

Truck and Transport Mechanic Level 3

Truck and Transport Mechanic

Unit: A3 Inspections Procedures: Truck and Bus

Level: Three

Duration: 7 hours

Theory: 2 hours

Practical: 5 hours

Overview:

This unit of instruction is designed to help the Truck and Transport Mechanic apprentice learn and apply safety inspection procedures as they relate to truck transport and passenger bus vehicles.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Objectives and content of this unit have been developed as part of the Department of Highway's Inspection Mechanic Certificate. Delivery of this program is provided by Department of Highway Instructors through a 1-day course. There is an out-of-pocket cost associated with this program, which is paid for by employers.	n/a

Truck and Transport Mechanic

Unit: B2 Customer Relations and Communications

Level: Three

Duration: 10 hours

Theory: 10 hours

Practical: 0 hours

Overview:

The unit of instruction is designed to help the Truck and Transport Mechanic apprentice develop interpersonal skills that facilitate effective and positive interaction with customers and industry peers.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe aspects of public relations and customer service.	25%
a. Today's truck transport mechanic	
b. Effective public relations	
c. Professionalism	
d. Creating trust	
e. Listening skills	
f. Telephone etiquette	
g. Customer appreciation	
h. Use of appropriate language	
i. Positive attitude	
j. Your role as a professional	
2. Describe basic communications principles and practices.	25%
a. Types of communications	
• Verbal	
• Non-verbal	
• Awareness of body language / non-verbal codes	
b. Factors influencing interpersonal communication	
• Self-awareness	
• Self-concept	
• Self-esteem	
c. Interpersonal skills	
• Assertiveness	
• Supportiveness	
• Feedback	
• Small group characteristics	
• Small group types	
• Panels	
• Discussion groups	

- Committees
 - Group roles
 - Task roles
 - Maintenance roles
 - Negative individual roles
- d. Small group interaction
- Conformity
 - Cohesiveness
 - Consensus
 - Conflict / conflict resolution

3. Describe and perform key on-the-job written communications duties.

50%

- a. Work orders
- b. Work procedures documentation
- c. Purchase orders
- d. Parts requisition
- e. Time sheets
- f. Warranty documentation
- g. Daily inspection book
- h. Working drawings

Truck and Transport Mechanic

Unit: D2 Engine Diagnosis, Startup, Tuneup and Engine Brakes

Level: Three

Duration: 40 hours

Theory: 18 hours

Practical: 22 hours

Overview:

This unit of instruction is designed to provide the Truck and Transport Mechanic apprentice with the working knowledge required to diagnose / troubleshoot engine problems (including engine brake and retarders), along with performing startup and tuneup procedures.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
<p>1. Describe specialized diagnostic measuring and diesel tools; describe and perform the diagnosis of engine problems.</p> <p>a. Specialized diagnostic measuring tools</p> <ul style="list-style-type: none">• Infrared thermometer• Cylinder compression gauge• Manometer• Leakdown tester <p>b. Describe specialized diesel tools</p> <ul style="list-style-type: none">• Injection puller/extractor• Diesel injector service set• Diesel injection pump tester• Nozzle pop tester• Diesel injection timer• Opacity smoke meter• Computer system diagnostic tools	25%
<p>2. Describe and perform tuneup procedures for diesel engines, mechanical governors, hydraulic governors, and fuel pumps; describe and perform injector service and exhaust valve bridge check / clearance.</p> <p>a. Diagnosis and evaluation of engine problems</p> <ul style="list-style-type: none">• Electronic diagnostics<ul style="list-style-type: none">-Fault codes• Primary engine checks• Cylinder balance<ul style="list-style-type: none">-Procedures for various fuel and ignition systems-Evaluate results• Vacuum tests<ul style="list-style-type: none">-Cranking vacuum test-Idle and running test-Restricted exhaust test	70%

- Effects of valve train problems on vacuum readings
 - Air induction system pressure test
 - Air inlet restriction pressure test
 - Air box pressure / turbocharger discharge pressure
 - Crankcase pressure testing
 - Verification of PCV system operation
 - Identification of cylinder sealing problems
 - External oil leak diagnosis
 - Exhaust back pressure test
 - Compression tests
 - Test preparation procedures (fuel and ignition system)
 - Test procedures and interpretation of test results
 - Cylinder leakdown tests
 - Procedures and precautions
 - Interpretation of results
 - Oil pressure tests
 - Engine preparations
 - Procedures and evaluations
 - Diagnosis of engine brake retarder problems
- b. Diesel engine troubleshooting procedures
- Driver complaints
 - Listening to engine operation
 - Non-starting
 - Smoke
 - Noises
 - Excessive vibration
 - Engine overheating
 - Unusual acceleration/deceleration/idling
 - Air-intake restriction and poor compression
 - Air-intake leaks
 - High exhaust back pressure
 - Oil consumption concerns
 - Low oil pressure gauge reading
 - Crankcase oil dilution
 - Fuel consumption concerns
 - Excessive crankcase pressure and measurement
 - Standard procedures: troubleshooting
 - Disassembly of engine
 - Role of pressure gauge
 - Role of manometer
- c. Procedures for tuning a diesel engine
- Checking of compression
 - Servicing of air filter
 - Checking for air leaks
 - Inspection of turbocharger/blower
 - Inspection of oil lines to turbocharger/blower
 - Inspection of aneroid
 - Inspection of external fuel lines
 - Inspection of fuel supply pump
 - Adjustment of valve tappets and bridges
 - Adjustment of unit injector tappets
 - Adjustment of fan belt
 - Inspection of cooling system

- Servicing of oil filters
 - Inspection of exhaust system
 - Inspection of fuel injection pump or injectors
 - Checking of timing
 - Inspection, repair and adjustment of engine brakes
- d. Tuneup procedures for mechanical governors
- Adjustment of exhaust valve clearance
 - Timing of fuel injectors
 - Adjustment of governor gap
 - Positioning of injector rack control lever
 - Adjustment of maximum no-load speed
 - Idle speed adjustment
 - Buffer speed adjustment
 - Adjustment of throttle booster spring
 - Adjustment of fuel modulator
- e. Tuneup procedures for hydraulic governors
- Adjustment of exhaust valve clearance
 - Timing of fuel injectors
 - Adjustment of fuel rod
 - Correct positioning of injector rack control lever
 - Adjustment of load limit screw
 - Compensation adjustment: PSG governor
 - Adjustment of speed droop
 - Adjustment of maximum no-load speed
 - Adjustment of fuel modulator
 - Adjustment of valve clearance
- f. Injector service
- Injector service procedures
 - Inspection and testing
 - Plunger and control rack movement tests
 - Spray pattern test
 - Pressure and leakage test
 - Fuel output test
 - Injector installation
 - Fuel spill back check
- g. Fuel pump adjustments
- Obtaining of manifold pressure and fuel supply vacuum readings
 - Role of full throttle
 - Reading of maximum swing of pressure gauge hand
 - Installation of vacuum gauge in fuel supply line
 - Checking of manifold pressure at rated speed/full-load
 - Adjustment of valve and injector lash to specifications
 - Checking of high idle or maximum governed speed
 - Rear throttle screw adjustment
 - Forward throttle screw adjustment
 - Idle speed adjustment
 - Replacement of fuel filter element
 - Cleaning of fuel pump screen
 - Adjustment of maximum governed speed
 - Bleeding of system
 - Procedures: CAV injection pump timing
- h. Describe and perform exhaust valve bridge check and clearance

- Removal of cylinder head
- Procedures for checking and adjusting exhaust valve bridges
- Procedures for performing exhaust valve clearance
 - Use of go/no-go feeler gauges
- i. Fuel injector timing
 - Adjustment of injector to specified height re: injector body
 - Timing of fire order sequence
 - Removal and cleaning of rocker cover

3. Describe and perform engine startup and break-in.

5%

- a. Use of manuals as reference
- b. Cooling system filling and bleeding
- c. Static timing adjustment
- d. Lubrication system (prelube)
- e. Turbocharger
- f. Air intake and cooling systems
- g. Fuel system precautions
- h. Proper startup procedures
- i. Final inspection
- j. Engine dynamometer run-in
 - Overall purpose
 - Gauge monitoring
 - Dynamometer check
 - Dynamometer operation

Truck and Transport Mechanic

Unit: G1 Cabs, Restraint Systems and Attached Equipment

Level: Three

Duration: 8 hours

Theory: 8 hours

Practical: 0 hours

Overview:

This unit of instruction is designed to provide the Truck and Transport Mechanic apprentice with the working knowledge to diagnose and repair cab structures, seating, restraint systems and interiors. As well, this unit enables the apprentice to understand, diagnose and repair attached equipment.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe restraint system components, inspections, manufacturers' tests and servicing.	25%
a. Restraint system operation (including airbag systems) and components	
• Active vs. passive restraint system components	
• Wheel chair tie-downs	
• Airbags vs. other restraint systems	
• Restraint sequence during crash	
• Common airbag components	
-Independent electrical system	
-Air bag module	
-Knee bolster	
• Electrical system components	
-Sensors	
-Diagnostic monitor assembly	
-Wiring harness	
-Clock spring	
-Air bag readiness light	
• Air bag module	
-Purpose, configuration and location	
-Air bag parts and components	
-Dual stage airbags	
-Mechanism and process for air bag release	
• Passenger-side and side air bags	
-Similarities and differences in design	
b. Active and passive restraint system inspections, manufacturers' tests and servicing	
• Seat belts servicing	
• Webbing inspection	
• Buckle inspection	
• Retractor inspection	
• Drive track assembly and anchor inspection	
-Anchors inspection	

- Upper body damage check
- Loose bolts
- Restoration of corrosion protection
- Drive motor
- Seat belt tensioner
- Rear seat restraint system
- Warning light and audible warning systems
- Seat belt retractors and receivers
- Modules
- Sensors
- Motors
- Collapsible steering wheels
- Knee bolsters
- Solenoids
- Actuators
- Switches
- Diagnosis and servicing procedures / guidelines
 - Thorough visual inspection of sensor integrity
 - Use of jumper wire and load simulator for air bag removal
 - Use of back-probe live system with multimeter and test light
 - Unitized module serviced as complete assembly
 - Servicing of crash sensors, mercury switches or other damaged parts
 - Steering clock spring and spiral wrap maintained in correct position
 - Caution: pulling of steering wheel during installation
 - Potential damage to spiral coupler or clock spring device
 - Bag deflection attitude maintained for proper deployment
 - Sensors securely placed
 - Use of test equipment specified only in service manual

2. Describe coupling device types, principles, operation and maintenance.

75%

- a. Fifth wheel principles and their operation
 - Overall purpose
 - Principles of operation
 - Key components
 - Pintle hooks/converter dollies
 - Fifth wheel types
 - Semi-oscillating
 - Sliding fifth wheel
 - Compensating and fully oscillating
 - Specialty fifth wheels
 - Fifth wheel height and location
 - Kingpin purpose and design
- b. Fifth-wheel maintenance
 - Maintenance interval
 - Maintenance procedures
 - General inspection
 - Inspection and adjustment: locking mechanism
 - Fifth-wheel adjustment
 - Adjustment: slide mechanism
 - Lubrication
 - Use of service tools
 - Coupling and uncoupling
- c. Fifth-wheel mounting
 - Manufacturers' recommendations
 - Mounting types
- d. Sliding fifth-wheels

- Sliding procedure
 - Sliding mechanism inspection and adjustment
 - Air vs. manual
- e. Pintle hooks and maintenance
- Pintle hooks

Truck and Transport Mechanic

Unit: G2 HVAC and MOPIA

Level: Three

Duration: 40 hours

Theory: 20 hours

Practical: 20 hours

Overview:

This unit of instruction will provide the Truck and Transport Mechanic apprentice with the knowledge required to both understand and respond to MOPIA-related problems. The unit also provides apprentices with the working knowledge to diagnose, service and repair problems related to all key aspects of HVAC.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe the fundamentals, health / safety issues and procedures / requirements involved in the handling of CFCs, HFCs and HCFCs.	10%
a. CFC, HFC, and HCFC fundamentals	
• Environmental damage potential of compounds	
-CFC and the ozone layer	
-The Montreal Protocol	
-CFC: refrigeration and manufacturing industries	
• Ozone Depletion Potential (ODP)	
-Chemical makeup and stability	
-ODP factors for various refrigerants	
-Global warming	
• Control strategies for CFCs, HFCs, and HCFCs	
-Environment Canada's role	
-Code of Practice	
-Responsibilities of service personnel	
-Implementation dates of legislation	
b. Health and safety issues: ozone depleting substances	
• Personal safety equipment used when handling compounds	
-Eye, hand and face protection	
• Handling dangers: CFCs, HFCs, and HCFCs	
• Toxicity	
• Flammability	
• Handling precautions	
• Inhalation	
• Skin and eye contact	
• Cylinder temperature and pressures	
c. Procedures and requirements: the handling and release of ozone depleting substances	
• The four "Rs" of emission reduction	
-Recovery	

- Re-use
- Recycle
- Reclaim
- Equipment used to cover refrigerants
- Refrigerant storage tank types: implications of use
- Provincial regulations: handling of recovered ozone depleting substances
- CFC code of practice
- Record keeping requirements
 - Recovered refrigerant
 - Vehicle tagging
 - Cylinder inventories
 - Refrigerant transfers
- Maintenance procedures: recovery and recharging equipment
- Safe operating procedures: recovery and recharging equipment
 - Safety wear
 - Overpressure, overfilling
- Identification and use of reclaim cylinders
- Identification bands
- Contents, recycled gas
- Types of quick disconnects and one-way check valves

2. Describe the major components and operating principles used in mobile air conditioning systems. 60%

- a. Laws of physics applicable to air conditioning system operation
 - Heat absorption
 - Solid, liquid and gas states
 - Gas laws, temperature, pressure and volume
 - Temperature and humidity relationship
 - Thermal expansion and contraction
 - Methods of heat transfer
 - A/C thermodynamics
 - Refrigerant compressors
 - System lubrication
 - Properties of refrigerants
 - Alternative refrigerants
 - Refrigerant waste law requirements
 - Major components of air conditioning systems
 - Condenser
 - Receiver dehydration
 - Accumulator-dryer
 - Evaporators
 - Compressors (Axial recirculating; Radial; Variable displacement)
 - Hoses, lines and fittings
 - Low and high pressure cutout
 - Low charge protection
 - Evaporator temperature control
 - Cycling clutch control
 - Orifice tubes
 - Expansion valves
 - Fan controls
 - Role of lubricant used in a/c operation
 - Refrigeration oils (R12 and R134A systems)
 - Red Tec refrigerant
- b. Refrigerant characteristics
 - R134A
 - Tetrafluoroethane
 - Boiling point, toxicity, flammability, etc.

- Lubricants for refrigerants
- Air conditioning thermodynamics
- Other refrigerants

3. Describe and perform the diagnosis, inspection, testing and repair of air conditioning and climate control systems. 30%

- a. Diagnosis, inspection and testing methods
 - Testing methods
 - Dyes
 - Electronic leak detectors
 - Bubble producing solutions
 - Nitrogen testing
 - Testing
 - Refrigerant identification
 - Testing for refrigerant leaks
 - Dyes
 - Electronic leak detectors
 - Bubble producing solutions
 - Nitrogen testing
 - Fittings
 - Lines
 - Seals
 - Compressors
 - Evaporator
 - Condenser
 - Testing system operating pressures and control functions
 - Observations during performance tests
 - Observance of government regulations for testing
 - System tests for low and high pressures using a manifold gauge set
 - Testing overall system for leaks using recommended equipment and procedures
- b. Repair air conditioning systems and components
 - Removal and replacement
 - Compressors, evaporators, condensers and control devices
 - Compressor drive belt adjustment procedures
 - Discharging, evacuating recovery, recycling and recharging
 - Line and leakage repairs
 - Service procedures
 - Refrigeration systems service
 - Retrofitting
- c. Inspection, testing and diagnostic procedures on climate control systems
 - System and component diagnosis with recommended repair
 - Control system circuit operation (using appropriate test equipment)

Truck and Transport Mechanic

Unit: H3 Air Brake Systems and Power Assist Units

Level: Three

Duration: 25 hours

Theory: 15 hours

Practical: 10 hours

Overview:

This unit of instruction is designed to provide the Truck and Transport Mechanic apprentice with the knowledge and skills to work on air brake systems. The unit also provides apprentices with the knowledge to acquire an Air Brake Endorsement (obtaining this endorsement is at the apprentice's discretion, and not a requirement for this Program's Technical Training).

Objectives and Content:

**Percent of
Unit Mark (%)**

- | | |
|--|-------------------|
| <p>1. Describe air brake system fundamentals, design and operation; inspect, test and diagnose air brake systems; describe and perform manufacturers' maintenance procedures.</p> <p>a. Air brake fundamentals</p> <ul style="list-style-type: none">• Law of levers, mechanical advantages• Coefficient of friction• Pneumatic principles• Pressure volume relationship• Spring brake chambers• Spring brake chamber calculations<ul style="list-style-type: none">-Potential energy-Linear force-Leverage-Brake torque• Brake friction factors<ul style="list-style-type: none">-Component devices-Air-Water-Contamination-Oil, grease, dirt-Temperature-Vehicle load• Introduction to ABS <p>b. Air brake supply circuit component operation</p> <ul style="list-style-type: none">• Supply circuit – overall purpose, design and operation• Compressor<ul style="list-style-type: none">-Loaded cycle-Unloaded cycle• Governor• Moisture and contamination controls | <p>50%</p> |
|--|-------------------|

- Automatic drain valves
 - Alcohol evaporators and injectors
 - Air dryers
 - Aftercooler type air dryers
 - Decisccant type air dryers
 - Air reservoirs
 - Supply
 - Primary service
 - Secondary service
 - Single check valves
 - Safety valve
 - Pressure gauges
 - Low-pressure warning devices
 - Tubing, hose and fittings
- c. Design, components and operation of primary service brake circuits
- Overall purpose
 - Dual-circuit brake valve (treadle valve)
 - Relay valve
 - Drive axle brake chambers
 - Service chambers
- d. Design, components and operation of secondary service brake circuits
- Overall purpose
 - Dual-circuit brake valve
 - Quick-release valve
 - Ratio valve
 - Servicing of brake chambers
 - Front brake limiting valve
- e. Design, components and operation of trailer control circuits
- Overall purpose
 - Trailer supply valve
 - Tractor protection valve
 - Trailer brake control valve
 - Glad hands
 - Bobtail valves
 - Hand control valve
- f. Inspection, testing and diagnosis of air brake systems
- Removal, inspection and assembly of foundation brakes
 - Disarming of spring brake chambers using recommended safe practices
 - Procedures for air compressor, dryer, receiver and testing
 - Testing control valves for recommended operation
 - Procedures for diagnosis
 - Reservoir leaking or water accumulation
 - Low or high pressure
 - Frozen air lines
 - Camshaft and bushing wear
 - Poor braking performance
- g. Manufacturers' maintenance procedures: air brake systems
- Removal and installation of hoses, fittings, connectors and related components
 - Adjustment of air brakes using recommended procedures
 - Adjustment of air compressor governors using recommended procedures

- 2. Describe procedures to remove, service, install, repair and replace slack adjusters, air dryers, reservoirs, air valves and air chambers. 20%**
- a. Slack adjusters
 - Types (manual; automatics)
 - Operation (servicing, adjustment procedures)
 - b. Air dryer servicing
 - Alcohol evaporators
 - Service procedures
 - c. Removal, servicing and installation of reservoirs
 - Dry
 - Wet
 - Purpose
 - Classification
 - Safety valves
 - Repair procedures and caution
 - d. Air valve operation and repair / replacement
 - Foot valve
 - Quick release valve
 - Relay and hand valves
 - Limiting valves
 - Tractor protection valve
 - Automatic reservoir drain valve
 - Check valve (single and double)
 - e. Describe the operation, repair or replacement of air chambers
 - Warnings and precautions
 - Types and designs; functions
 - Inter-relationship of mechanical components
 - Adjustment methods and limitations
- 3. Describe procedures to remove, repair and install air over hydraulic chambers. 10%**
- a. Air over hydraulic brakes
 - Types, designs, components
 - Principles of operation
 - Service procedures
 - Cylinder reconditioning precautions
 - Relationship to other hydraulic systems
 - Repair procedures and cautions
 - Adjustments
 - b. Brake accumulator
 - Purpose
 - Types
 - precautions
- 4. Describe power assist fundamentals, power boosters, and power booster operation. 20%**
- a. Power assist fundamentals
 - Overall purpose and concept
 - b. Hydraulic power boosters
 - Purpose of power booster
 - Design
 - Relation to master cylinder
 - Locations and configurations

- Component interface
- Reserve operation (manual braking, brake fluid reserve system)
- c. Hydraulic power booster operation
 - Fluid flow
 - Effect of applied force
 - Role of reaction piston
 - Role of check valve
 - Interruption of normal flow
 - Reserve operation

Truck and Transport Mechanic

Unit: I6 Spark Ignition Systems

Level: Three

Duration: 10 hours

Theory: 7 hours

Practical: 3 hours

Overview:

This unit of instruction is designed to provide the Truck and Transport Mechanic apprentice with the working knowledge required to understand, diagnose and service spark ignition systems.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define the fundamentals, types and components of ignition systems and controls; inspect, test and diagnose ignition system components.	70%
a. Ignition systems and controls: fundamentals and purpose	
• Combustion burn time	
• Engine load and spark timing	
• Factors that affect ignition timing	
-Engine speed, engine load, engine temperature, and altitude	
-Air and fuel ratio (AFR)	
• Distributor-type systems	
• Distributorless ignition systems	
b. Ignition components	
• Coils	
-E-core and conventional	
-Primary and secondary wirings	
• Rotors	
• Triggering devices	
-Magnetic pulse generator	
-LAD	
-Hall Effect device	
-Optical device	
• Spark timing advance mechanisms	
-Mechanical	
-Vacuum	
-Computer-controlled	
• Secondary voltage circuit	
-High-tension spark plug wires	
-Spark plugs (construction)	
• Magnetic	
• Relecutor	
• Control unit	
• Distributor	

- c. Inspection and testing of ignition components
 - Pickup coil
 - Control unit
 - Ignition coil
 - Distributor cap
 - Rotor
- d. Diagnosis of ignition system problems
 - No spark at plugs
 - Weak or intermittent spark at plugs
 - Missing at idle or low speed
 - Missing during acceleration
 - Missing at all speeds
 - Coil failure
 - Shortened spark plug life
 - Pre-ignition
 - Detonation
 - Backfire in intake manifold
 - Backfire in exhaust manifold

2. Describe procedures to remove, service and install spark plugs and perform tuneups on gasoline engines. 30%

- a. Removal, servicing and installation of spark plugs
 - Spark plug construction
 - Spark plug types
 - Heat range
 - Removal procedures
 - Cleaning procedures
 - Inspections
 - Gapping
 - Testing
 - Installation procedures
- b. Tuneups on gasoline engines
 - Types
 - Testing procedures
 - Tuneup procedures
 - Tuneup intervals
 - Visual inspection of engine
 - Check of air intake system
 - Check of engine compression
 - Adjustment of ignition timing

Truck and Transport Mechanic

Unit: J1 Fuel System Fundamentals, Gasoline Fuel Systems and Alternative Fuels

Level: Three

Duration: 10 hours

Theory: 7 hours

Practical: 3 hours

Overview:

This unit of instruction is designed to provide the Truck and Transport Mechanic apprentice with an understanding of the various fuel characteristics (including alternative fuels), along with their appropriate applications. The unit also provides the working knowledge required to service and repair fuel system components.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe fuel types.	10%
a. Safety considerations	
b. Types of fuels	
• Gasoline	
• Diesel	
-Low and ultralow sulfur fuels	
• Alternative fuels	
-Liquefied petroleum gas	
-Compressed natural gas	
-Alcohol-based	
-Electric (Battery powered; Electric motor – gas turbine driven; Electric motor – hard-wire powered; Parallel hybrid)	
-Hydrogen	
c. Relative heat produced by various fuels	
• Gasoline	
• Diesel	
• Alternate fuels	
d. Advantages and disadvantages of various fuels	
• Gasoline	
• Diesel	
• Alternate fuels	
e. Characteristics of diesel fuel	
• Viscosity and volatility	
• Cetane number	
• Diesel fuel grades (summer / winter / API)	
• Distillation range	
• Heat value	
• Specific gravity testing	

- Flash point
- Pour point
- Sulphur
- Carbon residue
- Ash
- Fuel additives
- Interpretation of fuel specifications
- Storage and handling

2. Describe service and repair procedures for tanks, lines and filters, fuel pumps and delivery systems; describe fuel filters and their replacement. 20%

a. Tanks and lines

- Safety precautions for fuel tanks
 - Disconnection of negative battery
 - Danger of heating bolts on fuel tank
 - Appropriate disposal of used rags and fuel
 - Leaks in steel tubing
 - Fuel line fittings to torque specifications
 - Proper fuel transfer system
 - Static electricity precautions
- Fuel tank construction
 - Plated pressed steel, aluminum or molded plastic polyethylene
 - Baffles
 - Pick-up tubes
 - Passage for fuel transfer
 - Venting
 - Drain (optional)
 - Ridges
- Location and arrangement
 - Dual tanks
- Pressure and vacuum filler cap
 - Normal operating conditions
 - Pressure or vacuum conditions
 - Relief of vacuum pressure
- Venting of fuel tanks
 - Vapour separator
 - Vapour storage canister
 - Rollover protection (valve; inertia switch)
- Fuel re-circulating system
 - In-pump
 - In-line
- Fuel tank inspection
 - Fuel lines
 - Fuel leaks
 - Types
 - Fittings
 - Road damage
 - Corrosion
 - Rust
 - Loose
 - Defective seams
- Fuel tank removal and replacement procedures
- Fuel tank repair procedures
- Storage precautions: prevention of fuel contamination
- Fuel lines
 - Types
 - Fittings
 - Removal and installation procedures

- Repair procedures
- Crossover lines and valves
- b. Fuel filters and their replacement
 - Overall purpose and function
 - Types
 - Cartridge, canister
 - In-tank, in-carburetor filter
 - Pleated paper, screen
 - Stone or ceramic filter – sintered bronze
 - In-line filters
 - Primary filters
 - Secondary filters
 - Restriction indicator
 - Water indicator
 - Water separators
 - Limitation of filters
 - Location
 - Service procedures
 - Filling and bleeding procedures
 - Fuel heater and filter
 - Removal procedures
 - Design and testing
 - Installation procedures
 - Replacement precautions
 - Use of drain pan
 - Direction of flow and leaks in fuel line connections
 - Proper start of nuts threads
 - Importance of cleanliness
- c. Fuel pumps and delivery systems
 - Fuel tank sending units
 - Fuel charging/transfer pumps
 - Gear-type pumps
 - Hand primer pumps
 - Mechanical fuel pump
 - Intake and outlet strokes
 - Rest stroke (chamber full, needle valve closed)
 - Pulsation damper principles and operation
 - Check valve
 - Diaphragm and spring
 - Rocker arm and spring
 - Pulsator diaphragm
 - Pump body (valve and lower body)
 - Electrical fuel pump
 - Impeller – rotor type
 - Pulsating – bellows type
 - Diaphragm
 - Plunger
 - Demand-style fuel pumps (Operation; Purpose of inertia switch)

3. Diagnose problems in gasoline fuel systems; describe procedures to test, repair and service fuel pumps. 10%

- a. Fuel systems: diagnosis of problems
 - Low fuel pump pressure
 - High fuel pump pressure
 - Low fuel pump volume
 - Fuel pump leaks (fuel/oil)

- Fuel pump noise
 - Flooding
 - Choke malfunctioning
 - Hard starting
 - Loss of power
 - Poor economy
 - Poor idling
 - Poor acceleration
 - Fuel line restriction or leakage
 - Clogged fuel filters
 - Defective speed control linkage
- b. Procedures for testing, repairing and servicing fuel pumps
- Testing
 - Pressure
 - Vacuum
 - Delivery volume
 - Removal procedures
 - Disassembly of pump
 - Identification of parts
 - Reassembly procedures
 - Importance of cleanliness
 - Installation procedures
 - Priming a fuel system
 - Importance of refueling
 - Service intervals

4. Describe carbureted fuel systems.

20%

- a. Overall purpose.
- b. Principles of carburetion
- Venture effect
 - Atomization and evaporation
 - Vaporization
- c. Types of carburetors
- Single-barrel
 - Two-barrel
 - Four-barrel
 - Downdraft carburetor
 - Updraft carburetor
 - Side-draft carburetor
- d. Carbureted fuel system components
- Fuel tank
 - Fuel lines – metal tubing; flexible nylon; synthetic rubber hose
 - Fuel pump
 - Carburetor
 - Fuel filter
- e. Carburetor circuits
- Float circuit
 - Idle circuit
 - Low-speed circuit
 - High-speed circuit or main metering circuit
 - Acceleration circuit
 - Choke circuit

- f. Air-fuel ratio in varying conditions
 - Choke – 8:1
 - Idle – 14.7:1; pre-emission control 11:1
 - Cruise – 14:7:1
 - Full power 13:1
- g. Governors

5. Describe electronic fuel injection systems. 20%

- a. Advantages of an electronic fuel injection system
 - Increase fuel economy
 - Fewer emissions
- b. Types of fuel injection systems
 - Throttle body
 - Multiport
 - Central port
- c. EFI fuel delivery components
 - Fuel lines
 - Fuel rails
 - Fuel pressure regulators
 - Fuel injectors
 - Control computers

6. Describe air intake systems. 20%

- a. Intake system concepts
 - Principles
 - Control
 - Design
 - Intercoolers
 - Volumetric efficiency
 - Comparison of manifold vacuum to ported vacuum
- b. Intake system components
 - Air intake ductwork
 - Air cleaner assembly
 - Mounting precautions
 - Air filters
 - Principles
 - Types: paper and polyurethane
 - Intake manifold
 - Super chargers
 - Service precautions
 - Turbo chargers
 - Service precautions
 - Naturally aspirated
 - Positive filters
 - Pre-cleaners
 - After-coolers and inter-coolers
 - Pressure waves
- c. Intake manifold
 - Cast iron or aluminum
 - Condensation prevention
 - Assistance in vapourization
 - Attached sensor

- Tuned intake system
- d. Intake manifolds operating principles
 - Cold air
 - Hot air
 - Control
 - Distribution
 - Tuning
 - Variable induction
 - Tuned port induction

Truck and Transport Mechanic

Unit: J2 Diesel Fuel Injection, Engine Management and Exhaust Systems

Level: Three

Duration: 60 hours

Theory: 35 hours

Practical: 25 hours

Overview:

This unit of instruction is designed to provide the Truck and Transport Mechanic apprentice with the working knowledge required to understand, diagnose and repair diesel fuel injection systems, engine management systems, and emission control / exhaust systems.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define the fundamentals of diesel fuel injection systems, hydraulic injector nozzles, port helix metering injection pumps, injection pump components and charging pumps.	30%
a. Diesel fuel injection system fundamentals	
• Safety precautions	
• Fuel quality and workspace cleanliness	
• Timing and pressurizing	
• Metering	
• Distribution	
• Units of pressure and linear measurement	
• Key engine management objectives	
b. Delivery, injection and combustion	
• Overall description and purpose	
• Injection lag	
• Ignition lag	
• Combustion	
• Nozzle closure lag	
• Afterburn	
c. Injector nozzles	
• Overall purpose and types	
• Nozzle opening pressure	
• Poppet nozzles	
• Pintle nozzles	
-Action	
-Atomization	
• Orifice nozzles	
-Back leakage	
• Action	

- Peak pressure
- Nozzle differential ratio
 - Residual line pressure
- Nozzle holders/injectors
 - Pencil-type injector nozzles
- HEUI
- Injector cups
- d. Port helix metering injection pumps
 - Overall description and purpose
 - Technical description
 - Camshaft
 - Tappets
 - Barrel
 - Plunger design and metering
 - Delivery valve
 - High pressure pipes
- e. Injection pump components
 - Pump housing
 - Camshaft
 - Tappets
 - Barrel
 - Plunger
 - Rack and control sleeves
 - Delivery valves
 - Injection and fuel rate
 - Variable advance and variable timing systems
 - Governors
 - Overall function
 - Terminology
 - Mechanical governor (Limiting speed; Variable speed; Insynchronous)
 - Servo-type governor
 - Hydraulic governor (Direct; Indirect)
- f. Charging pumps
 - Charging pressure
 - Lubrication

2. Describe engine management system types, functions, components and operation; describe and perform engine management diagnostic and repair procedures. 50%

- a. Engine management system types
 - Full authority systems
 - Partial authority systems
- b. Engine control system functions
 - Control of timing and air and fuel ratios
 - Control of emission control devices
- c. Engine management system components
 - Input sensors
 - A/C
 - Brake switch
 - Barometric pressure
 - ECT
 - Camshaft position
 - EGR diagnostic switch
 - EGR valve position sensor
 - Engine speed
 - Feedback pressure EGR sensor
 - Heated windshield module

- High gear switch
- Intake air temperature
- Knock sensor
- MAP sensor
- MAF sensor
- Neutral drive and gear switch
- Oxygen sensors
- Power steering switch
- System battery voltage
- Throttle position sensor
- Vehicle speed sensor
- Actuator (output)
 - Air management solenoids
 - EVAP valve
 - EGR flow solenoids
 - Fuel injectors
 - Idle speed controls
 - Ignition module
 - Mixture control solenoids
 - Motors and lights
 - Other solenoids
 - Warning indicators
- d. Engine management system operation
 - Computer and PCM (data processor)
 - Computer logic
 - System adaptive strategy
 - Look-up tables
 - Basic purpose of control loops
 - PCM's role in diagnostics
 - Closed vs. open loop mode
 - Fail safe or limp-in mode
 - Spark control systems
 - Fuel control systems
 - Emission control system (OBD II Standards)
 - Catalyst efficiency monitor
 - Engine misfire monitor
 - Fuel system monitor
 - Heated exhaust gas oxygen sensor monitor
 - Evaporative system monitor
 - Secondary air injection monitor
- e. Diagnostic and repair procedures
 - Understanding system's capabilities
 - Use of knowledge, logic and system together
 - Logical diagnosis
 - Flow chart as per manufacturers' specs
 - Likely to most unlikely cause
 - Consideration of all factors before final conclusion
 - Non-electronic check prior to electronic control check
 - Input sensors and wiring check first, then output devices, then computer
 - Visual inspection
 - Ground circuit check with voltage drop test
 - Ohmmeter and voltmeter checks
 - Lab scope checks
 - Vehicle's service history and TSBs
 - Compression, ignition system and air/fuel system
 - Intermittent faults
 - Service bulletin information

- Preliminary system checks
- Malfunction indicator lamp (MIL)
 - System check if MIL on while engine running
 - Flashing light

3. Describe emissions, emissions testing and controls; describe emission control system components, testing and operation; describe procedures to repair, replace and adjust emission components; describe exhaust systems, air filtration and exhaust system problems; describe and service exhaust system components. 20%

a. Emissions

- Overall description and purpose
- Overall context of emissions legislation
- Photochemical smog
 - Sulfur dioxide
 - Hydrocarbons
 - Ingredients
- Hydrocarbons
- Volatile organic compounds
- Carbon monoxide (CO)
- Ozone
- Oxides and nitrous oxides

b. Emission testing and controls

- Opacity meter
 - Constant volume sampling
- Current emission controls
 - ECM inputs
 - Management of combustion temperatures
 - Aneroid or fuel-ratio control (Helix-metering injection pumps)
 - Particulate traps
 - Reduction of SAC volume
 - Cooling of intake air
 - Variable geometry turbochargers
 - Exhaust gas recirculation
 - Oxidation catalytic converters
 - Cerium dioxide combustion catalyst
 - Physical entrapments of particulates
 - Gas analyzers

c. Vehicle emission control system components

- Key components
 - PCV valve
 - EGR valve
 - Air pump
 - Catalytic converter
- Fuel evaporator
 - Sealed gas cap
 - Vent line
 - Pressure and vacuum valve
 - Tank air dome
- Vacuum hoses
- Heated air intake
 - Thermostatic air cleaner system (Air inlet temperature)
 - Thermal valve
 - Vacuum motor
 - Air control door
 - Exhaust manifold shroud

d. Emission control system operation

- Engine modifications
 - Lower compression ratio

- Leaner air-fuel mixtures
- Heated intake manifolds
- Smaller combustion chamber surface
- Increased valve overlap
- Hardened valves and seats
- Wider spark plug gaps
- Reduced quench areas
- Higher operating temperatures
- Effects of emission equipment on oil drainage intervals
- Vehicle emission control systems
 - Positive Crankcase Ventilation (PCV) system
 - Heated air inlet system (Thermostatic air control)
 - Fuel evaporation control system (Closed vent)
 - Exhaust Gas Recirculation (EGR) system
 - Air injection system (Air pump)
 - Catalytic converter (Thermal reactor)
- e. Emission control system testing
 - Exhaust analyzer (Problems: carburetor, fuel injection, engine)
 - Vacuum system
 - Leaks
 - Ignition system
 - Exhaust gases
 - Hydrocarbon readings
 - Carbon monoxide readings
 - Carbon dioxide readings
 - Inspections
 - Rough idle
 - PCV testing
 - Paper test
 - Heated air inlet test
 - EGR test
 - Air injection test
 - Catalytic converter test
 - Manufacturers' specifications
- f. Emission component repair, replacement and adjustment procedures
 - Repairs
 - Procedures
 - Manufacturers' specs
 - Component replacement
 - Procedures
 - Testing Manufacturers' specs
- g. Exhaust systems
 - Manifolds
 - Mufflers and resonators
 - Reverse and through flow
 - Heat riser valve and operation (Butterfly valve; Thermostatic spring operated; Vacuum operated)
 - Pipes, supports, clamps
 - Rain trap
 - Spark arrestors
 - Oxygen sensors
 - Exhaust problems
- h. Air filtration and exhaust system problems
 - Air flow restricted
 - Air intake leaks
 - Checking of intake restriction
 - Excessive crankcase pressure

- Exhaust system leaks and restrictions
- Abnormal exhaust noise
- Pressure management methods
- i. Servicing of exhaust system components
 - Tools and sealers
 - Alignment
 - Removal procedures
 - Muffler
 - Rain trap
 - Exhaust manifold
 - Torquing of bolts to defined specifications
 - Proper alignment of mating parts
 - System checks for leaks and/or restrictions
 - Safety precautions (carbon monoxide)
 - Check operation of heat control valve (if applicable)
 - Installation procedures
