end gas, outline the principles of operation of an opacity meter, describe the SAE J1667 test procedure, correlate opacity test failures to an engine or engine management malfunction and analyze diesel engine smoke.

Vermont’s Framework of Standards:

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MHDTE 48: Troubleshooting and Diagnosis

In this lesson the student will quarterback all engine troubleshooting using the OEM-recommended EST and online SIS, adhere to software-driven sequential troubleshooting paths to diagnose engine faults, interpret engine OEM expectations when diagnosing engine complaints, understand when it is appropriate to think “outside the box”, use your technical and mechanical skills only when the OEM software fails to produce the root cause of a failure, analyze exhaust gas smoke emission by color, relate some typical engine performance malfunctions to smoke color, outline step-by-step sequential troubleshooting, troubleshoot some typical engine and fuel system failures, identify common operator and technician abuses of engine and fuel systems, develop a checklist for tackling lack of power complaints specific to an engine or chassis system, profile some of the most common engine malfunction symptoms to typical causes, and identify the role played by a DSM in providing product technical support.

Vermont’s Framework of Standards:

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Dear Parent or Guardian,

Hello my name is Chuck Lyman, I'm your son or daughters Diesel Technology instructor. I have high hopes for my students and the program, so I will be expecting a lot out of the students. They will have to keep their grades up in their academic classes as well. The first year students will be at school learning about engines and working in the shop. The second year students will be learning about all the other systems. Some will be at school working in the shop and some will be out co-oping at area businesses. We will have guest speakers on bio-diesel conversions, industry training, and field trips to area businesses. I will expect the students to be professionally dressed and have a professional attitude. The students will have homework on a daily basis, I try to cover one chapter a week with homework and test due on Fridays. The students will be expected to come prepared for class everyday. They will need:

1 .Pens **(NO RED PENS)**
2. Pencils
3. Highlighter
4. Boots that cover their ankles **(NO SNEAKERS)**
5. Proper clothing for industry that meets school regulations
6. Safety glasses **(FIRST PAIR PROVIDED BY INSTRUCTOR)**

There will be absolutely no cell phones allowed in class. There will be no food or drinks allowed in class except for break time and every student will go to lunch in the cafeteria. All students will wear pants to class that cover your boots **(NO SHORTS)** If the student is not ready for school each day they will not be allowed to work in the shop and take a zero for the day. I work with an active advisory board and they tell me what they are looking for in their employees, so I'm trying to prepare the students for industry and for them to succeed in the future. If you have any questions my phone number at school is 728-9595 ext 109 at my office or 728-9595 ext 128 in the shop or you can e-mail me at clyman @randolphtech.org

Please review this with your son or daughter sign it below and send back to me.

Thank you

Chuck Lyman

Student signature_____

Parent signature_____