



## COURSE OUTLINE: TCT814 - FUEL SYSTEMS

Prepared: Sylvain Belanger

Approved: Corey Meunier, Chair, Technology and Skilled Trades

<b>Course Code: Title</b>	TCT814: FUEL SYTEMS
<b>Program Number: Name</b>	6082: T/C TECHN-LEVEL III
<b>Department:</b>	MOTIVE POWER APPRENTICESHIP
<b>Semesters/Terms:</b>	20F
<b>Course Description:</b>	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.
<b>Total Credits:</b>	3
<b>Hours/Week:</b>	0
<b>Total Hours:</b>	24
<b>Prerequisites:</b>	There are no pre-requisites for this course.
<b>Corequisites:</b>	There are no co-requisites for this course.
<b>Essential Employability Skills (EES) addressed in this course:</b>	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.
<b>General Education Themes:</b>	Science and Technology
<b>Course Evaluation:</b>	
<b>Other Course Evaluation &amp; Assessment Requirements:</b>	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

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.



SAULT COLLEGE | 443 NORTHERN AVENUE | SAULT STE. MARIE, ON P6B 4J3, CANADA | 705-759-2554

CR (Credit) Credit for diploma requirements has been awarded.  
 S Satisfactory achievement in field /clinical placement or non-graded subject area.  
 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
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>Explain the purpose and fundamentals of HEUI fuel systems.</p> <ul style="list-style-type: none"> <li>- electronics</li> <li>- computers</li> <li>- input circuits</li> <li>- electronics schematics</li> <li>- hydraulics</li> <li>- oil pumps</li> <li>- fuel sub-systems</li> </ul> <p>Identify the functions, construction, types, and application of HEUI fuel systems.</p> <ul style="list-style-type: none"> <li>- system layout</li> <li>- input circuits</li> <li>- fuel circuit</li> <li>- high-pressure oil circuits</li> <li>- stepper pump</li> <li>- injection pressure control module</li> <li>- injection pressure control regulator</li> <li>- HEUI assembly</li> <li>- solenoid control</li> <li>- amplifier / intensifier piston</li> <li>- plunger and chamber</li> <li>- pilot/PRIME plungers</li> <li>- hydraulics nozzles</li> <li>- engine controller module (ECM)</li> </ul> <p>Describe the principle(s) of operation of HEUI fuel systems.</p> <ul style="list-style-type: none"> <li>- rail fuel flow</li> <li>- high-pressure oil management</li> <li>- HEUI actuation principles</li> <li>- cold start / warm-up strategies</li> <li>- emission control strategies</li> <li>- injection rate control</li> <li>- pilot/PRIME feature</li> <li>- oil specifications</li> </ul>

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.



		<p>Perform inspection, testing and diagnostic procedures on HEUI fuel systems.</p> <ul style="list-style-type: none"> <li>- service requirements</li> <li>- troubleshooting strategies</li> <li>- using diagnostic flow chart</li> <li>- cylinder balance testing</li> <li>- analyzing actuation voltage</li> <li>- interpreting fault codes</li> <li>- selecting and using the system appropriate EST</li> </ul> <p>Recommend reconditioning or repairs following manufacturers' procedures on HEUI fuel systems.</p> <ul style="list-style-type: none"> <li>- HEUI replacement precautions</li> <li>- HEUI replacement procedure</li> <li>- failure analysis</li> <li>- customer data programming</li> <li>- interpreting proprietary terminology and system differences</li> </ul>
	<b>Course Outcome 2</b>	<b>Learning Objectives for Course Outcome 2</b>
	<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"> <li>- electricity</li> <li>- electronics</li> <li>- computers</li> <li>- digital electronics</li> <li>- input and output circuits</li> <li>- characteristics of cam geometry</li> </ul> <p>Describe the principle(s) of operation of electronic unit pump systems.</p> <ul style="list-style-type: none"> <li>- pump driver units</li> <li>- actuation voltage characteristics</li> <li>- electronic unit pumps</li> <li>control solenoid cartridges</li> </ul> <p>Identify the functions, construction, and application of electronic unit pump systems</p> <ul style="list-style-type: none"> <li>- ECMs: chassis and engine/fuel controllers</li> <li>- switching apparatus</li> <li>- interface modules</li> <li>- pump driver units</li> <li>- EUP components</li> <li>- solenoid cartridge valves</li> <li>- tappet, plunger and barrel assemblies</li> <li>- charge fuel routing</li> <li>- hydraulic nozzle assemblies</li> <li>- electrohydraulic injectors (EHIs)</li> <li>- high-pressure pipes</li> <li>- distinguishing factors between different EUP systems</li> </ul>

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.

		<p>Describe the principle(s) of operation of electronic unit pump systems.</p> <ul style="list-style-type: none"> <li>- pump driver units</li> <li>- actuation voltage characteristics</li> <li>- electronic unit pumps</li> <li>- control solenoid cartridges</li> <li>- injection pumping components</li> <li>- hydraulic nozzles</li> <li>- electrohydraulic injector (EHIs) control</li> <li>- high-pressure pipes</li> <li>- effective stroke control</li> <li>- pilot injection</li> <li>- default modes</li> <li>- tattletale / audit trail logging</li> <li>- effective stroke duty cycle/pulse width</li> </ul> <p>Perform inspection, testing and diagnostic procedures electronic unit pump systems</p> <ul style="list-style-type: none"> <li>- analyze customer data programming</li> <li>- analyze proprietary data programming</li> <li>- perform sequential troubleshooting using OEM text</li> <li>- analyze circuit malfunctions</li> <li>- perform an electronic EUP cutout test</li> <li>- perform a snapshot test</li> </ul> <p>Recommend reconditioning or repairs following manufacturers' procedures on electronic unit pump systems.</p> <ul style="list-style-type: none"> <li>- outline procedure for diagnosing electronic malfunctions</li> <li>- outline procedure for diagnosing hydromechanical malfunctions</li> <li>- demonstrate proprietary data download procedures</li> <li>- outline procedure for removing and replacing EUPs</li> <li>- program customer engine and chassis data to an ECM</li> </ul>
	<p><b>Course Outcome 3</b></p>	<p><b>Learning Objectives for Course Outcome 3</b></p>
	<p>Upon successful completion, the apprentice is able to understand the principles of operation, diagnose and repair time-pressure (TP), electronic common rail systems.</p>	<p>Explain the purpose and fundamentals of Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> <li>- fuel sub-systems</li> <li>- time pressure hydraulic equation</li> <li>- dual cam geometry</li> <li>- quiescent combustion</li> </ul> <p>Identify the functions, construction, and application of Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> <li>- fuel sub-system</li> <li>- HPI-TP Injectors</li> <li>- plunger and cup</li> <li>- timing chamber</li> <li>- timing solenoid</li> </ul>

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.

	<ul style="list-style-type: none"> <li>- metering solenoid</li> <li>- cylinder head configuration</li> <li>- ECM fuel flow routing</li> </ul> <p>Describe the principle(s) of operation of Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> <li>- common rail, time-pressure theory</li> <li>- rail pressure management</li> <li>- metering solenoid functions</li> <li>- timing solenoid function</li> <li>- flow controls</li> <li>- dual camshaft functions</li> <li>- engine brake management</li> <li>- injector timing</li> <li>- effective stroke characteristics</li> <li>- trapped volume spill (TVS) management</li> </ul> <p>Perform inspection, testing and diagnostic procedures on Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> <li>- demonstrate adjustment procedure HPI-TP Injectors</li> <li>- demonstrate priming procedure</li> <li>- demonstrate electronic cylinder cutout procedure</li> <li>- troubleshooting strategies</li> </ul> <p>Recommend reconditioning or repairs following manufacturers' procedures on Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> <li>- demonstrate engine timing fear procedure</li> <li>- demonstrate electronically guided trouble shooting procedures</li> </ul>	<ul style="list-style-type: none"> <li>- metering solenoid</li> <li>- cylinder head configuration</li> <li>- ECM fuel flow routing</li> </ul> <p>Describe the principle(s) of operation of Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> <li>- common rail, time-pressure theory</li> <li>- rail pressure management</li> <li>- metering solenoid functions</li> <li>- timing solenoid function</li> <li>- flow controls</li> <li>- dual camshaft functions</li> <li>- engine brake management</li> <li>- injector timing</li> <li>- effective stroke characteristics</li> <li>- trapped volume spill (TVS) management</li> </ul> <p>Perform inspection, testing and diagnostic procedures on Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> <li>- demonstrate adjustment procedure HPI-TP Injectors</li> <li>- demonstrate priming procedure</li> <li>- demonstrate electronic cylinder cutout procedure</li> <li>- troubleshooting strategies</li> </ul> <p>Recommend reconditioning or repairs following manufacturers' procedures on Time Pressure (TP), electronic common rail fuel systems.</p> <ul style="list-style-type: none"> <li>- demonstrate engine timing fear procedure</li> <li>- demonstrate electronically guided trouble shooting procedures</li> </ul>
	<p><b>Course Outcome 4</b></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><b>Learning Objectives for Course Outcome 4</b></p> <p>Explain the purpose and fundamentals of Common Rail, Accumulator Fuel Systems.</p> <ul style="list-style-type: none"> <li>- fuel sub-systems</li> <li>- fuel circuit schematic</li> <li>- fueling hydraulic equations</li> <li>- fuel sub-system</li> <li>- linear proportioning solenoids</li> <li>- injector actuation and controls</li> </ul> <p>Identify the functions, construction, and application of Common Rail, Accumulator Fuel Systems.</p> <ul style="list-style-type: none"> <li>- fuel sub-system</li> <li>- electrohydraulic Injectors (EHI)</li> <li>- solenoid ` actuated</li> <li>- piezo-actuated</li> <li>- fuel rail design</li> </ul>

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.

- 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

Describe the principle(s) of operation of Common Rail, Accumulator Fuel Systems.

- 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:**

September 2, 2020

**Addendum:**

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

In response to public health requirements pertaining to the COVID19 pandemic, course delivery and assessment traditionally delivered in-class, may occur remotely either in whole or in part in the 2020-2021 academic year.