MPO-0100 SAFETY IN THE SHOP

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 1.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to identify procedures for the maintenance of a safe and clean work environment and proper fire extinguishing procedures. Course material includes:

- fire hazards
- fire extinguishers
- ventilation
- safe working habits
- explosion hazards

Prerequisites:

None

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- identify potential fire and explosion hazards
- demonstrate an understanding of safe work habits

Required Knowledge and Skills:

1. Describe potential fire hazards.
    - fire hazards: classification of fire types; purpose and use of fire extinguishers.
    - explosion hazards: spontaneous combustion; storage and handling of fuels
    - ventilation and hazardous gases: carbon monoxide, storage batteries

2. Describe safe working habits.
    - personal hazards
    - good housekeeping practices
    - reporting injuries

3. Describe explosion hazards.
   - recognize and prevent explosion hazards

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Classroom exercises as determined by the instructor

MPO-1105 GASKETS, SEALS AND SEALERS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 6 & 7.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to use gaskets, seals and sealing compounds. Course material includes:

- gaskets, o-rings, seals
- purpose
- installation
- sealing compounds

Prerequisites:

MPO-0100

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- identify types of gaskets, o-rings, seals and sealing compounds

Required Knowledge and Skills:

1. Describe types of gaskets, o-rings, seals and sealing compounds and their purposes.
    - gaskets
        - type and construction
        - purpose
        - installation
    - o-rings
        - types
        - limitations
        - installations
    - seals
        - types
        - installation

- sealing compounds
    - Room Temperature Vulcanizing (RTV)
    - anaerobic

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Classroom exercises as determined by the instructor

MPO-1110 GMAW (MIG) WELDING

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 16.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to describe the basic (GMAW) MIG welding process use MIG welding equipment. Course material includes:

- equipment used
- procedures
- advantages
- cautions

Prerequisites:

MPO-0100

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- demonstrate an understanding of basic welding procedures using the GMAW process

Required Knowledge and Skills:

1. Explain how to operate MIG welding equipment to industrial safety standards as needed for various motorized equipment.
    - equipment
    - shielding
    - filler wire
    - basic process
    - advantages
    - types
    - proper penetration
    - electrical system cautions
        - location of ground cables

    - possible bearing damage from welding
    - possible computer and electrical accessory damage from welding
    - procedures to prevent electrical and bearing damage
- set up and shut down procedures

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- set-up and shut down equipment
- perform basic welding on sheet metal

MPO-1115 OXY-FUEL WELDING

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 16.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to identify procedures for the safe and effective set up and operation of oxy-fuel equipment for heating, cutting and braze welding. Course material includes:

- equipment
- safety
- procedures
- braze welding
- cutting

Prerequisites:

MPO-0100

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- demonstrate basic welding and cutting procedures using the oxy-fuel process

Required Knowledge and Skills:

1. Explain how to operate oxy-fuel heating and cutting equipment to industrial safety standards for the removal and/or installation of parts.
    - safety precautions
        - safety apparel
        - storage and handling of welding gases
        - pre-operational inspection
    - equipment set-up
        - cylinders
        - gauges
        - regulators
        - valves-flame arrestor

        - torches and tips
        - hoses
        - testing for leaks
    - torch operation
        - lighting procedures
        - types of flame (adjustment)
        - shutting down procedures

2. Demonstrate braze welding using oxy-acetylene equipment.
    - braze welding

3. Demonstrate flame cutting with oxy-acetylene equipment.
    - flame cutting
        - cutting torch and tips
        - use of cutting torch

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- perform flame cutting
- perform braze welding

MPO-1125 ELECTRICAL & ELECTRONIC BASIC PRINCIPLES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 41, 42, 43 & 44.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to apply basic electrical and electronic principles. Course material include :

- safety
- procedures
- circuits
- testing
- electronic components

Prerequisites:

MPO-0100

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- understand basic electrical and electronic principles

Required Knowledge and Skills:

1. Describe basic electrical principles.
    - safety practices and procedures working with electrical equipment
    - terminology (abbreviations and glossary of electrical terms)
    - sources of electricity
        - generation of electricity
        - use of chemical, magnetic, heat, light and DC power supply
        - theory and laws of electricity
        - theory and laws of magnetism and inductance
    - Ohms Law (volts, ohms and amperes)
    - symbols and schematics (common automotive symbols)

- read schematics/wiring diagrams

2. Explain how to apply electrical principles using Ohms law to calculate volts, ohms and amperes.
   - series circuit
   - parallel circuit
   - series and parallel circuit

3. Describe instruments to test components of series, parallel and series parallel circuits to determine cause of malfunctions in an electrical circuit.
   - circuit testing devices
     - applications of volt, ohm and ampmeters
     - meter ranges
     - correct hookup of meters
     - test lights, circuit breakers
   - circuit problems and testing problems
     - short, open and grounds
     - diagnostic trouble-shooting procedures
     - testing procedures and equipment

4. Identify electronic components.
   - wires and terminals
     - types and sizes
     - terminals and connectors
     - conductors, semi-conductors and insulators
   - fibre optics
     - basics
   - capacitors
     - construction
     - purpose
     - uses
   - resistors
     - identification
     - purpose
     - uses
   - transistors
     - identification
     - purpose
     - uses
   - diodes
     - identification
     - purpose
     - uses
   - relays and switching devices
     - identification

- purpose
- uses

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- test components of series, parallel and series parallel circuits to determine the cause of malfunctions in an electrical circuit
- repair wiring and connectors

ODS-0100 OZONE DEPLETING SUBSTANCES (Optional)

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis.

Description:

This course is designed to provide the apprentice with the knowledge and skills on the requirements to legally handle ozone depleting substances (refrigerants) used in motor vehicles. Course material includes:

- regulation
- types of substances
- procedures

Prerequisites:

None

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- legally handle ozone depleting substances (refrigerants)

Required Knowledge and Skills:

1. Curriculum and certification supplied by HRAI to be delivered by instructors certified to teach ODS courses for Motive Power Occupations.

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Classroom exercises as determined by the instructor

MPO-1130 MOTIVE POWER COMPUTERS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 18.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to diagnose and/or repair/reprogram motive power computers. Course material includes:

- operation
- safety precautions
- tools and devices
- procedures
- tests

Prerequisites:

MPO-1125

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- understand the operation of computers in motive power equipment

Required Knowledge and Skills:

1. Explain the basic operation of computers.
    - rationale (reasons for using electronic controls)
        - more accurate control
        - less change in emissions and performance with accumulated mileage
    - basic computer systems
        - computers (compared to brain)
        - inputs (information to brain)
        - outputs (commands from brain)
    - computer operation
        - basic CPU
        - types of memory (RAM, ROM, PROM, EEPROM)

    - input and output interfaces
    - clock speed
    - feeds (power) and grounds for computers
- input circuits
    - discreet inputs
    - analogue inputs
    - 2-wire sensor systems
    - 3-wire sensor systems
- output circuits
    - high side and low side control of circuits
    - Pulse Width Modulation (PWM)
    - current limiting protection in newer computers versus burn-out of older units with no self-protection
- sensing devices
    - switches
    - thermistors
    - potentiometers
    - pressure sensors
    - permanent magnet (PM) generators
    - hall effect switches
    - LED operated
    - knock sensors
- feedback systems
    - open loop versus closed loop operation
    - oxygen sensors
- adaptative learning
    - purpose for adaptative strategies of computer systems
    - short-term versus long-term memories
    - ways of describing variation - counts or percentages
    - conditions versus commands - what does 115 integrator counts or long-term fuel trim of 110% mean.
- output systems
    - solenoids - on-off and PWM
    - relays
    - stepper motors
    - lights
    - trouble codes and diagnostic information

2. Explain how and why computers are used to control vehicle systems.
    - electrical and electronic fundamentals

3. Demonstrate safety precautions associated with computers and electronics components.
    - construction and programmability of computers
    - original PROMS and knock sensor calibrators

- programming of reprogrammable type before use

4. Describe scan tools and their operation.
    - scan tools
        - test circuitry for operation and defects
        - clear codes
        - road test with scanners and data recorders
    - understand J 1930 technology
    - test computer output sensors
        - solenoids/on off and PWM
        - relays
        - stepper motors
        - lights
        - trouble codes and diagnostic information
    - sensing devices
    - wiring diagrams
        - power and ground wiring and connectors
        - proper procedure for testing
    - use of logical approach to diagnosis
        - verify complaint
        - preliminary checks (visual, operational, and other systems)
        - diagnostic systems check (check operational of mil)
        - check for service bulletins
        - check for Diagnostic Trouble Codes (DTCs)
        - use symptoms diagnostic charts
        - repair and verify operation
    - diagnostic tools
        - shop manuals and other printed or electronic service information
        - digital VOM
        - various test lights - 12 volt - noid
        - pressure gauges
        - injector testers
        - test connector sets (for testing weatherproof terminal circuits)
    - specific tests
        - precautions with static electricity
        - diagnostic system check
        - computer feeds and grounds - voltage drops
        - scan tools to check inputs
        - VOM and oscilloscopes to check inputs
        - snap-shot functions in scan tools
        - fuel injector balance tests and current tests
        - fuel pump output tests

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Diagnose computerized vehicle control systems

MPO-0120 HYDRAULIC BASIC PRINCIPLES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 4, 45, 46, 47, 48, 49, 50, 57 & 60.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to apply basic hydraulic principles by using Pascal's Law to calculate force and fluid pressure as applied to motive powered equipment. Course material includes:

- principles
- components and systems
- symbols and diagrams
- safety

Prerequisites:

None

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- identify basic hydraulic components and systems and their applications
- interpret and use hydraulic symbols and diagrams
- identify safety practices when working around hydraulic fluid

Required Knowledge and Skills:

1. Describe basic hydraulic principles in a shop environment.
    - definition of Pascal's Law
    - multiplication of force
    - formulas to calculate area, pressure, force
    - Bernoulli's principle
    - advantages of hydraulic systems
    - hydrodynamics
    - hydrostatic
    - types of properties of hydraulic fluid

        - viscosity
        - friction
        - flow
        - volume
        - velocity
        - laminar
        - pressure
        - imperial
        - metric
    - force
    - energy
    - work
    - power
    - torque
    - pressure gauge
    - absolute pressure

2. Identify basic hydraulic components and systems and their applications.
    - basic hydraulic components
        - pump
        - hydraulic actuator
            - linear
            - rotary
        - pressure control valve
        - directional control valve
        - volume control valve
        - reservoir
        - hoses
    - types of hydraulic systems
        - open-centre
        - close-centre
        - advantages and disadvantages of different systems

3. Interpret and use hydraulic symbols and diagrams.
    - recognize symbols commonly used in hydraulic diagrams
    - interpretation of schematics and diagrams
        pictorial drawing
        - cutaway drawing
        - symbol drawing
        - exploded views

4. Identify safety practices when working around hydraulic fluid.
    - blocking prior to removal (procedures)
    - releasing system pressure

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Classroom activities as determined by the instructor

IMP-0135 SERVICE INFORMATION SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 11 & 13.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to select and use different types of service manuals for Heavy Duty Equipment Technician and Truck and Transport Mechanic occupations.

Prerequisites:

None

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- select and use various types of service information systems.

Required Knowledge and Skills:

1. Explain how to use an operator's manual.
   - methods of using
   - interpretation of sections

2. Explain how to use maintenance and lubrication manuals.
   - methods of using
   - interpretation of sections

3. Explain how to use a service manual.
   - methods of using
   - interpretation of sections

4. Explain how to use a parts manual.
   - methods of using
   - interpretation of sections

5. Describe special bulletins.
    - methods of using
    - purpose
    - interpretation
    - introduction to computers
        - computerized parts information
        - computerized service and repair information

6. Demonstrate computerized information systems.
    - work order
        - complaint
        - cause
        - correction
    - warranty claims
    - time ticket
    - tracking procedures
    - computerized info system
    - electronic service

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- locate the serial number of a vehicle on the following items:
    - chassis
    - motor
    - transmission
- using the appropriate manual, find the type and amount of hydraulic oil recommended
- using the appropriate manual, find the step-by-step removal procedure of the engine and transmission
- using the appropriate manual, make a parts list of a cylinder head

IMP-1140 HAND TOOLS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 3.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to use and maintain hand tools. Course material includes:

- types
- proper use
- care
- safety

Prerequisites:

MPO-0100, IMP-0135

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- select, use and maintain various hand tools

Required Knowledge and Skills:

1. Describe how to use and maintain hand tools.
    - screwdrivers
        - standard
        - Phillips
        - Robertson
        - torex
    - reconditioning procedures
    - correct use and care
        - reed and prince
        - offset
        - stubby
        - screw starters
        - pliers

        - combination
        - gripping
        - cutting
        - vise-grips
        - snap ring
        - needle nose
- hose clamp
        - proper use and care
- wrenches
        - open-end
        - box ends
        - ratcheting box ends
        - flex-head box ends
        - obstruction wrenches
        - striking wrenches
        - special-purpose box wrenches
        - adjustable wrenches
        - pipe wrenches
        - spanner wrenches
        - Allen & multi spline wrenches
                - recognition of sizes (imperial and metric)
                - proper use and care
- sockets and drives
        - drive sizes
        - socket points
        - deep sockets
        - flexible sockets
        - impact sockets
        - drive handle
        - ratchet
        - universal joint
        - adapters
        - extensions
        - speed handles
        - recognition of sizes (imperial and metric)
        - proper use and care
- hammers
        - ball peen hammer
        - cross peen hammer
        - plastic tip hammer
        - brass-headed hammer
        - rubber mallet hammer
        - dead blow hammer
        - sledgehammer
- hammer handles

        - installation procedures
        - proper use and care
    - punches
        - starting punch
        - pin punch
        - centre punch
        - aligning punch
        - reconditioning procedures
        - proper use and care
    - torque wrenches
        - types
        - sizes
        - purpose
        - proper use and care
    - torque multiplier
    - torque rods (stick)

2. Describe how to use and maintain cutting tools.
    - chisels
        - flat chisel
        - cape chisel
        - round nose cape chisel
        - diamond point chisel
        - rivet buster chisel
    - chisel holder
    - reconditioning procedures
    - proper use and care
    - hacksaws
        - types and designs
        - blade classification and selection
        - proper use and care
    - files
        - types and designs
        - file handle
        - file card
        - proper use and care
    - twist drills
        - types and designs
        - sharpening procedures
        - recognition of sizes (imperial and metric)
        - proper use and care
    - taps
        - taper taps
        - plug taps
        - bottoming taps

    - recognition of sizes (imperial and metric)
    - tap handle
    - proper use and care
- dies
    - types
    - recognition of sizes (imperial and metric)
    - dies stock
    - proper use and care
- thread restorers
    - types and designs
    - proper use and care

3. Describe how to use and maintain measuring tools.
    - steel rules and squares
    - calipers
    - micrometers
    - dial indicators
    - small hole gauge
    - telescoping gauge
    - vernier calipers
    - protractors
    - dividers
    - wire gauge
    - drill gauge
    - screw pitch gauge
    - feeler gauge
    - proper use and care

4. Describe how to use and maintain miscellaneous tools.
    - stud extractors
    - bushing and seal drivers
    - magnetic pickup tools
    - mechanical pickup tools
    - inspection mirrors
    - stamping sets
    - stethoscope

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- bench work projects to include the use of common hand tools, metal cutting, filing, measuring, drilling, tapping, threading and broken stud removal
- sharpen a twist drill

IMP-1145 SHOP TOOLS & EQUIPMENT

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 4.

Description:

This course is designed to give the apprentices the knowledge and skills necessary to use and maintain shop tools and equipment. Course material includes:

- types
- proper use
- care
- safety

Prerequisites:

IMP-1140

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- select, use and maintain shop tools and equipment

Required Knowledge and Skills:

1. Describe how to use and maintain shop tools.
    - power tools
        - impact wrenches
        - hand impact wrenches
        - air ratchet
        - air chisels
        - air hammers
        - electric impact wrenches
    - electric drills
    - air drills
    - air lines
    - air nozzles
    - air regulators

- face shield
- safety goggles
- drill press
- hydraulic press
- floor jacks
- hand jack
- transmission jack
- portable crane
- overhead crane
- hoist crane safety standards
- chain hoist
- hoists
- safety stands
- lifting cables, slings and chains
- cleaning equipment
    - solvent washers
    - pressure washers

2. Describe how to use and maintain shop equipment.
    - bench grinders
    - portable grinders
    - grinding wheels
    - grinder accessories
        - wire wheels
        - wheel dressers
        - eye shields
        - pedestal
    - pullers
        - gear and bearing pullers
        - slide hammer pullers
        - steering pullers
        - blind hole pullers
        - puller attachments
        - bench vises
        - vise jaw covers
        - extension lights
        - creepers

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- raise a vehicle, blocking it using safety stand and cross blocking
- wash a vehicle or a component with pressure washer equipment

IMP-1150 FASTENERS, TUBINGS & FITTINGS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 5 & 6.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to select and use common fasteners, tubing and fittings found in Heavy Duty Equipment Technician and Truck and Transport Mechanic occupations. Course material includes:

- fastening devices
- tubes and hoses
- fittings
- flaring tools

Prerequisites:

IMP-1140

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- use fasteners.
- use different types of tubing and hoses.
- use different types of fittings.
- use flaring tools.

Required Knowledge and Skills:

1. Describe how to select and use fasteners.
    - bolts
    - capscrews
    - nuts
    - studs
    - threads classification
        - imperial and metric
    - grade markings

- theory of torquing
- torquing pattern
- torque chart
- washers
    - flat washer
    - lock washer
    - external spring washer
    - internal spring washer
- machines screws
- sheet metal screws
- self tapping screws
- keys and pins
    - woodruff keys
    - square keys
    - cotter pins
    - spring pins
    - tapered pins
    - clevis pins
- locking devices
    - functions
    - types
- liquid compounds
    - lock-type compounds
    - anti-seizure compounds

2. Describe how to select and use different types of tubing and hoses.
    - steel tubing
    - copper tubing
    - plastic tubing
    - rubber tubing
    - recognition of sizes

3. Describe how to select and use different types of fittings.
    - types of low pressure fittings
    - types of flares
    - types of threads
    - torque limitation of fitting
    - thread sealers

4. Describe how to select and use flaring tools.
    - flaring tool kit
    - iso flaring
    - tubing cutter
    - deburring tool
    - tubing bender

- tubing wrenches
- cutting, bending and flaring procedures

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- cut, flare, bend and connect copper and steel tubing
- use fasteners, tubing and fasteners as directed by the instructor

IMP-1155 LUBRICATION & FLUIDS SERVICING

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 10, 19, 28, 29, 32, 34 & 35.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to perform engine oil and filter changes, chassis lubrication and service automatic lubrication systems. Course material includes:

- types
- equipment
- specifications
- disposal

Prerequisites:

IMP-1150

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- change engine oil and filter
- lubricate vehicle's chassis

Required Knowledge and Skills:

1. Describe how to select and use different types of oil.
    - classification
        - API
        - SAE
    - viscosity
    - additives
    - function
    - selection
    - recognition of contaminated fluid
    - hydraulic oil

    - function
    - classification
    - selection
- gear oil
    - function
    - classification
    - selection

2. Describe how to change engine oil.
    - procedures for draining the oil
    - precautions with hot oil
    - cleaning drain plug
    - filling procedures
    - importance of cleanliness
    - checking oil level
    - proper torque of drain plug
    - storage of used oil

3. Describe how to change engine oil filter
    - construction of filter
    - types of filter
    - selection of filter
    - oil filter removal
    - oil filter seals
    - importance of cleanliness

4. Demonstrate how to start and run engines
    - check for oil leaks
    - check engine oil pressure
    - check oil level

5. Explain how to select and use different types of grease
    - properties of grease
        - function
        - classification
        - selection
    - types of grease
        - wheel bearing grease
        - universal joint grease
        - chassis grease
        - high temperature grease
        - multipurpose grease

6. Explain how to lubricate vehicle's chassis
    - grease gun (hand and air)

- lubrication lines
- grease fitting
- refilling the grease gun
- grease gun adapters
- oilers
- storage and handling grease
- lubricating charts

7. Explain how to repair and service automatic lubrication systems.
    - types of systems
    - purpose
    - systems operations
        - reservoir
        - lubrication points
        - lubrication lines
        - regulator function
    - warning malfunction
    - reservoir refilling
    - procedures to repair hoses and fittings

8. Describe disposal of used lubricants.
    - environmental issues
    - health issues
    - filter crushers

9. Describe oil analysis.
    - contamination of sample
    - interpretation of analysis
    - identification of contaminants
    - collection of specimen

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- change engine oil and filter on a vehicle
- perform a complete lubrication service on a vehicle
- check fluid level on vehicle's components

IMP-1160 ARC WELDING

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 16.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to set up arc welding equipment and perform basic arc welding with SMAW process.

Prerequisites:

IMP-1145

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- set up SMAW equipment
- strike an arc and run stringer beads using the SMAW process
- perform basic arc welding using the SMAW process

Required Knowledge and Skills:

1. Discuss safety rules with arc welding.
    - proper ventilation
    - rays
        - ultraviolet
        - infrared
    - danger of high voltage
    - danger of damp areas

2. Explain how to use electric arc welding equipment.
    - types of welding machines
        - generators
        - transformer
        - rectifiers
    - electrodes holder
    - ground clamp

- protective shield
- welder's clothing
- cables
- chipping hammer
- plasma arc

3. Describe different types of electrodes.
   - AWS
   - ASTM
   - classification
     - E-6011
     - E-7018
   - selecting the electrode
     - quality of weld requirement
     - weld position
     - joint design
     - welding speed
     - composition of base metal
     - storing the electrodes

4. Discuss personal protective equipment used to arc weld.
   - wear goggles
   - head shield or helmet
   - gloves
   - aprons
   - shoes

5. Demonstrate how to set up welding equipment.
   - safety precautions
     - safety equipment
     - electrical connection
     - properly grounded machine
   - procedures to set the current

6. Demonstrate how to strike an arc and run stringer beads.
   - starting the arc
   - length of arc
   - travel speed
   - forming the crater
   - types of joints
   - cleaning metals to be welded
   - angle of electrode

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- strike and maintain an arc
- fillet weld flat position

IMP-1165 HYDRAULIC BRAKES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 59 & 60.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, disassemble, repair, assemble and install hydraulic brake systems and components used in the Heavy Duty Equipment Technician and Truck and Transport Mechanic occupations.

Prerequisites:

MPO-0120, IMP-1155

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- remove, repair and replace components of hydraulic brakes systems
- remove type brakes
- replace parking brakes
- bleed brake systems
- diagnose hydraulic brake problems

Required Knowledge and Skills:

1. Describe procedures to remove, repair and replace master cylinders.
    - fundamentals of brake systems
        - kinetic energy
        - heat
        - friction
        - coefficient of friction
        - heat dissipation
        - hydraulic principles
        - action of primary and secondary shoe
        - servo brakes
    - types of master cylinders

- removal and installation procedures
- identifications of parts
- cleaning procedures
- repair procedures
- bleeding of the master cylinder
- adjust brake pedal free play
- types and function of hydraulic valves
    - proportional valve
    - metering valve
    - brake warning switch
    - combination valve

2. Describe procedures to remove, repair and replace drum type brakes.
    - removal and installation of brake drum
    - removal of brake shoes
    - lining condition and wear
    - brake shoe arc
    - method of attaching lining to shoe
    - lubrication
    - adjustments
        - minor and major
    - measure drum for wear
    - machine drum
    - self-adjusting brakes
    - automatic star wheels
    - return springs
    - identification of primary and secondary shoe
    - backing plate

3. Describe procedures to remove, repair and replace wheel cylinders.
    - types of wheel cylinders
    - removal and installation procedures
    - identification of parts
    - cleaning procedures
    - repair procedures
    - bleeding the system

4. Describe procedures to remove, repair and replace disc type brakes.
    - operating principle
    - types
    - component identification
    - removal and installation of brake disc
    - removal and installation of caliper
    - recondition caliper
    - check brake pad wear and contamination

- measure disc wear
- machine brake disc

5. Describe procedures to remove, repair and replace parking brakes.
   - lever and fulcrum theory
   - mechanical advantage
   - application
   - types and designs
     - external band
     - internal shoe
     - drive shaft type
     - wheel type
   - parking brake lock mechanism
   - adjustment

6. Describe procedures to remove, repair and replace brake lines.
   - brake lines
   - fittings
   - repair and replacement procedures
   - safety rules to follow

7. Describe procedures to bleed brake systems.
   - types of fluids
   - properties of fluids
   - replacement of fluids
   - bleeding methods
     - pressure
     - gravity
     - procedures for bleeding
   - power boosters
     - hydraulic boost
     - vacuum

8. Diagnose hydraulic brake problems.
   procedures to diagnose hydraulic brakes problems
   - brake pedal goes to floorboard
   - one brake drag
   - all brake drag
   - vehicle pulls to one side
   - soft or spongy pedal
   - poor braking action
   - brakes too sensitive
   - noisy brakes
   - air in system
   - loss of brake fluid

- brakes do not self-adjust
- warning light comes on

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, repair and assemble a master cylinder
- disassemble, repair and assemble drum brakes
- disassemble, repair and assemble disc brakes
- machine drum and rotor

IMP-1170 AIR BRAKES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 53, 54, 55, 59 & 61.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, disassemble, repair, assemble and install air brake systems and components used in the Heavy Duty Equipment Technician and Truck and Transport Mechanic occupations.

Prerequisites:

IMP-1165

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service components of air brakes systems
- service air dryers
- service air over hydraulic chambers
- diagnose air brake problems

Required Knowledge and Skills:

1. Describe procedures to remove, repair and replace air compressors
    - fundamentals of air brake systems
    - air as a force multiplier
    - major components of air brakes systems and functions
        - compressor
        - reservoir
        - valves
        - brake chamber
        - brake shoes and drums
        - indicator and warning devices
    - compressors
        - types
        - classifications

    - operating principles
  - removal and replacement procedures
  - repair procedures
  - maintenance
  - troubleshooting

2. Describe procedures to remove, service and install reservoirs.
  - types
    - dry
    - wet
    - Purpose
    - Classification
    - Safety valves
    - Repair procedures and caution

3. Describe procedures to disassemble, repair and assemble air valves.
  - operating principles of the following valves
    - foot valve
    - quick release valve
    - relay valve
    - hand valve
    - limiting valve
    - tractor protection valve
    - automatic reservoir drain valve
    - check valve (single and double)
  - repair procedures

4. Describe procedures to inspect, repair or replace air chambers.
  - brake chamber
    - types and designs
    - functions
    - inter-relationship of mechanical components
    - principle of operations
    - adjustment methods and limitations
    - reconditioning procedures and precautions

5. Describe procedures to remove, repair and install drum type brakes.
  - types
    - cam
    - wedge
  - removal and installation procedures of brake drum
  - removal of brake shoes
  - check lining condition and wear
  - sequence of bolting the brake lining to shoe
  - installation procedures of brake shoe to backing plate

- lubrication

6. Describe procedures to remove, service and install slack adjusters.
   - types
     - manual
     - automatic
   - operation
     - servicing
     - adjustment procedures

7. Describe procedures to service air dryers.
   - types
     - air dryer
     - alcohol evaporators
     - purpose
     - service procedures

8. Describe procedures to remove, repair and install air over hydraulic chambers.
   - air over hydraulic brakes
     - types and designs
     - principles of operation
     - recognition and function of major components
     - service procedures
     - cylinder reconditioning precautions
     - relationship to other hydraulic systems
     - repair procedures and caution
     - adjustments
   - brake accumulator
   - purpose
   - types
   - precautions

9. Diagnose air brake problems.
   - procedures to diagnose air brakes problems
   - reservoir leaking or water accumulation
   - low or high air pressure
   - frozen air lines
   - camshaft and bushing wear
   - poor braking performance, etc.

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities.

- disassemble, repair and assemble air compressors
- disassemble, repair and assemble air valves
- disassemble, repair and assemble drum and disc brakes
- disassemble, repair and assemble air-packed (air over hydraulic unit)

IMP-1175 ENGINE BRAKES AND RETARDERS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service, repair and adjust engine brakes and retarders.

Prerequisites:

IMP-1170

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service and adjust engine brakes and retarders

Required Knowledge and Skills:

1. Describe procedures to inspect, repair and adjust engine brakes.
    - purpose of engine brakes
        - types
        - operation
        - components
        - electric circuit
    - exhaust system compression brakes
        - types
        - operation
        - components
    - maintenance recommendations
        - testing procedures
        - adjustment procedures
        - troubleshooting

2. Describe procedures to inspect, repair and adjust retarders
    - types
    - operation
    - components
        - hydraulic and electric circuits

3. Diagnose engine brakes and retarder problems.
    - maintenance recommendations
    - testing procedures
    - troubleshooting

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- service and adjust engine brakes and retarders

IMP-1180 DRIVE LINES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 8 & 30.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, repair and install drive lines used in the Heavy Duty Equipment Technician and Truck and Transport Mechanic occupations.

Prerequisites:

IMP-1155

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose drive shaft problems
- service drive lines components

Required Knowledge and Skills:

1. Describe procedures to remove, repair and install drive lines.
    - purpose of drive lines
    - types of drive lines
        - hotchkiss
        - rubber element
        - two-piece
    - construction details
        - provision for balance
        - provision for variation in length
    - removal and installation procedures

2. Describe procedures to remove and install universal joint.
    - purpose of universal joints
    - types
        - cross and roller
        - constant-velocity

- limitations of U-joints
- removal and installation procedures
- provision for lubrication
- journal cross phasing
- shaft alignment
- shaft balancing

3. Describe procedures to remove and install centre support bearings.
   - purpose
   - types

4. Diagnose drive shaft problems.
   - procedures to diagnose faulty drive lines
   - vibrations
   - out of phasing
   - out of balance
   - angles limitations
   - common failures
   - manufacturer's specifications

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove and replace drive shaft, check phasing, alignment and shaft angle
- remove, service and install universal joint

IMP-1185 ENGINE PRINCIPLES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 18.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to be familiar with internal combustion engines and components.

Prerequisites:

IMP-1155

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:

- demonstrate knowledge of the operation of all major parts and their purpose within engines.

Required Knowledge and Skills:

1. Identify and describe the components of engines.
    - engine operating theory
        - matter
        - mass
        - energy
        - inertia
        - force
        - momentum
        - torque
        - work
        - mechanical power
        - friction
        - combustion
        - atmospheric pressure
        - vacuum
        - laws of gases
            - Boyle’s law

        - Charlie's law

2. Describe the operation of all major parts and their purpose within the engine.
    - principle of engine operation
        - stroke
        - bore
        - throw
        - top-dead centre
        - bottom-dead centre
        - valve timing (diagram)
        - firing order
        - compression ratio
        - volumetric efficiency
        - mechanical efficiency
        - reciprocating and rotating movement
        - piston displacement
        - clearance volume
        - total volume
        - scavenging
        - engine clutches
        - 2 strokes
        - 4 strokes
    - horsepower
        - indicated HP
        - friction HP
        - flywheel or brake HP
        - drawbar HP
        - power take-off HP
        - rated HP
    - engine support system
        - cooling
        - lubrication
        - fuel
        - air intake
        - exhaust
    - cylinder head
    - valves
    - valve train
    - camshaft
    - cylinder block
    - sleeves
    - dry and wet
    - pistons
    - rings
    - connecting rod
    - crankshaft

- bearings
- lubrication pump
- oil cooler
- water pump
- flywheel
- intake manifold
- exhaust manifold
- valve arrangements
    - I head
    - H head
    - F head
    - L head
    - T head
- in-line engine
- V-engine
- overhead camshaft
- cooling system
    - air
    - liquid
- gasoline engine
- diesel engine
- combustion chambers design
    - open combustion
    - pre-combustion
    - turbulence combustion
    - energy cells
- disassembly procedures of engine
- procedures to measure engine dimensions
- procedures to assemble engine
- importance of following manufacturer's recommendations and specifications

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble an engine
- measure engine dimensions
- assemble an engine

IMP-1190 ENGINE REMOVAL & INSTALLATION

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 27 & 29.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove and reinstall engines according to manufacturer's recommended procedures.

Prerequisites:

IMP-1155, IMP-1185

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- remove and install engines to manufacturer's specifications
- inspect parts for wear

Required Knowledge and Skills:

1. Describe procedures to remove an engines.
    - systems drainage
        - oil
        - coolant
        - hydraulic fluid (if applicable)
    - disconnect and identify
        - electrical wires
        - hydraulic lines
    - disconnecting engine from transmission
    - supporting the transmission
    - suitable engine hoist
    - removing engine from chassis
    - precautions
    - following service manual recommendations

2. Describe procedures to inspect parts for wear.
    - inspect engine mounts

- check for loose or worn parts
- check linkages operation

3. Describe procedures to install engines.
   - installation procedures
   - importance of proper alignments of parts
   - torque attaching bolts
   - reconnect all attaching components
   - refill systems

4. Describe procedures to test engine operation.
   - start engine
   - check oil pressure
   - check for leaks
   - check for abnormal noise
   - check linkage operation
   - follow manufacturer's recommendations

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove and reinstall an engine
- inspect engine parts for wear

IMP-1195 COOLING SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 8, 18, 20 & 21.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service and repair engine cooling systems and components.

Prerequisites:

IMP-1190

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service and repair cab heating systems
- diagnose and service engine cooling systems and components

Required Knowledge and Skills:

1. Describe procedures to remove, repair and replace cooling systems.
    - types of cooling systems
        - liquid-cooled
        - air-cooled
    - purposes of cooling systems
    - heat dissipation
        - convection
        - radiation
        - conduction
    - cooling system components and functions
        - water pump
        - radiator
        - pressure caps
        - auxiliary tank
        - thermostat
        - fan
        - fan drive

    - water jackets
    - shutterstat and control
    - connecting pipes and hoses
    - liquid or coolant
    - filters and conditioners

2. Describe procedures to remove, service and replace radiators.
    - types of radiators
    - construction
    - removal procedures
    - cleaning procedures
    - installation procedures
    - pressurizing the system using pressure tester
    - construction of radiator caps

3. Describe procedures to remove, repair and replace water pumps.
    - types of pumps
    - construction
    - removal procedures
    - repair procedures
    - installation procedures
    - adjustment of belts

4. Describe procedures to remove, service and install thermostats.
    - types of thermostats
    - construction
    - opening temperature interpretation
    - removal procedures
    - testing procedures
    - installation procedures

5. Describe procedures to remove, service and install fans.
    - types of fans
        - pusher
        - suction
        - application
        - viscous fan drive
        - thermatic fan drive
    - removal procedures
    - inspection
    - installation procedures

6. Describe procedures to drain, flush and refill cooling systems
    - drainage procedures
    - flushing procedures
    - refilling procedures

- antifreeze ratio mixtures
- recycling, storage, etc of antifreeze
- methods of testing
    - Ph
    - density
- conditioners

7. Describe procedures to remove, repair and replace air cooling systems.
    - shrouds
    - fan
    - thermostat application
    - fan drive
    - removal and installation procedures

8. Describe procedures to service and repair cab heating systems.
    - cab heating systems
        - types
        - principles of operation
        - recognition of components
        - heater controls
        - installation procedures
        - bleeding procedures

9. Describe procedures to service engine heaters.
    - types
        - block heaters
        - in-line heaters
        - external sources
        - oil-based heaters
    - function
    - installation procedures

10. Diagnose cooling system problems.
    - cooling system troubleshooting
        - overheating
        - underheating
        - external leakage
        - internal leakage
        - exhaust gas leakage
        - restricted air flow
        - defective thermostat
        - rust and scale accumulation
        - air in coolant
        - worn or loose fan belt
        - defective pressure cap

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- drain, flush and pressure test a cooling system
- remove, service and install a thermostat
- remove, repair and install a water pump
- check antifreeze strength in cooling systems

IMP-1200 LUBRICATION SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 8, 9, 18 & 19.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service and repair engine lubrication systems and components.

Prerequisites:

IMP 1155, 1185

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose lubrication system problems
- service and repair engine lubrication systems and components

Required Knowledge and Skills:

1. Describe procedures to service and repair engine lubrication systems.
    - purpose of lubrication systems
    - types of lubrication systems
        - splash
        - pressurized
        - by-pass
        - full flow
        - combination
    - components of lubricating systems
        - oil pump
        - oil filter
        - oil cooler
        - oil pans
        - pressure regulating valve
        - oil filter by pass valve
        - oil cooler by pass valve
        - relief valve

2. Describe procedures to service and repair engine oil pumps.
    - types of oil pumps
        - gears
        - rotor
    - scavenging
    - disassembly procedures
    - inspecting and measuring pump wear
    - following manufacturer's specifications
    - reassembly procedures

3. Describe procedures to service and repair engine oil coolers.
    - disassembly procedures
    - inspecting and testing oil cooler
    - reassembly procedures

4. Describe procedures to check engine oil pressure.
    - installation of pressure gauge
    - importance of engine operating temperature
    - checking pressure at low and high speed
    - following manufacturer's recommendations

5. Diagnose lubrication system problems.
    - lubrication system troubleshooting
        - low oil pressure
        - high oil pressure
        - interpretation of oil contaminants
        - excessive oil consumption
        - oil leakage

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- repair and install an engine oil pump
- check engine oil pressure on an engine

IMP-1205 AIR FILTRATION & EXHAUST SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 18 & 22.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, service and install engine air cleaners and exhaust systems used in the Heavy Duty Equipment Technician and Truck and Transport Mechanic occupations.

Prerequisites:

IMP-1160, 1185

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose problems with air filtration and exhaust systems
- service air filtration systems and components
- service exhaust systems and components

Required Knowledge and Skills:

1. Describe procedures to remove, service and replace air filtration systems.
    - construction of air cleaning systems
    - purpose of air cleaning systems
    - types and designs
        - dry type
        - wet type
    - air cleaner system components
        - air filter
        - safety filter
        - spiral rotor air cleaner (donaclone)
        - air silencers
        - pre-cleaner
        - restriction indicator
        - crankcase ventilation system

2. Describe procedures to remove, service and install air cleaners.
    - dry type
        - element removal procedures
        - applicable cleaning procedures
        - inspection
        - importance of following manufacturer's specifications
        - importance of cleanliness
        - installation procedures
    - wet type
        - removal procedures
        - cleaning procedures
        - importance of using proper grade of oil
        - installation procedures

3. Describe procedures to service and repair exhaust systems
    - exhaust system components
        - muffler
        - rain trap
        - spark arrestors
        - manifold
        - pipes
        - clamps and hangers
        - heat control valves
        - catalytic converters
    - components removal procedures
        - muffler
        - rain trap
        - exhaust manifold
    - proper alignment of mating parts
    - check operation of heat control valve (if applicable)
    - installation procedures

4. Diagnose problems in air filtration and exhaust systems.
    - air flow restricted
    - air intake leaks
    - too much crankcase pressure
    - exhaust system leaks and restriction
    - abnormal exhaust noise
    - check intake restriction
    - pressure measurement methods

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- service dry and wet type air cleaner
- inspect, repair or replace exhaust system and related components
- check intake restrictions using manometers

IMP-1210 TURBOCHARGERS, BLOWERS & INTERCOOLERS

NOA Reference:

The material covered satisfies in whole or in part, the requirements the for National Occupational Analysis for Heavy Duty Equipment Technician task 22.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, service or repair and install engine turbochargers, blowers and intercoolers used on diesel engines.

Prerequisites:

IMP-1155, 1200

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service turbochargers, blowers and intercoolers.

Required Knowledge and Skills:

1. Describe procedures to remove, service and install turbochargers.
    - construction of turbochargers
    - purpose of turbocharger
    - types and designs
        - single-stage
        - two-stage
        - altitude compensators
    - action in turbochargers
    - components of turbochargers
        - turbine
        - compressor
        - shaft
        - bearings
        - seals
        - housing
    - removal procedures
    - inspection and tolerance checks

- installation procedures
- diagnosing turbocharger problems

2. Describe procedures to remove, service and install blowers.
   - construction of blowers
   - purpose of the blower
   - types and designs
     - centrifugal type
     - roots type
   - action in blower
   - removal procedures
   - inspection and tolerance checks
   - installation procedures
   - diagnosing blower problems

3. Describe procedures to remove, service and install intercoolers.
   - construction of intercoolers
   - purpose of intercoolers
   - types and designs
     - air to coolant
     - air to air
   - removal procedures
   - service checks
   - installation procedures
   - diagnosing intercooler problems

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, inspect and install a turbocharger
- disassemble, repair and assemble a blower

IMP-1215 DIESEL ENGINE OVERHAULING

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 8, 9, 18, 27, 28 & 29.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, inspect, repair and assemble diesel engines.

Prerequisites:

IMP-1185 to IMP-1210

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service diesel engines
- start and run engines

Required Knowledge and Skills:

1. Describe procedures to disassemble, inspect, repair and assemble diesel engines.
    - engine disassembly procedures
    - disassembly, checking and repair of the following components:
    - cylinder head service
        - valves
        - valves protrusion
        - injector tube service
    - pre-combustion chamber servicing
    - fuel galleries
        - seats
        - guides
        - springs
        - rotators
        - pressure testing cylinder head
        - warpage
        - crack detection
    - valve train servicing

    - rocker arm
    - rocker arm shaft
    - valve bridge
    - push rods
    - cam follower
    - gear train
- cylinder block servicing
    - cleaning and inspection
    - removal procedures of dry and wet sleeves
    - check sleeve wear
    - ridge removal
    - de-glazing cylinder walls
    - honing cylinder walls
    - checking sleeve protrusion
    - checking main bearing caps and bores
    - checking camshaft bores
- crankshaft and bearing servicing
    - inspecting and measuring for wear
    - remove and install crankshaft, bearing and bushing
- camshaft and bearing servicing
    - inspecting and measuring for wear
- piston and connecting rod servicing
    - piston wear or damage
    - rings wear
    - piston pin wear
    - connecting rod bend or damage
    - rebuilt connecting rods
- engine assembly procedures
    - torque
    - valve timing
- oil pump servicing
    - measuring all parts for wear and repairing to manufacturer's specifications

2. Demonstrate how to start and run engines.
    - reconnecting all components
    - refilling systems with oil and coolant
    - pre-start check points
        - fluid level
        - fluid leaks
        - belt tension
        - emergency shut-off
        - safety
    - starting engine and checking
        - oil pressure
        - water temperature

    - fluid leaks
    - abnormal noise
- engine disassembly procedures
- procedures to measure engine dimensions
- procedures to assemble engine
- importance of following manufacturer's recommendations and specifications
- fitting bearings
    - main
    - thrust
    - connecting rods
- replace camshaft bushings
- cylinder block boring
- re-condition cylinder head
    - check for straightness
    - check for cracks
    - replace injector tubes
    - reface valves
- check crankshaft
- recondition connecting rods

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- overhaul diesel engine

IMP-1220 DIESEL ENGINE PROBLEMS DIAGNOSIS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 18.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to evaluate and diagnose diesel engine problems and conditions.

Prerequisites:

IMP-1215

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose diesel engine problems and conditions

Required Knowledge and Skills:

1. Diagnose diesel engine problems and conditions.
    - basic steps in diagnosing engine problems
        - know the system
        - ask the operator
        - inspect the engine
        - operate the engine
        - list the possible causes
        - reach a conclusion
        - test your conclusion
    - leak down test
        - compression test
        - cranking speed test
    - engine noise and knock interpretations
        - rod bearings
        - main bearings
        - piston noises
        - valves
        - timing gears

        - wrist pin
    - lack of power
    - excessive vibration
    - engine starting problems
    - oil pressure too low
    - oil pressure too high
    - high oil consumption
    - crankcase oil dilution
    - engine overheating
    - exhaust smoke interpretations
        - black smoke
        - blue smoke
        - white smoke

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- using appropriate test equipment, check the following items on a diesel engine
    - cylinder compression
    - exhaust back pressure
    - crankcase pressure
    - air intake pressure

IMP-1225 GASOLINE FUEL SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 24.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to diagnose, service and repair gasoline fuel supply systems and carburetors used on gasoline engines.

Prerequisites:

MPO-1125, IMP-1205

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose problems in gasoline fuel systems
- service gasoline fuel systems

Required Knowledge and Skills:

1. Describe procedures to service and repair reservoir and fuel lines.
    - properties of gasoline
        - volatility
        - antiknock value
        - combustion process
        - octane rating
        - chemical control of detonation
        - fuel additives
    - safety precautions when handling gasoline
        - danger of explosion
        - storage
    - reservoir
        - location and arrangement
        - removal and replacement
        - repair procedures and precautions
        - inspect tank for leaks

        - fuel lines
    - types
    - fittings
    - removal and installation procedures
    - repair procedures

2. Describe procedures to service and repair fuel transfer pumps.
    - types of transfer pumps
        - mechanical
        - electric
    - removal procedures from engine
    - disassembly of pump (if applicable)
    - identification of parts
    - reassembly procedures

3. Describe procedures to test fuel pump performance.
    - pressure
    - vacuum
    - volume
    - removal procedures
    - importance of cleanliness
    - installation procedures

4. Describe procedures to remove, repair and replace carburetors.
    - principles of carburation
        - venturi effect
        - atomization
        - evaporation
        - vaporization
    - types of carburetors
        - single-barrel
        - two-barrel
        - four-barrel
        - downdraft carburetor
        - updraft carburetor
        - side-draft carburetor
    - carburetor circuits
        - float circuit
        - idle circuit
        - low-speed circuit
        - high-speed circuit or main metering circuit
        - acceleration circuit
        - choke circuit

5. Diagnose problems in gasoline fuel systems.
    - low fuel pump pressure

- low fuel pump volume
- flooding
- choke malfunctioning
- hard starting
- loss of power
- poor economy
- poor idling
- poor acceleration
- fuel lines restriction or leakage
- clogged fuel filters
- defective speed control linkage

6. Describe the operation of governors and service them.
    - purpose
    - types
        - mechanical
        - electronic
        - pneumatic
    - adjustment

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- check transfer pump performance
    - pressure
    - vacuum
    - delivery
- disassemble, repair and assemble carburetors

IMP-1230 ALTERNATIVE FUEL SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 25.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service, inspect and perform minor repairs on Liquefied Petroleum Gas (LPG) systems.

Prerequisites:

IMP-1225

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service LPG systems
- diagnose LPG system problems

Required Knowledge and Skills:

1. Describe procedures to service and repair LPG systems.
    - special type of fuel
        - combustion temperature
    - principles of operation of LPG systems
    - advantages and disadvantages of LPG
    - relationship to engine timing
    - safety rules in handling LPG
    - liquid withdrawal system
    - vapour withdrawal system
    - LPG components
        - tank
        - filter
        - converter
        - carburetor
        - safety valve
        - filler valve
        - liquid level gauge

        - fuel lines and fittings
    - repair or service
        - converter
        - carburetor
        - safety valves
    - check system for leaks
    - adjust engine timing
    - importance of following manufacturer's recommendations

2. Diagnose LPG system problems.
    - LPG troubleshooting
        - hard starting
        - loss of power
        - poor economy
        - freeze-up of converter
        - frost on fuel strainer
        - rough idling
        - overheating

3. Describe procedures to identify regulations related to fuel systems.
    - location of tanks
    - manufacturing hoses
    - provincial
    - federal

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- check and service the convertor and carburetor of a LPG engine
- adjust timing of a LPG engine
- check system for leaks

MPO-1135 DIESEL FUEL SUPPLY SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 23.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service, inspect and repair diesel fuel supply systems.

Prerequisites:

IMP-1350

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service diesel fuel supply systems

Required Knowledge and Skills:

1. Describe procedures to service and repair fuel tank and fuel lines.
    - properties of diesel fuel
    - fuel classification
        - certain number
        - specific gravity testing
        - viscosity
        - flash point
        - pour point
        - sulfur
        - volatility
        - carbon residue
        - fuel additives
        - interpretation of fuel specifications
        - summer and winter fuel
    - tank
        - location and arrangement
        - removal and replacement procedures
        - repair procedures and precautions

        - inspecting tank for leaks
        - design and material
    - fuel lines
        - types
        - fittings
        - removal and installation procedures
        - repair procedures

2. Describe proper fuel storage and handling techniques.
    - storage practices to prevent fuel contamination
    - safety precautions

3. Describe procedures to remove, service and install fuel filters.
    - filters
        - types
        - functions
        - restriction indicator
        - water indicator
        - water separators
        - limitations of filters
        - location
        - service procedures
        - filling and bleeding procedures
    - fuel heater and filter
        - removal procedures
        - design
        - testing
    - importance of cleanliness
    - installation procedures
    - bleeding the system

4. Describe procedures to service and repair fuel transfer pumps.
    - type
        - mechanical
        - electrical
    - location
    - testing
    - removal
    - disassembly of pump (if applicable)
    - identification of parts
    - reassembly procedures

5. Describe procedures to test fuel pump performance
    - pressure
    - vacuum
    - delivery volume

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- check transfer pump performance
    - pressure
    - vacuum
    - delivery
- change fuel filters, bleed system and start engines

IMP-1240 INJECTORS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 23 & 24.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, test, rebuild, service and install injectors used on diesel engines.

Prerequisites:

MPO-1135

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service injectiors, fuel injection lines and connections
- test injector operation

Required Knowledge and Skills:

1. Describe procedures to remove, rebuild and install injectors.
    - related safety precautions when fuel soaks skin
    - operation principles of injectors
        - timing
            - mechanical
            - electronic
        - atomization
        - metering
    - types
        - electronic unit injectors
        - hydraulic-actuated
        - unit injectors
        - pressure-timed injectors
    - nozzle holder
    - types of injection nozzles
        - purpose
    - injector action

- injector removal and installation procedures
- methods of timing
    - pressure-timed injectors
    - injector styles
        - unit
    - adjustment

2. Test injector operation.
    - testing the injector
        - opening pressure
        - closing pressure
        - valve seat test
        - back leakage test
        - spray pattern test
        - needle valve lift test
        - adjustment procedures
        - importance of cleanliness
    - locating faulty injector

3. Describe procedures to remove and install fuel injection lines and connections.
    - types
    - tensile strength
    - bend radius recommendations
    - removal and installation procedures
    - connectors
    - flares

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove and install injectors on a diesel engine.
- using an injector tester, check and adjust the following on the injector
    - opening and closing pressure
    - valve seat test
    - back leakage test
    - spray pattern

IMP-1245 INJECTION PUMPS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 23, 24.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, install, time and adjust low and high idle on diesel fuel injection pumps.

Prerequisites:

MPO-1135

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service fuel injection pumps and perform timing
- adjust engine low-and high-idle speed

Required Knowledge and Skills:

1. Describe procedures to remove and install fuel injection pumps and perform timing.
    - related safety precautions fuel impregnating skin
        - cleanliness
        - manufacturer's specifications
    - basic operating principle of the following injection systems
        - in-line pump
        - distributor pump
        - unit injection system
        - pressure time pump
    - metering principles
        - port and helix design
        - sleeves metering design
    - governors (diesel application)
        - types and designs
            - mechanical
            - hydraulic
            - pneumatic

        - servo
        - electronic
    - limiting speed governor
    - variable speed governor
    - knowledge of phasing calibration
    - timing procedures
        - electronic
        - static
        - skill
    - bleeding the system
    - governor terminology
        - low-idle speed
        - high-idle speed
        - droop speed
        - maximum torque speed
        - torque range speed
        - overspeed
        - governor cut-off speed
        - sensitivity
        - momentary speed
        - hunting
        - stability
        - hysterisis
        - speed regulation
    - minor repair and adjustment procedures
    - lubrication recommendation
    - shut-off
        - mechanical
        - electrical
    - removal and installation procedures for fuel injection pumps

2. Adjust engine low, and high-idle speed.
    - Adjusting low, and high-idle speed procedures

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- install a fuel injection pump
- perform tuning
- adjust engine idle speeds

IMP-1250 TUNE-UPS & DIAGNOSIS OF DIESEL FUEL SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 15, 23.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to perform a complete tune-up and diagnose problems on diesel fuel systems.

Prerequisites:

MPO-1135, IMP-1175, 1245

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose diesel fuel systems
- service diesel fuel systems

Required Knowledge and Skills:

1. Describe tune-up procedures on diesel fuel engines.
    - tune-up procedures
    - tune-up intervals
    - visual inspection of the engine
    - preliminary check
        - air cleaner condition
        - belt tension
        - battery condition
        - oil and coolant level
    - check following systems
        - air restriction
        - exhaust restriction
        - crankcase blow-by
        - boost pressure
    - procedures to adjust the following components
        - valve bridge
        - valve lash

- injectors timing
- governor gap
- injector racks
- no load speed
- idle speed
- buffer screw
- injector
    - timing
    - pressure timing

2. Explain how to check engine system pressure with manometer.
    - air restriction
    - exhaust restriction
    - crankcase blow-by
    - boost pressure
    - air box pressure

3. Diagnose fuel system problems.
    - evaluation of engine performance
        - trouble first noticeable
        - similar problems recorded
        - unusual noise
        - trouble noticeable at all speed
        - respond to acceleration or deceleration
        - poor idling
        - hard starting
        - excessive fuel consumption
    - checking fuel lines for leaks or restrictions
    - checking condition of fuel filters
    - checking speed control linkage
    - testing fuel transfer pump performance
        - pressure
        - vacuum
        - delivery
    - diesel exhaust smoke analysis
        - black
        - white
        - blue

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- perform a complete tune-up
- using appropriate test equipment, check
    - air restriction
    - exhaust restriction
    - crankcase blow-by
    - boost pressure

IMP-1255 ELECTRONIC FUEL CONTROL SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 23 .

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service, inspect and repair electronic fuel control systems on diesel engines.

Prerequisites:

MPO-1125, 1130, IMP-1240 to 1250

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose and service electronic engine control systems

Required Knowledge and Skills:

1. Describe procedures to service, inspect and repair or replace electronic engine control systems.
    - types of electronic control systems
    - advantages of electronic engine control systems
    - electronic engine control components
        - control module
        - throttle sensor
        - fuel rack sensor
        - fuel rack actuator
        - variable timing sensor
        - variable timing actuator
        - vehicle speed sensor
        - clutch and brake switch
        - electronic unit injectors
        - electronic distributor unit
        - fuel systems
    - procedures for using electronic control analyzer programmer
    - importance of following manufacturer's recommendations

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- using appropriate test equipment, service electronic engine control system to manufacturer's specifications

IMP-1260 BATTERIES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 38.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, service, charge and install batteries used on the Heavy Duty Equipment Technician and Truck and Transport Mechanic occupations.

Prerequisites:

MPO-1125

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose battery problems
- service batteries

Required Knowledge and Skills:

1. Describe procedures to remove and install batteries.
    - safety rules when working with battery
    - storage of batteries
    - battery construction:
        - positive plates
        - negatives plates
        - separators
        - electrolyte
        - chemical action
        - terminals
    - gel cell batteries
    - chemical action when discharging
    - chemical action when charging
    - sulfated battery
    - maintenance-free battery
    - temperature effects on battery

- battery polarity
- battery ratings:
    - cold power rating
    - reserve capacity rating
- battery selection
- procedures to remove and install battery cables
- terminal pullers
- hold-down clamp
- battery maintenance:
    - procedures to clean battery
    - battery inspection
    - electrolyte level
    - cell replacement

2. Identify battery connections.
    - battery circuit connections
        - parallel circuits
        - series circuits
        - series parallel circuits

3. Describe procedures to perform battery test.
    - battery test
        - hydrometer test
        - electrolyte - integrohydrometer
        - specific gravity variation
        - parasytic draw
        - light-load test
        - high-discharge test
        - cold-cranking test
        - reserve capacity test
    - correcting specific gravity readings to allow for temperature

4. Describe procedures to recharge batteries.
    - types of chargers
        - slow charge method
        - fast charge method
        - trickle charging
        - battery temperature precautions
        - importance of good ventilation
        - safety precautions with highly explosive gases

5. Describe procedures to replace battery cables and/or terminals.
    - types of cable terminals
    - cable size selection
    - methods of fastening terminals to cable (soldered and crimped)
    - importance of installing corrosion inhibitor over terminals

- voltage drop test

6. Describe procedures to start engines with booster battery.
   - importance of proper booster cables
   - proper polarity and connections
   - parallel connections
   - series connections
   - protective glasses
   - safety precautions

7. Diagnose battery problems.
   - effects on battery life
     - electrolyte level
     - overcharging
     - undercharging
     - cycling
   - battery hold-down loose or too tight
   - corroded terminals
   - frayed or broken cables
   - cracked case
   - voltage drop test

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, service, test and install battery
- hook up for slow and fast charging 12 and 24 volts
- replace terminals on battery cables
- start an engine using booster batteries

IMP-1265 STARTING SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis tasks for Heavy Duty Equipment Technician task 18.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, test, repair and assemble starting motors and components.

Prerequisites:

IMP-1260

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service starting motors
- diagnose starting system problems
- service starting systems

Required Knowledge and Skills:

1. Describe procedures to disassemble, test, repair and assemble starting motors.
    - operating principles of starting motor
    - identification of parts:
        - solenoid
        - drive mechanism
        - armature
        - field coil
        - pole shoe
        - commutator
        - brushes and holders
    - types of starters
        - permanent magnet
        - electric
        - four poles - two coils
        - four poles - four coils
        - six poles - six coils

        - parallel wound
        - series wound
        - compound wound
        - 12 volt high out-put
        - air
        - hydraulic
    - types of starter drive
        - Bendix
        - overrunning clutch
        - dyer
        - follow through
        - sprag
        - positork
        - friction-clutch
    - types of starter switches
        - magnetic switch
        - solenoid switch
        - series-parallel switch
    - disassembly procedures of starting motor
    - cleaning procedures
    - armature test
    - field coil test
    - solenoid test
    - checking brushes
    - checking bushings
    - resurfacing commutator
    - reassembly procedures
    - pinion clearance check

2. Describe procedures to test starters and circuit performance.
    - no-load test
    - torque test
    - amperage draw test
    - voltage drop test

3. Diagnose starting system problems.
    - engine will not crank
    - engine cranks slowly
    - starter turns but will not engage
    - starter makes excessive noise

4. Describe procedures to service and repair air starting systems.
    - air motor starting systems
        - circuitry
            - valve
            - supply systems

- operating principles
- applications (RPM)
- types of motor
- drive mechanisms
- maintenance procedures
- operational hazards and precautions
- lubrication provisions

5. Describe procedures to service and repair hydraulic starting systems.
   - hydraulic starting systems
     - hydraulic circuitry
       - valve
       - supply systems
     - operating principles
     - types of motors
     - relationship to other hydraulic systems
     - major components and functions
     - drive mechanisms
     - cooling and lubrication provisions

6. Describe procedures to service and repair starting aid components and functions.
   - glow plugs
   - intake manifold heater
   - fluid starting aids
   - block heater
   - battery warmer
   - booster battery

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, disassemble, test, repair and assemble 12 volts starter
- remove, disassemble, test, repair and assemble heavy duty 24 volts starter
- using appropriate test equipment, make the following tests on starting circuit:
  - voltage drop
  - amperage draw

IMP-1270 CHARGING SYSTEM COMPONENTS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 8, 18 & 39.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, test, repair and assemble charging systems and components.

Prerequisites:

IMP-1260

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service charging systems and components
- diagnose charging system problems

Required Knowledge and Skills:

1. Describe procedures to disassemble, test, repair and assemble alternators.
    - basic charging systems
    - operating principles of alternators
    - identification of parts:
        - stator
        - rotor
        - diodes
        - rectifier bridge
        - diode trio
        - brushes
    - types and functions of regulators
        - mechanical regulator
        - transistorized regulator
        - remote mounted regulator
        - integral type regulator
    - types of alternators
        - brushless alternator

        - 24 volt alternator
        - 12/24 volt alternator
        - oil-cooled alternator
    - disassembly procedures of alternator
        - internal circuitry
        - stator test
        - rotor test
        - diodes test
        - regulator test
        - checking bearings condition
        - checking slip ring condition
        - cleaning procedures
        - reassembly procedures

2. Describe procedures to test alternator performance.
    - alternator output test
        - voltage
        - amperage
        - appropriate testing equipment

3. Diagnose charging system problems.
    - no alternator output
    - low alternator output
    - high alternator output
    - noisy alternator
    - battery uses too much water

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, disassemble, test, repair and assemble an alternator
- using appropriate test equipment, check alternator output (amperage and voltage)
- check and adjust alternator belt tension

IMP-1275 IGNITION SYSTEMS & TUNE-UPS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 8 & 42.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to check and test ignition system components and perform tune-ups on gasoline engines.

Prerequisites:

IMP-1185, 1350, 1230, 1260

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service ignition systems
- perform tune-ups on gasoline engines
- diagnose ignition system problems

Required Knowledge and Skills:

1. Describe procedures to check and test components of ignition systems (electronic).
    - principles of operation of ignition systems
    - components
        - types of triggering devices
            - LAD
            - hall effects
        - magnetic
        - reluctor
        - control unit
        - distributor
        - rotor
        - coil
    - check and test condition of the following components:
        - pick-up coil
        - control unit
        - ignition coil

- distributor cap
- rotor

2. Describe procedures to remove, service and install spark plugs.
   - construction of spark plug
   - types
   - heat range
   - removal procedures
   - cleaning procedures
   - inspections
   - gapping
   - testing
   - installation procedures

3. Describe procedures to perform tune-ups on gasoline engines.
   - types
   - testing procedures
   - tune-up procedures
   - tune-up intervals
   - visual inspection of the engine
   - check air intake system
   - check engine compression
   - adjust ignition timing

4. Diagnose 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
   - short spark plug life
   - pre-ignition
   - detonation
   - backfire in intake manifold
   - backfire in exhaust manifold

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- check and test high tension leads
- perform a complete tune-up on a gasoline engine

IMP-1280 AIR CONDITIONING SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 67.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service, inspect and repair air conditioning systems used on the Heavy Duty Equipment Technician and Truck and Transport Mechanic occupations.

Prerequisites:

MPO-1125, IMP-1155, 1195

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service air conditioning systems
- diagnose air conditioning problems

Required Knowledge and Skills:

1. Describe procedures to service, inspect and repair air conditioning systems.
    - principles of refrigeration
        - liquid
        - gas
        - state of matter
        - pressure and heat
        - conduction
        - convection
        - radiation
        - refrigerants (freon)
    - refrigeration cycle
        - compression
        - condensation
        - expansion
        - evaporation
    - components of air conditioning systems

        - compressor
        - condenser
        - expansion valve, orifice tubes
        - evaporator
        - lines and connections
        - refrigerants and oil
        - principles of operation of major components
    - air conditioning service tools
        - vacuum pump
        - charging hose
        - gauge and manifold set
        - thermometer
        - refrigerant dispensing valve
        - leak detector
        - goggles
    - servicing the system
        - discharging the system
        - evacuating system using vacuum pump
        - safety rules when handling refrigerants
    - purging the system
    - charging the system
    - checking the system for leaks
    - checking and adding oil to reciprocating piston compressors
    - checking and adding oil to axial piston compressors

2. Describe procedures to diagnose air conditioning problems
    - main categories of problems:
        - electrical
        - mechanical
        - refrigeration
    - system produces no cooling
    - system will not produce sufficient cooling
    - system cools intermittently
    - system too noisy

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- check, remove and replace components of an air conditioning system

HDE-1285 START, MOVE, PARK AND PREPARE A VEHICLE TO BE TOWED

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 1 & 18.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to start, move and park heavy equipment machinery and prepare a vehicle to be towed.

Prerequisites:

IMP-1101, MPO-0100

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- use proper procedures to prepare vehicle to be towed or pushed

Required Knowledge and Skills:

1. Describe applicable safety rules to be followed before starting vehicles.
    - importance of good ventilation
    - fume hazard
    - sign interpretation

2. Describe procedures to perform pre-start checks.
    - fluid level checks
        - engine
        - cooling
        - hydraulic
        - transmission
        - fuel
        - check for lock-out
        - visual inspection

3. Describe procedures to perform equipment start-ups.
   - operator's manual interpretation
   - gauge interpretation
   - start-up procedures
   - importance of warm-up period
   - emergency shut-down

4. Describe procedures to operate vehicles.
   - parking brake release
   - accelerator controls
   - hydraulic controls
   - speed selection
   - checking brakes' operation
   - emergency shut-down
   - safety

5. Describe procedures to perform equipment shut-downs.
   - cooling period before shut-down
   - lower all attachments

6. Describe procedures to prepare vehicles to be towed or pushed.
   - recognition of towing and pushing procedures
   - steering operation
   - parking brake release
   - brake application methods
   - free to rotate or disconnect drive shafts
   - towing cables or chains and shackles
   - attaching techniques
   - towing capacity

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- start, move and park different types of vehicles where available
- prepare a vehicle to be towed

HDE-1290 TIRES, RIMS & WHEELS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 64.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove and install tires from a demountable rim flange used on heavy equipment machinery.

Prerequisites:

MPO-0100, IMP-0135 to 1150

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service tires, rims and wheels

Required Knowledge and Skills:

1. Describe procedures to demount and mount tires from rims.
    - tires
        - types and designs
        - construction
        - interpretation of sizing
        - tread design
    - rims
        - types and design
        - construction
        - two-piece rim
        - three-piece rim
        - five-piece rim
        - demounting procedures
        - inspecting tires
        - inspecting rims
        - mounting procedures
        - importance of using tire cage
        - inflation methods

- safety rules to follow

2. Describe procedures to use and maintain tire tools.
   - tire gauges
   - air chuck
   - special bars
   - tire safety cage
   - tire lubrication

3. Describe procedures to remove and install wheel from axles.
   - removal and installation procedures
   - inspection of rims
   - types of wheels, studs and nuts
   - importance of torque sequence
   - cause and effects of wheel off

4. Describe procedures to maintain tires.
   - causes and effects of abnormal tire wear
     - overinflation
     - under inflation
   - proper inflation
   - tire rotation
   - dual tires
     - advantages
     - disadvantages
     - matching
     - how to measure
   - tire ballast
     - purpose
     - types
     - advantages
     - disadvantages
   - tire chains
     - traction
     - protection

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- demount and mount a tire from removable rim flange

HDE-1295 MANUAL STEERING SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 56.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, repair, adjust and assemble manual steering gear boxes, steering linkage, steering wheel and shafts.

Prerequisites:

MPO-1105

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose problems in manual steering box
- service manual steerings systems and components

Required Knowledge and Skills:

1. Describe procedures to disassemble, repair, adjust and assemble manual steering gear boxes.
    - types
        - recirculating ball
        - worm and roller
        - cam and lever
    - functions of major components
    - steering ratio
    - identification of parts
    - removal and installation procedures of steering box
    - overhaul steering boxes
        - repair procedures
        - bearing adjustments
        - overcentre preload adjustments
        - steering gear lubricant

2. Describe procedures to remove and install steering wheel and shafts.
   - steering wheel removal and replacement
   - shaft and coupling service
   - steering wheel centering

3. Diagnose problems in manual steering box.
   - procedures in diagnosing problems in manual steering systems
     - problems related to improper adjustment
     - hard steering
     - wandering
     - noise

4. Describe procedures to remove, repair and install steering linkage and components.
   - steering linkage
     - steering knuckle
     - tie rod ends
     - centre link
     - drag link
     - idler arm
     - pitman arm
     - steering column
     - king pin and bushing
   - identification of component wear
   - methods of inspection
   - removal and installation procedures
   - safety precautions

5. Describe procedures to remove, repair and replace kingpin.
   - inspection for wear
   - removal and installation procedures
   - type of lubricant used
   - special tools

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, repair and assemble a manual steering box
- remove and install a steering wheel
- disassemble, inspect, reassemble and adjust steering linkage and components

HDE-1300 POWER STEERING SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 57.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, repair, adjust and assemble power steering gear boxes and components.

Prerequisites:

HDE-1295

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- inspect, test and diagnose problems in power steering systems
- service power steering systems and components

Required Knowledge and Skills:

1. Describe procedures to disassemble, repair, adjust and assemble power steering boxes.
    - types of power steering
        - linkage
        - integral
        - semi-integral
    - function of major components
    - ratio
    - identification of parts
    - removal and installation procedures of steering box
    - overhaul power steering box
    - repair procedures
    - bearing adjustments
    - overcentre preload adjustments

2. Describe procedures to remove, repair and install power steering pumps.
    - types of pumps
        - vane

    - gear
    - rotor
  - identification of parts and functions of major components
  - types of control valves
  - disassembly and assembly procedures
  - inspection of defective parts
  - importance of cleanliness

3. Describe procedures to remove and repair power steering lines.
   - types and constructions of lines
   - removal and replacement procedures
   - recognition of serviceability

4. Describe procedures to inspect, test and diagnose problems in power steering systems.
   - procedures in diagnosing problems in power steering systems
     - fluid level
     - pull to one side
     - hard to steer
     - jerky, erratic steering
     - power-assisted on one side only
     - loose belt
   - procedures to pressure-, and flow-test power steering systems

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, repair and assemble a power steering box
- disassemble, repair and assemble a power steering pump

HDE-1305 FRONT END ALIGNMENT

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 64.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to perform basic front-end alignment on heavy equipment vehicles.

Prerequisites:

IMP-1150, HDE-1300

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- perform front-end alignment

Required Knowledge and Skills:

1. Describe procedures to perform basic wheel alignments.
    - steering geometry
        - caster
        - camber
        - steering axis inclination
        - included angles
        - toe-in
        - toe-out on turns
    - procedures to check and adjust toe-in

2. Check condition of steering linkages and components.
    - check condition of:
        - steering box
        - tie rod ends
        - centre link
        - idler arms
        - pitman arms

- king pins

3. Diagnose wheel alignment problems.
   - pull to one side
   - tire wear
   - improper wheel track

4. Describe procedures to service electronically controlled steerings.
   - inspection for wear
   - removal and installation procedures
   - type of lubricant used

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- perform toe-in adjustment on a vehicle

HDE-1310 STEERING SYSTEMS (TRACKED)

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 65.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service, repair and adjust track-type steering systems.

Prerequisites:

HDE-1295

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service steering clutches
- service planetary steering systems
- diagnose steering clutch problems

Required Knowledge and Skills:

1. Describe procedures to remove, repair, install and adjust steering clutches.
    - types of steering clutches
        - dry
        - wet
        - mechanically applied and released
        - hydraulically applied and released
        - location
    - major components of steering clutches
        - drums
        - brake band
        - clutches
        - linkages
        - seals
        - bearings
    - removal procedures
    - inspection of parts for wear

- installation procedures
- adjustment procedures
    - brake band
    - free play
    - hydraulic pressure

2. Describe procedures to remove, repair, install and adjust planetary steering systems.
    - types of planetary steering
    - advantages

3. Diagnose steering clutch problems.
    - hard steering
    - no steering on both sides
    - steering on one side only
    - steering clutch slippage
    - dragging clutches

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- check, repair and adjust steering clutches on a crawler tractor

HDE-1315 FRONT & REAR SUSPENSIONS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 58.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, inspect, repair and install heavy equipment front and rear suspensions.

Prerequisites:

HDE-1305

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service front and rear suspensions
- diagnose front and rear suspension problems

Required Knowledge and Skills:

1. Describe procedures to remove, inspect, repair and replace front and rear suspensions.
    - independent
    - solid axle
    - twin I beam
    - single axle
    - tandem axles
    - suspension components
        - spring:
            - coil, leaf and torsion bar
        - shackles
        - insulators
        - rebound clips
        - centre bolt
        - u bolt
        - saddle assembly
        - walking beam

        - torque rod
        - equalizer beam
    - sprung and unsprung weight
    - spring helper
    - air-ride suspension
    - nitrogen charged suspension
    - shock absorbers
        - types
        - functions
        - principle of operation
    - removal and installation procedures of components
    - repair procedures
    - spring removal and replacement procedures
    - shock absorber removal and installation
    - safety rules to follow

2. Diagnose front and rear suspension problems.
    - procedures to diagnose front and rear axle and suspension problems
    - problems
        - broken leaf spring
        - broken centre bolt
        - loose or broken spring bracket
        - bent or twisted housing
        - mistracking of wheels

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, inspect and install front or rear vehicle suspension

HDE-1320 TRACK TYPE UNDERCARRIAGE

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 63 & 65.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, disassemble, repair, assemble and install a track-type undercarriage from a crawler tractor or excavator.

Prerequisites:

IMP-1155, IMP-1160, HDE-1290

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose undercarriage problems
- service track type undercarriage

Required Knowledge and Skills:

1. Describe procedures to remove, repair and replace track frames.
    - types of track frame
        - rigid frame
        - oscillating frame
    - cross members
    - stabilizer bar
    - diagonal bar
    - track guards
    - removal and installation procedures
    - repair procedures

2. Describe procedures to remove, repair and replace track rollers, carrier rollers and front idlers.
    - types of rollers:
        - track rollers
        - carrier rollers

    - front idlers
    - single flange
    - double flange
- rollers components:
    - shaft
    - bearing
    - bushings
    - seals
- lubrication recommendation
- removal and installation procedures
- recognition of wear limits
- repair procedures

3. Describe procedures to remove, repair and replace track adjusters.
    - types of track adjusters
        - mechanical
        - hydraulic
    - components
        - seals
        - piston
        - rod
        - cylinder
        - grease fitting
        - bleed valve
    - removal and installation procedures
    - repair procedures

4. Describe procedures to remove, repair and replace recoil mechanisms.
    - types of recoil mechanism
        - recoil spring
        - nitrogen gas
        - dual spring
        - staked cone spring plate
    - removal and installation procedures
    - repair procedures

5. Describe procedures to remove, repair and replace sprockets.
    - types of sprockets
        - hunting sprocket
        - non hunting sprocket
        - one-piece sprocket
        - segments sprocket
        - ring-type sprocket
    - method of attaching to final drive shaft
    - removal and installation procedures
    - recognition of wear limits

- repair procedures

6. Describe procedures to remove, inspect and replace track chains.
   - types of track chain:
     - flush
     - counter board
     - sealed track
     - lubricated track
     - links
     - pins
     - bushings
     - high sprocket track
   - master pins
     - identification
     - purpose
   - split master link
   - removal and installation procedures
   - recognition of wear limits
   - pin and bushing rotation
     - purpose
     - advantages
     - disadvantages

7. Describe procedures to remove and replace track shoes.
   - types of track shoes:
     - standard grouser shoe
     - semi-grouser shoe
     - cut-out grouser shoe
     - snow and ice shoe
     - flat shoe
     - shoe bolt and nuts
   - removal and installation procedures
   - recognition of wear limits

8. Describe procedures to perform track maintenance.
   - recognize undercarriage wear
   - elements of wear
     - contact
     - motion
     - load
   - causes of wear
     - undercarriage works and wear
     - forward and reverse drive side wear
     - sprocket wear
     - roller wear
     - idler wear

        - pin and bushing wear
        - shoe wear
    - general track inspection
    - roller and idler lubricant level
    - track alignment
        - camber toe
        - tighten hardware
        - track tension (sag)
        - importance of removing trash and mud
        - measure track pitch
        - measure sprocket pitch
        - measure roller wear
        - measure idler wear
        - measure link wear
        - measure pin and bushing wear
        - measure grouser (shoe) wear

9. Diagnose undercarriage problems.
    - procedures to diagnose undercarriage problems
    - inspection
        - track misalignment
        - track too loose or too tight
        - leaking track adjuster
        - abnormal wear rate
        - loose hardware
        - missing parts
        - bent or damaged equalizer bar
        - bent or damaged diagonal bar

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, disassemble, repair, assemble and install a track frame and all components
- using special wear gauges and tools, check pin, bushing, roller and sprocket wear
- make track alignment and track sag adjustments to the manufacturer's specifications

HDE-1325 ELECTRIC BRAKES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis task for Heavy Duty Equipment Technician task 62.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service, repair and adjust electric brake systems.

Prerequisites:

MPO-1125, IMP-1170

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service electric brakes
- diagnose electric brake problems

Required Knowledge and Skills:

1. Describe procedures to inspect, repair and adjust electric brakes.
    - electric brake systems
        - principles of operation
    - electro-mechanical actuating mechanical components
        - armature
        - magnet
    - recognition and function of major components
        - rheostat control

2. Diagnose electric brake problems.
    - procedures to diagnose electric brakes problems
        - broken wiring
        - malfunctioning solenoid
        - lining and drum wear
        - maintenance procedures
        - troubleshooting

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- classroom exercises as determined by the instructor

HDE-1330 MANUAL TRANSMISSION REMOVAL & INSTALLATION

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 33.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove and install manual transmissions used on heavy equipment machinery.

Prerequisites:

IMP-1180

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- remove and install manual transmission
- verify for proper operations of a manual transmission

Required Knowledge and Skills:

1. Describe procedures to remove manual transmissions.
    - removal procedures
        - drain transmission fluid
        - disconnect attaching parts
        - disconnect propeller shaft
        - use suitable lifting devices
        - importance of guide pins
        - follow service manual recommendations

2. Describe procedures to inspect parts for wear.
    - inspect transmission mounts
    - check for loose or worn parts
    - check shifting linkage
    - check for oil leaks

3. Describe procedures to install transmissions.
    - installation procedures
        - importance of proper alignment of parts
        - torque attaching bolts
        - reconnect all attaching components
        - refill transmission fluid
        - follow service manual recommendations

4. Demonstrate how to test transmission operation.
    - test-drive transmission operation
    - check transmission in all operation range
    - check for abnormal noise
    - check for oil leaks

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove and install a manual transmission

HDE-1335 CLUTCHES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 31.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, repair, install and adjust clutches used on heavy equipment machinery.

Prerequisites:

HDE-1330

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose clutch problems
- service clutch assemblies

Required Knowledge and Skills:

1. Describe procedures to remove, check, repair and install clutch assemblies.
    - principles of operation
    - types and designs
        - single disk
        - double disk
        - multidisk
        - external band clutch
        - internal band clutch
        - over-centre clutch
    - clutch disc
        - facing (asbestos & ceramic)
        - cushion springs
        - torsion springs
        - splines
    - removal and installation procedures
    - inspection
    - safety precautions when working with asbestos

2. Describe procedures to disassemble, repair and assemble pressure plate assemblies.
   - types of pressure plate
     - coil spring
     - diaphragm spring
     - angle spring
   - disassembly procedures
   - inspection
   - assembly procedures

3. Describe procedures to remove, check and replace release bearings.
   - release bearing and mechanism
     - purpose
     - types
     - lubrication and recommendations
   - removal and installation procedures
   - inspection

4. Describe procedures to remove, check and replace pilot bearings.
   - pilot bearing
     - purpose
     - types
     - lubrication recommendations
   - removal and installation procedures
   - inspection

5. Describe procedures to remove, check and replace clutch brakes.
   - clutch brakes
     - purpose
     - types
   - removal and installation procedures
   - inspection

6. Describe procedures to check and repair clutch operating mechanisms.
   - clutch operating mechanism
     - mechanical
     - hydraulic
     - pneumatic
   - inspection for wear

7. Describe procedures to install clutch assemblies.
   - installation procedures
   - check fly-wheel run-out
   - check clutch housing run-out
   - check clutch shaft condition

- importance of disc alignment
- pedal free-play adjustments
- clutch brake adjustments
- recommended lubrication for pilot and release bearing

8. Diagnose clutch problems.
    - basic clutch troubleshooting
        - slipping
        - chattering
        - vibrations
        - grabbing
        - dragging
        - rattles
        - squeaks
        - failure

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, repair, install and adjust clutch assembly in a vehicle

HDE-1340 MANUAL TRANSMISSION SERVICE & REPAIR

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 9 & 33.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, repair and assemble manual transmissions.

Prerequisites:

HDE-1330

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to
- diagnose problems in manual transmissions
- service manual transmission

Required Knowledge and Skills:

1. Describe procedures to disassemble, repair and assemble a manual transmissions.
    - principles of operation
        - mechanical advantages
        - gear ratio
        - types of gears
        - gear terminology
        - power flow
    - types of transmission
        - sliding gear
        - collar shift
        - synchromesh
    - transmission components
        - shaft
        - gears
        - bearings
        - seals
        - synchronizers

        - shifter rail and forks
        - shift controls
        - shift interlock mechanisms
    - disassembly procedures
    - inspection of parts
    - reassembly procedures
    - precautions
    - importance of cleanliness
    - manufacturer's specifications
    - lubrication level
    - maintenance

2. Describe procedures to check and service other types of transmissions.
    - transfer cases
    - principles of operation
    - types and designs
    - functions
    - relationship to power train system

3. Describe procedures to disassemble, repair and assemble transfer drives.
    - disassembly and assembly procedures
    - inspection of parts
    - precautions
    - importance of cleanliness
    - manufacturer's specifications
    - lubrication level
    - maintenance

4. Describe procedures to remove, repair and install power take offs.
    - functions
    - types and designs
    - principles of operation
    - service and alignment procedures
    - installation precautions
    - allowable tolerances
    - manufacturer's specifications
    - common failures

5. Diagnose problems in manual transmissions.
    - manual transmission troubleshooting
        - noisy in neutral
        - noisy in gear
        - hard to shift
        - sticks in gear
        - slips out of gear
        - gear clash when shifting

- oil leaks

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, inspect, repair and assemble a manual transmission

HDE-1345 TORQUE CONVERTERS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 32.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to repair, install and test torque converters.

Prerequisites:

IMP-1180

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose problems in torque converters
- service torque converters

Required Knowledge and Skills:

1. Describe procedures to disassemble, repair and assemble torque converters.
    - principles of operation and construction of torque converters
        - torque multiplication
        - vortex flow
        - rotary flow
        - energy transfer reaction
        - single turbine
        - twin turbine
        - fluid coupling versus torque converter
        - two phase - two stage converter
    - pump
    - turbine
    - stator
    - freewheel mechanism
    - disassembly and reassembly procedures
    - inspection of parts
    - importance of cleanliness

- manufacturer's specifications
- draining and filling procedures
- oil level interpretations

2. Describe procedures to test torque converter performance
   - main oil pressure
   - converter-out oil pressure
   - lubrication oil pressure
   - converter-out oil temperature
   - transmission stall test

3. Describe procedures to diagnose problems in torque converters.
   - overheating
   - noise
   - leaks
   - low power multiplication
   - contaminated fluid

4. Describe procedures to check and service lock-up clutches.
   - control mechanisms
   - components
   - service

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, inspect, repair and assemble a torque converter
- pressure test torque converter performance

HDE-1350 POWER SHIFT TRANSMISSIONS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 34.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to repair and install power shift transmissions used on heavy equipment machinery.

Prerequisites:

HDE-1345, MPO-1110

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose problems in power shift transmissions
- service power shift transmissions

Required Knowledge and Skills:

1. Describe the removal procedures for power shift transmissions.
    - removal procedures:
        - drain transmission fluid
        - disconnect attaching parts
        - disconnect propeller shaft
        - use suitable lifting equipment
        - follow service manual recommendations

2. Describe procedures to inspect parts for wear.
    - inspect transmission mounts
    - check for loose or worn parts
    - check shifting linkage
    - check for oil leaks

3. Describe procedures to disassemble, repair and assemble power shift transmissions.
    - principle of operation and construction of Power shift transmission
    - planetary gear set and drive combination

- members of planetary gear set
    - sun
    - planet pinions
    - carrier
    - ring gear
- components of power shift transmission
    - oil pumps
    - servos
    - bands
    - clutch plates
    - clutch discs
    - clutch piston
- types of valves
    - pressure regulator valves
    - manual control valves
    - shifter valves
    - throttle valves
    - upshift valves
    - downshift valves
    - lubrication valves
    - balance valves
    - oil filter relief valves
    - cooler relief valves
    - modulator valves
- governor
- accumulator
- oil cooler
- oil filter
- disassembly procedures
- inspection of parts
- importance of cleanliness
- reassembly procedures
- adjustments
- importance of following manufacturer's specifications

4. Describe procedures to install transmissions.
    - installation procedures
        - importance of proper alignment of parts
        - torque attaching bolts
        - reconnect all attaching parts
        - follow service manual recommendation
        - adjust shifting linkage

5. Describe procedures to change transmission filters and fluid.
    - procedures to remove filters
    - importance of cleanliness

- selection of filter element
- installation procedures
- procedures for refilling transmission fluid
- fluid level interpretation

6. Describe procedures to check and adjust power shift transmission pressure.
   - main pump pressure
   - clutch pack pressure
   - filter relief valve pressure
   - cooler relief valve pressure
   - lubricating oil pressure

7. Describe procedures to test transmission operation.
   - test drive transmission operation
   - check transmission in all operating ranges
   - check for abnormal noise
   - check for oil leaks

8. Diagnose problems in Power shift transmissions.
   - power shift transmission troubleshooting
     - machine won't move
     - shifts erratically
     - clutches slipping
   - low system pressure
   - transmission overheating
   - pressure test reading
   - common failures
   - manufacturer's specifications
   - towing and pushing precautions

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, repair and assemble a Power shift transmission
- test and adjust transmission pressure

HDE-1355 DIFFERENTIAL ASSEMBLIES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 37.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, check, repair, assemble and adjust differential assemblies used on heavy equipment machinery.

Prerequisites:

IMP-1180

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose problems in differential assemblies
- service differential assemblies

Required Knowledge and Skills:

1. Describe procedures to remove differential assemblies.
    - removal procedures
        - drain differential oil
        - disconnect attaching parts
        - jacking techniques
        - follow service manual recommendations

2. Describe procedures to inspect parts for wear.
    - inspect differential mounts
    - check for loose or worn parts

3. Describe procedures to check and repair bushings in oscillating axles.
    - pivot pin and bushings
    - bushing types and material
    - procedure to remove and install pin and bushings
    - lubrication

4. Describe procedures to disassemble, check, repair, assemble and adjust differential assemblies.
   - recognize functions of major components
     - ring gear
     - pinion gears
     - spiders gears
     - side gears
     - bearings
     - seals
   - types of differentials
     - single speed
     - single reduction
     - double reduction
   - nomenclature of gear
     - face
     - flank
     - heel
     - toe
   - types of gears
   - disassembly procedures of differential
   - inspection of parts
   - adjustments
     - pinion depth
     - bearings preload
     - tooth contact
     - backlash
   - importance of cleanliness
   - reassembly procedures
   - manufacturer's specifications

5. Describe procedures to remove, repair and install differential locks.
   - principles of operation
   - purpose
   - types and designs (differential locks)
     - mechanical
     - hydraulic
     - nonspin
     - torque proportional

6. Describe procedures to service and repair power dividers.
   - principles of operation
   - purpose
   - types and designs
   - method of shifting

7. Describe procedures to install differential assemblies.
    - installation procedures
        - importance of proper alignment of parts
        - proper torque of attaching bolts
        - reconnect all attaching parts
        - refill differential fluid
        - follow service manual recommendations

8. Describe procedures to test differential operation.
    - test-drive differential operation
    - check for abnormal noise
    - check for oil leaks

9. Diagnose problems in differential assemblies.
    - differential troubleshooting
    - noise interpretation
        - growling
        - knocking
    - leaking oil
    - oil level interpretations
    - common failures
    - manufacturer's specifications

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, repair and assemble differential assembly

HDE-1360 DRIVE AXLES AND FINAL DRIVES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 30 & 36.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, disassemble, repair, adjust and assemble drive axles and final drives used on wheel and track-type vehicles.

Prerequisites:

IMP-1185

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose problems in final drive assemblies and axles
- service final drives (wheel type and track type vehicle)

Required Knowledge and Skills:

1. Describe procedures to remove and install axles.
    - types of axles
        - semi-floating
        - three quarter floating
        - full floating
        - axle bearings
        - axle retaining method
    - removal and installation procedures

2. Describe procedures to remove, disassemble, repair, assemble and install final drives (wheel type vehicle).
    - removal procedures of final drive
    - principles of operation
    - final drive design types
        - gear drive
        - planetary drive

    - inboard final drive
    - outboard final drive
- components identification
    - ring gear
    - sun gear
    - pinions gear
    - bearings
    - seals
- repair procedures
- inspection of parts
- adjustments of bearings
- installation procedures
- lubrication recommendations

3. Describe procedures to remove, disassemble, repair, assemble and install final drives (track-type vehicle).
    - removal procedures of final drive
    - principles of operation
    - types and design of final drives
        - single reduction
        - double reduction
        - gear drive
        - planetary drive
    - components identification
        - sprocket shaft
        - final drive shaft
        - pinion shaft
        - planetary gears
    - types of bearings
    - types of seals
    - types of lubrication systems
        - splash
        - pressurized
    - disassembly procedures
    - inspection of parts
    - repair procedures
    - adjustment of bearings
    - installation procedures
    - lubrication recommendations

4. Diagnose problems in final drive assemblies and axles.
    - final drive troubleshooting
        - noise interpretation
        - overheating
        - leaking oil
        - common failures

    - manufacturer's specifications
- axles failures

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, repair and assemble a final drive (wheel-type vehicle)
- disassemble, repair and assemble a final drive (track-type vehicle)

HDE-1370 LIGHTING, GAUGES (ELECTRICAL AND ELECTRONIC) AND SAFETY SYSTEM CIRCUIT COMPONENTS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 41.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, test and replace lights, gauges and safety components used on heavy equipment machinery.

Prerequisites:

IMP-1185, 1230, 1350

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- interpret and use electrical symbols schematics and diagrams
- service lighting systems
- service switches
- service gauges and sending units
- service accessories components
- diagnose lighting, gauge and accessory problems

Required Knowledge and Skills:

1. Interpret and use electrical symbols, schematics and diagrams.
    - recognition of symbols commonly used in wiring diagrams
    - interpretation of schematics and diagrams
        - color coding
        - number coding
        - procedures for tracing problems by using schematics and diagrams

2. Describe procedures to remove, test and replace light bulbs.
    - bulb identification

        - single filament
        - double filament
        - sealed-beam
        - halogen beam
        - bulbs rating
    - headlights
    - park lights
    - brakelights
    - signal lights
    - revolving lights
    - dash lights
    - removal procedures
    - test procedures
    - replacement procedures
    - installation procedures
    - headlight aiming procedures

3. Describe procedures to remove, check and replace circuit protections.
    - purpose
    - types
        - fuse
        - circuit breakers
        - fusible link
    - terminal block
    - junction block
    - relays
    - removal procedures
    - test procedures
    - installation procedures

4. Describe procedures to remove, check and replace switches.
    - types of switches
        - ignition switch
        - toggle switch
        - push-pull switch
        - cutout switch
        - multiple contact switch
        - push-button switch
        - pressure switch
        - safety switch
    - removal procedures
    - test procedures
    - installation procedures

5. Describe procedures to remove, test and replace gauges and sending units.
    - mechanical gauges

- electrical gauges
- electronic gauges
- types of gauges
    - pressure gauge
    - temperature gauge
    - fuel gauge
    - ammeter gauge
    - voltmeter gauge
- sending unit
    - function
    - types
- removal procedures
- test procedures
- installation procedures

6. Describe procedures to remove, test and replace accessories components.
    - flashers
    - horns
    - buzzers
    - wiper motor
    - heater motor
    - hourmeter
    - tachometer
    - relays
    - back-up alarm
    - removal procedures
    - test procedures
    - installation procedures
    - fuel heaters

7. Describe procedures to diagnose lighting, gauge and accessory problems
    - types of failure
        - open
        - short
        - ground
    - dim lights
    - lights burn out prematurely
    - failure of gauges
    - failure of warning devices

8. Describe procedures to test starting circuit problems.
    - engine will not crank
    - engine cranks slowly
    - starter turns but will not engage
    - voltage drop test
    - amperage draw test

9. Describe procedures to test charging circuit problems.
   - alternator output test
   - voltage and amperage
   - no alternator output
   - low alternator output
   - high alternator output

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, check and reinstall lighting system components
- remove, check and reinstall gauges and sending unit
- test starting circuit problems
- test charging circuit problems

HDE-1371 HOSES, FITTINGS, TUBING FOR HYDRAULIC SYSTEMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 4, 5, 45, 46, 47, 48, 49, 50, 51 & 52.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, repair and install hydraulic hoses and fittings.

Prerequisites:

MPO-0120, IMP-1155

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service hoses, fittings and tubings for hydraulic systems

Required Knowledge and Skills:

1. Describe procedures to remove and replace hydraulic hoses.
    - hose classification
        - low pressure
        - medium pressure
        - high pressure
        - extreme high pressure
    - types of hoses
        - fabric braid
        - single wire braid
        - double wire braid
        - spiral wire
    - hose construction
        - inner tube
        - reinforcement layers
        - outer cover

- hose selection
- size ratings of hoses
    - identification of hose sizes
    - interpretation of dash number
    - flow capacities of hoses
- removal and installation procedures of hoses

2. Describe procedures to remove and install hydraulic fittings.
    - types and style of fittings
        - crimped (permanent)
        - reusable
        - low pressure
        - medium pressure
        - high pressure
        - male and female fittings
    - flare angles 45° and 37° (JIC & SAE)
    - Flare fitting
    - Inverted flare fitting
    - Split flange fitting
    - 45° and 90° fitting
    - Marking identification for size and pressure ratings
    - Methods of sealing fittings
        - thread seal
        - cone seat seal
        - o-ring seal
        - split flange seal
        - inverted flare
    - Sealing compounds and compatibility
        - teflon tape
        - liquid teflon

3. Describe procedures to remove and replace fittings to hoses
    - Crimped-type fittings
        - types of hose crimping machine
        - crimping procedures
        - importance of following proper procedures
        - importance of cleanliness
    - Reusable-type fittings
        - installation procedures for low pressure fittings
        - installation procedures for high pressure fittings
        - importance of cleanliness
    - Tightening procedures and torque values of fittings

4. Describe procedures to remove and replace hydraulic pipes and tubing
    - Types of pipes and tubing
    - Identification of sizes

- Removal and installation procedures
- Proper routing of pipes and tubing
- Bending
- Reuse versus replacement

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove and install hydraulic hose.
- install a crimped-type fitting to a hydraulic hose.
- install a reusable-type fitting to a hydraulic hose.

HDE-1375 RESERVOIRS & FLUID CONDITIONERS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for National Occupational Analysis for the Heavy Duty Equipment Technician tasks 45, 46, 47, 48 & 49.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service hydraulic reservoirs, and remove, service and install filters.

Prerequisites:

HDE-1371

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- Service filter, reservoirs and fluid conditioners

Required Knowledge and Skills:

1. Describe procedures to drain reservoir and service intake filters.
    - types and designs of reservoirs
    - shape and construction
    - capacity of reservoirs
    - features of reservoirs
        - filler cap
        - oil level gauge
        - baffles
        - intake filter (strainers)
        - return filter
        - outlet and return lines
        - drain plug
    - reservoir ventilation
    - pressurized reservoir
    - procedures to drain reservoirs
    - procedures to remove and install intake filter
    - refilling the reservoirs
    - interpretation of oil levels

- importance of cleanliness

2. Describe procedures to remove, service and install filters
   - types of filters
     - surface filter
     - depth filter
     - edge filter
   - filter element material
   - micron ratings of filter
   - types of filtering systems
     - full-flow system
     - by-pass system
   - filter selection
   - damaging effect of dirty filter
   - filter condition indicators
   - service oil filter
     - procedures to remove and install
     - inspection
     - cleanliness
     - precautions
   - importance of cutting open used filter to check for presence of foreign particles

3. Describe procedures to remove, service and install fluid conditioners
   - heat exchanger
   - cooling
   - heating
   - types of coolers
     - air to oil
     - water to oil
   - function of coolers
   - principles of operation
   - location in relation to system
   - recognition of faulty operation
   - removal procedures
   - cleaning methods
     - air pressure
     - steam pressure
     - precaution measures
     - installation procedures
     - testing

4. Identify basic service procedures
   - venting reservoir
   - pressure reservoir

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- drain hydraulic oil and fluids, inspect or clean intake filter and refill reservoir.
- remove, service and install hydraulic filters.
- check condition and service hydraulic oil cooler.

HDE-1380 HYDRAULIC PUMPS & MOTORS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 46 & 47.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, inspect, repair and assemble hydraulic pumps and motors.

Prerequisites:

HDE-1375

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose hydraulic motor problems
- diagnose hydraulic pump problems
- service hydraulic pumps and motors

Required Knowledge and Skills:

1. Describe procedures to remove and replace hydraulic pumps
    - function of the pump
    - pump classification:
        - non-positive displacement
        - positive displacement
        - fixed displacement
        - variable displacement
    - pump ratings/selections
    - types of pumps
    - gear types
        - external gears
        - internal gears
        - gerotor
    - vane type
        - balanced
        - unbalanced

- piston type
    - axial
    - radial
    - bend-axis
- identification of pump components:
    - gear pump
    - vane pump
    - piston pump
- removal procedures of pumps
- sealing of openings
- installation procedures
- importance of cleanliness

2. Describe procedures to disassemble, repair and assemble hydraulic pumps
    - disassembly procedures
    - pump inspections
        - wear patterns
        - clearance and tolerance
        - normal wear
        - specifications
    - reassembly procedures
    - precautions
    - importance of cleanliness
    - importance of following service manual recommendations

3. Describe procedures to diagnose hydraulic pump problems
    - pump failures and causes:
        - no fluid delivery
        - pump making noise
        - excessive fluid leakage
        - excessive pump wear
        - misaligned drive shaft
        - pump cavitation
        - pump aeration

4. Describe procedures to remove and replace hydraulic motors
    - types of motors:
        - gear
        - vane
        - piston
    - fixed and variable displacements motor
    - directional and bidirectional motors
    - torque rating
    - speed rating
    - horsepower rating
    - motor application and efficiency

- identification of motor components for:
  - gear motor
  - vane motor
  - piston motor
- removal procedures of motors
- sealing of openings
- installation procedures
- importance of cleanliness

5. Describe procedures to disassemble, check, repair and assemble hydraulic motors
   - disassembly procedures
   - cleanliness
   - check wear pattern
   - check tolerances
   - importance of following service manual recommendations
   - reassembly procedures

6. Diagnose hydraulic motor problems
   - motor won't turn
   - slow motor operation
   - erratic motor operation
   - motor turns in wrong direction
   - motor shaft not turning

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, check, repair and reassemble the following types of pumps:
  - gear
  - vane
  - piston
- Disassemble, check, repair and reassemble a hydraulic motor.

HDE-1385 HYDRAULIC CONTROL VALVES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 48 & 52.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, inspect, repair and assemble various types of hydraulic valves.

Prerequisites:

HDE-1380

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose hydraulic valve problems
- service hydraulic control valves

Required Knowledge and Skills:

1. Describe procedures to remove and install hydraulic control valves
    - major types of valves
        - pressure control
        - directional control
        - volume control
    - pressure control valves
        - direct acting relief valve
        - pilot operated (compound) relief valve
        - pressure reducing valves
        - sequence valves
        - unloading valves
        - secondary valves
    - directional control valves
        - open-centre valves
        - close-centre valves
        - two-way, two position valve
        - three-way, two position valve

        - three-way, three position valve
        - four-way, three position valve
        - four-way, four position valve
        - check valves
        - rotary valves
        - spool valves
        - pilot controlled valves
        - electro-hydraulic valves
        - valve stack
        - unibody valves
        - shuttle valves
        - anticavitation valves
        - counterbalance valves
        - quick-drop valves
        - load check valves
    - volume control valves
        - flow control
        - flow divider
        - priority valve
        - proportional valve
    - valve removal procedures
    - importance of cleaning valves and surrounding area
    - releasing hydraulic pressure
    - sealing of openings
    - installation procedures

2. Describe procedures to disassemble, check, repair and assemble valves
    - disassembly procedures
    - inspections
    - importance of cleanliness
    - reassembly procedures
    - adjustment procedures
    - importance of following manufacturer's specifications

3. Diagnose hydraulic valve problems
    - pressure control valves
        - low pressure
        - high pressure
        - excessive noise or chatter
        - unable to adjust properly
    - directional control valves
        - faulty valve shifting
        - cylinder creeps
        - load drops when raised
        - oil overheating
    - volume control valves

- variations in flow
- improper flow
- erratic flow

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, check, repair and assemble directional control valve.
- disassemble, check, repair and assemble various types of hydraulic valves.

HDE-1390 HYDRAULIC CYLINDERS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 49.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, disassemble, inspect, repair, assemble and install hydraulic cylinders.

Prerequisites:

HDE-1385

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose hydraulic cylinder problems
- service hydraulic cylinders

Required Knowledge and Skills:

1. Describe procedures to remove and install hydraulic cylinders
    - types of cylinders:
        - single acting
        - double acting
        - balanced
        - unbalanced
        - telescoping
        - ram
    - features of cylinders
        - stroke control
        - cushions
        - protection check valves
    - cylinder components:
        - barrel
        - rod
        - piston
        - seals and packing

- removal procedures
- importance of cleanliness
- sealing of openings
- installation procedures
- safety

2. Describe procedures to disassemble, check, repair and assemble hydraulic cylinders
   - disassembly procedures
   - cylinder inspections
   - service manual recommendations
   - check rod condition
   - reassembly procedures
   - importance of cleanliness

3. Diagnose hydraulic cylinder problems
   - external leakage
   - internal leakage
   - creeping of cylinder
   - sluggish operation
   - lack of lubrication
   - burrs on piston rod
   - loose mounting (pins and bushings)
   - misalignment

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, disassemble, repair, assemble and install a hydraulic cylinder.

HDE-1395 HYDRAULIC ACCUMULATORS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 50.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service, inspect and repair hydraulic accumulators and oil coolers.

Prerequisites:

HDE-1385

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose hydraulic accumulator problems
- service hydraulic accumulators

Required Knowledge and Skills:

1. Describe procedures to remove and install hydraulic accumulators
    - purpose of accumulators
    - types of accumulators
        - pneumatic
        - weight-loaded (introduction)
        - spring-loaded
    - components of accumulators
        - oil chamber
        - piston
        - bladder
        - gas valve
        - packing
        - nitrogen gas
    - service and non-service
        - test procedures

2. Describe procedures to disassemble, check, repair and assemble hydraulic accumulators
   - service manual recommendations
   - procedures to remove accumulator from machine
   - disassembly procedures
   - bleeding procedures
   - inspections
   - importance of cleanliness
   - reassembly procedures
   - charging accumulator
   - charging equipment
   - precautions
   - procedures to install accumulator on machine

3. Diagnose hydraulic accumulator problems
   - accumulator charge valve leaking
   - internal leakage
   - effect of different charge pressure

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, check, repair and reassemble a hydraulic accumulator.

HDE-1400 HYDRAULIC STEERING SYSTEMS (ARTICULATED)

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 57.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, inspect, repair and assemble steering components from articulated vehicles.

Prerequisites:

HDE-1390

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose articulated steering problems
- service hydraulic steering system (articulated)

Required Knowledge and Skills:

1. Describe procedures to remove and install articulated steering components
    - types of articulated steering
        - semi-hydrostatic
        - hydrostatic
        - steering wheel rock back and forth
        - metering pump steering
        - pilot-operated hydrostatic steering
        - orbital steering
    - emergency steering system
    - components of articulated steering:
        - steering valves
        - cylinders
        - oil lines
        - filters
        - pump

        - accumulator
        - follow-up link
    - procedures to remove steering components
    - importance of cleanliness
    - procedures to install steering components
    - safety precautions

2. Describe procedures to disassemble, check, repair and reassemble articulated steering valves
    - disassembly procedures
        - importance of cleanliness
        - service manual recommendations
        - adjustments
        - reassembly procedures

3. Diagnose articulated steering problems
    - slow steering
    - hard steering
    - opposite steering
    - no steering
    - steering wheel does not centre
    - steering wheel rocking back and forth
    - steering wheel continues to turn

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, repair, adjust and reassemble articulated steering valves.

HDE-1405 HYDROSTATIC TRANSMISSIONS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 34.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, disassemble, repair, assemble and install hydrostatic transmissions.

Prerequisites:

HDE-1335 to 1360, 1385

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose problems in hydrostatic transmissions
- service hydrostatic transmission systems

Required Knowledge and Skills:

1. Describe procedures to remove and install hydrostatic transmissions
    - theory of hydrostatic drive
    - principles of operation
    - types of hydrostatic drives (possible pump-motor combinations)
    - advantages and disadvantages of hydrostatic drives
    - hydrostatic transmission components
        - pump
        - motor
        - charge pump
        - filter
        - reservoir
        - cooler
        - valves
    - procedures to remove hydrostatic transmission
    - importance of cleanliness
    - bleeding procedures
    - procedures to install hydrostatic transmission

2. Describe procedures to service transmission controls
   - types
     - mechanical
     - electronic
     - diagnostic
   - service adjustment procedures

3. Describe procedures to disassemble, repair and assemble hydrostatic transmissions
   - disassembly procedures
   - inspection of parts
   - importance of cleanliness
   - reassembly procedures
   - adjustments
   - importance of following manufacturer's specifications

4. Diagnose problems in hydrostatic transmissions
   - machine will not move in either direction
   - machine moves in one direction only
   - system noisy
   - system operating hot
   - neutral hard to find
   - acceleration and deceleration sluggish

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, repair and assemble a hydrostatic transmission.

HDE-1410 HYDRAULIC SYSTEMS DIAGNOSTIC AND TESTING

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 45.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to diagnose and test hydraulic systems.

Prerequisites:

HDE-1395, 1400, 1405

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose problems in hydraulic systems
- diagnose and test hydraulic systems

Required Knowledge and Skills:

1. Describe procedures to identify basic steps for diagnosing and testing hydraulic systems
    - basic rules for troubleshooting hydraulic systems:
        - know the system
        - ask the operator
        - operate the machine
        - inspect the machine
        - list possible causes
        - reach a conclusion
        - test your conclusion
        - use service information
        - interpret data

2. Describe procedures to use and interpret schematics and hydraulic diagrams
    - knowledge of schematics and diagrams

- color coding of pressure oil
- hydraulic symbols
- basic steps to follow when tracing problems by using hydraulic diagrams

3. Describe procedures to use hydraulic testers
   - types of hydraulic testers
   - by-pass tester
   - in-line tester
   - pressure gauges
   - flow meter tester
   - temperature gauge
   - interpreting test data
   - precautions when testing

4. Describe procedures to test hydraulic systems
   - test pump efficiency
     - flow
     - pressure
     - leakage
     - temperature
   - test main relief valve setting
   - test individual circuit setting
   - test circuit efficiency by using cycle time

5. Diagnose problems in hydraulic systems
   - system inoperative
   - system operates slowly
   - system operates erratically
   - system operates too fast
   - oil foaming in the system
   - overheating of oil in the system
   - pump makes noise
   - load drops with control valve in neutral position
   - cylinder lowers when control valve is in slow raise position
   - contaminated hydraulic oil

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- using appropriate test equipment, check the following items on a hydraulic system:
    - pump efficiency
    - main relief valve setting
    - individual circuit relief valve setting
    - check circuits cycle time

HDE-1415 WINCHES, WIRE ROPES & ACCESSORIES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 72, 73.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to disassemble, repair and assemble winches and remove and install wire ropes and accessories used on heavy equipment machinery.

Prerequisites:

IMP-1160, HDE-1385

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- diagnose wire rope failures
- service winches, wire ropes and accessories

Required Knowledge and Skills:

1. Describe procedures to remove and install winches
    - types and designs of winches
        - mechanical winch
        - hydraulic winch
    - principles of operation
        - neutral position
        - pull-in position
        - power-out position
        - hold position
    - winch operation
        - gearing
        - drums
        - clutches
        - brake band
        - control valves
        - pump

- fair leads
- lubrication
- drives
    - power take off
    - single coupling
    - double coupling

2. Describe procedures to disassemble, check, repair and assemble winches
    - disassembly procedures
    - wear tolerances
    - service manual specifications
    - cleanliness
    - adjustments
    - reassembly procedures
    - safety precautions

3. Describe procedures to diagnose winch problems
    - winch drive shaft won't turn
    - lack of reel-in power
    - brake will not hold the load
    - drum turns while valve in neutral
    - winch makes noise

4. Describe procedures to remove and install wire rope from winch drums
    - wire rope terminology
        - strands number
        - strands material
        - grades
    - lay
        - overwind
        - underwind
        - left lay
        - right lay
    - methods to secure wire rope to the drums
    - seizing wire rope
    - cutting wire rope
    - drum capacity
    - unspooling cable

5. Describe procedures to remove and install wire rope connections and anchors
    - fitting
    - clamps
    - wedges
    - hooks
    - thimbles

6. Diagnose wire rope failures
   - lack of lubrication
   - improper rope selection
   - rope crushing
   - rope bending
   - rope kinking
   - safety factors

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- disassemble, repair and assemble a winch.
- adjust brake bend on a winch.
- remove and reinstall a wire rope on a winch drum.
- install different types of connections to wire rope.

HDE-1420 CABS & ROLL-OVER PROTECTION STRUCTURES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician , task 66.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, inspect, repair and install cabs and Roll-over Protection Structures (ROPS) used on heavy equipment machinery.

Prerequisites:

MPO -0100, IMP-0135 to 1160

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service cabs and ROPS

Required Knowledge and Skills:

1. Describe procedures to remove, inspect, repair and replace cabs
    - cab components
        - cab frame
        - cab platform
        - floor mat
        - cab windows
        - cab doors
        - door handles
        - door locks
        - seat
        - seat support and suspension
        - seat belts
    - removal procedures
    - repair procedures
    - installation procedures

2. Describe procedures to remove, inspect, repair and replace ROPS
    - roll-over protective structure (ROPS)
        - construction
        - features
        - safety precautions
        - removal procedures
        - service and repair procedures and regulations
        - installation procedures

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- Classroom exercises as directed by the instructor

HDE-1425 FIRE SUPPRESSION UNITS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 68.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service, inspect and repair fire suppression systems used on heavy equipment machinery.

Prerequisites:

MPO-0100, IMP-0135 to 1155, IMP-1160

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service fire suppression units

Required Knowledge and Skills:

1. Describe procedures to inspect, service and repair fire suppression units
    - types and functions of fire suppression units
    - where it is used
    - types and designs
    - principles of operations
    - components:
        - actuator (remote and dashboard type)
        - actuation cartridge
        - bursting disc
        - expellent gas cartridge
        - dry chemical tank
        - indicator fill cap
        - nozzle
        - blow-off cap
        - hoses and fittings
    - checking appearance of dry chemical tank
    - checking nameplate for readability on tank
    - checking fill cap gasket

- inspecting threads on fill cap
- checking pressure relief vent
- checking dry chemical level and condition
- checking tank mounting bracket
- checking condition of actuator cartridge
- checking nozzle opening
- checking condition of hoses and fittings
- recording date of maintenance
- procedures to recharge the system

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- service, inspect and repair fire suppression units.

HDE-1430 PORTABLE AIR COMPRESSORS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 53, 54 & 55.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service and repair portable air compressors.

Prerequisites:

MPO-0100, IMP-1155, 1160, HDE-1370

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service portable air compressors
- operate air compressors
- diagnose air compressor problems

Required Knowledge and Skills:

1. Describe procedures to service and repair air compressors
    - types of compressors:
        - rotary
        - reciprocating
        - single stage
        - double stage
    - rating of compressors
    - major components of air compressor unit
        - air receiver (reservoir)
        - intercooler
        - compressor
        - gauges
        - air lines and fittings
        - line oiler
        - filter
        - cooling system

    - lubrication system
    - unloader valve
    - governor
- valves
    - safety valves
    - manual blowdown valves
    - automatic blowdown valves
    - pressure valves
    - air inlet valves
    - minimum pressure valves
    - drain valves
    - three way selector valves
- auxiliary compressor
    - purpose
    - connection
- factors affecting pressure drop
- servicing the air compressor
- lubricant recommendation
- filter replacement
- oil change intervals
- cooling system service
- air cleaner service
- preventive maintenance
- adjustments of air pressure

2. Describe procedures to operate air compressors
    - before starting the compressor
    - starting the compressor
    - stopping the compressor

3. Diagnose air compressor problems
    - air pressure too low
    - air pressure too high
    - excessive lubricating oil consumption
    - unable to obtain correct engine speeds
    - overheating of compressor high discharge air
    - short air cleaner element life

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- service and repair air compressor unit.
- check and adjust air pressure on an air compressor.

HDE-1435 BOOMS & ATTACHMENTS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 69 & 71.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, inspect, repair and install booms, pins and bushings used on heavy equipment machinery.

Prerequisites:

MPO-0120, IMP-1155, 1160, HDE-1390

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service booms and attachments

Required Knowledge and Skills:

1. Describe procedures to remove and install booms
    - types and construction of boom:
        - main boom
        - secondary booms
        - telescoping booms
        - stabilizer or outrigger
    - removal procedures
    - precautions
    - inspections
    - following manufacturer's recommendations
    - installation procedures

2. Describe procedures to remove and install pins and bushings
    - types and designs of pins and bushings
    - removal procedures
    - inspections
    - lubrication recommendations

- installation procedures

3. Describe procedures to service booms and attachments
   - importance of following manufacturer's recommendations
   - inspecting boom for cracks
   - inspecting pins and bushing wear
   - lubrication recommendations

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove one section of a boom and check or replace all bushings and pins.

HDE-1440 BLADES, BUCKETS AND CUTTING EDGES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 69 & 70.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to remove, repair and install blades, buckets and cutting edges used on heavy equipment machinery.

Prerequisites:

MPO-1115, IMP-1160, HDE-1390

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- check and service quick-coupling attachments
- service blades, buckets and cutting edges

Required Knowledge and Skills:

1. Describe procedures to remove, repair and install blades
    - types and construction of blades:
        - straight blade
        - angle blade
    - components:
        - push arm
        - pitch arm
        - tilt arm
        - landside
        - pins
        - cutting edge
        - corner edge
    - types and applications of cutting edge
    - moldboard construction
    - blade removal procedures
        - blade inspection

        - bushing and pin replacement

2. Describe procedures to remove, reverse or replace and install cutting and corner edges
    - procedures to remove cutting and corner edge
    - reversing principles of cutting edge
    - installation procedures
    - importance of cleanliness
    - importance of torquing all attaching bolts

3. Describe procedures to remove, repair and install buckets
    - types and construction of buckets:
        - multipurpose bucket
        - rock bucket
        - snow bucket
        - four-in-one bucket
        - side-dump bucket
        - backhoe bucket
        - excavator bucket
    - components:
        - cutting edge
        - teeth
        - shank
        - bushings
        - pins
        - rms
    - bucket removal procedures
    - bucket inspections
    - replacement of shank
    - replacement of cutting edge
    - replacement of pins and bushings
    - installation procedures

4. Describe procedures to remove and replace bucket teeth
    - teeth removal procedures
    - method of attaching teeth to shank
    - importance of using proper teeth
    - teeth reversible principles (if applicable)
    - teeth installation procedures

5. Describe procedures to check and service quick-coupling attachments
    - types of quick-coupling systems:
        - hydraulic operated
        - air operated
    - advantages
    - service procedures

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, replace or reverse a cutting edge from a blade.
- remove and install bucket teeth.
- remove and install a bucket from a machine.

HDE-1445 APRONS, BOWLS AND TAILGATES

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician tasks 69 & 70.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service and repair aprons, bowls and tailgates used on scrapers.

Prerequisites:

HDE-1440

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service bowls, aprons and tailgates (ejector)

Required Knowledge and Skills:

1. Describe procedures to repair bowls, aprons and tailgates (ejector)
    - principles of scraper operation
    - types of scrapers
        - two-axles
        - three-axles
        - push-loading scraper
        - push-pull scraper
        - elevating scraper
        - two-engines scraper
    - components:
        - bowl
        - apron
        - ejector (tailgates)
        - gooseneck
        - cutting edge
    - repair procedures
    - check for cracks
    - check for worn pins and bushings
    - safety precautions

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- remove, change and install a cutting edge from a bowl scraper.
- service and repair aprons, bowls and tailgates of a scraper.

HDE-1450 FELLER HEADS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 69.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service and repair feller heads used on forestry machinery.

Prerequisites:

HDE-1430

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service feller heads

Required Knowledge and Skills:

1. Describe procedures to service and repair feller heads
    - feller heads
        - principles of operation
        - types and designs
    - components removal procedures
    - repair procedures
    - inspection
    - importance of following manufacturer's specifications
    - components installation procedures
    - maintenance recommendations

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- service and repair feller head assembly.

HDE-1455 DELIMBER MECHANISMS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 69.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service and repair delimber mechanisms used on forestry machinery.

Prerequisites:

HDE-1430, 1435

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service delimber mechanisms

Required Knowledge and Skills:

1. Describe procedures to service and repair delimber mechanisms
    - delimber mechanisms
        - principles of operation
        - types and designs
    - components removal procedures
    - repair procedures
    - inspection
    - importance of following manufacturer's specifications
    - components installation procedures
    - maintenance recommendations

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- service delimber mechanism units.

HDE-1460 SERVICE & REPAIR CIRCLE BEARING

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician.

Description:

This course is designed to provide the apprentice with the knowledge and skills necessary to service and repair circle bearing assemblies used on heavy equipment machinery.

Prerequisites:

HDE-1385

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- service circle bearing assemblies
- service swing reducer assemblies

Required Knowledge and Skills:

1. Describe procedures to service and repair circle bearing assemblies
    - types and designs of bearings
    - removal procedures
    - bearing inspection
    - bearing replacement and adjustment procedures
    - lubrication recommendations
    - following manufacturer's recommendations
    - installation procedure
    - service procedures

2. Describe procedures to service and repair swing reducer assemblies
    - principles of operation
    - types and designs
    - removal procedures
    - repair procedures
    - adjustments of parts
    - lubrication recommendations

- installation procedures
- service procedures

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- classroom exercises as determined by the instructor

HDE-1465 PREVENTIVE MAINTENANCE INSPECTIONS

NOA Reference:

The material covered satisfies in whole or in part, the requirements for the National Occupational Analysis for Heavy Duty Equipment Technician task 14.

Description:

This course is designed to provide the apprentice the knowledge and skills necessary to perform a complete preventive maintenance inspection, to manufacturer's specifications, on heavy equipment machinery.

Prerequisites:

Entire program

Course Outcomes:

Upon successful completion of this course, the apprentice will be able to:
- perform preventive maintenance inspections

Required Knowledge and Skills:

1. Perform preventive maintenance inspections
    - follow procedures carefully
    - preventive maintenance program
        - scheduled lubrication
        - scheduled servicing
        - frequent cleaning
        - adjusting
        - inspecting
        - correction of defects
        - keeping complete records
        - legal responsibility
    - preventive maintenance chart
    - importance of respecting scheduled maintenance
    - importance of good written inspection report
    - following report checklist
    - fluid check the following items:
        - engine

    - transmission
    - differential
    - final drive
    - hydraulic
    - radiator
- oil level interpretation and condition
- checking the following filters:
    - air
    - fuel
    - hydraulic systems
    - transmission
    - power steering
- checking belt tension
- checking and cleaning battery
- checking brake systems
- checking hydraulic systems
- checking power train systems
- checking lighting systems
- checking all gauges
- checking air conditioning systems
- checking charging systems
- checking starting systems
- checking engine operation
- checking exhaust system for leaks
- checking tire pressure
- checking track sagc
- checking condition of cutting edge
- checking condition of bucket teeth
- checking for oil leaks
- checking for loose or missing parts
- fill inspection report sheet to manufacturer's specifications

Suggested Learning Activities:

Suggested learning activities are assigned to enhance the apprentice's ability to meet the objectives of the course. The learning activities outlined in this course are provided as suggestions only and may be substituted by the instructor for other relevant activities. Suggested learning activities include:

- perform preventive maintenance inspections on a machine according to manufacturer's recommendations.