

## **COURSE HEA3400: BASIC TOOLS & MATERIALS**

**Level:** First Period Apprenticeship, Section One

**Prerequisite:** HEA3900: Apprenticeship Safety

**Description:** Students develop knowledge, skills and attitudes in the practice of workshop safety, communication and the use of specialty hand tools, measuring tools and fasteners.

**Parameters:** Access to a materials work centre, complete with basic measuring tools, specialty hand tools and fastening devices, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Materials and Fastening Devices 190101f; Hand, Shop and Power Tools 190101g; Measuring Tools 190101h

**Outcomes:** The student will:

### **1. identify materials and fasteners commonly used in the trade**

- 1.1 identify common metallic materials and their applications, including:
  - 1.1.1 alloys
  - 1.1.2 ferrous metals; e.g., steel, cast iron, wrought iron and stainless steel
  - 1.1.3 non-ferrous metals; e.g., aluminum, brass, copper, lead, magnesium, nickel, silver, gold
- 1.2 identify characteristics and properties common to metal, including:
  - 1.2.1 ductility, toughness, malleability, elastic limit, elasticity
  - 1.2.2 tensile strength, hardness, work hardening
  - 1.2.3 oxidation, annealing, tempering, quench
- 1.3 identify common non-metallic materials and their applications, including:
  - 1.3.1 natural and synthetic rubber
  - 1.3.2 plastics, Teflon and nylon
  - 1.3.3 fibreglass, asbestos, silicone and synthetic fibre
- 1.4 identify types of threaded fasteners and their applications, including:
  - 1.4.1 bolts and cap screws
  - 1.4.2 nuts and washers
  - 1.4.3 machine and set screws
- 1.5 describe fastener classification and sizing, including:
  - 1.5.1 thread standards
  - 1.5.2 thread class
  - 1.5.3 bolt head markings
  - 1.5.4 bolt identification
- 1.6 identify various types of torque wrenches, including dial, indicating click type, digital and deflecting beam
- 1.7 explain torque procedures and precautions required when securing fastening devices, considering:
  - 1.7.1 bolt clamp loads
  - 1.7.2 torque methods; e.g., sequence methods and torque and turn methods

- 1.8 identify types of non-threaded fasteners and their applications, including:
  - 1.8.1 keys
  - 1.8.2 splines
  - 1.8.3 cotter, spring, tapered, split ring and roll pins
  - 1.8.4 standard, internal and external locking rings
  - 1.8.5 rivets, monobolts and huckbolts
- 1.9 identify various types of adhesives and sealants and their applications, including:
  - 1.9.1 gasket sealers
  - 1.9.2 anaerobic sealers
  - 1.9.3 aerobic sealers
  - 1.9.4 thread locking sealers
- 2. demonstrate the correct use of hand, shop and power tools common to the trade**
  - 2.1 describe types, uses and care of hammers, including:
    - 2.1.1 ball peen
    - 2.1.2 soft face
    - 2.1.3 sledge
    - 2.1.4 cross peen
    - 2.1.5 club
    - 2.1.6 hand
  - 2.2 describe the types, uses and care of screwdrivers, including:
    - 2.2.1 blade
    - 2.2.2 Phillips
    - 2.2.3 Robertson
    - 2.2.4 clutch
    - 2.2.5 torx
    - 2.2.6 pozi-drive
  - 2.3 identify the various types of punches and their uses, including:
    - 2.3.1 hole
    - 2.3.2 prick
    - 2.3.3 centre
    - 2.3.4 taper
    - 2.3.5 starting parallel
    - 2.3.6 aligning
    - 2.3.7 roll pin
  - 2.4 identify the various types of chisels and their uses, including:
    - 2.4.1 cold
    - 2.4.2 flat
    - 2.4.3 cape diamond point
    - 2.4.4 half-round
    - 2.4.5 bushing cutter
    - 2.4.6 rivet buster
  - 2.5 describe the various types of wrenches and their uses, including:
    - 2.5.1 open end
    - 2.5.2 box end
    - 2.5.3 flex head
    - 2.5.4 flare nut
    - 2.5.5 Allen
    - 2.5.6 adjustable
    - 2.5.7 socket

- 2.6 identify the various types of pliers and their uses, including:
  - 2.6.1 standard or slip joint
  - 2.6.2 adjustable
  - 2.6.3 needle-nose
  - 2.6.4 vise grip
  - 2.6.5 diagonal
- 2.7 identify various types of holding devices, including:
  - 2.7.1 fixed and swivel base vises
  - 2.7.2 wood clamps
  - 2.7.3 c-clamps
  - 2.7.4 quick clamps
  - 2.7.5 spring clamps
- 2.8 identify the various tools for removing broken fasteners and explain how to use them
- 2.9 describe the procedures required to safely operate various types and capacities of shop puller and pressing equipment, including:
  - 2.9.1 two and three jaw pullers
  - 2.9.2 specialty pullers
  - 2.9.3 bearing separators or splitters
  - 2.9.4 hydraulic presses
- 2.10 describe and use cutting hand tools common to the trade, including:
  - 2.10.1 jab saws and adjustable frame hacksaws
  - 2.10.2 hole saws
  - 2.10.3 single and double cut files
  - 2.10.4 half round, triangle, flat, square and round file configurations
  - 2.10.5 twist drills
  - 2.10.6 tapered, stepped and adjustable reamers
  - 2.10.7 pipe, machine screw, taper, plug and bottoming taps
  - 2.10.8 solid and adjustable dies
- 2.11 demonstrate how to sharpen a twist drill, including understanding of:
  - 2.11.1 drill bit angles
  - 2.11.2 sharpening tools
- 2.12 identify tools and demonstrate proper thread repair techniques, using:
  - 2.12.1 thread repair tools; e.g., thread files, chasers, shaft thread repair and spark plug hole
  - 2.12.2 heli-coil and permanent lock thread inserts
- 2.13 demonstrate the use of:
  - 2.13.1 tubing flaring
  - 2.13.2 sheet abrasives and grinding compounds
  - 2.13.3 lapping blocks and honing stones
- 2.14 demonstrate the care and safe use of common power hand tools, including:
  - 2.14.1 grinders
  - 2.14.2 air impacts and pneumatic tools
- 2.15 demonstrate knowledge of personal protective equipment (PPE) and tool safety
- 3. demonstrate the correct use of measuring tools common to the trade**
  - 3.1 perform calculations related to measurement, using imperial and metric units, including:
    - 3.1.1 length, area, volume and mass measurements
    - 3.1.2 force, velocity and pressure measurements
    - 3.1.3 heat and temperature measurements
    - 3.1.4 converting fractions to decimals
    - 3.1.5 converting decimals to fractions

- 3.2 perform linear measurements using basic non-precision measuring tools, including:
  - 3.2.1 tape measures
  - 3.2.2 protractors
  - 3.2.3 try squares
  - 3.2.4 feeler gauges
  - 3.2.5 levels
  - 3.2.6 straightedges
  - 3.2.7 steel squares
- 3.3 perform linear measurements, using precision measuring tools, including:
  - 3.3.1 common calipers; e.g., spring, firm joint, lock joint, lock joint transfer
  - 3.3.2 small hole gauges
  - 3.3.3 telescoping gauges
  - 3.3.4 outside, inside and depth micrometers
  - 3.3.5 vernier, dial and electronic digital calipers
  - 3.3.6 dial indicators
- 3.4 perform accurate torque measurements, demonstrating an understanding of the following:
  - 3.4.1 definition of torque
  - 3.4.2 beam, dial and click type torque wrenches
  - 3.4.3 torque multipliers
  - 3.4.4 pull scales
- 4. demonstrate basic competencies**
  - 4.1 demonstrate fundamental skills to:
    - 4.1.1 communicate
    - 4.1.2 manage information
    - 4.1.3 use numbers
    - 4.1.4 think and solve problems
  - 4.2 demonstrate personal management skills to:
    - 4.2.1 demonstrate positive attitudes and behaviours
    - 4.2.2 be responsible
    - 4.2.3 be adaptable
    - 4.2.4 learn continuously
    - 4.2.5 work safely
  - 4.3 demonstrate teamwork skills to:
    - 4.3.1 work with others
    - 4.3.2 participate in projects and tasks
- 5. create a transitional strategy to accommodate personal changes and build personal values**
  - 5.1 identify short-term and long-term goals
  - 5.2 identify steps to achieve goals

## **COURSE HEA3405: BEARINGS & SEALS**

**Level:** First Period Apprenticeship, Section Two

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials

**Description:** Students develop the knowledge, skills and attitudes necessary to service and maintain vehicle bearings and seals and to use oxy-fuel heating and cutting systems.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools, fastening devices and oxy-fuel heating and cutting equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Bearings and Seals 190102c; Oxyacetylene Equipment, Heating and Cutting 190101i

**Outcomes:** The student will:

### **1. service common bearings and seals**

- 1.1 state bearing functions and applications, considering:
  - 1.1.1 bearing design and functions
  - 1.1.2 radial, axial and combination bearing loads
  - 1.1.3 friction and antifriction bearings
  - 1.1.4 ball, roller and needle bearings
- 1.2 state seal functions, classifications and applications, considering:
  - 1.2.1 fluid containment, contamination prevention, holding pressure or vacuum
  - 1.2.2 static and dynamic seals
  - 1.2.3 external and integral seals
  - 1.2.4 O-rings, gaskets, sealants, radial lip seals, mechanical seals
  - 1.2.5 exclusion and clearance seals
  - 1.2.6 wind back and face seals
  - 1.2.7 dust shields and packings
- 1.3 diagnose common bearing and seal faults, demonstrating knowledge of:
  - 1.3.1 troubleshooting and failure analysis
  - 1.3.2 peeling, spalling, brinelling, arcing and bearing fatigue
  - 1.3.3 ingested contamination, pitting, bruising and etching of seals
- 1.4 perform bearing and seal service, including:
  - 1.4.1 non-destructive removal methods
  - 1.4.2 heating
  - 1.4.3 bearing splitter, external and internal puller usage
  - 1.4.4 destructive removal methods
  - 1.4.5 cleaning bearings
  - 1.4.6 lubricating and packing bearings
  - 1.4.7 cold and hot mounting bearing installation methods
  - 1.4.8 bearing adjustments
  - 1.4.9 preloading and locking methods
  - 1.4.10 static and dynamic seal service procedures

- 2. perform metal cutting and heating operations safely, using oxyacetylene equipment**
  - 2.1 describe the characteristics and handling procedures for oxygen, propane and acetylene, considering:
    - 2.1.1 properties of oxygen, acetylene and propane
    - 2.1.2 cylinders, valves and handling procedures
    - 2.1.3 mounting for use
  - 2.2 demonstrate handling procedures for regulators and hoses, considering:
    - 2.2.1 single- and two-stage regulators
    - 2.2.2 types and identification of hoses
    - 2.2.3 valve checks
  - 2.3 demonstrate the use, care and maintenance of torches and tips, considering:
    - 2.3.1 torch valves
    - 2.3.2 purge and leak checks
    - 2.3.3 heating tip sizes and application
    - 2.3.4 tip cleaning and O-ring seal checks
    - 2.3.5 acetylene, carbonizing, oxidizing and neutral flame characteristics and uses
    - 2.3.6 pressure adjustment and balancing
    - 2.3.7 backfires
    - 2.3.8 continuous backfire and burnback
    - 2.3.9 flashback
    - 2.3.10 cutting attachment components
    - 2.3.11 cutting torch start-up and shut-down procedures
    - 2.3.12 cleaning and maintenance
  - 2.4 demonstrate the use of personal protective equipment and safety precautions, including:
    - 2.4.1 goggles and lens shades
    - 2.4.2 clothing and footwear
    - 2.4.3 fire prevention
    - 2.4.4 ventilation
  - 2.5 perform heating and cutting operations, using oxygen and acetylene, demonstrating:
    - 2.5.1 suitable and unsuitable materials for cutting
    - 2.5.2 preheating, torch inclination and travel speed
    - 2.5.3 hole piercing and the cutting of nuts, bolts and rivets
- 3. demonstrate basic competencies**
  - 3.1 demonstrate fundamental skills to:
    - 3.1.1 communicate
    - 3.1.2 manage information
    - 3.1.3 use numbers
    - 3.1.4 think and solve problems
  - 3.2 demonstrate personal management skills to:
    - 3.2.1 demonstrate positive attitudes and behaviours
    - 3.2.2 be responsible
    - 3.2.3 be adaptable
    - 3.2.4 learn continuously
    - 3.2.5 work safely
  - 3.3 demonstrate teamwork skills to:
    - 3.3.1 work with others
    - 3.3.2 participate in projects and tasks
- 4. create a transitional strategy to accommodate personal changes and build personal values**
  - 4.1 identify short-term and long-term goals
  - 4.2 identify steps to achieve goals

## **COURSE HEA3410: FRAMES & SUSPENSION**

**Level:** First Period Apprenticeship, Section Two

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials  
HEA3405: Bearings & Seals

**Description:** Students develop the knowledge, skills and attitudes necessary to service and maintain vehicle frames and suspension systems.

**Parameters:** Access to a materials work centre, complete with basic measuring tools, specialty hand tools and fastening devices, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Frame and Suspension Fundamentals 190102a; Frame and Suspension Service 190102b

**Outcomes:** The student will:

### **1. explain the operating principles and design features of common frame and suspension systems**

- 1.1 state the functions of a vehicle frame, including:
  - 1.1.1 providing a platform to which all vehicle components are attached
  - 1.1.2 supporting the load the vehicle is carrying
  - 1.1.3 handling shock and torsional loads
  - 1.1.4 withstanding maximum bending moment
- 1.2 identify types, designs, structural considerations and components of frames commonly used in truck and trailer applications, including:
  - 1.2.1 ladder frames
  - 1.2.2 highboy trailer frames
  - 1.2.3 slider frames
  - 1.2.4 channel, box and I-beam frame rail construction
  - 1.2.5 steel and aluminum alloy frame materials
  - 1.2.6 frame size and shape
  - 1.2.7 resisting bending moment (RBM)
- 1.3 explain the functions of a vehicle suspension system, including:
  - 1.3.1 securing the axles to the frame components
  - 1.3.2 supporting vehicle weight and stability maintenance components
  - 1.3.3 sprung and unsprung weight and load distribution
  - 1.3.4 leaf spring, rubber and air spring energy absorption devices
  - 1.3.5 tire and road surface contact
- 1.4 explain the operating principles and components of common suspension systems, including:
  - 1.4.1 suspension limiting components; e.g., axle stops, torque rods, rubber bushings and shock absorbers
  - 1.4.2 solid mount suspension systems components
  - 1.4.3 leaf spring suspensions
  - 1.4.4 steering and drive axle suspensions

- 1.4.5 rubber cushion type suspensions
  - 1.4.6 air spring suspensions
  - 1.4.7 ride height control valves
  - 1.4.8 two-way control and dump valves
  - 1.4.9 cab air suspension systems
- 2. repair common types of frame and suspension systems**
- 2.1 demonstrate frame inspection and repair procedures, including:
    - 2.1.1 frame inspection for sidesway, diamond or weaving, twists, sags or bow conditions
    - 2.1.2 frame corrosion and cracking inspection
    - 2.1.3 frame alignment
    - 2.1.4 frame components and frame fasteners
    - 2.1.5 frame straightening
    - 2.1.6 crack repair and frame reinforcement
  - 2.2 explain the suspension noise inspection process and the causes of suspension system malfunctions, including:
    - 2.2.1 vehicle leaning to one side
    - 2.2.2 wandering
    - 2.2.3 bottoming
    - 2.2.4 leaf spring breakage
  - 2.3 demonstrate suspension system repair procedures for the following:
    - 2.3.1 leaf spring suspension service
    - 2.3.2 steering axle suspension service
    - 2.3.3 drive axle suspension service
    - 2.3.4 tandem drive axle service
    - 2.3.5 equalizer beam service
    - 2.3.6 rubber cushion suspension service
    - 2.3.7 air spring suspension service
    - 2.3.8 air control system service
- 3. demonstrate basic competencies**
- 3.1 demonstrate fundamental skills to:
    - 3.1.1 communicate
    - 3.1.2 manage information
    - 3.1.3 use numbers
    - 3.1.4 think and solve problems
  - 3.2 demonstrate personal management skills to:
    - 3.2.1 demonstrate positive attitudes and behaviours
    - 3.2.2 be responsible
    - 3.2.3 be adaptable
    - 3.2.4 learn continuously
    - 3.2.5 work safely
  - 3.3 demonstrate teamwork skills to:
    - 3.3.1 work with others
    - 3.3.2 participate in projects and tasks
- 4. create a transitional strategy to accommodate personal changes and build personal values**
- 4.1 identify short-term and long-term goals
  - 4.2 identify steps to achieve goals



## **COURSE HEA3415: WHEELS & PREVENTIVE MAINTENANCE**

**Level:** First Period Apprenticeship, Section Two

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials

**Description:** Students develop the knowledge, skills and attitudes necessary to service and maintain vehicle wheels, tires and hubs and to perform preventive maintenance procedures.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools, tire machines and balancing equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Wheels, Tires and Hubs 190102d; Preventive Maintenance 190102i

**Outcomes:** The student will:

### **1. service wheels, tires and hubs**

- 1.1 identify common wheel types and mounting designs, including:
  - 1.1.1 spoke and disc wheel design and components
  - 1.1.2 stud piloted and hub piloted disc wheels
  - 1.1.3 on-highway and off-road hub designs
- 1.2 explain tire construction, care and maintenance in relation to design and sizing, considering:
  - 1.2.1 solid, tube and tubeless tires
  - 1.2.2 rib design, block design and directional tread on-highway tire design
  - 1.2.3 construction, flotation, traction and directional off-road tire design
  - 1.2.4 bias ply and radial ply tire construction
  - 1.2.5 off-road tire breakers and extra tread depth designs
  - 1.2.6 tire sizing
  - 1.2.7 tire matching
  - 1.2.8 tire care and under- or over-inflation concerns
  - 1.2.9 tire rotation patterns
- 1.3 state the safety procedures required when handling tires and wheels, including:
  - 1.3.1 safety precautions
  - 1.3.2 deflating tires
  - 1.3.3 on-highway tire service
  - 1.3.4 off-highway tire service
  - 1.3.5 wheel/rim inspection
  - 1.3.6 inflating tires and seating tire beads
  - 1.3.7 safety rules
  - 1.3.8 occupational health and safety regulations
- 1.4 perform wheel removal, inspection and installation, including:
  - 1.4.1 non-driving axle hubs
  - 1.4.2 truck, off-road and trailer bearing adjustments
  - 1.4.3 on-highway hubs and axles removal, inspection and installation
  - 1.4.4 wheel installation and wheel tightening patterns

- 1.5 explain wheel balancing procedures and problems, including:
  - 1.5.1 static and dynamic balance problems
  - 1.5.2 runout
  - 1.5.3 static and dynamic tire balancing
- 1.6 diagnose wheel and tire faults, including:
  - 1.6.1 on-highway tire damage
  - 1.6.2 off-highway tire damage
  - 1.6.3 under-inflating or overloading issues
  - 1.6.4 radial sidewall cracks
  - 1.6.5 irregular or rapid tread wear
  - 1.6.6 ply or tread separation and liner failures of tubeless tires
  - 1.6.7 over-inflating problems
  - 1.6.8 impact tire damage
  - 1.6.9 wheel/rim damage
- 2. explain typical maintenance programs used with off-road and on-road equipment**
  - 2.1 explain the types of maintenance systems and concerns, including:
    - 2.1.1 breakdown maintenance and crisis management
    - 2.1.2 unexpected equipment downtime
    - 2.1.3 secondary component damage
    - 2.1.4 reduced equipment life
    - 2.1.5 equipment value depreciation
    - 2.1.6 preventive maintenance programs
    - 2.1.7 predictive maintenance
  - 2.2 explain the principles of preventive maintenance and their effects, considering:
    - 2.2.1 the program purpose of preventive maintenance
    - 2.2.2 preventive maintenance monitoring systems
    - 2.2.3 maintenance scheduling based on hours, days or weeks
    - 2.2.4 fuel consumption
  - 2.3 explain the principles of predictive maintenance and their effects, considering:
    - 2.3.1 component replacement determined by predicted lifespan
    - 2.3.2 baseline measurements
    - 2.3.3 oil analysis and oil filter contamination
    - 2.3.4 vibration analysis
    - 2.3.5 heat detection
    - 2.3.6 component life history
    - 2.3.7 advantages; e.g., increased productivity, reduced maintenance costs, reduced emergency and breakdown time, reduced secondary damage and support of scheduled maintenance
  - 2.4 demonstrate basic preventive maintenance and service procedures, including:
    - 2.4.1 classifications of grease
    - 2.4.2 advantages and disadvantages of grease
    - 2.4.3 tractor service or inspection points including steering axle, steering column, spring hangers, slack adjuster and S-Cam bushings
    - 2.4.4 driveline lubrication/inspection points
    - 2.4.5 tractor front and rear drive axle lube and inspection points
    - 2.4.6 spring shackle, hanger pin and bushings lubrication
    - 2.4.7 coupling system (fifth wheel) lubrication and maintenance
    - 2.4.8 trailer and dolly axle shackle, hanger pin and bushing lubrication

**3. demonstrate basic competencies**

3.1 demonstrate fundamental skills to:

- 3.1.1 communicate
- 3.1.2 manage information
- 3.1.3 use numbers
- 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:

- 3.2.1 demonstrate positive attitudes and behaviours
- 3.2.2 be responsible
- 3.2.3 be adaptable
- 3.2.4 learn continuously
- 3.2.5 work safely

3.3 demonstrate teamwork skills to:

- 3.3.1 work with others
- 3.3.2 participate in projects and tasks

**4. create a transitional strategy to accommodate personal changes and build personal values**

4.1 identify short-term and long-term goals

4.2 identify steps to achieve goals

## **COURSE HEA3420: TRAILER SYSTEMS**

- Level:** First Period Apprenticeship, Section Two
- Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials
- Description:** Students develop the knowledge, skills and attitudes necessary to inspect, service and maintain trailer systems and components.
- Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.
- ILM Resources:** Trailer Systems and Components 190102e; Coupling Units Fundamentals and Service 190102f; Landing Gear Fundamentals and Service 190102g; Orientation to Trailer Inspection 190102h
- Outcomes:** The student will:

### **1. identify common trailer systems and components**

- 1.1 describe types and configurations of on-highway trailers, including:
  - 1.1.1 deck, highboy and lowboy trailers
  - 1.1.2 temperature-controlled van, livestock and bulk material van trailers
  - 1.1.3 tank trailers
  - 1.1.4 end dump, bottom dump trailers
  - 1.1.5 logging and extendable trailers
  - 1.1.6 heavy hauling trailers
- 1.2 identify trailer configurations according to number of axles and hitch points, including:
  - 1.2.1 truck and pony trailer
  - 1.2.2 truck and full trailer
  - 1.2.3 tractor and a single semi-trailer
  - 1.2.4 tractor and A-Train combination
  - 1.2.5 tractor and B-Train combination
  - 1.2.6 tractor and C-Train combination
- 1.3 identify trailer axle configurations, including:
  - 1.3.1 fixed axles
  - 1.3.2 steering axles
  - 1.3.3 C-Train converter dolly with steering axles

### **2. service trailer coupling systems**

- 2.1 identify common types of trailer coupling units, including:
  - 2.1.1 fifth wheel couplings
  - 2.1.2 Fontaine locking mechanism
  - 2.1.3 Holland hitch
  - 2.1.4 pintle hitch components
  - 2.1.5 rigid and no-slack pintle hook types
  - 2.1.6 drawbar and eye

- 2.2 explain fifth wheel ratings and capacity concerns, including:
  - 2.2.1 stationary and sliding mounting arrangements
  - 2.2.2 fifth wheel oscillation
  - 2.2.3 safety restraints
- 2.3 service fifth wheel couplings, including:
  - 2.3.1 cleaning and visual inspection
  - 2.3.2 operational testing
  - 2.3.3 wear checks
  - 2.3.4 fifth wheel rebuild and adjustment procedure
  - 2.3.5 trailer king pin inspection
- 2.4 service a no-slack pintle hitch, including:
  - 2.4.1 pintle hook inspection
  - 2.4.2 drawbar and eye inspection and measurements
  - 2.4.3 inspection of safety restraints
  - 2.4.4 pintle hook rebuild procedure
- 2.5 explain procedures and safety precautions required when coupling and uncoupling trailer systems and when using landing gear
- 3. service trailer landing gear**
  - 3.1 identify common types of trailer landing gear and explain their purpose, including:
    - 3.1.1 drop-leg type landing gear components and operation
    - 3.1.2 gear-operated landing gear principles, components and operation
    - 3.1.3 low-speed and high-speed operation
  - 3.2 service common types of trailer landing gear by completing the following:
    - 3.2.1 landing gear inspection
    - 3.2.2 operational checks
    - 3.2.3 rebuild procedures for leg assembly
    - 3.2.4 rebuild procedures for gearbox assembly
- 4. explain trailer inspection according to Commercial Vehicle Inspection (CVI) regulations**
  - 4.1 outline trailer inspection regulations and standards for the following:
    - 4.1.1 general inspection mechanic
    - 4.1.2 trailer inspection mechanic
    - 4.1.3 inspection stations
  - 4.2 identify conditions caused by damage, wear or corrosion that would make a trailer unsafe or inoperable by completing the following inspections:
    - 4.2.1 trailer and semi-trailer inspection procedures
    - 4.2.2 coupler and hitch inspection
    - 4.2.3 suspension system inspection
    - 4.2.4 tire and wheel inspection
    - 4.2.5 hydraulic brake system inspection
    - 4.2.6 electric brake inspection
    - 4.2.7 air brake inspection
    - 4.2.8 lamp and electrical system inspection
    - 4.2.9 body components inspection
    - 4.2.10 corrosion inspection
    - 4.2.11 frame, cross member, sliding suspension and landing gear inspection
    - 4.2.12 van type trailer, tanker trailer, lowboy, flat deck, cattle liner, grain and gravel trailer inspection

**5. demonstrate basic competencies**

5.1 demonstrate fundamental skills to:

- 5.1.1 communicate
- 5.1.2 manage information
- 5.1.3 use numbers
- 5.1.4 think and solve problems

5.2 demonstrate personal management skills to:

- 5.2.1 demonstrate positive attitudes and behaviours
- 5.2.2 be responsible
- 5.2.3 be adaptable
- 5.2.4 learn continuously
- 5.2.5 work safely

5.3 demonstrate teamwork skills to:

- 5.3.1 work with others
- 5.3.2 participate in projects and tasks

**6. create a transitional strategy to accommodate personal changes and build personal values**

6.1 identify short-term and long-term goals

6.2 identify steps to achieve goals

## **COURSE HEA3425: BRAKE FUNDAMENTALS**

**Level:** First Period Apprenticeship, Section Three

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials

**Description:** Students develop the knowledge, skills and attitudes necessary to inspect, service and maintain hydraulic brake systems and components.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Hydraulic Brake System Fundamentals 190103a; Hydraulic Brake System (Drum and Disc) 190103b; Hydraulic Brake System Diagnosis and Service 190103c

**Outcomes:** The student will:

### **1. apply scientific principles to braking system operation**

- 1.1 explain braking principles, with emphasis on heat, friction and hydraulic forces, including:
  - 1.1.1 purpose of brake systems
  - 1.1.2 work, torque and power calculations
  - 1.1.3 law of conservation of energy
  - 1.1.4 conduction, convection and radiation forms of heat energy
  - 1.1.5 coefficient of friction
  - 1.1.6 static and kinetic friction
  - 1.1.7 hydraulic principles
  - 1.1.8 hydraulic fundamentals
  - 1.1.9 hydrostatic pressure and system pressure calculations
- 1.2 explain the properties, specifications and handling procedures of brake fluid, including:
  - 1.2.1 boiling point
  - 1.2.2 viscosity
  - 1.2.3 non-corrosiveness
  - 1.2.4 hygroscopic ability
  - 1.2.5 lubrication value
  - 1.2.6 stability with various materials
  - 1.2.7 miscibility with other brake fluids
  - 1.2.8 composition of brake fluid
  - 1.2.9 Society of Automotive Engineers (SAE) specifications
  - 1.2.10 United States Department of Transportation (DOT); DOT 3, 4 and 5 specifications
  - 1.2.11 water contamination
  - 1.2.12 rubber compatibility
  - 1.2.13 brake fluid handling and disposal

## **2. explain the operation of hydraulic drum and disc brake systems**

- 2.1 explain the principles of operation of drum brake systems, considering:
  - 2.1.1 drum brake system components
  - 2.1.2 self-energizing, servo-action and non-servo-action brake shoes
  - 2.1.3 non-asbestos organic and semi-metallic brake shoe linings
  - 2.1.4 wheel cylinders
  - 2.1.5 brake hardware
  - 2.1.6 brake drums
- 2.2 explain the principles of operation of disc brake systems, considering:
  - 2.2.1 disc brake advantages
  - 2.2.2 brake caliper
  - 2.2.3 brake disc or brake rotor
  - 2.2.4 brake pads
  - 2.2.5 brake pad wear indicators
- 2.3 explain the construction and operation of master cylinders, including:
  - 2.3.1 master cylinder functions
  - 2.3.2 master cylinder components
  - 2.3.3 low brake fluid level warning system
- 2.4 explain the purpose and construction of brake lines and hoses, including:
  - 2.4.1 steel brake lines
  - 2.4.2 double and ISO flares
  - 2.4.3 flexible brake hoses
  - 2.4.4 hydraulic brake fittings
- 2.5 explain the construction and operation of wheel cylinders and calipers, including:
  - 2.5.1 single piston and two piston wheel cylinders
  - 2.5.2 adjuster style wheel cylinders
  - 2.5.3 floating and fixed brake disc calipers
- 2.6 explain the purpose and operation of the metering, proportioning and pressure differential valves, including:
  - 2.6.1 residual check valves
  - 2.6.2 pressure differential valves
  - 2.6.3 pressure differential light switch
  - 2.6.4 metering valves
  - 2.6.5 proportioning valves
  - 2.6.6 combination valves

## **3. service hydraulic drum and disc brake systems**

- 3.1 list safety responsibilities required when servicing and repairing brake systems, including:
  - 3.1.1 safety responsibilities to the general public, to the employer and to self
  - 3.1.2 health hazards
  - 3.1.3 physical hazards
  - 3.1.4 specifications and standards
- 3.2 diagnose brake system faults through:
  - 3.2.1 troubleshooting
  - 3.2.2 vehicle walk-around
  - 3.2.3 vehicle road test



- 3.3 service a typical drum brake assembly, including:
  - 3.3.1 raising and supporting the vehicle
  - 3.3.2 brake drum component inspection, replacement and repair
  - 3.3.3 brake drum measurements
  - 3.3.4 brake drum machining
  - 3.3.5 brake shoes, wheel cylinders, brake hardware and backing plates
  - 3.3.6 initial and final brake adjustment
- 3.4 service a typical disc brake assembly, including:
  - 3.4.1 raising and supporting the vehicle
  - 3.4.2 disc brake component inspection, replacement and repair
  - 3.4.3 brake rotor thickness and rotor lateral runout measurements
  - 3.4.4 brake pad installation
  - 3.4.5 wheel bearing adjustment
  - 3.4.6 brake adjustment
- 3.5 describe reconditioning procedures required for master cylinders, wheel cylinders and brake calipers, including:
  - 3.5.1 master cylinder components, inspection and service
  - 3.5.2 wheel cylinder components, inspection and service
  - 3.5.3 disc brake caliper components, inspection and service
- 3.6 demonstrate brake flushing and bleeding procedures on hydraulic brake systems, including:
  - 3.6.1 flushing the brake system
  - 3.6.2 bench bleeding the master cylinder
  - 3.6.3 pressure tank brake bleeding
- 4. demonstrate basic competencies**
  - 4.1 demonstrate fundamental skills to:
    - 4.1.1 communicate
    - 4.1.2 manage information
    - 4.1.3 use numbers
    - 4.1.4 think and solve problems
  - 4.2 demonstrate personal management skills to:
    - 4.2.1 demonstrate positive attitudes and behaviours
    - 4.2.2 be responsible
    - 4.2.3 be adaptable
    - 4.2.4 learn continuously
    - 4.2.5 work safely
  - 4.3 demonstrate teamwork skills to:
    - 4.3.1 work with others
    - 4.3.2 participate in projects and tasks
- 5. create a transitional strategy to accommodate personal changes and build personal values**
  - 5.1 identify short-term and long-term goals
  - 5.2 identify steps to achieve goals

## **COURSE HEA3430: BRAKE SERVICE & REPAIR**

**Level:** First Period Apprenticeship, Section Three

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials  
HEA3425: Brake Fundamentals

**Description:** Students develop the knowledge, skills and attitudes necessary to inspect, service and maintain hydraulic, electric and parking brake systems and components.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Hydraulic Brake Booster System Fundamentals and Service 190103d; Parking Brake System Fundamentals and Service 190103e; Electric Brake Fundamentals and Service 190103f

**Outcomes:** The student will:

### **1. explain power braking system service procedures**

- 1.1 identify common power assist braking systems, including:
  - 1.1.1 hydraulic-over-hydraulic (hydroboost) systems
  - 1.1.2 vacuum/atmospheric systems
  - 1.1.3 air-over-hydraulic systems
- 1.2 explain the principles of operation for vacuum brake booster systems, including:
  - 1.2.1 integral power brake booster-vacuum suspended
  - 1.2.2 integral power brake booster-operating conditions
  - 1.2.3 brakes released, brakes applied, and brakes holding conditions
- 1.3 describe the diagnosis and repair procedures for vacuum brake booster systems, including:
  - 1.3.1 power brake booster-vacuum suspended troubleshooting and repair
- 1.4 explain the principles of operation of air-over-hydraulic brake booster systems in:
  - 1.4.1 power booster–power cluster systems
- 1.5 describe the diagnosis and repair procedures for air-over-hydraulic brake booster systems
- 1.6 explain the principles of operation for hydraulic-over-hydraulic brake booster systems, considering:
  - 1.6.1 hydraulic brake booster components
  - 1.6.2 four stages of operation
  - 1.6.3 the role of the accumulator
  - 1.6.4 electric-hydraulic pump backup
- 1.7 describe the diagnosis and repair procedures for hydraulic-over-hydraulic brake booster systems, using:
  - 1.7.1 troubleshooting procedure
  - 1.7.2 troubleshooting flow charts
  - 1.7.3 brake booster module wiring schematics
  - 1.7.4 inspection, diagnosis and repair procedures

- 2. explain service procedures for parking brake systems**
  - 2.1 explain the principles of operation for common parking brake systems, including:
    - 2.1.1 mechanical linkage type
    - 2.1.2 hydraulically operated type
    - 2.1.3 mechanically operated driveshaft type
    - 2.1.4 internal shoe, external band and disc type
    - 2.1.5 electric/hydraulic activated
  - 2.2 describe the adjusting procedures for common parking brake systems, including:
    - 2.2.1 mechanical linkage type adjustments
    - 2.2.2 hydraulically operated inspection and adjustments
    - 2.2.3 internal shoe driveshaft type adjustments
    - 2.2.4 external band type adjustments
  - 2.3 describe repair procedures for common parking brake systems, including:
    - 2.3.1 mechanical linkage type problem areas
    - 2.3.2 hydraulically operated common problems
    - 2.3.3 driveshaft type adjustments
    - 2.3.4 parking brake electronic control module inspection
    - 2.3.5 electric driven parking brake hydraulic pump service
- 3. explain service procedures of electric braking systems**
  - 3.1 explain the principles of operation for electric braking systems, including:
    - 3.1.1 electric brake controllers
    - 3.1.2 breakaway switches and auxiliary breakaway battery
    - 3.1.3 electric brake assemblies
    - 3.1.4 electromagnets
  - 3.2 identify basic electric braking system failures, including:
    - 3.2.1 operator abuse or misuse
    - 3.2.2 mechanical component failure
    - 3.2.3 electrical component failure
    - 3.2.4 synchronizing truck and trailer brakes
    - 3.2.5 electromagnetic action
    - 3.2.6 voltage and amperage checks
- 4. demonstrate basic competencies**
  - 4.1 demonstrate fundamental skills to:
    - 4.1.1 communicate
    - 4.1.2 manage information
    - 4.1.3 use numbers
    - 4.1.4 think and solve problems
  - 4.2 demonstrate personal management skills to:
    - 4.2.1 demonstrate positive attitudes and behaviours
    - 4.2.2 be responsible
    - 4.2.3 be adaptable
    - 4.2.4 learn continuously
    - 4.2.5 work safely
  - 4.3 demonstrate teamwork skills to:
    - 4.3.1 work with others
    - 4.3.2 participate in projects and tasks
- 5. create a transitional strategy to accommodate personal changes and build personal values**
  - 5.1 identify short-term and long-term goals
  - 5.2 identify steps to achieve goals

## **COURSE HEA3435: HYDRAULIC SYSTEMS**

**Level:** First Period Apprenticeship, Section Three

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials

**Description:** Students develop the knowledge, skills and attitudes necessary to inspect, service and maintain hydraulic systems and components.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journeyperson certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Hydraulic Fundamentals 190103g; Hydraulic System Components: Reservoir, Filters, Hoses and Coolers 190103h; Hydraulic System Components: Pumps, Valves and Cylinders 190103i

**Outcomes:** The student will:

### **1. explain hydraulic principles**

- 1.1 define basic hydraulic terminology common to all hydraulic systems, including:
  - 1.1.1 force, mass, power, pressure, torque, velocity, volume, work
  - 1.1.2 fluid, flow rate, hydraulics
  - 1.1.3 actuator, orifice, pump, vacuum
  - 1.1.4 hydrodynamics
  - 1.1.5 hydrostatics
- 1.2 explain, using mathematical calculations, the hydraulic principles of pressure, force and area, including:
  - 1.2.1 characteristics of fluids
  - 1.2.2 Pascal's law
  - 1.2.3 relationship between pressure, area and force
  - 1.2.4 hydraulic force generation
  - 1.2.5 force multiplication using hydraulic principles
  - 1.2.6 reaction of pressure in series and parallel circuits
  - 1.2.7 measuring pressure
  - 1.2.8 atmospheric pressure
  - 1.2.9 pressure gauges
  - 1.2.10 scales of pressure measurement
- 1.3 draw and interpret basic hydraulic schematics, including:
  - 1.3.1 hydraulic schematic diagrams
  - 1.3.2 pictorial schematic diagrams
  - 1.3.3 cutaway schematic diagrams
  - 1.3.4 schematic diagrams using graphic symbols

- 1.4 identify hydraulic conductors, including:
  - 1.4.1 hydraulic connectors
  - 1.4.2 hydraulic reservoirs
  - 1.4.3 hydraulic pumps and motors
  - 1.4.4 hydraulic cylinders
- 1.5 identify hydraulic valves, including:
  - 1.5.1 pressure control
  - 1.5.2 flow control
  - 1.5.3 directional control
- 1.6 identify hydraulic accessories, including:
  - 1.6.1 prime movers
  - 1.6.2 hydraulic filters
  - 1.6.3 heat exchangers
  - 1.6.4 accumulators
  - 1.6.5 pressure switches
- 1.7 state the safety precautions that must be observed when working with hydraulic systems, including:
  - 1.7.1 general safety precautions
  - 1.7.2 safety information and instructions
  - 1.7.3 hydraulic pressure
  - 1.7.4 pinhole leaks
  - 1.7.5 hydraulically supported equipment
  - 1.7.6 pinch points
  - 1.7.7 pressurized hydraulic lines
- 2. explain the function of the following hydraulic components: hydraulic oils, reservoirs, filters, conductors and heat exchangers**
  - 2.1 explain the functions of hydraulic oil, including:
    - 2.1.1 transmission of power
    - 2.1.2 lubrication
    - 2.1.3 sealing
    - 2.1.4 cooling
  - 2.2 state the primary quality characteristics of hydraulic oil, including:
    - 2.2.1 preventing rust
    - 2.2.2 preventing the formation of sludge, varnish and gum
    - 2.2.3 suppressing foaming
    - 2.2.4 retaining its stability and consistency over a wide temperature range
    - 2.2.5 preventing corrosion and pitting
    - 2.2.6 allowing water to settle out
    - 2.2.7 compatibility with seals and gaskets
  - 2.3 explain the properties of hydraulic fluid and the criteria for its selection, including:
    - 2.3.1 viscosity
    - 2.3.2 viscosity index
    - 2.3.3 pour point
    - 2.3.4 lubricating ability
    - 2.3.5 oxidation resistance
    - 2.3.6 corrosion and rust protection
    - 2.3.7 foaming and emulsion resistance

- 2.4 state the functions of the hydraulic reservoir and its related components, including:
  - 2.4.1 holding the system oil supply
  - 2.4.2 cooling the oil
  - 2.4.3 allowing air and contamination to separate from the oil
- 2.5 describe the common types of hydraulic reservoirs used on mobile equipment, including:
  - 2.5.1 vented or atmospheric reservoirs
  - 2.5.2 pressurized or closed reservoirs
- 2.6 state the functions and principles of operation of filtration devices, including:
  - 2.6.1 hydraulic filter functions
  - 2.6.2 filter construction
  - 2.6.3 absolute, nominal and beta filter ratings
  - 2.6.4 filter locations
  - 2.6.5 filter bypass devices and restriction indicators
- 2.7 explain the construction and applications of common types of hydraulic conductors, including:
  - 2.7.1 steel pipe and pipe sizing
  - 2.7.2 pipe connections and fittings
  - 2.7.3 steel tubing and tubing sizes
  - 2.7.4 tubing connections and fittings
  - 2.7.5 hydraulic hose construction and sizes
  - 2.7.6 permanent and reusable hydraulic hose connectors
- 2.8 state the function and applications of hydraulic heat exchangers, including:
  - 2.8.1 hydraulic oil heaters
  - 2.8.2 hydraulic oil coolers

**3. explain the functions and principles of operation of hydraulic system components**

- 3.1 explain gear pump operating principles, including:
  - 3.1.1 hydraulic gear pump function
  - 3.1.2 non-positive and positive displacement pumps
  - 3.1.3 calculating pump displacement
  - 3.1.4 pump flow ratings
  - 3.1.5 mechanical and volumetric pump efficiency
  - 3.1.6 pressure ratings
  - 3.1.7 external and internal gear pumps
  - 3.1.8 pump inlet design
  - 3.1.9 direction of driveshaft rotation
  - 3.1.10 cavitation
  - 3.1.11 aeration
- 3.2 explain the principles of operation of the basic types of hydraulic control valves, including:
  - 3.2.1 direct-acting pressure relief valves
  - 3.2.2 poppet directional control valves
  - 3.2.3 rotary directional control valves
  - 3.2.4 spool directional control valves
- 3.3 describe the most common methods of valve actuation for heavy equipment valves, including:
  - 3.3.1 mechanical
  - 3.3.2 electrical
  - 3.3.3 pilot (hydraulic or air)
- 3.4 explain the principles of operation and construction of basic hydraulic cylinders, including:
  - 3.4.1 single-acting cylinders
  - 3.4.2 double-acting cylinders

**4. demonstrate basic competencies**

4.1 demonstrate fundamental skills to:

- 4.1.1 communicate
- 4.1.2 manage information
- 4.1.3 use numbers
- 4.1.4 think and solve problems

4.2 demonstrate personal management skills to:

- 4.2.1 demonstrate positive attitudes and behaviours
- 4.2.2 be responsible
- 4.2.3 be adaptable
- 4.2.4 learn continuously
- 4.2.5 work safely

4.3 demonstrate teamwork skills to:

- 4.3.1 work with others
- 4.3.2 participate in projects and tasks

**5. create a transitional strategy to accommodate personal changes and build personal values**

5.1 identify short-term and long-term goals

5.2 identify steps to achieve goals

## **COURSE HEA3440: ELECTRICAL THEORY**

**Level:** First Period Apprenticeship, Section Four

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials

**Description:** Students develop the knowledge, skills and attitudes necessary to understand and analyze electrical and electronic systems and components.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Electrical Theory 190104a; Electrical Circuits 190104b; Magnetism 190104c

**Outcomes:** The student will:

### **1. apply scientific principles to explain electrical theory**

- 1.1 explain the physical properties of conductors, semiconductors and insulators, considering:
  - 1.1.1 elements and atom theory
  - 1.1.2 compounds and molecular theory
  - 1.1.3 the law of electrical charges (Coulomb's law)
  - 1.1.4 conductors and valence bond theory
  - 1.1.5 insulators and valence bond theory
  - 1.1.6 semiconductor usage
- 1.2 explain electricity in terms of voltage, current and resistance, considering:
  - 1.2.1 voltage—potential difference or electromotive force (EMF)
  - 1.2.2 electrostatic energy (friction)
  - 1.2.3 electromagnetic induction
  - 1.2.4 electrochemical energy
  - 1.2.5 photoelectric energy
  - 1.2.6 conventional theory of current flow
  - 1.2.7 electron theory of current flow
  - 1.2.8 resistance
  - 1.2.9 factors that determine resistance
  - 1.2.10 relationship among current, voltage and resistance
- 1.3 explain direct current, alternating current and static electricity

### **2. identify electrical circuit types and circuit defects**

- 2.1 list the components of a basic electrical circuit, including:
  - 2.1.1 basic electrical symbols
  - 2.1.2 electrical circuit conditions
- 2.2 identify the three circuit types and their properties, including:
  - 2.2.1 series circuit
  - 2.2.2 parallel circuit
  - 2.2.3 series-parallel circuit



- 2.3 explain electrical laws and formulas that apply to the operation of electrical units, including:
  - 2.3.1 Ohm's law
  - 2.3.2 Kirchhoff's voltage law
- 2.4 apply electrical laws and formulas to mathematically calculate circuit values, considering:
  - 2.4.1 conventional circuit diagrams
  - 2.4.2 source voltage
  - 2.4.3 amount and direction of current by polarity
  - 2.4.4 voltage drop
  - 2.4.5 total resistance of circuits
  - 2.4.6 Ohm's law
  - 2.4.7 resistance in series, parallel and series-parallel circuits
- 2.5 explain the effects of circuit defects on voltage, current and resistance and on circuit operation, considering:
  - 2.5.1 open circuits
  - 2.5.2 short circuits
  - 2.5.3 grounds
  - 2.5.4 high resistance
- 3. apply scientific principles to explain the theory of magnetism**
  - 3.1 explain the fundamental laws of magnetism, including:
    - 3.1.1 magnetic fields and flux lines
    - 3.1.2 permeability
    - 3.1.3 reluctance
  - 3.2 explain the properties and applications of permanent magnets, including:
    - 3.2.1 permanent magnetism creation
    - 3.2.2 causes of loss of magnetic strength
    - 3.2.3 current flow in linear and cross-sectional views of conductors
  - 3.3 explain the construction, operation and applications of electromagnets, considering:
    - 3.3.1 electromagnetism theory
    - 3.3.2 right hand rule for conductors and coils
    - 3.3.3 electromagnets and changing electrical energy into mechanical energy
    - 3.3.4 solenoids
    - 3.3.5 motors
    - 3.3.6 electromagnetic induction and changing mechanical energy into electrical energy
    - 3.3.7 basic generators
  - 3.4 explain the principles of electromagnetic induction, including:
    - 3.4.1 induction
    - 3.4.2 self-induction
    - 3.4.3 self-induction arcing protection
    - 3.4.4 mutual induction
    - 3.4.5 useful and harmful mutual induction
    - 3.4.6 inductive reactance
- 4. demonstrate basic competencies**
  - 4.1 demonstrate fundamental skills to:
    - 4.1.1 communicate
    - 4.1.2 manage information
    - 4.1.3 use numbers
    - 4.1.4 think and solve problems

- 4.2 demonstrate personal management skills to:
  - 4.2.1 demonstrate positive attitudes and behaviours
  - 4.2.2 be responsible
  - 4.2.3 be adaptable
  - 4.2.4 learn continuously
  - 4.2.5 work safely
- 4.3 demonstrate teamwork skills to:
  - 4.3.1 work with others
  - 4.3.2 participate in projects and tasks
- 5. create a transitional strategy to accommodate personal changes and build personal values**
  - 5.1 identify short-term and long-term goals
  - 5.2 identify steps to achieve goals

## **COURSE HEA3445: ELECTRICAL SERVICE**

**Level:** First Period Apprenticeship, Section Four

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials  
HEA3440: Electrical Theory

**Description:** Students develop the knowledge, skills and attitudes necessary to inspect, service and maintain electrical and electronic systems and components.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Test Equipment 190104d; Battery Fundamentals and Service 190104e; Electrical Wiring, Lighting Circuits and Circuit Protection 190104f

**Outcomes:** The student will:

### **1. use electrical test equipment to measure electrical values and check circuit operation**

- 1.1 explain the construction and operation of voltmeters, ammeters and ohmmeters, including:
  - 1.1.1 electrical test meter construction
  - 1.1.2 digital display
  - 1.1.3 meter markings
  - 1.1.4 multimeter inputs
  - 1.1.5 manual and auto ranging digital display meters
- 1.2 explain meter precautions when measuring voltage, current and resistance, including:
  - 1.2.1 meter use guidelines and precautions
  - 1.2.2 meter polarity
  - 1.2.3 meter impedance
  - 1.2.4 digital multimeter pre-checks
  - 1.2.5 voltmeter operation
  - 1.2.6 series ammeter operation
  - 1.2.7 ohmmeter operation
- 1.3 measure voltage at various points on a circuit and interpret the results, including:
  - 1.3.1 open circuit voltage
  - 1.3.2 voltage drop
- 1.4 measure current flow at various points on a circuit and interpret the results by using:
  - 1.4.1 a series ammeter
  - 1.4.2 an inductive ammeter
- 1.5 measure resistance, using an ohmmeter, including:
  - 1.5.1 a digital ohmmeter
  - 1.5.2 a manual ranging ohmmeter
  - 1.5.3 an auto ranging ohmmeter

- 1.6 identify and use additional electrical test equipment, including:
  - 1.6.1 test lights
  - 1.6.2 circuit testers
  - 1.6.3 battery, charging and starting system test meters
  - 1.6.4 battery load testers
- 2. service, test and charge a lead–acid battery**
  - 2.1 identify hazards and precautionary measures associated with lead–acid storage batteries, including:
    - 2.1.1 breathing and eye protection; i.e., safety glasses and face shield
    - 2.1.2 electrolyte burns and neutralizers
    - 2.1.3 frozen battery precautions
    - 2.1.4 watches, rings and jewelry precautions
  - 2.2 explain battery construction, sizing, capacity and ratings, including:
    - 2.2.1 low maintenance
    - 2.2.2 maintenance free
    - 2.2.3 deep cycle batteries
    - 2.2.4 electrolyte
    - 2.2.5 battery operation
    - 2.2.6 chemical reactions while charging and discharging
    - 2.2.7 self-discharge and temperature effects on batteries
    - 2.2.8 reserve capacity rating (RC)
    - 2.2.9 ampere hour rating (AH)
    - 2.2.10 cold cranking amps (CCA)
    - 2.2.11 cranking amps (CA)
  - 2.3 perform battery maintenance and testing, including:
    - 2.3.1 visual inspection
    - 2.3.2 open-circuit voltage (OCV)
    - 2.3.3 specific gravity measurements
    - 2.3.4 high rate discharge test (load test)
    - 2.3.5 conductance battery testing
    - 2.3.6 battery sulphation test
    - 2.3.7 cable removal and installation
    - 2.3.8 battery cleaning, storage and disposal
    - 2.3.9 problem diagnostics
    - 2.3.10 causes of battery failure
  - 2.4 list safety precautions and procedures for boosting batteries
  - 2.5 list the safety precautions and procedures for charging batteries, including:
    - 2.5.1 slow, fast and trickle charging
    - 2.5.2 charging time
  - 2.6 explain multiple battery circuits in relation to connections and battery compatibility, including:
    - 2.6.1 batteries connected in series
    - 2.6.2 batteries connected in parallel
    - 2.6.3 battery compatibility and guide for connecting battery groups
    - 2.6.4 battery replacement
- 3. test and repair electrical circuits**
  - 3.1 trace electrical circuits by using symbols that are common to the industry, including:
    - 3.1.1 electrical schematics
    - 3.1.2 component identification lettering
    - 3.1.3 conductor number and colour codes
    - 3.1.4 conductor sizing

- 3.2 perform wiring harness inspection and repair, including:
    - 3.2.1 opening a wiring harness
    - 3.2.2 repairing and replacing wiring harness components
    - 3.2.3 using heat shrink tubing, electrical tape, liquid electrical tape and harness protection
    - 3.2.4 repairing broken conductors
    - 3.2.5 using soldering gun/iron and torches, soldering paste, solid core and internal flux solder
    - 3.2.6 crimping butt and splice connectors
    - 3.2.7 using crimp and seal connectors
    - 3.2.8 repairing coaxial and twisted cables
  - 3.3 identify and repair wiring harness connectors that are common to the industry, including:
    - 3.3.1 weatherproof conductor connector repairs
    - 3.3.2 weatherproof connector terminal repairs
    - 3.3.3 screw-secured conductor repairs
    - 3.3.4 stud-secured conductor repairs
  - 3.4 test circuit protection devices, switches, relays and solenoids, including:
    - 3.4.1 circuit breakers
    - 3.4.2 fusible links
    - 3.4.3 fuses
    - 3.4.4 relay coils
  - 3.5 repair an electrical lighting circuit for each of the following: a short circuit, a ground fault, an open circuit and high resistance
- 4. demonstrate basic competencies**
- 4.1 demonstrate fundamental skills to:
    - 4.1.1 communicate
    - 4.1.2 manage information
    - 4.1.3 use numbers
    - 4.1.4 think and solve problems
  - 4.2 demonstrate personal management skills to:
    - 4.2.1 demonstrate positive attitudes and behaviours
    - 4.2.2 be responsible
    - 4.2.3 be adaptable
    - 4.2.4 learn continuously
    - 4.2.5 work safely
  - 4.3 demonstrate teamwork skills to:
    - 4.3.1 work with others
    - 4.3.2 participate in projects and tasks
- 5. create a transitional strategy to accommodate personal changes and build personal values**
- 5.1 identify short-term and long-term goals
  - 5.2 identify steps to achieve goals

## **COURSE HEA3450: ELECTRONICS**

**Level:** First Period Apprenticeship, Section Four

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials  
HEA3440: Electrical Theory  
HEA3445: Electrical Service

**Description:** Students develop the knowledge, skills and attitudes necessary to inspect, service and maintain electronic systems and components.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journeyperson certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Basic Electronics 190104g; Electronic Control Systems 190104h

**Outcomes:** The student will:

### **1. test discrete electronic components used in the trade**

- 1.1 compare and contrast solid state electronic and electrical circuitry, considering:
  - 1.1.1 solid state electrical systems
  - 1.1.2 solid state electronic systems
  - 1.1.3 electronic fundamentals
  - 1.1.4 doping, N-type and P-type semiconductors
- 1.2 explain the properties, applications and test procedures for resistors, including:
  - 1.2.1 fixed value resistors
  - 1.2.2 tapped resistors
  - 1.2.3 variable type resistors
- 1.3 explain the properties, applications and test procedures for diodes, including:
  - 1.3.1 diode function
  - 1.3.2 diode rating
  - 1.3.3 diode testing
  - 1.3.4 diode faults
  - 1.3.5 diode applications
  - 1.3.6 light-emitting diodes (LED)
  - 1.3.7 zener diodes
- 1.4 identify the conditions that affect the life of electronic devices, including:
  - 1.4.1 heat
  - 1.4.2 vibration
  - 1.4.3 excess voltage
  - 1.4.4 excess current

## **2. describe the operation of basic computer-controlled systems**

- 2.1 identify the terminology commonly used with computer controls and components, including:
  - 2.1.1 inputs and switches
  - 2.1.2 reference voltage and voltage generating sensors
  - 2.1.3 electronic control modules (ECM) and electronic control units (ECU)
  - 2.1.4 closed loop logic
  - 2.1.5 analog signals
  - 2.1.6 encoding
  - 2.1.7 digital voltage signals
  - 2.1.8 bit (binary digit)
  - 2.1.9 byte and binary word
  - 2.1.10 message frames
  - 2.1.11 pulse width modulation (PWM)
  - 2.1.12 data links
  - 2.1.13 nodes
  - 2.1.14 multiplexing
  - 2.1.15 power line carriers
- 2.2 explain the function of electronic control system components, including:
  - 2.2.1 electronically controlled system functions
  - 2.2.2 electronic control basics
  - 2.2.3 temperature, pressure, speed, position and level inputs
  - 2.2.4 reference voltage inputs
  - 2.2.5 digital signals
  - 2.2.6 read-only memory (ROM)
  - 2.2.7 programmable read-only memory (PROM)
  - 2.2.8 electrically erasable programmable read-only memory (EEPROM)
  - 2.2.9 random access memory (RAM)
  - 2.2.10 volatile and non-volatile RAM
  - 2.2.11 internal clocks
  - 2.2.12 solenoids, relays and electric motor outputs
- 2.3 explain the interaction between inputs, processors and outputs and multiplexing to control a circuit or a system, including:
  - 2.3.1 control modules
  - 2.3.2 antilock braking system
  - 2.3.3 automatic traction control system
  - 2.3.4 automatic temperature control system
- 2.4 identify electronic test equipment used for diagnosis of electronic systems, including:
  - 2.4.1 on-board fault code display panels
  - 2.4.2 scanning tools
  - 2.4.3 data link and breakout connectors
  - 2.4.4 high impedance meters

## **3. demonstrate basic competencies**

- 3.1 demonstrate fundamental skills to:
  - 3.1.1 communicate
  - 3.1.2 manage information
  - 3.1.3 use numbers
  - 3.1.4 think and solve problems

- 3.2 demonstrate personal management skills to:
  - 3.2.1 demonstrate positive attitudes and behaviours
  - 3.2.2 be responsible
  - 3.2.3 be adaptable
  - 3.2.4 learn continuously
  - 3.2.5 work safely
- 3.3 demonstrate teamwork skills to:
  - 3.3.1 work with others
  - 3.3.2 participate in projects and tasks
- 4. create a transitional strategy to accommodate personal changes and build personal values**
  - 4.1 identify short-term and long-term goals
  - 4.2 identify steps to achieve goals



## **COURSE HEA3455: AIR BRAKE FUNDAMENTALS**

**Level:** First Period Apprenticeship, Section Five

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials

**Description:** Students develop the knowledge, skills and attitudes necessary to inspect, service and maintain air brake systems and components.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Air Brake System Fundamentals 190105a; Truck/Tractor Air Brake System Components Part A 190105cA; Truck/Tractor Air Brake System Components Part B 190105cB

**Outcomes:** The student will:

### **1. explain the fundamental principles of operation of an air brake system**

- 1.1 explain the principles of operation of an air brake system, including:
  - 1.1.1 friction, heat and traction
  - 1.1.2 stopping power
  - 1.1.3 stopping time
  - 1.1.4 compressed air
  - 1.1.5 pressure and temperature
- 1.2 demonstrate an understanding of basic air brake system components, including:
  - 1.2.1 an air compressor
  - 1.2.2 governor
  - 1.2.3 air dryer
  - 1.2.4 air reservoir
  - 1.2.5 brake valve
  - 1.2.6 brake chambers and slack adjusters
  - 1.2.7 foundation brakes
  - 1.2.8 connecting lines and fittings

### **2. explain the principles of operation of truck/tractor air brake systems**

- 2.1 explain the functions and principles of operation of common air brake supply circuit components, including:
  - 2.1.1 compressors
  - 2.1.2 governors
  - 2.1.3 moisture and contamination controls
  - 2.1.4 air dryers
  - 2.1.5 primary, secondary and supply air reservoirs
  - 2.1.6 safety valves
  - 2.1.7 pressure gauges
  - 2.1.8 low pressure warning devices
  - 2.1.9 tubing, hoses and fittings

- 2.2 explain the functions and principles of operation of common primary service brake circuit components, including:
  - 2.2.1 dual circuit brake valves
  - 2.2.2 relay valves
  - 2.2.3 service brake chambers
- 2.3 explain the functions and principles of operation of common secondary service brake circuit components, including:
  - 2.3.1 dual circuit brake valves
  - 2.3.2 quick release valves
- 2.4 explain the functions and principles of operation of common parking/emergency brake circuit components, considering:
  - 2.4.1 parking/emergency brake circuit purposes
  - 2.4.2 parking/emergency brake circuit components
  - 2.4.3 component operation
- 2.5 explain the functions and principles of operation of common trailer control circuit components, including:
  - 2.5.1 trailer supply line
  - 2.5.2 trailer service line
  - 2.5.3 tractor brake circuit components and operation
  - 2.5.4 glad-hands
  - 2.5.5 brake light switches
  - 2.5.6 ratio valves
  - 2.5.7 bobtail valves
- 3. demonstrate basic competencies**
  - 3.1 demonstrate fundamental skills to:
    - 3.1.1 communicate
    - 3.1.2 manage information
    - 3.1.3 use numbers
    - 3.1.4 think and solve problems
  - 3.2 demonstrate personal management skills to:
    - 3.2.1 demonstrate positive attitudes and behaviours
    - 3.2.2 be responsible
    - 3.2.3 be adaptable
    - 3.2.4 learn continuously
    - 3.2.5 work safely
  - 3.3 demonstrate teamwork skills to:
    - 3.3.1 work with others
    - 3.3.2 participate in projects and tasks
- 4. create a transitional strategy to accommodate personal changes and build personal values**
  - 4.1 identify short-term and long-term goals
  - 4.2 identify steps to achieve goals

## **COURSE HEA3460: AIR BRAKE MECHANICS**

**Level:** First Period Apprenticeship, Section Five

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials  
HEA3455: Air Brake Fundamentals

**Description:** Students develop the knowledge, skills and attitudes necessary to inspect, service and maintain trailer air brake systems and components.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Air Brake System Mechanical Components 190105b; Trailer Air Brake System Components 190105d

**Outcomes:** The student will:

### **1. explain the operating principles of air brake mechanical components**

- 1.1 explain the components and operating principles of a typical cam-operated foundation brake, including:
  - 1.1.1 brake drums
  - 1.1.2 brake shoes and lining
  - 1.1.3 brake spider and backing plates
  - 1.1.4 brake shoe retaining and return springs
  - 1.1.5 camshaft and brake chamber support brackets
  - 1.1.6 manual and automatic slack adjuster
- 1.2 explain the operating principles of a typical air disc foundation brake, including:
  - 1.2.1 power shaft disc brakes
  - 1.2.2 cam and lever disc brakes

### **2. explain the principles of trailer brake system component operation**

- 2.1 explain the functions and principles of operation of a pre-CMVSS 121 single trailer brake circuit, including:
  - 2.1.1 trailer service line
  - 2.1.2 trailer supply line
  - 2.1.3 relay emergency valve
  - 2.1.4 trailer air reservoir
  - 2.1.5 trailer brake chambers and foundation brakes
- 2.2 explain the functions and principles of operation of a CMVSS 121 single trailer brake circuit, including:
  - 2.2.1 trailer service and supply lines
  - 2.2.2 trailer spring brake control valves
- 2.3 explain the functions and principles of operation of common components used on multiple trailer combinations, including:
  - 2.3.1 towing trailer air brake circuit
  - 2.3.2 converter dolly air brake circuit

**3. demonstrate basic competencies**

3.1 demonstrate fundamental skills to:

- 3.1.1 communicate
- 3.1.2 manage information
- 3.1.3 use numbers
- 3.1.4 think and solve problems

3.2 demonstrate personal management skills to:

- 3.2.1 demonstrate positive attitudes and behaviours
- 3.2.2 be responsible
- 3.2.3 be adaptable
- 3.2.4 learn continuously
- 3.2.5 work safely

3.3 demonstrate teamwork skills to:

- 3.3.1 work with others
- 3.3.2 participate in projects and tasks

**4. create a transitional strategy to accommodate personal changes and build personal values**

4.1 identify short-term and long-term goals

4.2 identify steps to achieve goals

## **COURSE HEA3465: AIR BRAKE SERVICE**

**Level:** First Period Apprenticeship, Section Five

**Prerequisites:** HEA3900: Apprenticeship Safety  
HEA3400: Basic Tools & Materials  
HEA3455: Air Brake Fundamentals  
HEA3460: Air Brake Mechanics

**Description:** Students develop the knowledge, skills and attitudes necessary to inspect, test, service and maintain air brake and antilock systems and components.

**Parameters:** Access to a materials work centre, complete with basic hand tools, specialty hand tools and equipment, and to instruction from an individual with journey person certification in the trade(s) of heavy duty mechanic; heavy duty equipment mechanic (off-road); truck and transport mechanic; or transport-trailer mechanic.

**ILM Resources:** Air Brake System Testing and Service 190105e; Air Antilock Brake System Fundamentals 190105f

**Outcomes:** The student will:

### **1. service and diagnose truck/tractor and trailer air brake systems**

- 1.1 state the safety precautions that must be observed prior to performing air brake system testing and service, including:
  - 1.1.1 using immobilization techniques for the vehicle and trailer
  - 1.1.2 using PPE
  - 1.1.3 working around moving, rotating, leaking, heated or electrically charged components
  - 1.1.4 draining air tanks
  - 1.1.5 referring to manufacturers' specifications
  - 1.1.6 avoiding dust inhalation
- 1.2 perform a visual inspection of the air brake system, including:
  - 1.2.1 compressor and compressor drive components
  - 1.2.2 air lines, hoses and connections
  - 1.2.3 moisture controls and air reservoirs
  - 1.2.4 air brake mechanical components
- 1.3 perform air brake system testing, including:
  - 1.3.1 governor cut-out
  - 1.3.2 low pressure warning
  - 1.3.3 pressure buildup
  - 1.3.4 supply circuit leakage
  - 1.3.5 service delivery circuit leakage
  - 1.3.6 manual parking/emergency brake circuit operation
  - 1.3.7 automatic emergency brake circuit operation
- 1.4 analyze test results and state possible causes for system malfunction, including:
  - 1.4.1 governor cut-out
  - 1.4.2 low pressure warning indicator
  - 1.4.3 pressure buildup

- 1.4.4 supply circuit leakage
- 1.4.5 service delivery circuit leakage
- 1.4.6 manual parking/emergency brake circuit failure
- 1.4.7 automatic emergency brake circuit failure
- 1.5 service cam-operated foundation brakes, including:
  - 1.5.1 reconditioning cam-operated foundation brakes
  - 1.5.2 removing cam-operated foundation brake components
  - 1.5.3 inspecting cam-operated foundation brake components
  - 1.5.4 assembling cam-operated foundation brake components
  - 1.5.5 replacing brake shoes and rotors
  - 1.5.6 adjusting cam-operated foundation brakes
  - 1.5.7 measuring push rod travel
- 2. describe the basic operation of an air antilock brake system**
  - 2.1 list the advantages of operating a vehicle equipped with an antilock brake system, including:
    - 2.1.1 directional stability and control
    - 2.1.2 decreased stopping distances
  - 2.2 explain the operation of an antilock air brake system (ABS), including:
    - 2.2.1 basic theory of operation of an antilock brake system
    - 2.2.2 basic components
    - 2.2.3 purpose of antilock components
    - 2.2.4 wheel speed sensor signals
    - 2.2.5 braking with and without antilock operation
    - 2.2.6 braking in the event of ABS failure
  - 2.3 identify typical system layout and component locations on a vehicle equipped with an antilock air brake system, including:
    - 2.3.1 tandem drive axle truck chassis with ABS
    - 2.3.2 tandem trailer
  - 2.4 describe antilock air brake system service precautions, including:
    - 2.4.1 control systems
    - 2.4.2 removal and replacement of wheel and hub assembly
    - 2.4.3 importance of tire size
- 3. demonstrate basic competencies**
  - 3.1 demonstrate fundamental skills to:
    - 3.1.1 communicate
    - 3.1.2 manage information
    - 3.1.3 use numbers
    - 3.1.4 think and solve problems
  - 3.2 demonstrate personal management skills to:
    - 3.2.1 demonstrate positive attitudes and behaviours
    - 3.2.2 be responsible
    - 3.2.3 be adaptable
    - 3.2.4 learn continuously
    - 3.2.5 work safely
  - 3.3 demonstrate teamwork skills to:
    - 3.3.1 work with others
    - 3.3.2 participate in projects and tasks
- 4. create a transitional strategy to accommodate personal changes and build personal values**
  - 4.1 identify short-term and long-term goals
  - 4.2 identify steps to achieve goals

## **COURSE HEA3470: HEA PRACTICUM A**

**Level:** First Period Apprenticeship

**Prerequisite:** None

**Description:** Students, on the work site, continue to develop and refine those competencies developed in related Career and Technology Studies (CTS) occupational areas, previous practicums and other experiences.

**Parameters:** This course should be accessed only by students continuing to work toward attaining a recognized credential offered by an agency external to the school. Practicum courses extend the competencies developed in related CTS occupational areas. The practicum courses may not be delivered as stand-alone courses and may not be combined with core courses. This course may not be used in conjunction with Registered Apprenticeship Program courses. This practicum course may be delivered on- or off-campus. Instruction must be delivered by a qualified teacher with journey person certification or an experienced professional with journey person certification, who is under the supervision of the qualified teacher; both must be authorized to supervise trainees for the external credential.

**Outcomes:** The student will:

- 1. perform assigned tasks and responsibilities efficiently and effectively, as required by the agency granting credentials**
  - 1.1 identify regulations and regulatory bodies related to the credential
  - 1.2 describe personal roles and responsibilities, including:
    - 1.2.1 key responsibilities
    - 1.2.2 support functions/responsibilities
    - 1.2.3 code of ethics
  - 1.3 describe personal work responsibilities and categorize them as:
    - 1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
    - 1.3.2 non-routine tasks; e.g., emergencies
    - 1.3.3 tasks requiring personal judgement
    - 1.3.4 tasks requiring approval of a supervisor
- 2. analyze personal performance in relation to established standards**
  - 2.1 evaluate application of competencies developed in related CTS courses
  - 2.2 evaluate standards of performance in terms of:
    - 2.2.1 quality of work
    - 2.2.2 quantity of work
  - 2.3 evaluate adherence to workplace policies and procedures related to health and safety
  - 2.4 evaluate the work environment in terms of:
    - 2.4.1 location
    - 2.4.2 floor plan of work area
    - 2.4.3 analysis of workflow patterns

- 2.5 evaluate a professional in a related occupation in terms of:
  - 2.5.1 training and certification
  - 2.5.2 interpersonal skills
  - 2.5.3 technical skills
  - 2.5.4 professional ethics

**3. demonstrate basic competencies**

- 3.1 demonstrate fundamental skills to:
  - 3.1.1 communicate
  - 3.1.2 manage information
  - 3.1.3 use numbers
  - 3.1.4 think and solve problems
- 3.2 demonstrate personal management skills to:
  - 3.2.1 demonstrate positive attitudes and behaviours
  - 3.2.2 be responsible
  - 3.2.3 be adaptable
  - 3.2.4 learn continuously
  - 3.2.5 work safely
- 3.3 demonstrate teamwork skills to:
  - 3.3.1 work with others
  - 3.3.2 participate in projects and tasks



## **COURSE HEA3475: HEA PRACTICUM B**

**Level:** First Period Apprenticeship

**Prerequisite:** None

**Description:** Students, on the work site, continue to develop and refine those competencies developed in related Career and Technology Studies (CTS) occupational areas, previous practicums and other experiences.

**Parameters:** This course should be accessed only by students continuing to work toward attaining a recognized credential offered by an agency external to the school. Practicum courses extend the competencies developed in related CTS occupational areas. The practicum courses may not be delivered as stand-alone courses and may not be combined with core courses. This course may not be used in conjunction with Registered Apprenticeship Program courses. This practicum course may be delivered on- or off-campus. Instruction must be delivered by a qualified teacher with journey person certification or an experienced professional with journey person certification, who is under the supervision of the qualified teacher; both must be authorized to supervise trainees for the external credential.

**Outcomes:** The student will:

- 1. perform assigned tasks and responsibilities efficiently and effectively, as required by the agency granting credentials**
  - 1.1 identify regulations and regulatory bodies related to the credential
  - 1.2 describe personal roles and responsibilities, including:
    - 1.2.1 key responsibilities
    - 1.2.2 support functions/responsibilities
    - 1.2.3 code of ethics
  - 1.3 describe personal work responsibilities and categorize them as:
    - 1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
    - 1.3.2 non-routine tasks; e.g., emergencies
    - 1.3.3 tasks requiring personal judgement
    - 1.3.4 tasks requiring approval of a supervisor
- 2. analyze personal performance in relation to established standards**
  - 2.1 evaluate application of competencies developed in related CTS courses
  - 2.2 evaluate standards of performance in terms of:
    - 2.2.1 quality of work
    - 2.2.2 quantity of work
  - 2.3 evaluate adherence to workplace policies and procedures related to health and safety
  - 2.4 evaluate the work environment in terms of:
    - 2.4.1 location
    - 2.4.2 floor plan of work area
    - 2.4.3 analysis of workflow patterns

- 2.5 evaluate a professional in a related occupation in terms of:
  - 2.5.1 training and certification
  - 2.5.2 interpersonal skills
  - 2.5.3 technical skills
  - 2.5.4 professional ethics

**3. demonstrate basic competencies**

- 3.1 demonstrate fundamental skills to:
  - 3.1.1 communicate
  - 3.1.2 manage information
  - 3.1.3 use numbers
  - 3.1.4 think and solve problems
- 3.2 demonstrate personal management skills to:
  - 3.2.1 demonstrate positive attitudes and behaviours
  - 3.2.2 be responsible
  - 3.2.3 be adaptable
  - 3.2.4 learn continuously
  - 3.2.5 work safely
- 3.3 demonstrate teamwork skills to:
  - 3.3.1 work with others
  - 3.3.2 participate in projects and tasks

## **COURSE HEA3480: HEA PRACTICUM C**

**Level:** First Period Apprenticeship

**Prerequisite:** None

**Description:** Students, on the work site, continue to develop and refine those competencies developed in related Career and Technology Studies (CTS) occupational areas, previous practicums and other experiences.

**Parameters:** This course should be accessed only by students continuing to work toward attaining a recognized credential offered by an agency external to the school. Practicum courses extend the competencies developed in related CTS occupational areas. The practicum courses may not be delivered as stand-alone courses and may not be combined with core courses. This course may not be used in conjunction with Registered Apprenticeship Program courses. This practicum course may be delivered on- or off-campus. Instruction must be delivered by a qualified teacher with journey person certification or an experienced professional with journey person certification, who is under the supervision of the qualified teacher; both must be authorized to supervise trainees for the external credential.

**Outcomes:** The student will:

- 1. perform assigned tasks and responsibilities efficiently and effectively, as required by the agency granting credentials**
  - 1.1 identify regulations and regulatory bodies related to the credential
  - 1.2 describe personal roles and responsibilities, including:
    - 1.2.1 key responsibilities
    - 1.2.2 support functions/responsibilities
    - 1.2.3 code of ethics
  - 1.3 describe personal work responsibilities and categorize them as:
    - 1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
    - 1.3.2 non-routine tasks; e.g., emergencies
    - 1.3.3 tasks requiring personal judgement
    - 1.3.4 tasks requiring approval of a supervisor
- 2. analyze personal performance in relation to established standards**
  - 2.1 evaluate application of competencies developed in related CTS courses
  - 2.2 evaluate standards of performance in terms of:
    - 2.2.1 quality of work
    - 2.2.2 quantity of work
  - 2.3 evaluate adherence to workplace policies and procedures related to health and safety
  - 2.4 evaluate the work environment in terms of:
    - 2.4.1 location
    - 2.4.2 floor plan of work area
    - 2.4.3 analysis of workflow patterns

- 2.5 evaluate a professional in a related occupation in terms of:
  - 2.5.1 training and certification
  - 2.5.2 interpersonal skills
  - 2.5.3 technical skills
  - 2.5.4 professional ethics

**3. demonstrate basic competencies**

- 3.1 demonstrate fundamental skills to:
  - 3.1.1 communicate
  - 3.1.2 manage information
  - 3.1.3 use numbers
  - 3.1.4 think and solve problems
- 3.2 demonstrate personal management skills to:
  - 3.2.1 demonstrate positive attitudes and behaviours
  - 3.2.2 be responsible
  - 3.2.3 be adaptable
  - 3.2.4 learn continuously
  - 3.2.5 work safely
- 3.3 demonstrate teamwork skills to:
  - 3.3.1 work with others
  - 3.3.2 participate in projects and tasks

## **COURSE HEA3485: HEA PRACTICUM D**

**Level:** First Period Apprenticeship

**Prerequisite:** None

**Description:** Students, on the work site, continue to develop and refine those competencies developed in related Career and Technology Studies (CTS) occupational areas, previous practicums and other experiences.

**Parameters:** This course should be accessed only by students continuing to work toward attaining a recognized credential offered by an agency external to the school. Practicum courses extend the competencies developed in related CTS occupational areas. The practicum courses may not be delivered as stand-alone courses and may not be combined with core courses. This course may not be used in conjunction with Registered Apprenticeship Program courses. This practicum course may be delivered on- or off-campus. Instruction must be delivered by a qualified teacher with journey person certification or an experienced professional with journey person certification, who is under the supervision of the qualified teacher; both must be authorized to supervise trainees for the external credential.

**Outcomes:** The student will:

- 1. perform assigned tasks and responsibilities efficiently and effectively, as required by the agency granting credentials**
  - 1.1 identify regulations and regulatory bodies related to the credential
  - 1.2 describe personal roles and responsibilities, including:
    - 1.2.1 key responsibilities
    - 1.2.2 support functions/responsibilities
    - 1.2.3 code of ethics
  - 1.3 describe personal work responsibilities and categorize them as:
    - 1.3.1 routine tasks; e.g., daily, weekly, monthly, yearly
    - 1.3.2 non-routine tasks; e.g., emergencies
    - 1.3.3 tasks requiring personal judgement
    - 1.3.4 tasks requiring approval of a supervisor
- 2. analyze personal performance in relation to established standards**
  - 2.1 evaluate application of competencies developed in related CTS courses
  - 2.2 evaluate standards of performance in terms of:
    - 2.2.1 quality of work
    - 2.2.2 quantity of work
  - 2.3 evaluate adherence to workplace policies and procedures related to health and safety
  - 2.4 evaluate the work environment in terms of:
    - 2.4.1 location
    - 2.4.2 floor plan of work area
    - 2.4.3 analysis of workflow patterns

- 2.5 evaluate a professional in a related occupation in terms of:
  - 2.5.1 training and certification
  - 2.5.2 interpersonal skills
  - 2.5.3 technical skills
  - 2.5.4 professional ethics

**3. demonstrate basic competencies**

- 3.1 demonstrate fundamental skills to:
  - 3.1.1 communicate
  - 3.1.2 manage information
  - 3.1.3 use numbers
  - 3.1.4 think and solve problems
- 3.2 demonstrate personal management skills to:
  - 3.2.1 demonstrate positive attitudes and behaviours
  - 3.2.2 be responsible
  - 3.2.3 be adaptable
  - 3.2.4 learn continuously
  - 3.2.5 work safely
- 3.3 demonstrate teamwork skills to:
  - 3.3.1 work with others
  - 3.3.2 participate in projects and tasks

## COURSE HEA3900: APPRENTICESHIP SAFETY

<b>Level:</b>	First Period Apprenticeship
<b>Prerequisite:</b>	None
<b>Description:</b>	Students develop knowledge, skills and attitudes in the practice of workshop health and safety, communication and career planning.
<b>Parameters:</b>	Access to a materials work centre and to instruction from an individual with specialized training in occupational health and safety (and understanding of the heavy equipment industry) and/or a heavy equipment technician.
<b>ILM Resources:</b>	Safety Legislation, Regulations and Industry Policy in the Trades 650101a; Climbing, Lifting, Rigging and Hoisting 650101b; Hazardous Materials and Fire Protection 650101c; Communication 090101d; Lifting Procedures and Wire Rope 190101e
<b>Note:</b>	This course may promote discussions around sensitive topics (e.g., injury and death) in the context of student safety with respect to workplace hazards.
<b>Outcomes:</b>	The student will:

### **1. describe legislation, regulations and practices intended to ensure a safe workplace in the heavy equipment technician apprenticeship trade**

- 1.1 demonstrate the ability to apply the *Occupational Health and Safety (OHS) Act, Regulation and Code*, as well as the changes from Bill C-45
- 1.2 explain the core requirements applicable to all industries, including:
  - 1.2.1 engineering controls
  - 1.2.2 administrative controls
  - 1.2.3 personal protective equipment (PPE)
- 1.3 demonstrate an understanding of the 26 parts of the OHS Code requirements applicable to all industries
- 1.4 demonstrate an understanding of the 12 parts of the OHS Code requirements applicable to specific industries and activities
- 1.5 demonstrate an understanding of the 11 OHS Code Schedules that the Explanation Guide does not address
- 1.6 explain the role of the employer and employee in regard to occupational health and safety legislation, considering:
  - 1.6.1 employer responsibilities (OHS Regulation)
  - 1.6.2 employee responsibilities (OHS Regulation)
  - 1.6.3 Workplace Hazardous Materials Information System (WHMIS)
  - 1.6.4 fire regulations
  - 1.6.5 Workers' Compensation Board (WCB)
  - 1.6.6 related advisory bodies and agencies; e.g., Alberta Construction Safety Association (ACSA), Construction Owners Association of Alberta (COAA), Occupational Health and Safety Council (OHSC), Work Safe Alberta, Safety Codes Council
- 1.7 explain industry practices for hazard assessment and control procedures in four main hazard categories, including:
  - 1.7.1 biological

- 1.7.2 chemical
- 1.7.3 ergonomic
- 1.7.4 physical hazards
- 1.8 identify and describe hazard assessment tools that both employees and employers must use in assessing and controlling work-site hazards, including:
  - 1.8.1 work-site hazard identification and assessment
  - 1.8.2 health and safety plan
  - 1.8.3 joint work-site health and safety committee
  - 1.8.4 emergency response plans
  - 1.8.5 first-aid and incident reports
- 1.9 identify and describe employer engineering controls that provide the highest level of worker protection, including:
  - 1.9.1 elimination
  - 1.9.2 substitution
  - 1.9.3 redesign
  - 1.9.4 isolation
  - 1.9.5 automation
- 1.10 identify and describe employer administrative controls that limit hazards to the lowest level possible, including:
  - 1.10.1 safe work practices
  - 1.10.2 job procedures, policies and rules
  - 1.10.3 work/rest schedules to reduce exposure
  - 1.10.4 limiting hours of work
  - 1.10.5 scheduling hazardous work during non-peak times
  - 1.10.6 using optional methods; e.g., wet sanding as opposed to dry sanding or sweeping
- 1.11 describe the responsibilities of employees and employers to apply emergency procedures, including:
  - 1.11.1 emergency response plans
  - 1.11.2 first aid
- 1.12 describe positive tradesperson attitudes with respect to the legal responsibilities for all workers, including:
  - 1.12.1 housekeeping
  - 1.12.2 lighting
  - 1.12.3 personal protective equipment (PPE)
  - 1.12.4 emergency procedures
- 1.13 describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE), including:
  - 1.13.1 eye protection; e.g., class 1 (spectacles), class 2 (goggles), class 3 (welding helmets), class 4 (welding hand shields), class 5 (hoods), class 6 (face shields), class 7 (respirator face pieces)
  - 1.13.2 flame resistant clothing
  - 1.13.3 foot protection; e.g., category 1, 2 or 3 footwear requirements
  - 1.13.4 head protection; e.g., class G (general), class E (electrical), class C (conducting)
  - 1.13.5 hearing protection; e.g., earplugs or earmuffs
  - 1.13.6 life jackets and personal flotation devices (PFDs)
  - 1.13.7 limb and body protection
  - 1.13.8 respiratory protective equipment; e.g., particulate filters; chemical cartridges or canisters; airline respirators, hoods, helmets and suits; self-contained breathing apparatus (SCBA)
  - 1.13.9 a combination of any of the above



**2. describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in the heavy equipment technician apprenticeship trade**

- 2.1 select, use and maintain specialized PPE and materials for climbing, lifting and loading, including:
  - 2.1.1 full body harness
  - 2.1.2 body belt
  - 2.1.3 ladders
  - 2.1.4 scaffold systems
  - 2.1.5 lifting and moving equipment
  - 2.1.6 PPE for lifting
  - 2.1.7 materials handling equipment; e.g., forklift, four-wheel dolly, chain hoist, overhead crane
- 2.2 describe manual lifting procedures, including correct body mechanics, considering:
  - 2.2.1 back safety
  - 2.2.2 general procedure for lifting
  - 2.2.3 employer and employee preventive actions to avoid back injuries
- 2.3 describe rigging hardware and safe work load, considering:
  - 2.3.1 wire rope slings
  - 2.3.2 synthetic fibre web slings
  - 2.3.3 chain slings
  - 2.3.4 rigging hardware inspection
  - 2.3.5 sling angle on load
- 2.4 select the correct equipment for rigging typical loads, including:
  - 2.4.1 eye bolts
  - 2.4.2 shackles
  - 2.4.3 rings and links
  - 2.4.4 hooks
  - 2.4.5 swivels
  - 2.4.6 spreader bars and equalization beams
  - 2.4.7 blocks
  - 2.4.8 sheaves
  - 2.4.9 turnbuckles
- 2.5 describe hoisting and load-moving procedures
- 2.6 explain the most commonly used sling configurations to connect a load to a hook, including:
  - 2.6.1 vertical hitch
  - 2.6.2 bridle hitch
  - 2.6.3 single and double basket hitch
  - 2.6.4 wrap hitch
  - 2.6.5 single and double choker hitch
- 2.7 demonstrate the standard movement signals a signaler is required to know to signal a crane operator, including:
  - 2.7.1 hoist and lower load
  - 2.7.2 raise and lower boom
  - 2.7.3 swing boom
  - 2.7.4 stop
  - 2.7.5 emergency stop
  - 2.7.6 dog everything

- 3. perform lifting operations using proper techniques and equipment and following occupational health and safety standards**
  - 3.1 demonstrate knowledge and use of hoisting and lifting equipment, including:
    - 3.1.1 differential and screw-gear chain hoists
    - 3.1.2 spur-gear and electric chain hoists
    - 3.1.3 forklifts and boom hoists
    - 3.1.4 floor gantry and overhead travelling cranes
    - 3.1.5 mechanical and hydraulic jacks and jack stands
  - 3.2 describe applications of wire rope on machinery following regulations set out by the *Occupational Health and Safety Act*, including:
    - 3.2.1 guidelines for wire rope installation and maintenance
  - 3.3 demonstrate the correct use of jacking and blocking techniques common to off-road and on-road equipment and trailers, considering:
    - 3.3.1 safety concerns
    - 3.3.2 floor or ground stability
    - 3.3.3 load to be lifted or supported
    - 3.3.4 lift points
    - 3.3.5 height the equipment needs to be raised
- 4. describe the safety practices for hazardous materials and fire protection in the heavy equipment technician apprenticeship trade**
  - 4.1 describe the roles, responsibilities, features and practices related to the Workplace Hazardous Materials Information System (WHMIS) program, including:
    - 4.1.1 suppliers', employers' and employees' responsibilities
    - 4.1.2 WHMIS classifications
    - 4.1.3 health effects from exposure to chemicals
  - 4.2 describe the three key elements of WHMIS, including:
    - 4.2.1 worker education
    - 4.2.2 supplier and workplace product labelling
    - 4.2.3 material safety data sheets
  - 4.3 describe handling, storage and transportation procedures when dealing with hazardous materials, including:
    - 4.3.1 handling, storing and transporting flammable liquids
    - 4.3.2 handling, storing and transporting compressed gas
    - 4.3.3 storing incompatible materials
  - 4.4 describe safe venting procedures when working with hazardous materials, including:
    - 4.4.1 mechanical general ventilation
    - 4.4.2 local ventilation
    - 4.4.3 portable smoke extractor
    - 4.4.4 working in a confined space
  - 4.5 describe fire hazards, classes, procedures and equipment related to fire protection, including:
    - 4.5.1 elements of a fire
    - 4.5.2 classes of fires
    - 4.5.3 fire extinguisher labels
    - 4.5.4 extinguishing small fires
    - 4.5.5 the PASS method

**5. demonstrate communication skills and workshop safety as they pertain to occupational health and safety standards**

5.1 use various types of communication to provide trade-related information, employing standard terms for components and operations, including:

- 5.1.1 personal appearance
- 5.1.2 business appearance
- 5.1.3 suppliers and sales representatives
- 5.1.4 customers
- 5.1.5 tradespeople

5.2 identify key areas of responsibility that an employee has in regards to shop and trade safety, including:

- 5.2.1 housekeeping
- 5.2.2 waste containers
- 5.2.3 power tools and rotating machinery
- 5.2.4 compressed air
- 5.2.5 exhaust gases
- 5.2.6 control of carbon monoxide (CO)
- 5.2.7 hazardous materials, dangerous goods and controlled products

5.3 explain the correct use of fire extinguishers and explain fire prevention techniques

**6. demonstrate an understanding of the heavy equipment technician apprenticeship trade and of apprenticeship opportunities that exist by creating a personal career portfolio**

6.1 demonstrate an understanding of the heavy equipment technician apprenticeship trade and related job opportunities

6.2 describe what it means to be an apprentice and describe requirements for the employee and employer

6.3 refine and present a personal career portfolio, showing evidence of strengths and competencies, including:

- 6.3.1 application completion
- 6.3.2 cover letter
- 6.3.3 résumé with references

6.4 demonstrate knowledge of workplace requirements, rights and responsibilities and relate this knowledge to personal career/employment expectations

6.5 outline the educational requirements to move into the heavy equipment technician apprenticeship trade and:

- 6.5.1 conduct successful employment searches
- 6.5.2 communicate in the language in which business is conducted
- 6.5.3 prepare a personal employment search portfolio
- 6.5.4 use technologies, tools and information systems appropriately for job preparation

**7. demonstrate basic competencies**

7.1 demonstrate fundamental skills to:

- 7.1.1 communicate
- 7.1.2 manage information
- 7.1.3 use numbers
- 7.1.4 think and solve problems

7.2 demonstrate personal management skills to:

- 7.2.1 demonstrate positive attitudes and behaviours
- 7.2.2 be responsible
- 7.2.3 be adaptable
- 7.2.4 learn continuously
- 7.2.5 work safely

- 7.3 demonstrate teamwork skills to:
  - 7.3.1 work with others
  - 7.3.2 participate in projects and tasks
- 8. create a transitional strategy to accommodate personal changes and build personal values**
  - 8.1 identify short-term and long-term goals
  - 8.2 identify steps to achieve goals