NL Curriculum Standard

Plan of Training

Refrigeration and Air Conditioning Mechanic

Government of Newfoundland and Labrador
Department of Immigration, Skills and Labour
Apprenticeship and Trades Certification Division

June 2019

PLAN OF TRAINING

Refrigeration and Air Conditioning Mechanic

June, 2019

Government of Newfoundland and Labrador
Department of Advanced Education, Skills and Labour
Apprenticeship and Trades Certification Division

Approved by:

Chairperson, Provincial Apprenticeship and Certification Board

Date: July 22, 2019

Preface

This NL curriculum standard is based on the 2018 edition of the Red Seal Occupational Standard (RSOS) and aligned with the National Harmonization sequencing and levels for the Refrigeration and Air Conditioning Mechanic trade. It describes the direct entry curriculum content for the Refrigeration and Air Conditioning Mechanic apprenticeship training program.

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We offer a sincere thank you.

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A. RSOS Comparison Chart

2018 RSOS Tasks and Sub-Task		2019 Plan of Training	
Task 1 – Performs Safety-Related Functions			
1.01	Maintains safe work environment	RF1162	Safety In context throughout courses
1.02	Performs lock-out, tag-out and isolation procedures		
1.03	Uses personal protective equipment (PPE) and safety equipment		
Task 2 – Uses Tools and Equipment.			
2.01	Uses hand tools	RF1172	Tools and Equipment
2.02	Uses portable and stationary power tools		
2.03	Uses brazing and soldering equipment		
2.04	Uses recovery and recycling equipment		
2.05	Uses evacuation tools and equipment		
2.06	Uses charging tools and equipment		
2.07	Uses diagnostic and measuring tools and equipment		
2.08	Uses access equipment	RF1342	Hoisting, Rigging, Lifting and Access/Egress Equipment
2.09	Uses rigging, hoisting and lifting equipment		
2.10	Uses digital technology	RF1181	In context throughout courses
Task 3 – Organizes Work			
3.01	Interprets blueprints, drawings and specifications	RF1811	Blueprints and Specifications
		RF2351	Refrigeration System Design
		RF2000	Large Commercial/Industrial Compressors
		RF2010	Heating Systems
		RF1430	Fluid Dynamics and Pumps
		RF3751	Control Systems
		RF3030	Troubleshooting Refrigeration and Air Conditioning Electronic Controls
		RF3040	Advanced Motors
		RF3550	Refrigeration Capacity Control
		RF3590	Air Conditioning System Design

2018 RSOS Tasks and Sub-Task		2019 Plan of Training	
		RF3670	Duct Systems and Design
		RF4001	Job Coordination
		RF4791	Industrial Refrigeration Systems
		RF4721	Chillers and Chiller Systems
		RF4620	Air Measurement and System Air Balancing
3.02	Uses documentation and reference material	RF1181	In context throughout courses
		RF2351	Refrigeration System Design
		RF2731	Commercial Refrigeration Systems
		RF2000	Large Commercial/Industrial Compressors
		RF3590	Air Conditioning System Design
		RF3751	Control Systems
		RF3030	Troubleshooting Refrigeration and Air Conditioning Electronic Controls
		RF4721	Chillers and Chiller Systems
		RF4620	Air Measurement and System Air Balancing
		RF4001	Job Coordination
3.03	Plans job tasks and procedures	RF1181	In context throughout courses
		RF2351	Refrigeration System Design
		RF2731	Commercial Refrigeration Systems
		RF3751	Control Systems
		RF3590	Air Conditioning System Design
		RF3040	Advanced Motors
		RF3550	Refrigeration Capacity Control
		RF3670	Duct System and Design
		RF4001	Job Coordination
Task 4 – Uses Communication and Mentoring Techniques			
4.01	Uses communication techniques	RF1181	In context throughout courses
		RF4001	Job Coordination
4.02	Uses mentoring techniques	RF4100	Mentoring

2018 RSOS Tasks and Sub-Task		2019 Plan of Training	
Task 5 – Performs Work Site Preparation			
5.01	Prepares work site	RF1162	Safety
		RF4001	Job Coordination
			In context throughout courses
5.02	Handles Materials And Supplies		In context throughout courses
Task 6 – Performs Routine Trade Activities			
6.01	Performs brazing and soldering	RF1212	Piping, Tubing, Soldering and Brazing
6.02	Performs leak and pressure tests on systems	RF1263	Leak Testing, Evacuation and Charging
		RF1452	Refrigeration and Air Conditioning Installation
6.03	Evacuates systems	RF1263	Leak Testing, Evacuation and Charging
6.04	Uses refrigerants, gases and oils	RF1242	Refrigerants, Gases and Oils
		RF1290	Ozone-Depletion Substances
		RF2731	Commercial Refrigeration Systems
6.05	Performs field wiring of systems	RF1272	Electrical Fundamentals
		RF1482	Control Circuits and Wiring Diagrams
		RF2541	Packaged Air Conditioning Systems
		RF2510	Split Air Conditioning Systems
		RF3751	Control Systems
6.06	Applies sealants and adhesives	RF1212	Piping, Tubing, Soldering and Brazing
Task 7 – Plans Installation of HVAC/R Systems			
7.01	Verifies HVAC/R system parameters and requirements	RF1661	Air Conditioning Load Calculations
		RF2520	Refrigeration Load Calculations
		RF3030	Troubleshooting Refrigeration and Air Conditioning Electronic Controls
		RF3590	Air Conditioning System Design
		RF3040	Advanced Motors
		RF4421	Evaporative Condensers, Cooling Towers and Fluid Coolers

2018 RSOS Tasks and Sub-Task		2019 Plan of Training	
7.02	Selects HVAC/R equipment, components and accessories	RF1362	Compressor Fundamentals
		RF1382	Evaporators
		RF1191	Residential and Commercial Compressors
		RF1402	Refrigerant Flow Controls and Accessory Devices
		RF1612	Air Movement and Indoor Air Quality
		RF1600	Heat Pump Systems
		RF2541	Packaged Air Conditioning Systems
		RF2510	Split Air Conditioning Systems
		RF2731	Commercial Refrigeration Systems
		RF3590	Air Conditioning System Design
		RF4721	Chillers and Chiller Systems
7.03	Determines placement of HVAC/R equipment, components and accessories	RF1362	Compressor Fundamentals
		RF1452	Refrigeration and Air Conditioning Installation
		RF1382	Evaporators
		RF2510	Split Air Conditioning Systems
		RF2351	Refrigeration System Design
		RF3590	Air Conditioning System Design
		RF3670	Duct Systems and Design
		RF4721	Chillers and Chiller Systems
7.04	Performs HVAC/R material take-off	RF1452	Refrigeration and Air Conditioning Installation
		RF1362	Compressor Fundamentals
		RF2351	Refrigeration System Design
		RF3670	Duct Systems and Design
		RF4001	Job Coordination
Task 8 – Plans Installation of Control Systems			
8.01	Verifies control system parameters and requirements	RF1322	Control Fundamentals
		RF1482	Control Circuits and Wiring Diagrams
		RF3751	Control Systems
		RF4791	Industrial Refrigeration Systems

2018 RSOS Tasks and Sub-Task		2019 Plan of Training	
8.02	Selects control system components and accessories	RF1482	Control Circuits and Wiring Diagrams
		RF2351	Refrigeration System Design
		RF3751	Control Systems
		RF4791	Industrial Refrigeration Systems
		RF4001	Job Coordination
8.03	Determines placement of control system components and accessories	RF1272	Electrical Fundamentals
		RF1482	Control Circuits and Wiring Diagrams
		RF2351	Refrigeration System Design
		RF3751	Control Systems
		RF4641	Troubleshooting with Schematic Wiring Diagrams
8.04	Performs control system material take-off	RF1482	Control Circuits and Wiring Diagrams
		RF2541	Packaged Air Conditioning Systems
		RF3751	Control Systems
		RF4001	Job Coordination
Task 9 – Installs HVAC/R Systems			
9.01	Confirms system layout	RF1362	Compressor Fundamentals
		RF1452	Refrigeration and Air Conditioning Installation
		RF2731	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF3751	Control Systems
		RF2010	Heating Systems
9.02	Assembles HVAC/R equipment, components and accessories	RF1362	Compressor Fundamentals
		RF1452	Refrigeration and Air Conditioning Installation
		RF2731	Commercial Refrigeration Systems
		RF1600	Heat Pump Systems
		RF2541	Packaged Air Conditioning Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF3670	Duct Systems and Design
		RF2010	Heating Systems

2018 RSOS Tasks and Sub-Task		2019 Plan of Training	
9.03	Places HVAC/R equipment, components and accessories	RF1172	Tools and Equipment
		RF1362	Compressor Fundamentals
		RF1212	Piping, Tubing, Soldering and Brazing
		RF1282	Motor Fundamentals
		RF1252	Valves and Accessory Devices
		RF1382	Evaporators
		RF1452	Refrigeration and Air Conditioning Installation
		RF1191	Residential and Commercial Compressors
		RF1372	Condensers
		RF1391	Metering Devices
		RF1600	Heat Pump Systems
		RF1402	Refrigerant Flow Controls and Accessory Devices
		RF2000	Large Commercial/Industrial Compressors
		RF2731	Commercial Refrigeration Systems
		RF3040	Advanced Motors
		RF2010	Heating Systems
		RF1430	Fluid Dynamics and Pumps
9.04	Installs fasteners, brackets and hanger	RF1212	Piping, Tubing, Soldering and Brazing
9.05	Installs HVAC/R piping and tubing	RF1212	Piping, Tubing, Soldering and Brazing
		RF2731	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems
9.06	Applies HVAC/R holding charge	RF1263	Leak Testing, Evacuation and Charging
		RF2731	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems

2018 RSOS Tasks and Sub-Task		2019 Plan of Training	
Task 10 – Installs Control Systems			
10.01	Places control system components	RF1452	Refrigeration and Air Conditioning Installation
		RF1172	Tools and Equipment
		RF2731	Commercial Refrigeration Systems
		RF1482	Control Circuits and Wiring Diagrams
		RF3751	Control Systems
10.02	Connects control systems	RF1172	Tools and Equipment
		RF1452	Refrigeration and Air Conditioning Installation
		RF1482	Control Circuits and Wiring Diagrams
		RF2731	Commercial Refrigeration Systems
		RF3751	Control Systems
Task 11 – Commissions HVAC/R Systems			
11.01	Performs pre start-up checks for HVAC/R systems	RF3590	Air Conditioning System Design
		RF4001	Job Coordination
		RF4721	Chillers and Chiller Systems
11.02	Performs start-up of HVAC/R systems	RF3590	Air Conditioning System Design
		RF4721	Chillers and Chiller Systems
		RF4791	Industrial Refrigeration Systems
11.03	Completes HVAC/R system charge	RF3550	Refrigeration Capacity Control
		RF4721	Chillers and Chiller Systems
		RF4791	Industrial Refrigeration Systems
11.04	Sets up primary and secondary HVAC/R components	RF1362	Compressor Fundamentals
		RF1452	Refrigeration and Air Conditioning Installation
		RF3751	Control Systems
		RF4721	Chillers and Chiller Systems
Task 12 – Commissions Control Systems			
12.01	Performs start-up checks for control systems	RF3751	Control Systems
		RF4620	Air Measurement and System Air Balancing
		RF4641	Troubleshooting with Schematic Wiring Diagrams
12.02	Verifies/sets operating parameters	RF3751	Control Systems
		RF4001	Job Coordination

2018 RSOS Tasks and Sub-Task		2019 Plan of Training	
Task 13 – Maintains HVAC/R Systems			
13.01	Inspects HVAC/R systems	RF1172	Tools and Equipment
		RF1452	Refrigeration and Air Conditioning Installation
		RF1222	Refrigeration Fundamentals
		RF1452	Refrigeration and Air Conditioning Installation
		RF2731	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems
13.02	Performs predictive and scheduled maintenance on HVAC/R systems	RF1172	Tools and Equipment
		RF1242	Refrigerants, Gases and Oils
		RF1322	Control Fundamentals
		RF1402	Refrigerant Flow Controls and Accessory Devices
		RF2731	Commercial Refrigeration Systems
		RF3590	Air Conditioning System Design
13.03	Tests HVAC/R system components and accessories	RF1172	Tools and Equipment
		RF1272	Electrical Fundamentals
		RF1402	Refrigerant Flow Controls and Accessory Devices
		RF1382	Evaporators
		RF2731	Commercial Refrigeration Systems
Task 14 – Services HVAC/R Systems			
14.01	Troubleshoots HVAC/R systems	RF1362	Compressor Fundamentals
		RF1352	Pressure Enthalpy Diagrams
		RF2510	Air Conditioning Systems
		RF2541	Packaged Air Conditioning Systems
		RF2731	Commercial Refrigeration Systems
		RF1600	Heat Pump Systems
		RF3030	Troubleshooting Refrigeration and Air Conditioning Electronics
		RF3040	Advanced Motors
		RF3590	Air Conditioning System Design
		RF3670	Duct Systems and Design
		RF4641	Troubleshooting with Schematics Wiring Diagrams

2018 RSOS Tasks and Sub-Task		2019 Plan of Training	
14.02	Repairs HVAC/R systems	RF1362	Compressor Fundamentals
		RF2731	Commercial Refrigeration Systems
		RF3030	Troubleshooting Refrigeration and Air Conditioning Electronics
		RF4620	Air Measurement and System Air Balancing
		RF4641	Troubleshooting with Schematic Wiring Diagrams
		RF4721	Chillers and Chiller Systems
		RF4001	Job Coordination
Task 15 – Maintains and Services Control Systems			
15.01	Performs maintenance and inspection on control systems	RF2731	Commercial Refrigeration Systems
		RF3751	Control Systems
		RF4001	Job Coordination
15.02	Troubleshoots control systems	RF1482	Control Circuits and Wiring Diagrams
		RF2731	Commercial Refrigeration Systems
		RF3751	Control Systems
		RF3030	Troubleshooting Refrigeration and Air Conditioning Electronics
		RF4641	Troubleshooting with Schematics and Wiring Diagrams
15.03	Calibrates operating and safety controls	RF2731	Commercial Refrigeration Systems
		RF3751	Control Systems
		RF4791	Industrial Refrigeration Systems
15.04	Repairs control systems	RF2731	Commercial Refrigeration Systems
		RF3751	Control Systems
		RF4641	Troubleshooting with Schematic Wiring Diagrams
		RF4791	Industrial Refrigeration Systems

B. Program Structure

For each and every course, a formal assessment is required for which 70% is the pass mark. A mark of 70% must be attained in both the theory examination and the practical project assignment, where applicable as documented on an official transcript.

The order of course delivery within each level can be determined by the training institution, as long as pre-requisite conditions are satisfied.

Upon completion of an entry level program, individuals may be required to complete other certifications (employer or job site specific) in order to gain employment.

Level 1			
Course No.	**Course Name**	**Hours**	**Pre-Requisite(s)**
RF1290	Ozone-Depletion Substances	6	None
RF1162	Safety	4	None
RF1342	Hoisting, Lifting, Rigging and Access/Egress Equipment	10	RF1162
RF1172	Tools and Equipment	20	RF1162
RF1222	Refrigeration Fundamentals	52	RF1172
RF1242	Refrigerants, Gases and Oils	22	RF1290 RF1222
RF1362	Compressor Fundamentals	16	RF1222
RF1252	Valves and Accessory Devices	15	RF1362
RF1212	Piping, Tubing, Soldering and Brazing	24	RF1222
RF1263	Leak Testing, Evacuation and Charging	21	RF1242
RF1272	Electrical Fundamentals	32	RF1162
RF1282	Motor Fundamentals	24	RF1272
RF1452	Refrigeration and Air Conditioning Installation	60	RF1222 RF1263 RF1272
RF1352	Pressure Enthalpy Diagrams and System Analysis	12	RF1222
RF1382	Evaporators	12	RF1222

RF1191	Residential and Commercial Compressors	24	RF1272 RF1362
RF1372	Condensers	12	RF1222
RF1391	Metering Devices	15	RF1382
RF1402	Refrigerant Flow Controls and Accessory Devices	18	RF1362
RF1332	Air Conditioning Fundamentals	10	RF1222
RF1612	Air Movement and Indoor Air Quality	12	RF1332
RF1322	Control Fundamentals	14	RF1282
RF1482	Control Circuits and Wiring Diagrams	30	RF1322
RF1811	Blueprints, Drawings and Specifications	15	None
Total Level 1 Hours		**480**	

Required Work Experience

Level 2			
Course No.	**Course Name**	**Hours**	**Pre-Requisite(s)**
RF2520	Refrigeration Load Calculations	24	Level 1
RF2351	Refrigeration System Design	36	
RF2000	Large Commercial/Industrial Compressors	24	
RF2010	Heating Systems	30	
RF2731	Commercial Refrigeration Systems	36	
RF2510	Split Air Conditioning Systems	30	
RF2541	Packaged Air Conditioning Systems	30	
RF1600	Heat Pump Systems	30	
Total Level 2 Hours		**240**	

Required Work Experience

Level 3			
Course No.	**Course Name**	**Hours**	**Pre-Requisite(s)**
RF1430	Fluid Dynamics and Pumps	15	Level 1I
RF3751	Control Systems	42	
RF3030	Troubleshooting Refrigeration and Air Conditioning Electronic Controls	42	
RF3040	Advanced Motors	30	
RF3550	Refrigeration Capacity Control	30	
RF1661	Air Conditioning Load Calculations	15	
RF3590	Air Conditioning System Design	36	
RF3670	Duct Systems and Design	30	
Total Level 3 Hours		**240**	

Required Work Experience

Level 4			
Course No.	**Course Name**	**Hours**	**Pre-Requisite(s)**
RF4421	Evaporative Condensers, Cooling Towers and Fluid Coolers	30	Level 3
RF4620	Air Measurement and System Air Balancing	30	
RF4721	Chillers and Chiller Systems	40	
RF4791	Industrial Refrigeration Systems	40	
RF4641	Troubleshooting with Schematic Wiring Diagrams	45	
RF4001	Job Coordination	19	
RF4100	Mentoring	6	
RF4800	Program Review	30	
Total Level 4 Hours		**240**	

Total Course Credit Hours	**1200**

Level 1

RF1290 Ozone-Depletion Substances

Learning Outcomes:

- Demonstrate knowledge of regulations on ozone-depleting substances.

Duration: 6 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Describe procedures for handling ozone-depletion substances (refrigerants) used in the Refrigeration and Air Conditioning Mechanic Occupation.

2. Identify the federal and provincial halocarbon regulations relating to ozone-depletion substances regulations.

NOTE: **Curriculum and certification supplied by HRAI are to be delivered by instructors who are certified to teach ODS courses.**

Practical Requirements:

1. Complete ODS course with a certified instructor.

RF1162 Safety

Learning Outcomes:

- Demonstrate knowledge of maintaining a safe work environment
- Demonstrate knowledge of codes and regulations pertaining to a safe work environment and work site safety.
- Demonstrate knowledge of procedures used to lock-out, tag-out and isolate equipment.
- Demonstrate knowledge of PPE and safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of standards and regulations pertaining to PPE and safety equipment.
- Demonstrate knowledge of safe work practices.

Duration: 4 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define terminology associated with PPE and safety equipment.

2. Identify workplace hazards and describe safe work practices.
   i. high voltage
   ii. corrosive chemicals
   iii. toxicity
   iv. combustive reactions
   v. fire
   vi. rotating equipment
   vii. working at heights
   viii. confined spaces
   ix. noisy locations
   x. pressure hazards
   xi. refrigerants
   xii. weather
   xiii. overhead obstacles

3. Describe procedures used to maintain a safe work environment and to remedy the potential dangers related to workplace hazards.

4. Describe procedures used to handle, store, transport and dispose of hazardous materials.

5. Interpret codes and regulations pertaining to workplace hazards and safe work practices.

6. Describe procedures used to lock-out, tag-out and isolate equipment and confirm zero energy.

7. Determine when a lock-out procedure is required.

8. Identify energy sources to be locked out.

9. Identify the potential of stored energy.

10. Identify types of PPE and safety equipment, their applications and procedures for use.
    i. PPE
        - hard hats
        - safety glasses
        - respirators
        - boots
        - gloves
        - safety vests
        - harnesses
        - lanyards
    ii. safety equipment
        - fire extinguishers
        - eye wash stations
        - first aid kits
        - spill kits

11. Describe the procedures used to maintain and store PPE and safety equipment.

12. Identify standards and regulations pertaining to PPE and safety equipment.

13. Describe the procedures used to conduct a job hazard assessment.

Practical Requirements:

None.

RF1342 Hoisting, Lifting, Rigging, Access/Egress Equipment

Learning Outcomes:

- Demonstrate knowledge of hoisting, lifting, rigging and access/egress equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of regulations pertaining to access equipment.
- Demonstrate knowledge of regulations pertaining to rigging, hoisting and lifting equipment.
- Demonstrate knowledge of communication methods.
- Demonstrate knowledge of basic hand signals.

Duration: 10 Hours

Pre-Requisite(s): RF1162

Objectives and Content:

1. Define terminology associated with rigging, hoisting and lifting equipment.

2. Identify hazards and describe safe work practices pertaining to the use of rigging, hoisting and lifting equipment.

3. Interpret codes and regulations pertaining to using rigging, hoisting and lifting, equipment.

4. Interpret information pertaining to using rigging, hoisting and lifting equipment found on drawings and specifications.

5. Identify types of rigging, hoisting and lifting equipment and accessories, and describe their applications, limitations and procedures for use.
   i. belts
   ii. ropes
   iii. cables
   iv. slings
   v. shackles
   vi. spreader bars
   vii. come-alongs/chain falls
   viii. jacks
   ix. hoists
   x. pry bars

6. Identify types of knots, hitches and bends, and describe their applications and associated procedures.
   i. reef knot
   ii. bowline
   iii. timber hitch

7. Identify the factors to consider when selecting hoisting, lifting, rigging and access/egress equipment.
   i. safety factor
   ii. load characteristics
   iii. environment
   iv. application

8. Identify the factors to consider when rigging a load (material and/or equipment) for hoisting and lifting.
   i. load characteristics
   ii. equipment and accessories
   iii. environmental factors
   iv. anchor points/attachment locations
   v. sling angles
   vi. machine capacity/load chart

9. Identify and interpret communication methods used during hoisting, lifting, rigging, and using access/egress equipment and describe their associated procedures.
   i. visual
      - standard crane and hoist hand signals
      - video
   ii. audible
      - radio
      - two-way radios
      - mobile phones

10. Describe the procedures used to inspect, store and maintain rigging, hoisting and lifting equipment.

11. Describe the procedures used to rig and secure a load (material and/or equipment) for lifting and hoisting.

12. Describe the procedures used to perform a lift.

13. Identify types of access/egress equipment, and describe their applications, limitations and procedures for use.
    i. ladders
    ii. staging
    iii. scaffolding
    iv. lifts

14. Identify hazards and describe safe work practices pertaining to the use of egress/ access equipment.

15. Interpret information pertaining to the using egress/access equipment found on drawings and specification.

16. Describe the procedures used to inspect, store and maintain egress/ access equipment.

17. Interpret codes and regulations pertaining to using egress/ access equipment.

18. Describe the procedures used to inspect, store and maintain egress/access equipment.

Practical Requirements:

1. Tie various knots for lifting and securing loads.

2. Perform crane hand signals.

RF1172 Tools and Equipment

Learning Outcomes:

- Demonstrate knowledge of hand tools, and portable and stationary power tools, their applications, maintenance and procedures for use.
- Demonstrate knowledge of recovery and recycling tools and equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of evacuation and charging tools and equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of diagnostic and measuring tools and equipment, their applications, maintenance and procedures for use.

Duration: 20 Hours

Pre-Requisite(s): RF1162

Objectives and Content:

1. Define terminology associated with hand tools and equipment.
   i. flaring tools
   ii. pipe cutters
   iii. benders
   iv. wrenches
   v. screwdrivers

2. Identify hazards and describe safe work practices pertaining to the use of hand tools and equipment.

3. Identify types of hand tools and describe their applications and procedures for use.
   i. screwdrivers
   ii. hammers
   iii. pliers
   iv. wrenches
   v. measuring and layout tools

4. Describe the procedures used to care for, store and maintain hand tools.
   i. lubricate
   ii. sharpen
   iii. tighten

5. Define terminology associated with portable and stationary power tools.

6. Identify types of portable and stationary power tools, and describe their applications and procedures for use.
   i. pneumatic
   ii. electric
   iii. hydraulic
   iv. gas
   v. generators

7. Identify hazards and describe safe work practices pertaining to the use of portable and stationary power tools.

8. Describe the procedures used to care for, store and maintain portable and stationary power tools.
   i. lubricate
   ii. sharpen
   iii. tighten

9. Identify types of anchors and supports used to place HVAC/R equipment.
   i. hangers
   ii. hurricane straps
   iii. seismic restraints

10. Define terminology associated with recovery and recycling tools and equipment.
    i. recovery units
    ii. hoses
    iii. cylinders
    iv. gauges
    v. scales
    vi. filter driers

11. Identify hazards and describe safe work practices pertaining to the use of recovery and recycling tools and equipment.

12. Identify types of recovery and recycling equipment, and describe their applications and procedures for use.

13. Identify the method of recovery.

14. Identify the capacity of recovery systems.

15. Describe the procedures used to care for, store and maintain recovery and recycling tools equipment.

16. Define terminology associated with evacuation tools and equipment and charging tools and equipment.

17. Identify hazards and describe safe work practices pertaining to the use of evacuations tools and equipment and charging tools and equipment.

18. Identify types of evacuation and charging tools and equipment and describe their applications and procedures for use.
    i. gauge manifold
    ii. charging hoses
    iii. vacuum pumps
    iv. electronic thermistor
    v. electronic weight scales

19. Describe the procedures used to care for, store and maintain evacuation and charging tools and equipment.

20. Define terminology associated with diagnostic and measuring tools and equipment.
    i. thermometers
    ii. scales
    iii. leak detectors
    iv. meters
    v. calipers
    vi. micrometers
    vii. gauge manifolds
    viii. manometers
    ix. hygrometers
    x. refractometer
    xi. decibel meters

21. Identify hazards and describe safe work practices pertaining to the use of diagnostic and measuring tools and equipment.

22. Identify types of diagnostic and measuring tools and equipment, and describe their applications and procedures for use.

23. Describe the procedures used to care for, store and maintain diagnostic and measuring tools and equipment.

24. Identify the types of fasteners and fastening devices and describe their sizes, classifications, use and application.

25. Identify tools and equipment used to install control systems, and describe their applications and procedures for use.

26. Identify tools and materials used to connect and secure wiring and control tubing, and describe their applications and procedures for use.

27. Identify types of tools and test equipment and their procedures for use and inspection.
    i. thermometers
    ii. gauges
    iii. hand tools
    iv. electrical meters
    v. psychrometers
    vi. instruments
    vii. electronic devices
    viii. analysing devices

Practical Requirements:

1. Assemble and dis-assemble equipment using various tools.

2. Test systems with various test instruments, tools and accessories.

RF1222 Refrigeration Fundamentals

Learning Outcomes:

- Demonstrate knowledge of refrigeration fundamentals.
- Demonstrate knowledge of the refrigeration cycle.

Duration: 52 Hours

Pre-Requisite(s): RF1172

Objectives and Content:

1. Define terminology associated with refrigeration.

2. Explain concepts associated with refrigeration.

3. Identify pressure and temperature scales, and describe the procedures used to perform conversion calculations.

4. Explain heat flow and identify methods of heat transfer.

5. Identify states of matter and describe their characteristics.

6. Explain basic gas laws associated with refrigeration, and describe the associated calculations to demonstrate relationships.

7. Explain the effect of pressure on evaporation, condensing, freezing and melting temperatures.

8. Explain the operation of the vapour compression cycle.

9. Identify components of a vapour compression cycle, and describe their purpose and operation.
   i. compressor
   ii. discharge line
   iii. condenser
   iv. liquid line
   v. metering device
   vi. evaporator
   vii. suction line
   viii. system accessories
   ix. condensate line

10. Describe the physical changes of the refrigerant as it circulates through the system.

11. Describe the pressure/temperature chart and its use in determining refrigerant conditions.
    i. dew point
    ii. bubble point

12. Explain superheat and sub-cooling, and their significance in the refrigeration cycle.

13. Identify factors that affect system capacity.
    i. condensing pressure/temperature
    ii. evaporating pressure/temperature
    iii. heat of compression
    iv. sub-cooling
    v. superheat

Practical Requirements:

1. Operate and monitor a refrigeration system.
    i. measure operating temperatures
    ii. obtain operating pressures
    iii. determine the amount of superheat
    iv. determine the amount of subcooling
    v. determine net refrigerating effect

2. Perform calculations.
    i. convert temperatures from one scale to another
    ii. convert pressures from absolute to gauge pressure
    iii. use various gas laws
    iv. heat calculations

RF1242 Refrigerants, Gases and Oils

Learning Outcomes:

- Demonstrate knowledge of refrigerants, gases and refrigerant oils, their applications and procedures for use.
- Demonstrate knowledge of codes and regulations pertaining to refrigerants, gases and refrigerant oils.
- Demonstrate knowledge of the procedures used to recover and recycle refrigerants and oils.

Duration: 22 Hours

Pre-Requisite(s): RF1290, RF1222

Objectives and Content:

1. Define terminology associated with refrigerants, gases and refrigerant oils.

2. Identify hazards and safe work practices pertaining to refrigerants, gases and oils.

3. Identify types of refrigerants and describe their characteristics and applications.
   i. primary
   ii. secondary

4. Identify the safety classifications of refrigerants.
   i. toxicity
   ii. flammability

5. Identify types of refrigerant containers and colour coding classifications.

6. Identify types of refrigerant oils and describe their characteristics and applications.

7. Identify types of gases and describe their characteristics and applications.
   i. nitrogen
   ii. acetylene
   iii. oxygen
   iv. carbon dioxide
   v. argon
   vi. helium

8. Describe the procedures used to perform refrigerant and oil conversions.

9. Describe the procedures used to recover and recycle refrigerants and oils.

10. Describe the procedures used to store and transport refrigerants, gases and oils.

Practical Requirements:

1. Remove, add and transfer refrigerant in an operating system.

2. Test refrigerant in an operating system to determine type.

3. Perform refrigerant and oil conversion.

4. Perform a compressor oil change.

5. Recover refrigerant from a refrigeration system.

6. Perform an acid test.

RF1362 Compressor Fundamentals

Learning Outcomes:

- Demonstrate knowledge of the fundamental principles of compressors.
- Demonstrate knowledge of compressors, their applications, components, accessories and operation.
- Demonstrate knowledge of codes and regulations pertaining to HVAC/R equipment, components and accessories.

Duration: 16 Hours

Pre-Requisite(s): RF1222

Objectives and Content:

1. Define terminology associated with compressors.

2. Identify hazards and describe safe work practices pertaining to compressors.

3. Interpret codes and regulations pertaining to compressors and the placement of compressors, components and accessories.

4. Interpret information pertaining to compressors found on drawings and specifications.

5. Explain compressor efficiency.

6. Explain the purpose and operation of compressors and their components.

7. Identify types of compressors, and describe their characteristics and applications.
   i. reciprocating
   ii. scroll
   iii. rotary
   iv. screw
   v. centrifugal
   vi. swing
   vii. linear

8. Describe belt drive and direct drive compressors.

9. Identify compressor components, and describe their characteristics and applications.

10. Identify methods used to lubricate compressors.

11. Identify methods used to cool compressors.

12. Identify common compressor failures and describe their causes and remedies.
    i. mechanical
    ii. electrical

Practical Requirements:

1. Disassemble, inspect, and reassemble open type and semi-hermetic compressors.

RF1252 Valves and Accessory Devices

Learning Outcomes:

- Demonstrate knowledge of refrigeration valves, their characteristics, applications and operation.
- Demonstrate knowledge of refrigeration accessory devices, their characteristics, applications and operation.
- Demonstrate knowledge of codes and regulations pertaining to HVAC/R equipment, components and accessories.

Duration: 15 Hours

Pre-Requisite(s): RF1362

Objectives and Content:

1. Define terminology associated with valves and accessory devices.

2. Identify hazards and describe safe work practices pertaining to valves and accessory devices.

3. Interpret codes and regulations pertaining to valves and accessory devices.

4. Interpret information pertaining to valves and accessory devices found on drawings and specifications.

5. Explain the purpose and operation of valves and accessory devices.

6. Identity types of valves and describe their characteristics and applications.
   i. safety
   ii. metering
   iii. service/access
   iv. flow controls
   v. water regulating valves

7. Identify types of accessory devices and describe their characteristics and applications.
   i. pressure regulators
   ii. filters and driers
   iii. liquid/moisture indicators
   iv. suction accumulators
   v. oil separators
   vi. liquid receivers
   vii. pressure relief devices
   viii. heat exchangers

8. Identify common valves and accessory device failures and describe their causes and remedies.

Practical Requirements:

None.

RF1212 Piping, Tubing, Soldering and Brazing

Learning Outcomes:

- Demonstrate knowledge of refrigeration piping, tubing and fittings, and their applications.
- Demonstrate knowledge of the procedures used to install piping, tubing and their associated components.
- Demonstrate knowledge of codes and regulations pertaining to the installation of piping and tubing.
- Demonstrate knowledge of the procedures used to solder and braze piping and fittings.
- Demonstrate knowledge of sealants and adhesives, their applications and procedures for use.
- Demonstrate knowledge of codes and regulations pertaining to sealants and adhesives.
- Demonstrate knowledge of the procedures used to install fasteners, brackets and hangers, and their applications.
- Demonstrate knowledge of codes and regulations pertaining to the installation of fasteners, brackets and hangers.

Duration: 24 Hours

Pre-Requisite(s): RF1222

Objectives and Content:

1. Define trade terminology.
   i. piping and tubing
   ii. soldering and brazing
   iii. fasteners, brackets and hangers

2. Identify hazards and describe safe work practices.
   i. piping and tubing
   ii. soldering and brazing

3. Identify and interpret codes and regulations.
   i. piping and tubing
   ii. soldering and brazing
   iii. installation of piping and tubing
   iv. securing fasteners, brackets and hangers
   v. sealants and adhesives

4. Interpret information found on drawings and specifications.
   i. piping and tubing
   ii. soldering and brazing
   iii. fasteners, brackets and hangers

5. Identify specialized tools and equipment used in piping practices, and describe their applications and procedures for use.
   i. cutting
   ii. bending
   iii. joining
      - flaring
      - swaging
      - brazing
      - soldering
      - threading

6. Identify types of refrigeration piping, tubing and fittings, and describe their characteristics and applications.

7. Identify types of pipe materials, fittings and accessories.
   i. copper
   ii. stainless steel
   iii. steel
   iv. copper-iron alloy
   v. brass
   vi. aluminum

8. Identify brazing, soldering and welding materials and fillers, and describe their characteristics and applications.
   i. silver brazing alloys
   ii. flux
   iii. BCuP
   iv. solder

9. Describe the use, care and application of nitrogen when brazing copper tubing.

10. Identify types of pipe hangers, brackets and fasteners, and describe their characteristics and applications.

11. Identify tools and equipment used in installation, and describe their applications and procedures for use.
   i. hand tools
   ii. power tools
   iii. measuring tapes
   iv. levelling devices

12. Identify when the scope of work requires certified welding.

13. Identify the requirements for selecting hardware and fasteners for specific base materials.

14. Identify types of pipe and tubing insulation, and describe their characteristics and applications.

15. Identify types of sealants and adhesives, and describe their characteristics and applications.
    i. sealants
        - silicone
        - spray foam
        - thread seal
        - fire stop
        - duct seal
        - mastic
    ii. adhesives
        - insulation glues
        - primers
        - pipe adhesives

16. Identify tools and equipment used to apply sealants and adhesives, and describe their applications and procedures for use.
    i. brushes
    ii. caulking guns

17. Identify the factors to consider when selecting piping system components for installation.

18. Describe the procedures used to install piping systems.
    i. cutting
    ii. bending
    iii. joining
        - flaring
        - swaging
        - brazing
        - soldering
        - threading
    iv. supporting
        - hangers
        - brackets/fasteners
    v. insulating
    vi. applying sealants and adhesives

19. Identify types of isolation components used to eliminate vibration transmission and noise.

Practical Requirements:

1. Assemble air-acetylene and oxy-acetylene equipment.

2. Install soft and hard drawn copper tubing.
   i. different methods of cutting copper tubing
   ii. ream copper tubing
   iii. bend copper tubing
   iv. prepare tubing for soldering/brazing
   v. solder and braze copper tubing
   vi. select copper/brass mechanical and sweat fittings

3. Fabricate flares and swages in various sized copper tubes.

4. Assemble, ignite and adjust air-acetylene and oxy-acetylene equipment and demonstrate safe use.

RF1263 Leak Testing, Evacuation and Charging

Learning Outcomes:

- Demonstrate knowledge of the procedures used to leak test refrigeration systems.
- Demonstrate knowledge of the procedures used to evacuate refrigeration systems.
- Demonstrate knowledge of the procedures used to charge refrigeration systems.
- Demonstrate knowledge of codes and regulations pertaining to leak and pressure testing.
- Demonstrate knowledge of applying holding charge.
- Demonstrate knowledge of refrigerants, their applications and procedures for use.
- Demonstrate knowledge of codes and regulations pertaining to evacuation and holding charge.

Duration: 21 Hours

Pre-Requisite(s): RF1242

Objectives and Content:

1. Define terminology associated with leak and pressure testing, evacuation and charging of refrigeration systems.

2. Identify hazards and describe safe work practices pertaining to leak and pressure testing, evacuation and charging of refrigeration systems.

3. Identify hazards and safe work practices pertaining to refrigerants and applying a holding charge.

4. Interpret codes and regulations pertaining to leak and pressure testing, evacuation and charging of refrigeration systems.

5. Identify specialized tools and equipment used to leak test, evacuate and charge a refrigeration system, and describe their applications and procedures for use.

6. Describe the procedures used to leak test a refrigeration system.

7. Identify tools and equipment used to evacuate systems, and describe their applications and procedures for use.

8. Describe the procedures used to evacuate and dehydrate a refrigeration system.
   i. single evacuation
   ii. multiple evacuation (sweeping)

9. Determine approved and compatible liquids or gases required for system pressure test.

10. Calculate volumes of liquids in glycol loops and gases required to pressure test a system.

11. Describe the methods used to verify the charge of a refrigeration system.
   i. superheat
   ii. sub-cooling
   iii. critical charge
   iv. charge charts
   v. sight glass

12. Identify tools and equipment used to apply a holding charge and describe their applications and procedures for use.
   i. service valve wrenches
   ii. charging scales
   iii. transfer pumps (recovery unit)
   iv. gauge manifold

13. Describe the procedures used to pressurize a system with refrigerant to achieve a positive pressure.
   i. primary (CFC, HFC, HFO, HCFC, HC)
   ii. natural (R744, R717)
   iii. secondary (water, glycol solutions, brine solutions)

14. Identify types of refrigerants and describe their characteristics and applications.

Practical Requirements:

1. Install and remove gauge manifold on refrigeration and air conditioning systems.

2. Evacuate a refrigeration system using a vacuum pump and vacuum gauge.

3. Charge a refrigeration system.
   i. using a refrigerant weighing device
   ii. with no refrigerant weighing device

4. Pressurize a refrigeration/air conditioning system with nitrogen then check for leaks.

RF1272 Electrical Fundamentals

Learning Outcomes:

- Demonstrate knowledge of the fundamental concepts of electricity.
- Demonstrate knowledge of the procedures used to measure voltage, resistance, current and power, and to calculate their interrelationships.
- Demonstrate knowledge of electrical circuits and loads.
- Demonstrate knowledge of conductors, relays, switches, contactors, overloads and transformers, and their operation.
- Demonstrate knowledge of electronic controls and their operation.
- Demonstrate knowledge of electrical wiring diagrams.
- Demonstrate knowledge of testing systems and components.

Duration: 32 Hours

Pre-Requisite(s): RF1162

Objectives and Content:

1. Define terminology associated with electrical fundamentals.

2. Identify hazards and describe safe work practices pertaining to electricity.

3. Explain current and electron flow in both alternating current (AC) and direct current (DC) circuits.

4. Explain the relationship between voltage, current, resistance and power.

5. Identify units of electrical measurement and symbols.

6. Identify types of conductors and describe their characteristics and applications.

7. Identify the factors used to determine conductor ampacity rating.

8. Identify types of wire insulating materials and describe their characteristics and applications.
9. Identify the factors to consider when selecting resistors using rating and coding information.

10. Identify types of electrical circuits and describe their characteristics and applications.
    i. series
    ii. parallel
    iii. series-parallel

11. Describe an overloaded, grounded, open and short circuit.

12. Identify types of distribution panels and wiring configurations used in single phase and three-phase systems, and describe their characteristics and applications.

13. Identify types of over-current and overload protection devices, and describe their characteristics, applications and operation.

14. Identify types of relays, starters, switches and contactors, and describe their characteristics, applications and operation.

15. Identify types of transformers and describe their characteristics, applications and operation.

16. Identify types of electronic controls, and explain their purpose and operation.

17. Identify types of electrical wiring diagrams and explain their purpose.

18. Describe the procedures used to troubleshoot basic electrical control circuit systems and components using schematic wiring diagrams.

19. Identify types of wiring termination.

20. Identify types of gauges of wire.

21. Identify types of components.
    i. strain relief connectors
    ii. junction boxes
    iii. terminal strips

22. Interpret codes and regulations pertaining to wiring of systems.
    i. Canadian Electrical Code
    ii. jurisdictional regulations

23. Describe the procedure to calculate voltage, current and resistance in series, parallel and combination circuits.

24. Describe the use, application and procedures of electrical test instruments.

25. Describe the procedures used to test electrical components.
    i. relays
    ii. motors
    iii. coils
    iv. controls
    v. defrost timers
    vi. defrost heaters
    vii. drain pan heaters

Practical Requirements:

1. Measure the voltage, component resistance and current of a refrigeration system using a digital meter.

2. Perform labs to demonstrate the characteristics of series, parallel, and combination electrical circuits using Ohm's law and Kirchhoff voltage and current laws.

3. Troubleshoot overload circuits and components for proper operation.

RF1282 Motor Fundamentals

Learning Outcomes:

- Demonstrate knowledge of basic motors, their components, accessories and operation.
- Demonstrate knowledge of basic motor controls and their operation.

Duration: 24 Hours

Pre-Requisite(s): RF1272

Objectives and Content:

1. Define terminology associated with basic motors and motor controls.

2. Identify hazards and describe safe work practices pertaining to basic motors and motor controls.

3. Interpret codes and regulations pertaining to basic motors and motor controls.

4. Interpret information pertaining to basic motors and motor controls found on drawings and specifications.

5. Explain the purpose and operation of motors and their components.

6. Identify types of motors and their components, and describe their characteristics and applications.
   i. single-phase
   ii. three-phase
   iii. electrically commutated motors (ECM)
   iv. multi-lead
   v. dual-voltage
   vi. multi-speed

7. Interpret information found on motor nameplates.

8. Identify types of starting devices for single-phase motors, and describe their characteristics, applications, operation and wiring configurations.

9. Identify types of capacitors and describe their characteristics and applications.

10. Explain the effects of load and voltage changes on motor operation.

11. Describe the procedures used to test capacitors.

12. Describe the procedures used to change rotation of motors.

13. Describe the procedures used to measure voltage, resistance and current in motor circuits.

14. Identify common motor failures and describe their causes and remedies.
    i. mechanical
    ii. electrical

15. Describe the effects of motor pulley selection, adjustment and alignment.

16. Identify the types of motor overload protection devices and describe their use and applications.

Practical Requirements:

1. Test single and three phase motors for normal operation.

2. Install electrical starting components on single phase motors.

3. Connect, run and reverse three phase motors.

4. Check motor insulation resistance with a megohmmeter.

RF1452 Refrigeration and Air Conditioning Installation

Learning Outcomes:

- Demonstrate knowledge of the procedures used to prepare for the installation of refrigeration and air conditioning systems and their components.
- Demonstrate knowledge of determining placement of refrigeration and air conditioning equipment, components and accessories.
- Demonstrate knowledge of the procedures used to install refrigeration and air conditioning systems and their components.
- Demonstrate knowledge of the procedures used to start up and commission refrigeration and air conditioning systems and their components.
- Demonstrate knowledge of types of controls and devices, their applications and operations.
- Demonstrate knowledge of connecting system wiring and control tubing.
- Demonstrate knowledge of systems, their applications and components.

Duration: 60 Hours

Pre-Requisite(s): RF1222, RF1263, RF1272

Objectives and Content:

1. Define terminology associated with refrigeration and air conditioning installations.

2. Identify hazards and describe safe work practices pertaining to refrigeration and air conditioning installations.

3. Interpret codes and regulations pertaining to refrigeration and air conditioning installations and the placement of equipment, components and accessories.

4. Interpret information pertaining to refrigeration and air conditioning installations found in drawings, specifications and diagrams.
   i. electrical diagrams
   ii. piping schematic diagrams

5. Identify tools and equipment used for refrigeration and air conditioning system installations, and describe their applications and procedures for use.

6. Identify the factors to consider when selecting refrigeration and air conditioning system components for installation.

7. Identify components used in the installation of refrigeration and air conditioning systems, and describe their characteristics and applications.

8. Identify the factors to consider when installing refrigeration and air conditioning systems.
   i. component placement
   ii. tool requirements
   iii. material list
   iv. scheduling

9. Describe the procedures used to prepare for the placement of refrigeration and air conditioning system installations.

10. Describe the procedures used to install refrigeration and air conditioning systems.

11. Identify sequence of operation required for correct operation and proper function of HVAC/R systems.

12. Identify the factors to consider when performing a system start-up.
   i. phasing, voltage imbalance and amperage
   ii. refrigerant charge adjustments
   iii. oil levels
   iv. operating pressures and temperatures
   v. system control adjustments
   vi. manufacturers' recommendations
   vii. air movement requirements

13. Identify documentation requirements for system installation, start up and commissioning.

14. Identify system problems at start-up and describe their causes and remedies.

15. Describe the procedures used to start up and commission refrigeration and air conditioning systems.

16. Describe the procedures used to verify system requirements.
   i. voltages
   ii. amperages
   iii. temperatures
   iv. pressures

17. Interpret information pertaining to controls and devices found on drawings and specifications.

18. Interpret codes and regulations pertaining to controls and devices.

19. Describe the sequence of operation of a control circuit and explain its relationship to its physical wiring configuration.

20. Describe the procedures used to test mechanical components and accessories.
    i. compressors
    ii. condensers
    iii. metering devices
    iv. evaporators
    v. fans and fan motors
    vi. actuators
    vii. dampers
    viii. crankcase heaters
    ix. solenoid valves
    x. limit switches

Practical Requirements:

1. Install refrigeration and air conditioning systems and components.

2. Commission an operating refrigeration/AC system.

RF1352 Pressure Enthalpy Diagrams and System Analysis

Learning Outcomes:

- Demonstrate knowledge of pressure enthalpy diagrams and their use in troubleshooting refrigeration systems.

Duration: 12 Hours

Pre-Requisite(s): RF1222

Objectives and Content:

1. Define terminology associated with pressure enthalpy diagrams and system analysis.

2. Locate and interpret information found on pressure enthalpy diagrams.

3. Identify the factors affecting system capacity and explain their effect.
   i. saturated discharge temperature
   ii. saturated suction temperature
   iii. liquid sub-cooling
   iv. suction superheat
   v. suction to liquid heat exchange
   vi. high and low side pressure drops

4. Explain theoretical horsepower and brake horsepower.

5. Explain the effects of pressure drop in refrigeration piping.

6. Explain the concept of system equilibrium and the factors that determine system balance.

7. Explain the effects of an unbalanced system on system performance.

8. Plot a refrigeration cycle using a pressure enthalpy diagram and perform associated calculations.

9. Apply cycle diagrams to assist with system troubleshooting.

Practical Requirements:

1. Plot a refrigeration cycle on a pressure enthalpy diagram.

2. Calculate the following from plotted data:
   i. actual displacement
   ii. brake horsepower
   iii. coefficient of performance
   iv. compression ratio
   v. condenser heat of rejection
   vi. desuperheating
   vii. heat of compression
   viii. mass flow rate
   ix. net refrigeration effect
   x. subcooling
   xi. system capacity
   xii. theoretical displacement
   xiii. theoretical horsepower
   xiv. total heat rejected from the condenser
   xv. total heat rejected from the system

RF1382 Evaporators

Learning Outcomes:

- Demonstrate knowledge of evaporators, their components, accessories and their operation.
- Demonstrate knowledge of the procedures used to place and install evaporators and their components and accessories.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot evaporators and their components.
- Demonstrate knowledge of codes and regulations pertaining to equipment, components and accessories.

Duration: 12 Hours

Pre-Requisite(s): RF1222

Objectives and Content:

1. Define terminology associated with evaporators and their components.

2. Identify hazards and describe safe work practices pertaining to evaporators and their components.

3. Interpret codes and regulations pertaining to evaporators and components and their placement of evaporators and their components.

4. Interpret information pertaining to evaporators and their components found on drawings and specifications.

5. Identify specialized tools and equipment used with evaporators and their components, and describe their applications and procedures for use.

6. Explain the purpose and operation of evaporators and their components.

7. Identify types of evaporators and describe their characteristics and applications.
   i. counter, cross and parallel flow
   ii. direct expansion, flooded and liquid overfeed
   iii. forced and induced
   iv. plate or eutectic
   v. brazed plate/plate and frame
   vi. primary and secondary surface
   vii. chiller barrel (fluid cooler)

8. Identify evaporator components, and describe their characteristics and applications.
   i. drain pan heaters
   ii. evaporator fans and controls
   iii. drain lines
   iv. flow switches
   v. defrost heaters

9. Describe defrost methods and identify their associated electrical and piping considerations.

10. Describe defrost cycle and operation.

11. Identify the factors and conditions that determine evaporator capacity and efficiency.

12. Describe the procedures used to size evaporators.

13. Identify the factors and environmental issues to consider when placing and selecting evaporators and their components for installation.

14. Describe the procedures used to place and install evaporators, their components and accessories.

15. Describe the procedures used to maintain and troubleshoot evaporators and their components.

16. Identify evaporator and component failures, and describe their causes and repair procedures.

17. Identify alternative heat transfer devices and describe their characteristics and applications.

Practical Requirements:

1. Select evaporators based on given design criteria.

RF1191 Residential and Commercial Compressors

Learning Outcomes:

- Demonstrate knowledge of the procedures used to install residential and commercial compressors and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot residential and commercial compressors and their components.

Duration: 24 Hours

Pre-Requisite(s): RF1272, RF1362

Objectives and Content:

1. Define terminology associated with residential and commercial compressors.

2. Identify hazards and describe safe work practices pertaining to residential and commercial compressors.

3. Interpret codes and regulations pertaining to residential and commercial compressors.

4. Interpret information pertaining to residential and commercial compressors found on drawings and specifications.

5. Identify specialized tools and equipment used with residential and commercial compressors, and describe their applications and procedures for use.

6. Explain the purpose and operation of residential and commercial compressors and their components.

7. Identify types of residential and commercial compressors, and describe their characteristics and applications.
   i. hermetic
      - reciprocating
      - scroll
      - swing (rotary)
   ii. semi-hermetic
      - reciprocating

8. Identify residential and commercial compressor components, and describe their characteristics and applications.

9. Describe compressor classifications according to temperature ranges and capacities.
10. Identify the factors that affect compressor efficiency.
    i. compression ratio
    ii. clearance volume
    iii. wear
    iv. types of valves

11. Identify the factors to consider when selecting residential and commercial compressors and their components for installation.

12. Describe the procedures used to install residential and commercial compressors and their components.

13. Describe the procedures used to maintain and troubleshoot residential and commercial compressors and their components.

14. Describe control strategies for compressor protection.
    i. pump down cycle
    ii. pressure controls

15. Describe the procedures used to start up, commission and shut down residential and commercial compressors.

16. Describe the difference between oil pump pressure and net oil pressure.

17. Describe the procedures to determine net oil pressure.

18. Identify residential and commercial compressor failures, and describe their causes and procedures for repair.
    i. mechanical
        - mechanical component failure
        - improper lubrication/oil return
        - high discharge temperatures
        - slugging
        - improper refrigerant control
    ii. electrical
        - defective motor or motor protector
        - improper clean up after a previous compressor failure
        - low, high, or unbalanced voltage/amperage
        - loose wiring or faulty controls
        - mechanical failure
        - misapplication of compressor
    iii. lubrication
        - improper liquid refrigerant control
        - refrigerant migration

- flooded starts
- compressor overheating

Practical Requirements:

1. Test and replace current and potential relays.
2. Test and replace start and run capacitors.
3. Sketch and explain overload operation.
4. Test and check compressor motor windings.
5. Disassemble compressors to identify failure.

RF1372 Condensers

Learning Outcomes:

- Demonstrate knowledge of condensers, their components, accessories and operation.
- Demonstrate knowledge of the procedures used to install condensers and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot condensers and their components.

Duration: 12 Hours

Pre-Requisite(s): RF1222

Objectives and Content:

1. Define terminology associated with condensers.

2. Identify hazards and describe safe work practices pertaining to condensers.

3. Interpret codes and regulations pertaining to condensers.

4. Interpret information pertaining to condensers found on drawings and specifications.

5. Identify specialized tools and equipment used with condensers, and describe their applications and procedures for use.

6. Explain the purpose and operation of condensers and their components.

7. Identify types of condensers and describe their characteristics and applications.
   i. air-cooled
   ii. water-cooled
   iii. evaporative

8. Identify condenser components and describe their characteristics and applications.

9. Describe heat reclaim strategies.

10. Describe head pressure control strategies.

11. Identify the factors and conditions that determine condenser capacity and efficiency.

12. Identify the factors to consider when selecting condensers and their components for installation.

13. Describe the procedures used to size condensers.

14. Describe the procedures used to install condensers and their components.

15. Describe the procedures used to maintain and troubleshoot condensers and their components.

16. Identify condenser failures and describe their causes and procedures for repair.

Practical Requirements:

1. Select condensers based on given design criteria.

RF1391 Metering Devices

Learning Outcomes:

- Demonstrate knowledge of metering devices, their components, accessories and operation.
- Demonstrate knowledge of the procedures used to install metering devices and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot metering devices and their components.

Duration: 15 Hours

Pre-Requisite(s): RF1382

Objectives and Content:

1. Define terminology associated with metering devices.

2. Identify hazards and describe safe work practices pertaining to metering devices.

3. Interpret codes and regulations pertaining to metering devices.

4. Interpret information pertaining to metering devices found on drawings and specifications.

5. Identify specialized tools and equipment used with metering devices, and describe their applications and procedures for use.

6. Explain the purpose and operation of metering devices and their components.

7. Identify types of metering devices and describe their characteristics and applications.

8. Identify metering device components and describe their characteristics and applications.

9. Identify the factors to consider when selecting and installing metering devices and their components.

10. Describe the procedures used to install metering devices and their components.

11. Describe the procedures used to maintain and troubleshoot metering devices and their components.

12. Identify metering device and component failures and describe their causes and procedures for repair.

13. Describe the charging methods for various metering devices.

Practical Requirements:

1. Select expansion valves based on various applications.

2. Troubleshoot systems operating with:
   i. high load conditions
   ii. low load conditions
   iii. refrigerant overcharge
   iv. refrigerant undercharge
   v. restricted expansion valve

RF1402 Refrigerant Flow Controls and Accessory Devices

Learning Outcomes:

- Demonstrate knowledge of refrigerant flow controls and accessory devices, and their operation.
- Demonstrate knowledge of the procedures used to install refrigerant flow controls and accessory devices.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot refrigerant flow controls and accessory devices.
- Demonstrate knowledge of HVAC/R systems, their applications and components.

Duration: 18 Hours

Pre-Requisite(s): RF1362

Objectives and Content:

1. Define terminology associated with refrigerant flow controls and accessory devices.

2. Identify hazards and describe safe work practices pertaining to refrigerant flow controls and accessory devices.

3. Interpret codes and regulations pertaining to refrigerant flow controls and accessory devices.

4. Interpret information pertaining to refrigerant flow controls and accessory devices found on drawings and specifications.

5. Identify specialized tools and equipment used with refrigerant flow controls and accessory devices, and describe their applications and procedures for use.

6. Explain the purpose and operation of refrigerant flow controls and accessory devices.

7. Identify types of refrigerant flow controls and accessory devices, and describe their characteristics and applications.
   i. direct-acting
   ii. pilot-operated
   iii. reverse-acting
   iv. pressure regulators
   v. reversing valves

8. Identify the factors to consider when selecting and installing refrigerant flow controls and accessory devices.

9. Describe the procedures used to install refrigerant flow controls and accessory devices.

10. Describe the procedures used to maintain and troubleshoot refrigerant flow controls and accessory devices.

11. Identify refrigerant flow controls and accessory device failures and describe their causes and procedures for repair.

Practical Requirements:

1. Disassemble, inspect, service, repair and adjust various refrigeration flow control valves.

RF1332 Air Conditioning Fundamentals

Learning Outcomes:

- Demonstrate knowledge of air conditioning fundamentals.
- Demonstrate knowledge of air conditioning systems, their components and operation.
- Demonstrate knowledge of psychrometrics.

Duration: 10 Hours

Pre-Requisite(s): RF1222

Objectives and Content:

1. Define terminology associated with air conditioning and psychrometrics.

2. Explain air quality, air circulation and ventilation.

3. Identify the factors that affect human comfort with respect to air quality.

4. Identify specialized tools and instruments used to determine air quality, air circulation and ventilation.

5. Identify types of air conditioning systems and their components, and describe their characteristics, applications and operation.

6. Explain the fundamentals of psychrometrics.

7. Describe psychrometric processes.
   i. cooling
   ii. evaporative cooling
   iii. humidification
   iv. heating and humidification
   v. heating
   vi. heating and dehumidification
   vii. dehumidification
   viii. cooling and dehumidification

8. Describe indoor and outdoor design conditions.

Practical Requirements:

1. Plot air properties on a psychrometric chart.

RF1612 Air Movement and Indoor Air Quality

Learning Outcomes:

- Demonstrate knowledge of air movement and indoor air quality components and their operation.
- Demonstrate knowledge of the procedures used to install air movement and indoor air quality components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot air movement and indoor air quality components.

Duration: 12 Hours

Pre-Requisite(s): RF1332

Objectives and Content:

1. Define terminology associated with air movement and indoor air quality.

2. Identify hazards and describe safe work practices pertaining to air movement and indoor air quality components.

3. Interpret codes and regulations pertaining to air movement and indoor air quality components.

4. Interpret information pertaining to air movement and indoor air quality components found on drawings, specifications and curve charts.

5. Identify specialized tools and equipment used with air movement and indoor air quality components, and describe their applications and procedures for use.

6. Explain the purpose and operation of air movement and indoor air quality components.

7. Identify types of air movement components, and describe their characteristics and applications.
   i. fans
      - axial
      - radial
   ii. mechanical drives
      - belt
      - direct

8. Identify factors that affect fan performance.

9. Identify types of indoor air quality components, and describe their characteristics and applications.
   i. filter
   ii. cleaner
   iii. purifier
   iv. humidifier
   v. exhaust/fresh air
   vi. dehumidifier

10. Identify the factors to consider when selecting and installing air movement and indoor air quality components.

11. Describe the procedures used to install air movement and indoor air quality components.

12. Describe the procedures used to maintain and troubleshoot air movement and indoor air quality components.

13. Identify air movement and indoor air quality component failures and describe their causes and procedures for repair.

14. Describe the procedures used to start up, commission and shut down air movement and indoor air quality components.

Practical Requirements:

None.

RF1322 Control Fundamentals

Learning Outcomes:

- Demonstrate knowledge of control fundamentals.
- Demonstrate knowledge of controls, their components, applications and operation.
- Demonstrate knowledge of performing predictive and scheduled maintenance on HVAC/R systems.

Duration: 14 Hours

Pre-Requisite(s): RF1282

Objectives and Content:

1. Define terminology associated with controls.

2. Explain closed and open loop control.

3. Explain the purpose and operation of control systems, devices and components.

4. Identify types of control systems and their components, and describe their characteristics and applications.
   i. electromechanical
   ii. electronic
   iii. pneumatic
   iv. direct digital control (DDC)

5. Identify types of control devices, and describe their characteristics and applications.
   i. relays
   ii. switches
   iii. actuators

6. Identify types of sensing controls, and describe their characteristics and applications.
   i. flow
   ii. humidity
   iii. liquid level
   iv. pressure
   v. temperature

7. Describe control and control actions.

8. Describe the procedures used to perform a basis diagnosis of electronic controls.

Practical Requirements:

1. Draw and describe an open and closed loop control circuit.
2. Draw and describe various control circuits.
3. Draw and describe a typical residential heat/cool system control circuit.

RF1482 Control Circuits and Wiring Diagrams

Learning Outcomes:

- Demonstrate knowledge of the procedures used to install control circuit components.
- Demonstrate knowledge of the procedures used to troubleshoot control circuits.
- Demonstrate knowledge of wiring diagrams and their use.
- Demonstrate knowledge of connecting system wiring and control tubing.
- Demonstrate knowledge of codes and regulations pertaining to HVAC/R control system wiring and tubing.

Duration: 30 Hours

Pre-Requisite(s): RF1322

Objectives and Content:

1. Define terminology associated with control circuits and wiring diagrams their components and accessories.

2. Identify hazards and describe safe work practices pertaining to control circuits systems.

3. Interpret codes and regulations pertaining to control circuits.

4. Interpret information pertaining to control circuits found in on drawings, wiring diagrams, and schematic diagrams.

5. Interpret information pertaining to control systems found in drawings, wiring diagrams, and schematic diagrams.
   i. pictorial
   ii. schematic
   iii. ladder
   iv. component location
   v. installation

6. Identify specialized tools and equipment used with control circuits, and describe their applications and procedures for use.

7. Identify types of control circuits and their components, and describe their characteristics and applications.
   i. operating
   ii. safety

8. Identify types of wiring diagrams and describe their characteristics and applications.
   i. pictorial
   ii. schematic
   iii. ladder
   iv. component location
   v. installation

9. Describe the sequence of operation of a control circuit and explain its relationship to its physical wiring configuration.

10. Identify the factors to consider when selecting and installing control circuit components.

11. Describe the procedures used to install control circuits and their components.

12. Describe the procedures used to troubleshoot control circuits using wiring diagrams.

13. Describe the procedure to sketch a schematic wiring diagram based on a written sequence of control events.

14. Describe the procedure to sketch a schematic wiring diagram from a pictorial diagram.

15. Describe the procedure to sketch a pictorial diagram from a schematic wiring diagram.

16. Interpret codes and regulations pertaining to HVAC/R control system wiring and tubing.

Practical Requirements:

1. Draw schematic diagrams based on a written sequence of control events complete with a legend.

2. Draw a schematic wiring diagram from a pictorial diagram.

RF1811 Blueprints, Drawings and Specifications

Learning Outcomes:

- Demonstrate knowledge of blueprints/drawings and specifications and their applications.

Duration: 15 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define terminology associated with blueprints/drawings and specifications.

2. Identify types of specification documents and describe their applications.
   i. manufacturers'
   ii. engineers'
   iii. contractors'
   iv. clients'

3. Identify types of blueprints/drawings and describe their applications.
   i. civil/site
   ii. architectural
   iii. mechanical
   iv. structural
   v. electrical
   vi. plan views
   vii. shop drawings
   viii. sketches
   ix. as-built

4. Identify views used on blueprints/drawings.
   i. plan
   ii. section
   iii. detail

5. Identify information found on blueprints/drawings.
   i. lines
   ii. legend
   iii. symbols and abbreviations
   iv. title block
   v. notes and specifications
   vi. schedules
   vii. units of measurement (metric/imperial)

6. Explain the use of blueprints/drawings measurement scales.

7. Describe the procedures used to convert between metric and imperial units of measurement.

8. Describe the procedures used to interpret and extract information from blueprints/drawings and specifications.

9. Describe the procedure to perform conversions between the metric and imperial systems of measurement.

10. Describe the procedure to perform a basic take-off from a blueprint/drawing.

Practical Requirements:

1. Sketch and interpret basic drawings and diagrams.

2. Perform conversions between the metric and imperial systems of measurement.

3. Perform a basic take-off from a blueprint/drawing.

Level 2

RF2520 Refrigeration Load Calculations

Learning Outcomes:

- Demonstrate knowledge of refrigeration load calculations.

Duration: 24 Hours

Pre-Requisite(s): Level 1

Objectives and Content:

1. Define terminology associated with refrigeration load calculations.

2. Describe the procedure to perform load calculations and determine total loads for refrigeration systems.
   - i. transmission
     - K, C, U and R values
     - solar load
   - ii. air change
     - infiltration
     - ex-filtration
     - usage
   - iii. product
     - sensible heat
     - latent heat
     - heat of respiration
   - iv. miscellaneous
     - fans
     - lighting
     - motors
     - people
     - equipment
   - v. defrost load
     - air
     - electric
     - hot gas
   - vi. BTU/h total

Practical Requirements:

1. Calculate heat of transmission loads for fixture temperatures above and below 32°F.

2. Calculate air infiltration loads for fixture temperatures above and below 32°F.

3. Calculate product loads for fixture temperatures above and below 32°F.

4. Calculate miscellaneous loads for fixture temperatures above and below 32°F.

5. Calculate total loads for fixture temperatures above and below 32°F.

6. Calculate BTU/h load requirements.
   i. air defrost
   ii. electric defrost
   iii. hot gas defrost

RF2351 Refrigeration System Design

Learning Outcomes:

- Demonstrate knowledge of refrigeration system design principles.
- Demonstrate knowledge of refrigeration system equipment, components and accessory devices, and their selection based on design criteria.
- Demonstrate knowledge of sketching piping schematics.
- Demonstrate knowledge of sketching electrical schematics.
- Demonstrate knowledge of performing HVAC/R material take-off.
- Demonstrate knowledge of documentation and reference materials, its purpose, application and use.
- Demonstrate knowledge of the procedures used to complete and interpret documentation.
- Demonstrate knowledge of control systems and their components.
- Demonstrate knowledge of codes and regulations pertaining to control systems and their components.

Duration: 36 Hours

Pre-Requisite(s): Level 1

Objectives and Content:

1. Define terminology associated with refrigeration system design.

2. Explain the fundamental principles of refrigeration system design.

3. Interpret codes and regulations pertaining to refrigeration system design.

4. Interpret information pertaining to refrigeration system design found on drawings, specifications, graphs and tables.

5. Identify types of refrigeration systems, and describe their characteristics and applications.
   i. coolers
   ii. freezers
   iii. chillers
   iv. process refrigeration systems
   v. ultra-low
   vi. cryogenic
   vii. ice machines
   viii. plate freezers

6. Identify capacity ratings of refrigeration system components.

7. Describe the selection of air cooled condensers for a given temperature difference using heat of rejection factors and/or pressure enthalpy diagram.

8. Identify types of system designs and describe their characteristics and applications.
   i. high temperature system
   ii. medium temperature system
   iii. low temperature system
   iv. ultra-low temperature system

9. Identify the factors to consider when designing and laying out refrigeration systems.

10. Identify the factors to consider when selecting equipment, components and accessory devices for refrigeration systems based on design criteria.

11. Explain the importance of balancing system capacity with system load.

12. Identify the factors to consider when selecting refrigerant based on design criteria.

13. Identify the factors to consider when sizing pipe for refrigeration piping systems.

14. Describe the procedures used to size pipe for refrigeration piping systems.

15. Describe the procedure to sketch piping schematics for refrigeration systems.

16. Describe the procedure to sketch electrical schematics for refrigeration systems.

17. Identify the factors to consider when determining materials and pipe required.

18. Describe the procedures used to perform a material take-off list.

19. Identify the types of alternative materials that may be considered as options.

20. Identify types of control systems and their components, and describe their characteristics and applications.

21. Identify the factors to consider when selecting control systems and their components.

22. Explain how to incorporate various control strategies into control systems.

23. Explain the purpose and operation of control systems and their components.

24. Interpret codes and regulations pertaining to control systems, components and accessories.

25. Identify types of mechanical controls, and explain their purpose and operations.

Practical Requirements:

1. Select equipment from manufacturers catalogues based on design criteria ensuring that components selected are matched and balanced.

2. Calculate then select tubing sizes for suction, liquid, discharge and condensate lines for refrigeration systems.

3. Gather and analyze data from refrigeration system components.
   i. compressor
   ii. multiple compressors
   iii. compressors with cylinder unloading
   iv. evaporator
   v. multiple evaporators operating at the same and different temperatures

4. Analyze refrigerant pressure losses and velocities from tables.

RF2000 Large Commercial/Industrial Compressors

Learning Outcomes:

- Demonstrate knowledge of HVAC/R equipment, components and accessories.
- Demonstrate knowledge of the procedures used to install large commercial/industrial compressors and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot large commercial/industrial compressors and their components.
- Demonstrate knowledge of the causes of large commercial/industrial compressor failures and their procedures for repair.

Duration: 24 Hours

Pre-Requisite(s): Level 1

Objectives and Content:

1. Define terminology associated with large commercial/industrial compressors.

2. Identify hazards and describe safe work practices pertaining to large commercial/industrial compressors.

3. Interpret codes and regulations pertaining to large commercial/industrial compressors.

4. Interpret information pertaining to large commercial/industrial compressors found on drawings and specifications.

5. Identify specialized tools and equipment used with large commercial/industrial compressors, and describe their applications and procedures for use.

6. Explain the purpose and operation of large commercial/industrial compressors and their components.

7. Identify types of large commercial/industrial compressors, and describe their characteristics and applications.
   i. centrifugal
   ii. rotary
   iii. screw
   iv. open drive
   v. semi-hermetic
   vi. magnetic bearing
   vii. reciprocating
   viii. scroll

ix. swing (rotary)
x. linear

8. Identify types of large commercial/industrial compressors components, and describe their characteristics and applications.

9. Identify methods used to cool large commercial/industrial compressors.

10. Identify methods used to lubricate large commercial/industrial compressors.

11. Identify methods of large commercial/industrial compressor capacity control.

12. Identify the factors to consider when selecting and installing large commercial/industrial compressors and their components.

13. Describe the procedures used to install large commercial/industrial compressors and their components.

14. Describe the procedures used to maintain and troubleshoot large commercial/industrial compressors and their components.

15. Identify large commercial/industrial compressor failures and describe their causes and procedures for repair.
    i. mechanical
    ii. electrical

16. Describe the procedures used to start up, commission and shut down large commercial/industrial compressors.

Practical Requirements:

None.

RF2010 Heating Systems

Learning Outcomes:

- Demonstrate knowledge of heating systems, their components and operation.
- Demonstrate knowledge of the procedures used to install heating equipment, components and accessories.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot heating systems, and their equipment, components and accessories.

Duration: 30 Hours

Pre-Requisite(s): Level 1

Objectives and Content:

1. Define terminology associated with heating systems.

2. Identify hazards and describe safe work practices pertaining to heating systems.

3. Interpret codes and regulations pertaining to heating systems.

4. Interpret information pertaining to heating systems found on drawings and specifications.

5. Identify specialized tools and equipment used with heating systems, and describe their applications and procedures for use.

6. Explain the purpose and operation of heating systems, equipment, components and accessories.

7. Identify types of refrigerant flow controls and accessory devices, and describe their characteristics and applications.
   i. direct-acting
   ii. reverse-acting
   iii. pilot-operated
   iv. pressure regulators
   v. reversing valves

8. Identify types of heating systems and describe their characteristics and applications.
   i. forced-air
   ii. hydronic
   iii. electric
   iv. infrared
   v. radiant

9. Identify types of heating system equipment, components and accessories, and describe their characteristics and applications.

10. Identify the factors to consider when selecting and installing heating system equipment, components and accessories.

11. Describe the procedures used to install heating system equipment, components and accessories.

12. Describe the procedures used to maintain and troubleshoot heating systems and their equipment, components and accessories.

13. Identify heating system failures and describe their causes and procedures for repair.

14. Describe the procedures used to start up, commission and shut down heating systems.

Practical Requirements:

None.

RF2731 Commercial Refrigeration Systems

Learning Outcomes:

- Demonstrate knowledge of commercial refrigeration systems, their components and operation.
- Demonstrate knowledge of the procedures used to assemble and install commercial refrigeration systems and their components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and inspect commercial refrigeration systems and their components.
- Demonstrate knowledge of performing predictive and scheduled maintenance.
- Demonstrate knowledge of codes and regulations pertaining to HVAC/R refrigerant and oil retrofits.
- Demonstrate knowledge of procedures used to retrofit refrigerant and oil in HVAC/R systems.
- Demonstrate knowledge of calibrating operating and safety controls.
- Demonstrate knowledge of repairing controls systems.

Duration: 36 Hours

Pre-Requisite(s): Level 1

Objectives and Content:

1. Define terminology associated with commercial refrigeration systems.

2. Identify hazards and describe safe work practices pertaining to commercial refrigeration systems.

3. Interpret codes and regulations pertaining to commercial refrigeration systems.

4. Interpret information pertaining to commercial refrigeration systems found on drawings and specifications.

5. Identify documentation requirements for HVAC/R system installation.
   i. start up reports
   ii. commissioning reports
   iii. warranty documentation
   iv. record of pressure level
   v. jurisdictional requirements
   vi. manufacturer’s requirements.

6. Identify specialized tools and equipment used with commercial refrigeration systems, and describe their applications and procedures for use.

7. Explain the purpose and operation of commercial refrigeration systems and their components.

8. Identify types of chillers and describe their characteristics and applications. direct expansion, flooded, absorption

9. Identify types of commercial refrigeration systems, and describe their characteristics and applications.
   i. supermarket/multi-plex
   ii. walk-in freezers/coolers
   iii. ice machines
   iv. food service
   v. specialty
      - ultra-low
      - cascade
      - cryogenic

10. Identify types of commercial refrigeration system components, and describe their characteristics and applications.

11. Identify types of commercial refrigeration defrost systems, and describe their characteristics and applications.
   i. hot gas
   ii. electric

12. Identify commercial refrigeration defrost system components, and describe their characteristics and applications.

13. Identify the factors that optimize shelf life and quality of refrigerated and frozen products.

14. Identify the factors to consider when selecting and installing commercial refrigeration systems and their components.

15. Describe the procedures used to install commercial refrigeration systems and their components.

16. Describe the procedures used to maintain and troubleshoot commercial refrigeration systems and their components.

17. Identify commercial refrigeration system and component failures and abnormalities, and describe their causes and procedures for repair.

18. Identify system abnormalities and describe their causes and procedures for repair.

19. Describe the procedures used to test mechanical components and accessories.

20. Identify pressure and temperature scales, and describe the procedures used to perform conversion calculations.

21. Identify codes and regulations pertaining to retrofit requirements.

22. Identify procedures used to retrofit refrigerant and oil in HVAC/R systems.

23. Describe the procedures used to start up, commission and shut down commercial refrigeration systems.

24. Describe the procedures to inspect HVAC/R systems and their components.

25. Describe the procedures used to perform refrigerant and refrigerant oil conversions.

26. Describe the procedures used to store and transport refrigerants, gases and refrigerant oils.

27. Interpret codes and regulations pertaining to refrigerants, gases and refrigerant oils.

28. Describe the procedures used to recover and recycle refrigerants and refrigerant oils.

29. Identify tools and equipment used to install and maintain commercial refrigeration control systems and their components, and describe their applications and procedures for use.

30. Identify tools and equipment used to install and repair commercial refrigeration control systems, and describe their applications and procedures for use.
    i. hand tools
    ii. power tools
    iii. data loggers
    iv. instruments
    v. electronic devices
    vi. interfaces and computers
    vii. analysing devices
    viii. meters

31. Describe the procedures used to calibrate operating and safety controls.

32. Describe the procedures used to inspect control systems and their components.

33. Describe the procedures used to troubleshoot control systems.

34. Describe procedures used to repair control systems, components, wiring, cabling and connections.

35. Interpret codes and regulations pertaining to controls, control systems and devices.

36. Describe the procedures used to install and configure control systems.

37. Identity hazards and describe safe work practices pertaining to control systems.

Practical Requirements:

None.

RF2510 Split Air Conditioning Systems

Learning Outcomes:

- Demonstrate knowledge of split air conditioning systems, their components, accessories and operation.
- Demonstrate knowledge of the procedures used to assemble and install split air conditioning systems and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot split air conditioning systems and their components.

Duration: 30 Hours

Pre-Requisite(s): Level 1

Objectives and Content:

1. Define terminology associated with split air conditioning systems.

2. Identify hazards and describe safe work practices pertaining to split air conditioning systems.

3. Interpret codes and regulations pertaining to split air conditioning systems.

4. Interpret information pertaining to split air conditioning systems found on drawings and specifications.

5. Identify components and accessories used in the assembling of HVAC/R systems, and describe their characteristics and applications.

6. Identify specialized tools and equipment used with split air conditioning systems, and describe their applications and procedures for use.

7. Explain the purpose and operation of split air conditioning systems and their components.

8. Identify types of split air conditioning systems, and describe their characteristics and applications.
   i. residential
   ii. commercial
   iii. industrial

9. Identify types of split air conditioning system components, and describe their characteristics and applications.

10. Identify the factors to consider when selecting and installing split air conditioning systems and components.

11. Describe the procedures used to install split air conditioning systems and their components.

12. Describe the procedures used to field wire systems.

13. Describe the procedures used to maintain and troubleshoot split air conditioning systems and their components.

14. Identify split air conditioning system and component failures, and describe their causes and procedures for repair.

15. Describe the procedures used to start up, commission and shut down split air conditioning systems.

16. Explain the importance of balancing system capacity with system load.

Practical Requirements:

None.

RF2541 Packaged Air Conditioning Systems

Learning Outcomes:

- Demonstrate knowledge of packaged air conditioning systems, their applications, components, accessories and operation.
- Demonstrate knowledge of the procedures used to assemble and install packaged air conditioning systems and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot packaged air conditioning systems and their components.
- Demonstrate knowledge of performing control system take-off.

Duration: 30 Hours

Pre-Requisite(s): Level 1

Objectives and Content:

1. Define terminology associated with packaged air conditioning systems.

2. Identify hazards and describe safe work practices pertaining to packaged air conditioning systems, their assembly and installation.

3. Interpret codes and regulations pertaining to packaged air conditioning systems.

4. Interpret information pertaining to packaged air conditioning systems found on drawings and specifications.

5. Identify components and accessories used in the assembling of HVAC/R systems, and describe their characteristics and applications.

6. Identify specialized tools and equipment used with packaged air conditioning systems, and describe their applications and procedures for use.

7. Explain the purpose and operation of packaged air conditioning systems and their components.

8. Identify types of packaged air conditioning systems and describe their characteristics and applications.
   i. residential
   ii. commercial
   iii. industrial

9. Identify packaged air conditioning system components and accessories and describe their characteristics and applications.
   i. economizer
   ii. indoor air quality components

10. Identify the factors to consider when selecting and installing packaged air conditioning systems and their components.

11. Describe the procedures used to install packaged air conditioning systems and their components.

12. Describe the procedures used to field wire systems.

13. Identify tools and equipment used to wire systems, and describe their applications and procedures for use.

14. Identify types of wiring termination.

15. Identify types and gauges of wire.

16. Identify types of components.
   i. Connectors
   ii. junction boxes
   iii. terminal strips

17. Interpret codes and regulations pertaining to wiring of systems.
   i. Canadian Electrical Code
   ii. jurisdictional regulations

18. Describe the procedures used to maintain and troubleshoot packaged air conditioning systems and their components.

19. Identify packaged air conditioning system and component failures, and describe their causes and procedures for repair.

20. Describe the procedures used to start-up, commission and shut-down packaged air conditioning systems.

21. Explain the importance of balancing system capacity with system load.

22. Describe the procedures used to perform control system take-off.

Practical Requirements:

None.

RF1600 Heat Pump Systems

Learning Outcomes:

- Demonstrate knowledge of heat pump systems, their components, accessories and operation.
- Demonstrate knowledge of the procedures used to assemble and install heat pump systems and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot heat pump systems and their components.
- Demonstrate knowledge of codes pertaining to HVAC/R equipment, components and accessories.

Duration: 30 Hours

Pre-Requisite(s): Level 1

Objectives and Content:

1. Define terminology associated with heat pump systems.
   i. auxiliary heat
   ii. balance point
   iii. coefficient of performance (COP)
   iv. emergency heat
   v. indoor coil
   vi. outdoor coil
   vii. energy efficiency rating (EER)
   viii. seasonal energy efficiency rating (SEER)
   ix. heating seasonal performance factor(HSPF)

2. Identify hazards and describe safe work practices pertaining to heat pump systems.

3. Interpret codes and regulations pertaining to heat pump systems.

4. Interpret information pertaining to heat pump systems found on drawings and specifications.

5. Identify specialized tools and equipment used with heat pump systems and describe their applications and procedures for use.

6. Explain the purpose and operation of heat pump systems and their components.

7. Identify types of heat pump systems and describe their characteristics and applications.
   i. air to air
   ii. liquid to air
   iii. liquid to liquid
   iv. air to liquid
   v. geothermal

8. Identify heat pump equipment and components and accessories and describe their characteristics and applications.

9. Describe the operation of the defrost cycle as it relates to heat pumps.

10. Explain water quality as it relates to heat pump systems.

11. Explain control sequences for heat pump systems.

12. Identify the factors to consider when selecting and installing heat pumps and components.
   i. environmental considerations
   ii. energy efficiency
   iii. source
      - well
      - loop
      - air
   iv. ambient conditions
   v. physical location

13. Describe the procedures used to install heat pump systems and their components.

14. Describe the procedures used to maintain and troubleshoot heat pumps and their components.

15. Identify heat pump system failures and describe their causes and procedures for repair.

16. Describe the procedures used to start-up, commission and shut-down heat pump systems.

Practical Requirements:

None.

Level 3

RF1430 Fluid Dynamics and Pumps

Learning Outcomes:

- Demonstrate knowledge of fluid dynamics within piping systems.
- Demonstrate knowledge of pumps, their components and operation.
- Demonstrate knowledge of the procedures used to install pumps and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot pumps and their components.

Duration: 15 Hours

Pre-Requisite(s): Level 2

Objectives and Content:

1. Define terminology associated with fluid dynamics and pumps.

2. Identify hazards and describe safe work practices pertaining to fluid dynamics and pumps.

3. Interpret codes and regulations pertaining to fluid dynamics and pumps.

4. Interpret information pertaining to fluid dynamics and pumps found on drawings and specifications.

5. Identify types and sources of documentation and reference materials, and describe their applications.

6. Identify specialized tools and equipment used with fluid dynamics and pumps, and describe their applications and procedures for use.

7. Explain the principles of fluid dynamics.

8. Explain the purpose and operation of liquid pumps and their components.

9. Identify types of pumps and describe their characteristics and applications.

10. Identify pump components and describe their characteristics and applications.

11. Identify the factors to consider when selecting and installing pumps and their components.
    i. system parameters
    ii. pump curves
    iii. circuit configurations

12. Describe the procedures used to install pumps and their components.

13. Describe the procedures used to maintain and troubleshoot pumps and their components.

14. Identify pump and component failures and describe their causes and procedures for repair.

15. Describe the procedures used to fill, start up and commission pump systems.

16. Describe the procedures used to purge air from an open or closed pump system.

17. Identify types of fluid coolers and their components, and describe their characteristics and applications.

Practical Requirements:

None.

RF3751 Control Systems

Learning Outcomes:

- Demonstrate knowledge of control systems, their components and operation.
- Demonstrate knowledge of determining placement of control systems and their components.
- Demonstrate knowledge of the procedures used to install control systems and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot control systems and their components.
- Demonstrate knowledge of codes and regulations pertaining to control systems and their components.
- Identify system control strategies and describe their characteristics and applications.
- Demonstrate knowledge of performing control system take-off.
- Demonstrate knowledge of setting up primary and secondary HVAC/R components.
- Demonstrate knowledge of performing start-up checks for control systems.
- Demonstrate knowledge of calibrating operating and safety controls.

Duration: 42 Hours

Pre-Requisite(s): Level 2

Objectives and Content:

1. Define terminology associated with control systems and their components.

2. Identify hazards and describe safe work practices pertaining to control systems.

3. Interpret codes and regulations pertaining to control systems and their components.

4. Explain the purpose and operation of control systems, devices and components.

5. Identify types of control systems and their components, and describe their characteristics and applications.
   i. electrical
   ii. mechanical
   iii. electronic
   iv. integrated control circuits
   v. pneumatic

6. Interpret information pertaining to control systems and their placement found on drawings, wiring diagrams, schematic diagrams and specifications.

7. Identify types of mechanical controls, and explain their purpose and operation.

8. Identify specialized tools and equipment used with control systems, and describe their applications and procedures for use.

9. Identify tools and equipment used to calibrate and repair operating and safety controls, and describe their applications and procedures for use.

10. Identify system control strategies and describe their characteristics and applications.
    i. two position control
    ii. floating control
    iii. pulse width modulation (PWM)
    iv. proportional (P)
    v. proportional plus integral (PI)
    vi. proportional plus integral plus derivative (PID)
    vii. AI
    viii. adaptive

11. Explain how to incorporate various control strategies into control systems.
    i. electric
    ii. electronic
    iii. pneumatic
    iv. direct digital control (DDC)

12. Identify the factors to consider when selecting and installing control systems and their components.

13. Identify the factors to consider when determining materials required.

14. Describe the procedures used to perform control system take-off.

15. Describe the method for determining the location, orientation and position of controls systems.

16. Describe the procedures used to maintain and troubleshoot control systems and their components.

17. Describe sequence of operation required for proper function of control systems.

18. Describe the procedures used to perform a diagnosis of controls.

19. Interpret information pertaining to control systems and their components found on manufacturers' specifications and maintenance schedule.

20. Describe communication protocols for control systems.
    i. ethernet
    ii. Wi-Fi
    iii. Bluetooth

21. Identify control system failures and describe their causes and procedures for repair.

22. Describe the procedures used to calibrate operating and safety controls.

23. Describe the procedures used to start up and commission control systems.

24. Describe the application, operation, service, maintenance and troubleshooting of an economizer.

25. Describe the procedures used to inspect control systems and their components.

26. Identify types of tools and equipment used to set up primary and secondary HVAC/R components.

27. Describe the procedures used to set up primary and secondary HVAC/R components.

28. Identify types of HVAC/R primary components, their characteristics, applications and operation.

29. Identify types of HVAC/R secondary components, their characteristics, applications and operation.

30. Identify codes and regulations pertaining to primary and secondary HVAC/R components.

31. Identify types of tools and equipment used to set operating parameters.

32. Describe the procedures used to verify and set operating parameters.

33. Describe the procedures used to calibrate components.
    i. thermostats
    ii. pressure controls
    iii. transducers
    iv. pneumatic devices
    v. enthalpy controllers

34. Describe the procedures used to adjust parameter set points.

35. Identify and interpret codes and regulations pertaining to verifying and setting safety parameters.

Practical Requirements:

1. Sketch the components of a basic pneumatic control system.

2. View an operating D.D.C. control system installed at a facility.

RF3030 Troubleshooting Refrigeration and Air Conditioning Electronic Controls

Learning Outcomes:

- Demonstrate knowledge of testing tools and equipment, their applications and procedures for use.
- Demonstrate knowledge of the procedures used to troubleshoot electronic components and control boards.
- Demonstrate knowledge of HVAC/R system parameters and requirements.
- Demonstrate knowledge of repairing HVAC/R systems.

Duration: 42 Hours

Pre-Requisite(s): Level 2

Objectives and Content:

1. Define terminology associated with refrigeration and air conditioning electronic controls.

2. Identify hazards and describe safe work practices pertaining to refrigeration and air conditioning electronic controls.

3. Interpret codes and regulations pertaining to refrigeration and air conditioning electronic controls.

4. Interpret information pertaining to refrigeration and air conditioning electronic controls found on drawings, specifications and service manuals.

5. Identify specialized tools and equipment used to test and troubleshoot refrigeration and air conditioning electronic components and control boards, and describe their applications and procedures for use.

6. Identify refrigeration and air conditioning electronic components and control boards, and describe their purpose and operation.

7. Describe the procedures used to troubleshoot refrigeration and air conditioning electronic components and control boards.

8. Identify the factors used to determine conductor ampacity rating.

9. Identify types of electrical circuits and describe their characteristics and applications.

10. Identify HVAC/R system and component failures, and describe their causes and procedures for repair.

Practical Requirements:

None.

RF3040 Advanced Motors

Learning Outcomes:

- Demonstrate knowledge of the procedures used to install complex motors and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot complex motors and their components.
- Demonstrate knowledge of the procedures used to install motor controls.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot motor controls.
- Demonstrate knowledge of HVAC/R system parameters and requirements.

Duration: 30 Hours

Pre-Requisite(s): Level 2

Objectives and Content:

1. Define terminology associated with complex motors and motor controls.

2. Identify hazards and describe safe work practices pertaining to complex motors and motor controls.

3. Interpret codes and regulations pertaining to complex motors and motor controls.

4. Interpret information pertaining to complex motors and motor controls found on drawings and specifications.

5. Identify types of electrical components and describe their characteristics and applications.

6. Identify types of basic motors and describe their characteristics and applications.

7. Identify specialized tools and equipment used with complex motors and motor controls, and describe their applications and procedures for use.

8. Explain the purpose and operation of complex motors and motor controls and their components.

9. Identify types of motors and their components, and describe their characteristics and applications.
   i. multi-lead
   ii. dual-voltage
   iii. multi-speed
   iv. ECM
   v. inverter
   vi. 3 phase

10. Identify types of motor controls for complex motors, and describe their characteristics, applications and wiring configuration.
   i. multi-tap
   ii. variable frequency drive (VFD)

11. Describe the methods used to change the speed of a motor.

12. Identify the factors to consider when selecting and installing complex motors, their components and motor controls.

13. Describe the procedures used to install complex motors and their components.

14. Describe the procedures used to maintain and troubleshoot complex motors and their components.

15. Describe the procedures used to install motor controls.

16. Describe the procedures used to maintain and troubleshoot motor controls.

17. Identify complex motor and motor control failures, and describe their causes and procedures for repair.

18. Diagnose single-phase and multi-phase motor failures and describe their causes.

Practical Requirements:

None.

RF3550 Refrigeration Capacity Control

Learning Outcomes:

- Demonstrate knowledge of refrigeration capacity control.
- Demonstrate knowledge of the procedures used to install refrigeration capacity control components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot refrigeration capacity control components.
- Demonstrate knowledge of completing HVAC/R system charge.

Duration: 30 Hours

Pre-Requisite(s): Level 2

Objectives and Content:

1. Define terminology associated with refrigeration capacity control.

2. Identify hazards and describe safe work practices pertaining to refrigeration capacity control.

3. Interpret codes and regulations pertaining to refrigeration capacity control.

4. Interpret information pertaining to refrigeration capacity control found on drawings and specifications.

5. Identify specialized tools and equipment used with refrigeration capacity control, and describe their applications and procedures for use.

6. Explain the purpose and operation of refrigeration capacity controls and their components.

7. Identify types of refrigeration capacity control and describe their characteristics and applications.
   i. on-off
   ii. multi-staging
   iii. cylinder unloading
      - gas-operated
      - hydraulic-operated
   iv. hot gas bypass
   v. inlet guide vanes
   vi. slide valve
   vii. variable frequency drive (VFD)
   viii. variable refrigerant flow (VRF)/variable refrigerant volume (VRV)

8. Identify refrigeration capacity control components and describe their characteristics and applications.

9. Identify the factors to consider when selecting and installing refrigeration capacity controls and their components.

10. Describe the procedures used to install refrigeration capacity controls and their components.

11. Describe the procedures used to maintain and troubleshoot refrigeration capacity controls and their components.

12. Identify refrigeration capacity control and component failures and describe their causes and procedures for repair.

13. Identify types of tools and equipment used to complete HVAC/R system charge.

14. Describe the pressure/temperature chart and its use in determining refrigerant conditions.

15. Describe the methods used to determine the charge of an HVAC/R system.

Practical Requirements:

None.

RF1661 Air Conditioning Load Calculations

Learning Outcomes:

- Demonstrate knowledge of air conditioning load calculations.
- Demonstrate knowledge of HVAC/R system parameters and requirements.
- Demonstrate knowledge of load calculations.

Duration: 15 Hours

Pre-Requisite(s): Level 2

Objectives and Content:

1. Define terminology associated with air conditioning load calculations.

2. Explain how to perform heat gain and heat loss calculations for air conditioning systems.
   - i. transmission
     - K, C, U and R values
     - solar load
   - ii. air change
     - infiltration
     - ventilation
   - iii. heat gain/loss
     - sensible
     - latent
   - iv. miscellaneous
     - lighting
     - occupancy
     - ducting
     - equipment
   - v. BTU/h total

3. Describe the air conditioning process, identify the air properties and the procedures.
   i. used to plot on a psychrometric chart.
   ii. air mixing
   iii. by-pass factor
   iv. cooling and dehumidification
   v. heating and humidification
   vi. evaporative cooling
   vii. dehumidication
   viii. humidification
   ix. sensible cooling
   x. sensible heating

4. Describe the changes in air properties in a variety of situations.
   i. sensible heating and cooling
   ii. heating and humidification
   iii. cooling and dehumidification
   iv. air mixing
   v. evaporative cooling

5. Explain concepts association with refrigeration.
   i. temperature
   ii. heat
   iii. mass and weight
   iv. density
   v. specific gravity
   vi. specific volume
   vii. pressure

6. Explain air quality, air circulations and ventilation.

7. Describe psychrometric processes.
   i. cooling
   ii. evaporative cooling
   iii. humidification
   iv. heating and humidification
   v. heating
   vi. heating and dehumidification
   vii. dehumidification
   viii. cooling and dehumidification

8. Identify types of air movement components, and describe their characteristics and applications.

9. Describe procedures used to determine system parameters.

10. Describe procedures used to perform calculations to determine refrigeration loads.

11. Describe procedures used to perform calculations to determine HVAC loads.

12. Explain how to calculate heat gain and heat loss for HVAC systems.

Practical Requirements:

1. Plot system conditions on a psychrometric chart.

RF3590 Air Conditioning System Design

Learning Outcomes:

- Demonstrate knowledge of air conditioning system design principles.
- Demonstrate knowledge of air volume requirements of air conditioning systems.
- Demonstrate knowledge of air conditioning system equipment, components and accessory devices, and their selection based on design criteria.
- Demonstrate knowledge of sketching piping schematics for air conditioning systems.
- Demonstrate knowledge of sketching electrical schematics for air conditioning systems.
- Demonstrate knowledge of energy inefficiencies in the operation of refrigeration and air conditioning systems.
- Demonstrate knowledge of determining placement of HVAC/R equipment, components and accessories.
- Demonstrate knowledge of procedures used to confirm HVAC/R system layout.
- Demonstrate knowledge of performing HVAC/R material take-off.
- Demonstrate knowledge of performing pre-start-up checks for HVAC/R systems.
- Demonstrate knowledge of performing start-up of HVAC/R systems.

Duration: 36 Hours

Pre-Requisite(s): Level 2

Objectives and Content:

1. Define terminology associated with air conditioning system design.

2. Explain the fundamental principles of air conditioning system design.

3. Interpret codes and regulations pertaining to air conditioning system design.

4. Identify hazards and describe safe work practices pertaining to HVAC/R installations.

5. Identify types of HVAC/R components and accessories and describe their characteristics and applications.

6. Identify documentation requirements for system start-up and commissioning.

7. Interpret information pertaining to air conditioning system design found in drawings, wiring diagrams, manufacturers' literature, schematic drawings, specifications, graphs and tables.
8. Identify capacity ratings of air conditioning system components.

9. Identify methods of zoning and describe their applications.

10. Identify types of system designs and describe their characteristics and applications.
    i. constant air volume (CAV)
    ii. variable air volume (VAV)
    iii. variable refrigerant flow (VRF)/variable refrigerant volume (VRV)
    iv. dual duct

11. Identify the factors to consider for the design and layout of air conditioning systems.

12. Identify the factors to consider when selecting equipment, components and accessory devices for air conditioning systems based on design criteria.

13. Explain the purpose and operation of air movement and indoor air quality (IAQ).

14. Explain the importance of balancing system capacity with system load.

15. Identify components and accessories used in the assembling of HVAC/R systems, and describe their characteristics and applications.

16. Describe the procedures used to size pipe for air conditioning systems.

17. Describe the procedure to sketch piping schematics for air conditioning systems.

18. Describe the procedure to sketch electrical schematics for air conditioning systems.

19. Describe ventilation air and discuss the recommended ventilation air quantities required for various applications.

20. Describe efficiency ratings.
    i. energy efficiency rating (EER)
    ii. seasonal energy efficiency rating (SEER)
    iii. coefficient of performance (COP)
    iv. heating season performance factor (HSPF)

21. Describe methods of energy management and their benefits.
    i. ventilation control
        - minimize outdoor air for ventilation
        - low leakage dampers
        - close ventilation during unoccupied periods
    ii. free cooling
        - economizer
        - cooling tower
    iii. exhaust fan control
        - manual control (as opposed to continuous)
        - timed control
        - backdraft dampers
    iv. reset control of heating and cooling setpoints
    v. equipment scheduling
    vi. night setback of heating and setup of cooling setpoints
    vii. conversion of constant volume systems to variable air volume
    viii. optimum start/stop
    ix. power demand monitoring

22. Identify the factors to consider when modifying system components and accessories or their location.
    i. piping
    ii. duct work
    iii. supports
    iv. thermostats
    v. economizers
    vi. flow switches
    vii. head pressure controls
    viii. dampers
    ix. louvers

23. Identify utilities required for HVAC/R system.

24. Identify types of energy sources and describe their application.
    i. electric
    ii. natural gas
    iii. propane
    iv. fossil fuel
    v. solar
    vi. pneumatics
    vii. alternative fuels

25. Describe the procedures used to prepare for HVAC/R installations.

Practical Requirements:

1. Develop an energy management strategy based on a given building model.

2. Calculate the operating capacity of an air conditioning unit using a psychometric chart.

RF3670 Duct Systems and Design

Learning Outcomes:

- Demonstrate knowledge of duct system design.
- Demonstrate knowledge of duct systems, their components and operation.
- Demonstrate knowledge of the procedures to maintain and troubleshoot duct systems and their components.
- Demonstrate knowledge of performing HVAC/R material take-off.

Duration: 30 Hours

Pre-Requisite(s): Level 2

Objectives and Content:

1. Define terminology associated with duct systems and design.

2. Identify hazards and describe safe work practices pertaining to duct systems.

3. Interpret codes and regulations pertaining to duct systems.

4. Interpret information pertaining to duct systems found on drawings and specifications.

5. Identify specialized tools and equipment used with duct systems and components, and describe their applications and procedures for use.

6. Explain the purpose and operation of duct systems and their components.

7. Identify types of duct systems and describe their characteristics and applications.

8. Identify duct system components and describe their characteristics and applications.

9. Identify the factors affecting duct system sizing, layout and design.

10. Identify the factors to consider when selecting and installing duct system components.

11. Identify methods of duct sizing and describe associated procedures.

12. Identify types of duct insulation and sealants, and describe their characteristics and applications.

13. Describe the procedures used to place and install duct system components.
    i. dual duct system
    ii. terminal reheat (cool) system
    iii. variable air volume system (VAV)
    iv. variable volume and temperature system (VVT) induction reheat system
    v. hydronic system
    vi. multiple unitary/heat pump system

14. Describe the procedures used to maintain and troubleshoot duct systems and their components.

15. Identify duct system and component failures, and describe their causes and procedures for repair.

16. Identify limitations for the placement of HVAC/R equipment, components and accessories.

17. Identify methods of zoning and describe their applications.

18. Describe the procedures used to perform an HVAC/R material take-off list

19. Identify types of air distribution systems and their components, and describe the procedures use to troubleshoot them.

Practical Requirements:

1. Size a duct system based on manufacturer criteria and HVAC equipment air flow.

Level 4

RF4421 Evaporative Condensers, Cooling Towers and Fluid Coolers

Learning Outcomes:

- Demonstrate knowledge of evaporative condensers, cooling towers and fluid coolers, their components and operation.
- Demonstrate knowledge of the procedures used to install evaporative condensers, cooling towers and fluid coolers, and their associated components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot evaporative condensers, cooling towers and fluid coolers, and their associated components.

Duration: 30 Hours

Pre-Requisite(s): Level 3

Objectives and Content:

1. Define terminology associated with evaporative condensers, cooling towers and fluid coolers.

2. Identify hazards and describe safe work practices pertaining to evaporative condensers, cooling towers and fluid coolers.

3. Interpret codes and regulations pertaining to evaporative condensers, cooling towers and fluid coolers.

4. Interpret information pertaining to evaporative condensers, cooling towers and fluid coolers found in drawings and specifications.

5. Identify specialized tools and equipment used with evaporative condensers, cooling towers and fluid coolers, and describe their applications and procedures for use.

6. Explain the purpose and operation of evaporative condensers, cooling towers and fluid coolers.

7. Identify types of evaporative condensers and their components, and describe their characteristics and applications.

8. Identify types of cooling towers and their components, and describe their characteristics and applications.

9. Identify types of fluid coolers and their components, and describe their characteristics and applications.

10. Identify the factors that influence the effectiveness of evaporative condensers, cooling towers and fluid coolers, based on psychrometric principles.

11. Identify methods to control head pressure and describe their associated procedures.

12. Identify the factors to consider when selecting and installing evaporative condensers, cooling towers and fluid coolers, and their associated components.

13. Describe the procedures used to install evaporative condensers, cooling towers and fluid coolers, and their associated components.

14. Describe the procedures used to maintain and troubleshoot evaporative condensers, cooling towers and fluid coolers, and their associated components.

15. Identify failures in evaporative condensers, cooling towers and fluid coolers, and their associated components, and describe their causes and procedures for repair.

16. Describe the procedures used to start up, commission and shut down evaporative condensers, cooling towers and fluid coolers.

17. Describe approach and range as they apply to cooling towers.

Practical Requirements:

1. Using industry catalogues, compare various cooling towers and evaporative condensers.

RF4620 Air Measurement and System Air Balancing

Learning Outcomes:

- Demonstrate knowledge of the principles and procedures for air measurement and system air balancing.
- Demonstrate knowledge of air measuring instruments, their applications and procedures for use.
- Demonstrate knowledge of HVAC/R system parameters and requirements.

Duration: 30 Hours

Pre-Requisite(s): Level 3

Objectives and Content:

1. Define terminology associated with air measurement and system air balancing.

2. Identify hazards and describe safe work practices pertaining to air measurement and system air balancing.

3. Interpret codes and regulations pertaining to air measurement and system air balancing.

4. Interpret information pertaining to air measurement and system air balancing found on drawings and specifications.

5. Identify types of air measuring instruments, and describe their applications and procedures for use.

6. Explain the principles of air movement and air balancing.

7. Explain air quality, air circulations and ventilation.

8. Describe psychometric processes.

9. Identify types of air movement components, and describe their characteristics and applications.

10. Identify types of charts and tables used to monitor and balance air systems, and describe their applications and procedures for use.
    i. air velocity chart
    ii. air volume chart
    iii. occupancy table

11. Describe the procedures used in system air balancing.

12. Describe the procedure to perform calculations for system air balancing.

Practical Requirements:

None.

RF4721 Chillers and Chiller Systems

Learning Outcomes:

- Demonstrate knowledge of chillers and chiller systems, their associated components and operation.
- Demonstrate knowledge of the procedures used to install chillers, chiller systems and their associated components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot chillers, chiller systems and their associated components.
- Demonstrate knowledge of performing pre-start-up checks for HVAC/R systems.
- Demonstrate knowledge of setting up primary and secondary HVAC/R components.

Duration: 40 Hours

Pre-Requisite(s): Level 3

Objectives and Content:

1. Define terminology associated with chillers and chiller systems.

2. Identify hazards and describe safe work practices pertaining to chillers and chiller systems.

3. Interpret codes and regulations pertaining to chillers and chiller systems.

4. Interpret information pertaining to chillers and chiller systems found on drawings, specifications and schematic diagrams.

5. Identify specialized tools and equipment used with chillers and chiller systems, and describe their applications and procedures for use.

6. Explain the purpose and operation of chillers and chiller systems, and their associated components.
   i. primary
   ii. secondary

7. Identify types of compressors in chillers and describe their characteristics and applications.
   i. reciprocating
   ii. screw
   iii. scroll
   iv. rotary
   v. centrifugal

vi. absorption

8. Identify chiller components and describe their characteristics and applications.
   i. compressor
   ii. oil pump
   iii. condenser
   iv. purge unit
   v. chiller barrel

9. Identify chiller applications and describe their characteristics.
   i. air conditioning
   ii. ice rink/surface
   iii. process
   iv. supermarket

10. Identify chiller system components and describe their characteristics and applications.
   i. pumps
   ii. cooling coils
   iii. valves
   iv. air handlers

11. Identify the methods of chiller capacity control.

12. Identify the factors to consider when selecting and installing chillers, chiller systems and their associated components.

13. Describe the procedures used to place and install chillers, chiller systems, and their associated components.

14. Identify the factors to consider when performing an HVAC/R system start-up.
   i. phasing
   ii. voltage imbalance and amperage
   iii. refrigerant charge adjustments
   iv. oil levels
   v. operating pressures and temperatures
   vi. system control adjustments
   vii. manufacturers' recommendations
   viii. liquid or air requirements

15. Describe the procedures required to start up and commission HVAC/R chiller systems.

16. Describe the procedures used to test and adjust components.
    i. fans
    ii. pumps
    iii. compressors
    iv. motors
    v. dampers
    vi. temperature/pressure controls
    vii. valves, safety components

17. Identify the correct sequence of operation prior to start-up.

18. Identify types of tools and equipment used to complete chiller system charge.

19. Describe the pressure/temperature chart and its use in determining refrigerant conditions.

20. Describe the methods used to determine the charge of an HVAC/R systems.

21. Describe the procedures used to charge a HVAC/R system.

22. Identify types of refrigerants and describe their characteristics and applications.

23. Identify codes and regulations pertaining to refrigerants.

24. Identify types of tools and equipment used to set up primary and secondary HVAC/R components.

25. Describe the procedures used to set up primary and secondary HVAC/R components.

26. Identify codes and regulations pertaining to primary and secondary HVAC/R components.

27. Describe the procedures used to maintain and troubleshoot chillers, chiller systems and their associated components.

28. Identify chiller and chiller system failures, and describe their causes and procedures for repair.

Practical Requirements:

None.

RF4791 Industrial Refrigeration Systems

Learning Outcomes:

- Demonstrate knowledge of industrial refrigeration systems, their components and operation.
- Demonstrate knowledge of the procedures used to install industrial refrigeration systems and their components.
- Demonstrate knowledge of the procedures used to maintain and troubleshoot industrial refrigeration systems and their components.

Duration: 40 Hours

Pre-Requisite(s): Level 3

Objectives and Content:

1. Define terminology associated with industrial refrigeration systems.

2. Identify hazards and safe work practices pertaining to industrial refrigeration systems.

3. Interpret codes and regulations pertaining to industrial refrigeration systems.

4. Interpret information pertaining to industrial refrigeration systems found on drawings and specifications.

5. Identify specialized tools and equipment used with industrial refrigeration systems, and describe their applications and procedures for use.

6. Explain the purpose and operation of industrial refrigeration systems and their components.

7. Identify types of industrial refrigeration systems and describe their characteristics and applications.
   i. parallel
   ii. compound
   iii. cascade

8. Identify industrial refrigeration system components and describe their characteristics and applications.

9. Describe the types of condensers used in industrial systems.

10. Identify types of liquid recirculation systems and describe their characteristics and applications.
    i. flooded
    ii. pumped liquid

11. Identify the factors to consider when selecting and installing industrial refrigeration systems and their components.

12. Describe the procedures used to install industrial refrigeration systems and their components.

13. Describe the procedures used to maintain and troubleshoot industrial refrigeration systems and their components.

14. Identify industrial refrigeration system and component failures, and describe their causes and procedures for repair.

15. Describe the procedures used to start up, commission and shut down industrial refrigeration systems.

16. Describe the procedures used to test and adjust industrial refrigeration components.

17. Describe the sequence of operation of industrial systems.

18. Identify codes and regulations pertaining to refrigerants.

19. Identify factors to consider when selecting control systems, types of control systems and their components, and describe their characteristics and applications.

20. Describe the procedures used to calibrate operating and safety controls.
    i. thermostats
    ii. current sensing device
    iii. loss of charge switch
    iv. flow switches
    v. low/high pressure switches
    vi. refrigerant and gas monitors

21. Explain procedures used to isolate, de-energize and lock out control systems.

Practical Requirements:

1. Tour an operating industrial plant with the plant engineer and identify system components and review their operation.

2. Sketch an operating refrigeration plant to include all components and piping.

RF4641 Troubleshooting With Schematic Wiring Diagrams

Learning Outcomes:

- Demonstrate knowledge of advanced schematic wiring diagrams and their use in troubleshooting complex systems.
- Demonstrate knowledge of electrical circuits and loads.
- Demonstrate knowledge of performing start-up checks for control systems.
- Demonstrate knowledge of procedures used to troubleshoot and repair HVAC/R systems.

Duration: 45 Hours

Pre-Requisite(s): Level 3

Objectives and Content:

1. Define terminology associated with schematic wiring diagrams.

2. Interpret information pertaining to HVAC/R systems and components found on drawings, specifications and service manuals.

3. Identify symbols on schematics and wiring diagrams and their application.

4. Interpret advanced schematic wiring diagrams for use in troubleshooting complex systems.
   i. manufacturers' drawings
   ii. as-built drawings

5. Identify troubleshooting techniques using advanced schematic wiring diagrams and describe their associated procedures.

6. Describe the difference between a pictorial wiring diagram and a schematic (ladder) wiring diagram.

7. Identify types of tools and equipment used to troubleshoot HVAC/R systems.

8. Describe the procedures used to troubleshoot HVAC/R systems and their components.

9. Identify HVAC/R system and component problems, and describe their causes.

10. Identify HVAC/R system and component failures, and describe their causes and procedures for repair.

11. Identify air and secondary refrigerant distribution systems, and component failures, and describe their causes and procedures for repair.

12. Describe the procedures used to troubleshoot electrical control circuit systems and components using schematic wiring diagrams.

13. Identify the sequence of operations and procedures used to troubleshoot.

14. Interpret codes and regulations pertaining to HVAC/R systems.

15. Identify types of electronic controls, and explain their purpose and operation.

16. Interpret codes and regulations pertaining to control system components and accessories.

17. Identify the factors used to determine conductor ampacity rating.

18. Identify types of electrical circuits and describe their characteristics and applications.

19. Describe the procedures used to verify basic electrical control circuit systems and components using schematic wiring diagrams.

20. Interpret information pertaining to HVAC/R electronic controls found on drawings, specifications and service manuals.

21. Describe the procedures used to perform a basic diagnosis of electronic controls.

22. Identify control system failures and describe their causes and sources.

Practical Requirements:

1. Use schematic diagrams to troubleshoot various circuits.

2. Use pictorial diagrams and schematic diagrams to troubleshoot various wiring circuits.

3. Determine system sequence of operation from schematic diagrams.

RF4001 Job Coordination

Learning Outcomes:

- Demonstrate knowledge of effective job coordinating practices.
- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of equipment and material acquisition.
- Demonstrate knowledge of HVAC/R, control systems and components factors related to job coordination.

Duration: 19 Hours

Pre-Requisite(s): Level 3

Objectives and Content:

1. Define terminology associated with job tasks, procedures and coordination.

2. Interpret codes, regulations, procedures, blueprints and specifications pertaining to job coordination.

3. Identify sources of information relevant to job coordinating.
   - i. trade-related documentation
     - warranties
     - manufacturers' specifications
     - wholesaler catalogues
     - log sheets
     - permits
     - reports
   - ii. related professionals
   - iii. customers
   - iv. co-workers
     - dispatchers
     - sales staff
     - managers

4. Identify information gathering and communication techniques, and describe their associated procedures.
   - i. questioning for clarification
   - ii. relaying technical information
   - iii. using communication equipment

5. Describe the procedures used to coordinate work requirements.
   i. prepare material list
   ii. requisition equipment, components and accessories
   iii. arrange for delivery and storage of equipment/materials
   iv. coordinate access to work site
   v. conduct work area inspection
   vi. coordinate activities with customer and other professionals

6. Estimate work requirements.
   i. tools and equipment
   ii. components and accessories
   iii. time and costs

7. Identify tools and equipment used for checking HVAC/R system equipment, components and accessories, and describe their applications and procedures for use.

8. Describe the procedures used to ensure proper installations of HVAC/R systems.

9. Identify safety regulations pertaining to retrofitting HVAC/R systems.

10. Identify types of alternative materials that may be considered as options when performing HVAC/R material take-off.

11. Identify the types of alternative materials that may be considered as options.
   i. control devices
   ii. wiring
   iii. tubing
   iv. hangers
   v. fasteners

12. Interpret information pertaining to control systems and their components found on drawings, manufacturers' specifications, and maintenance schedules.

13. Describe communication protocols for control systems.

Practical Requirements:

1. Create a job site procedure.
   i. material list
   ii. requisition equipment
   iii. coordinate access to worksite
   iv. coordinate activities with customer and other trades
   v. estimate job requirements

RF4100 Mentoring

Learning Outcomes:

- Demonstrate knowledge of strategies for learning skills in the workplace.
- Demonstrate knowledge of strategies for teaching workplace skills.

Duration: 6 Hours

Pre-Requisite(s): Level 3

Objectives and Content:

1. Describe the importance of individual experience.

2. Describe the shared responsibilities for workplace learning.

3. Determine one's own learning preferences and explain how these relate to learning new skills.

4. Describe the importance of different types of skills in the workplace.

5. Describe the importance of essential skills in the workplace.
   i. reading
   ii. writing
   iii. document use
   iv. oral communication
   v. numeracy
   vi. thinking skills
   vii. working with others
   viii. digital technology
   ix. continuous learning

6. Identify different learning styles.
   i. seeing it
   ii. hearing it
   iii. trying it
   iv. applying it

7. Identify different learning needs and describe the strategies to meet these needs.
   i. learning disabilities
   ii. learning preferences
   iii. language proficiency

8. Identify strategies to assist in learning a skill.
   i. understanding basic principles of instruction
   ii. developing coaching skills
   iii. being mature and patient
   iv. providing feedback

9. Identify different roles played by a workplace mentor.

10. Describe teaching skills.
   i. identifying the point of the lesson
   ii. linking the lesson
   iii. demonstrating the skill
   iv. providing practice
   v. giving feedback
   vi. assessing skills and progress

11. Explain the importance of identifying the lesson point of a lesson.

12. Identify how to choose a good time to present a lesson.

13. Explain the importance of linking the lesson.

14. Identify the components of the skill (the context).

15. Describe considerations in setting up opportunities for skill practice.

16. Explain the importance of providing feedback.

17. Identify techniques for giving effective feedback.

18. Describe a skills assessment.

19. Identify methods of assessing progress.

20. Explain how to adjust a lesson to different situations.

Practical Requirements:

None.

RF4800 Program Review

Learning Outcomes:

- Demonstrate knowledge of the Red Seal Occupational Standard (RSOS) and its relationship to the Interprovincial Examination.
- Demonstrate knowledge of overall comprehension of the trade in preparation for the Interprovincial Examination.

Duration: 30 Hours

Pre-Requisites: Level 3

Objectives and Content:

1. Define terminology associated with an RSOS.
   i. major work activities (MWA) / blocks
   ii. tasks
   iii. sub-tasks

2. Explain how a RSOS is developed and the link it has to the Interprovincial Examination.
   i. development
   ii. validation
   iii. MWA / block and task weighting
   iv. examination breakdown (pie chart)

3. Identify Red Seal products and describe their use when preparing for the Interprovincial Examination.
   i. Red Seal website
   ii. examination preparation guide
   iii. examination counselling sheets
   iv. sample questions
   v. preparation checklists

4. Explain the relationship between the RSOS and the Plan of Training (POT).

5. Review Common Occupational Skills for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
   i. safety-related functions
   i. tools and equipment
   ii. organizes work
   iii. communication and mentoring

6. Review process to perform routine trade for the for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
   i. work site preparation
   ii. trade activities

7. Review process to plan installations for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
   i. HVAC/R systems
   ii. control systems

8. Review process to perform commissioning for the for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
   i. HVAC/R systems
   ii. control systems

9. Review process to perform maintenance and service for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
   i. HVAC/R systems
   ii. control systems

Practical Requirements:

None.

C. Conditions Governing Apprenticeship Training

1.0 General

The following general conditions apply to all apprenticeship training programs approved by the Provincial Apprenticeship and Certification Board (PACB) in accordance with the **Apprenticeship Training and Certification Act (1999)**. If an occupation requires additional conditions, these will be noted in the specific Plan of Training for the occupation. In no case should there be a conflict between these conditions and the additional requirements specified in a certain Plan of Training. All references to Memorandum of Understanding will also apply to Letter of Understanding (LOU) agreements.

2.0 Entrance Requirements

2.1 Entry into the occupation as an apprentice requires:

Indenturing into the occupation by an employer who agrees to provide the appropriate training and work experiences as outlined in the Plan of Training.

2.2 Notwithstanding the above, each candidate must have successfully completed a high school program or equivalent, and in addition may be required to have completed certain academic subjects as specified in a particular Plan of Training. Mature students, at the discretion of the Director of Apprenticeship and Trades Certification, may be registered. A mature student is defined as one who has reached the age of 19 and who can demonstrate the ability and the interest to complete the requirements for certification.

2.3 At the discretion of the Director of Apprenticeship and Trades Certification, credit toward the apprenticeship program may be awarded to an apprentice for previous work experience and/or training as validated through prior learning assessment.

2.4 An Application for Apprenticeship form must be duly completed along with a Memorandum of Understanding as applicable to be indentured into an Apprenticeship. The Memorandum of Understanding must contain signatures of an authorized employer representative, the apprentice and an official representing the Provincial Apprenticeship and Certification Board to be valid.

2.5 A new Memorandum of Understanding must be completed for each change in an employer during the apprenticeship term.

3.0 Probationary Period

The probationary period for each Memorandum of Understanding will be six months or 900 employment credit hours. Within that period the memorandum may be terminated by either party upon giving the other party and the PACB one week notice in writing.

4.0 Termination of a Memorandum of Understanding

After the probationary period referred to in Section 3.0, the Memorandum of Understanding may be terminated by the PACB by mutual consent of the parties involved, or cancelled by the PACB for proper and sufficient cause in the opinion of the PACB, such as that stated in Section 14.

5.0 Apprenticeship Progression Schedule, Wage Rates and Advanced Training Criteria

Progression Schedule

Refrigeration and Air Conditioning Mechanic - 7200 Hours			
Apprenticeship Level and Wages			
Level	Wage Rate	Requirements for Progression to Next Level	Next Level
1st	60%	▪ Completion of Level 1 training ▪ Registration as an apprentice ▪ Pass Level 1 exam* ▪ Minimum 1800 hours of combined relevant work experience and training	2nd Year
2nd	70%	▪ Completion of Level 2 training ▪ Pass Level 1I exam* ▪ Minimum 3600 hours of combined relevant work experience and training	3rd Year
3rd	80%	▪ Completion of Level 3 training ▪ Pass Level 3 exam* ▪ Minimum 5400 hours of combined relevant work experience and training	4th Year
4th	90%	▪ Completion of Level 4 training ▪ Pass Level 4 exam* ▪ Minimum 7200 hours of combined relevant work experience and training ▪ Sign-off of all workplace skills in apprentice logbook ▪ Pass certification exam	Journeyperson Certification

Wage Rates

- Rates are percentages of the prevailing journeyperson's wage rate in the place of employment of the apprentice.
- Rates must not be less than the wage rate established by the Labour Standards Act (1990), as now in force or as hereafter amended, or by other order, as amended from time to time replacing the first mentioned order.
- Rates must not be less than the wage rate established by any collective agreement which may be in force at the apprentice's workplace.
- Employers are free to pay wage rates above the minimums specified.

Level Exams*

- This program may **not** currently contain Level Exams, in which case this requirement will be waived until such time as Level Exams are available.

Refrigeration and Air Conditioning Mechanic - 7200 Hours		
Class Calls (After Apprenticeship Registration)		
Call Level	Requirements for Class Call	Hours Awarded for In-School Training
Direct Entry Level 1	▪ Minimum of 1800 hours of relevant work experience ▪ Prior Learning Assessment (PLA) at designated college (if applicable)	480
Level 2	▪ Minimum of 3000 hours of relevant work experience and training	240
Level 3	▪ Minimum of 5000 hours of relevant work experience and training	240
Level 4	▪ Minimum of 7000 hours of relevant work experience and training	240

Class Calls at Minimum Hours

- Class calls may not always occur at the minimum hours indicated. Some variation is permitted to allow for the availability of training resources and apprentices.

6.0 Tools

Apprentices shall be required to obtain their own hand tools applicable for the designated occupation of registration or tools as specified by the PACB.

7.0 Periodic Examinations and Evaluation

7.1 Every apprentice shall submit to such occupational tests and examinations as the PACB shall direct. If after such occupational tests and examinations the apprentice is found to be making unsatisfactory progress, his/her apprenticeship level and rate of wage shall not be advanced as provided in Section 5 until his/her progress is satisfactory to the Director of Apprenticeship and Trades Certification and his/her date of completion shall be deferred accordingly. Persistent failure to pass required tests shall be a cause for revocation of his/her Memorandum of Understanding.

7.2 Upon receipt of reports of accelerated progress of the apprentice, the PACB may shorten the term of apprenticeship and advance the date of completion accordingly.

7.3 For each and every course, a formal assessment is required for which 70% is the pass mark. A mark of 70% must be attained in both the theory examination and the practical project assignment, where applicable as documented on an official transcript.

7.4 Course credits may be granted through the use of a PACB approved matrix which identifies course equivalencies between designated trades and between current and historical Plans of Training for the same trade.

8.0 Granting of Certificates of Apprenticeship

Upon the successful completion of apprenticeship, the PACB shall issue a Certificate of Apprenticeship.

9.0 Hours of Work

Any hours employed in the performance of duties related to the designated occupation will be credited towards the completion of the term of apprenticeship. Appropriate documentation of these hours must be provided.

10.0 Copies of the Registration for Apprenticeship

The Director of Apprenticeship and Trades Certification shall provide copies of the Registration for Apprenticeship form to all signatories to the document.

11.0 Ratio of Apprentices to Journeypersons

Under normal practice, the ratio of apprentices to journeypersons shall not exceed two apprentices to every one journeyperson employed. Other ratio arrangements would be determined and approved by the PACB.

12.0 Relationship to a Collective Bargaining Agreement

Where applicable in Section 5 of these conditions, Collective Agreements take precedence.

13.0 Amendments to a Plan of Apprenticeship Training

A Plan of Training may be amended at any time by the PACB.

14.0 Employment, Re-Employment and Training Requirements

14.1 The Plan of Training requires apprentices to regularly attend their place of employment.

14.2 The Plan of Training requires apprentices to attend training for that occupation as prescribed by the PACB.

14.3 Failure to comply with Sections 14.1 and/or 14.2 will result in cancellation of the Memorandum of Understanding. Apprentices may have their MOUs reinstated by the PACB but would be subject to a commitment to complete the entire program as outlined in the General Conditions of Apprenticeship. Permanent cancellation in the said occupation is the result of non-compliance.

14.4 Cancellation of the Memorandum of Understanding to challenge journeyperson examinations, if unsuccessful, would require an apprentice to serve a time penalty of two (2) years before reinstatement as an apprentice or qualifying to receive a class call to training as a registered Trade Qualifier. Cancellation must be mutually agreed upon by the employer and the apprentice.

14.5 An employer shall ensure that each apprentice is under the direct supervision of an approved journeyperson supervisor who is located at the same worksite as the apprentice, and that the apprentice is able to communicate with the journeyperson with respect to the task, activity or function that is being supervised.

14.6 Under the Plan of Training the employer is required to keep each apprentice employed as long as work is available, and if the apprentice is laid off due to lack of work, to give first opportunity to be hired before another is hired.

14.7 The employer will permit each apprentice to attend training programs as prescribed by the PACB.

14.8 Apprentices who cannot acquire all the workplace skills at their place of employment will have to be evaluated in a simulated work environment at a PACB authorized training institution and have sign-off done by instructors to meet the requirements for certification.

15.0 Appeals to Decisions Based on Conditions Governing Apprenticeship Training

Persons wishing to appeal any decisions based on the above conditions must do so in writing to the Minister of Immigration, Skills and Labour within 30 days of the decision.

D. Requirements for Red Seal Endorsement

1. Evidence the required work experiences outlined in this Plan of Training have been obtained. This evidence must be in a format clearly outlining the experiences and must be signed by an appropriate person or persons attesting that these experiences have been obtained to the level required.

2. Successful completion of all required courses in the program.

3. A combination of training from an approved training program and suitable work experience totaling 7200 hours.

   Or

   A total of 10,800 hours of suitable work experience.

4. Completion of a National Red Seal examination, to be set at a place and time determined by the Apprenticeship and Trades Certification Division.

E. Roles and Responsibilities of Stakeholders in the Apprenticeship Process

The apprenticeship process involves a number of stakeholders playing significant roles in the training of apprentices. This section outlines these roles and the responsibilities resulting from them.

The Apprentice:

- completes all required technical training courses as approved by the PACB.
- finds appropriate employment.
- completes all required work experiences in combination with the required hours.
- ensures work experiences are well documented.
- approaches apprenticeship training with an attitude and commitment that fosters the qualities necessary for a successful career as a qualified journeyperson.
- obtains the required hand tools as specified by the PACB for each period of training of the apprenticeship program.

The Employer:

- provides high quality work experiences in an environment conducive to learning.
- remunerates apprentices as set out in the Plan of Training or Collective Agreements.
- provides feedback to training institutions, Apprenticeship and Trades Certification Division and apprentices in an effort to establish a process of continuous quality improvement.
- where appropriate, releases apprentices for the purpose of returning to a training institution to complete the necessary technical courses.
- ensures work experiences of the apprentice are documented.
- ensures a certified journeyperson is currently on staff in the same trade area as the apprentice and whose certification is recognized by the NL Department of Immigration, Skills and Labour.

The Training Institution:

- provides a high quality learning environment.
- provides the necessary student support services that will enhance an apprentice's ability to be successful.
- participates with other stakeholders in the continual updating of programs.

The Apprenticeship and Trades Certification Division:

- establishes and maintains program advisory committees under the direction of the PACB.
- promotes apprenticeship training as a viable career option to prospective apprentices and other appropriate persons involved, such as career guidance counsellors, teachers, parents, etc.
- establishes and maintains a protocol with training institutions, employers and other appropriate stakeholders to ensure the quality of apprenticeship training programs.
- ensures all apprentices are appropriately registered and records are maintained as required.
- schedules all necessary technical training periods for apprentices to complete requirements for certification.
- administers Level, provincial and interprovincial examinations.

The Provincial Apprenticeship and Certification Board:

- sets policies to ensure the provisions of the **Apprenticeship and Certification Act (1999)** are implemented.
- ensures advisory and examination committees are established and maintained.
- accredits institutions to deliver apprenticeship training programs.
- designates occupations for apprenticeship training and/or certification.