



COURSE OUTLINE: TCT814 - FUEL SYSTEMS

Prepared: Sylvain Belanger

Approved: Corey Meunier, Chair, Technology and Skilled Trades

Course Code: Title	TCT814: FUEL SYTEMS
Program Number: Name	6082: T/C TECHN-LEVEL III
Department:	MOTIVE POWER APPRENTICESHIP
Semesters/Terms:	20W
Course Description:	Upon successful completion the apprentice is able to understand the principles of operation, diagnose and repair hydraulically actuated, electronic unit injector systems, electronic unit pump diesel fuel systems, time-pressure (TP), electronic common rail systems, and electronically controlled, common rail accumulator, high pressure injection pumps.
Total Credits:	3
Hours/Week:	0
Total Hours:	24
Prerequisites:	There are no pre-requisites for this course.
Corequisites:	There are no co-requisites for this course.
Essential Employability Skills (EES) addressed in this course:	EES 2 Respond to written, spoken, or visual messages in a manner that ensures effective communication. EES 3 Execute mathematical operations accurately. EES 4 Apply a systematic approach to solve problems. EES 5 Use a variety of thinking skills to anticipate and solve problems. EES 6 Locate, select, organize, and document information using appropriate technology and information systems. EES 7 Analyze, evaluate, and apply relevant information from a variety of sources. EES 10 Manage the use of time and other resources to complete projects.
General Education Themes:	Science and Technology
Course Evaluation:	
Other Course Evaluation & Assessment Requirements:	Theory testing 70% Practical application testing 30% Grade Definition Grade Point Equivalent A+ 90 - 100% 4.00 A 80 - 89% B 70 - 79% 3.00 C 60 - 69% 2.00 D 50 - 59% 1.00 F (Fail)49% and below 0.00 CR (Credit) Credit for diploma requirements has been awarded. S Satisfactory achievement in field /clinical placement or non-graded subject area.



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U Unsatisfactory achievement in field/clinical placement or non-graded subject area.
 X A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
 NR Grade not reported to Registrar's office.
 W Student has withdrawn from the course without academic penalty.

Books and Required Resources:

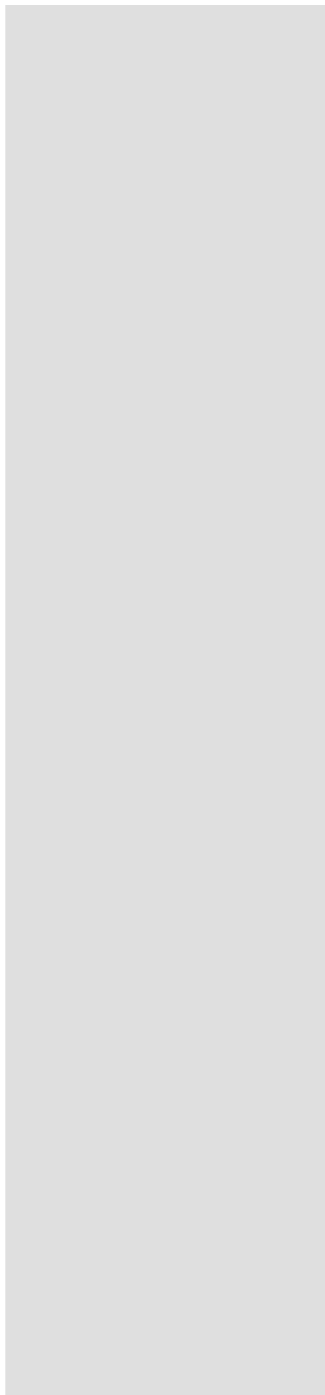
medium/heavy duty truck engines, fuels and computerized management systems by Sean Bennett
 Publisher: cengage Edition: 5

Course Outcomes and Learning Objectives:

Course Outcome 1	Learning Objectives for Course Outcome 1
<p>Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair of Hydraulically Actuated, Electronic Unit Injector (HEUI) Systems.</p>	<p>:</p> <p>Explain the purpose and fundamentals of HEUI fuel systems.</p> <ul style="list-style-type: none"> - electronics - computers - input circuits - electronics schematics - hydraulics - oil pumps - fuel sub-systems <p>Identify the functions, construction, types, and application of HEUI fuel systems.</p> <ul style="list-style-type: none"> - system layout - input circuits - fuel circuit - high-pressure oil circuits - stepper pump - injection pressure control module - injection pressure control regulator - HEUI assembly - solenoid control - amplifier / intensifier piston - plunger and chamber - pilot/PRIME plungers - hydraulics nozzles - engine controller module (ECM) <p>Describe the principle(s) of operation of HEUI fuel systems.</p> <ul style="list-style-type: none"> - rail fuel flow - high-pressure oil management - HEUI actuation principles - cold start / warm-up strategies - emission control strategies - injection rate control - pilot/PRIME feature - oil specifications <p>Perform inspection, testing and diagnostic procedures on HEUI fuel systems.</p> <ul style="list-style-type: none"> - service requirements - troubleshooting strategies - using diagnostic flow chart



		<ul style="list-style-type: none"> - cylinder balance testing - analyzing actuation voltage - interpreting fault codes - selecting and using the system appropriate EST <p>Recommend reconditioning or repairs following manufacturers' procedures on HEUI fuel systems.</p> <ul style="list-style-type: none"> - HEUI replacement precautions - HEUI replacement procedure - failure analysis - customer data programming - interpreting proprietary terminology and system differences
	Course Outcome 2	Learning Objectives for Course Outcome 2
	<p>Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair Electronic Unit Pump Diesel Fuel Systems.</p>	<p>Explain the purpose and fundamentals of electronic unit pump systems.</p> <ul style="list-style-type: none"> - electricity - electronics - computers - digital electronics - input and output circuits - characteristics of cam geometry <p>Describe the principle(s) of operation of electronic unit pump systems.</p> <ul style="list-style-type: none"> - pump driver units - actuation voltage characteristics - electronic unit pumps control solenoid cartridges <p>Identify the functions, construction, and application of electronic unit pump systems</p> <ul style="list-style-type: none"> - ECMs: chassis and engine/fuel controllers - switching apparatus - interface modules - pump driver units - EUP components - solenoid cartridge valves - tappet, plunger and barrel assemblies - charge fuel routing - hydraulic nozzle assemblies - electrohydraulic injectors (EHIs) - high-pressure pipes - distinguishing factors between different EUP systems <p>Describe the principle(s) of operation of electronic unit pump systems.</p> <ul style="list-style-type: none"> - pump driver units - actuation voltage characteristics - electronic unit pumps - control solenoid cartridges - injection pumping components - hydraulic nozzles



- electrohydraulic injector (EHIs) control
- high-pressure pipes
- effective stroke control
- pilot injection
- default modes
- tattletale / audit trail logging
- effective stroke duty cycle/pulse width

Perform inspection, testing and diagnostic procedures electronic unit pump systems

- analyze customer data programming
- analyze proprietary data programming
- perform sequential troubleshooting using OEM text
- analyze circuit malfunctions
- perform an electronic EUP cutout test
- perform a snapshot test

Recommend reconditioning or repairs following manufacturers' procedures on electronic unit pump systems.

- outline procedure for diagnosing electronic malfunctions
- outline procedure for diagnosing hydromechanical malfunctions
- demonstrate proprietary data download procedures
- outline procedure for removing and replacing EUPs
- program customer engine and chassis data to an ECM

Course Outcome 3

Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair time-pressure (TP), electronic common rail systems.

Learning Objectives for Course Outcome 3

Explain the purpose and fundamentals of Time Pressure (TP), electronic common rail fuel systems.

- fuel sub-systems
- time pressure hydraulic equation
- dual cam geometry
- quiescent combustion

Identify the functions, construction, and application of Time Pressure (TP), electronic common rail fuel systems.

- fuel sub-system
- HPI-TP Injectors
- plunger and cup
- timing chamber
- timing solenoid
- metering solenoid
- cylinder head configuration
- ECM fuel flow routing

Describe the principle(s) of operation of Time Pressure (TP), electronic common rail fuel systems.

- common rail, time-pressure theory
- rail pressure management
- metering solenoid functions
- timing solenoid function



		<ul style="list-style-type: none"> - flow controls - dual camshaft functions - engine brake management - injector timing - effective stroke characteristics - trapped volume spill (TVS) management <p>Perform inspection, testing and diagnostic procedures on Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> - demonstrate adjustment procedure HPI-TP Injectors - demonstrate priming procedure - demonstrate electronic cylinder cutout procedure - troubleshooting strategies <p>Recommend reconditioning or repairs following manufacturers' procedures on Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> - demonstrate engine timing fear procedure - demonstrate electronically guided trouble shooting procedures
	<p>Course Outcome 4</p>	<p>Learning Objectives for Course Outcome 4</p>
	<p>Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair of electronically controlled, common rail accumulator, high pressure injection pumps.</p>	<p>Explain the purpose and fundamentals of Common Rail, Accumulator Fuel Systems.</p> <ul style="list-style-type: none"> - fuel sub-systems - fuel circuit schematic - fueling hydraulic equations - fuel sub-system - linear proportioning solenoids - injector actuation and controls <p>Identify the functions, construction, and application of Common Rail, Accumulator Fuel Systems.</p> <ul style="list-style-type: none"> - fuel sub-system - electrohydraulic Injectors (EHI) - solenoid ` actuated - piezo-actuated - fuel rail design - Fuel Amplified Common Rail Systems (FACR) - intensifier piston - amplification ratios - high pressure pipes - quill/transfer tubes - low pressure fuel flow routing - high pressure fuel flow routing <p>Describe the principle(s) of operation of Common Rail, Accumulator Fuel Systems.</p> <ul style="list-style-type: none"> - common rail fuel equations - rail pressure management - desired pressure/actual pressure

- rail pressure regulator
- rail pressure sensors
- flow controls
- pump characteristics
- injection controls
- solenoid actuators
- piezo actuators
- Fuel Amplified Common Rail Systems (FACR)
- fuel rate shaping
- multi-pulse injection

Perform inspection, testing & diagnostic procedures following manufacturers' recommendations on common rail systems

- cylinder balance test
- static actuator test
- test data analysis
- outline procedure for removing/replacing high pressure pipes

Evaluation Process and Grading System:

Evaluation Type	Evaluation Weight
practical application testing	30%
theory testing	70%

Date:

February 10, 2020

Addendum:

Please refer to the course outline addendum on the Learning Management System for further information.

