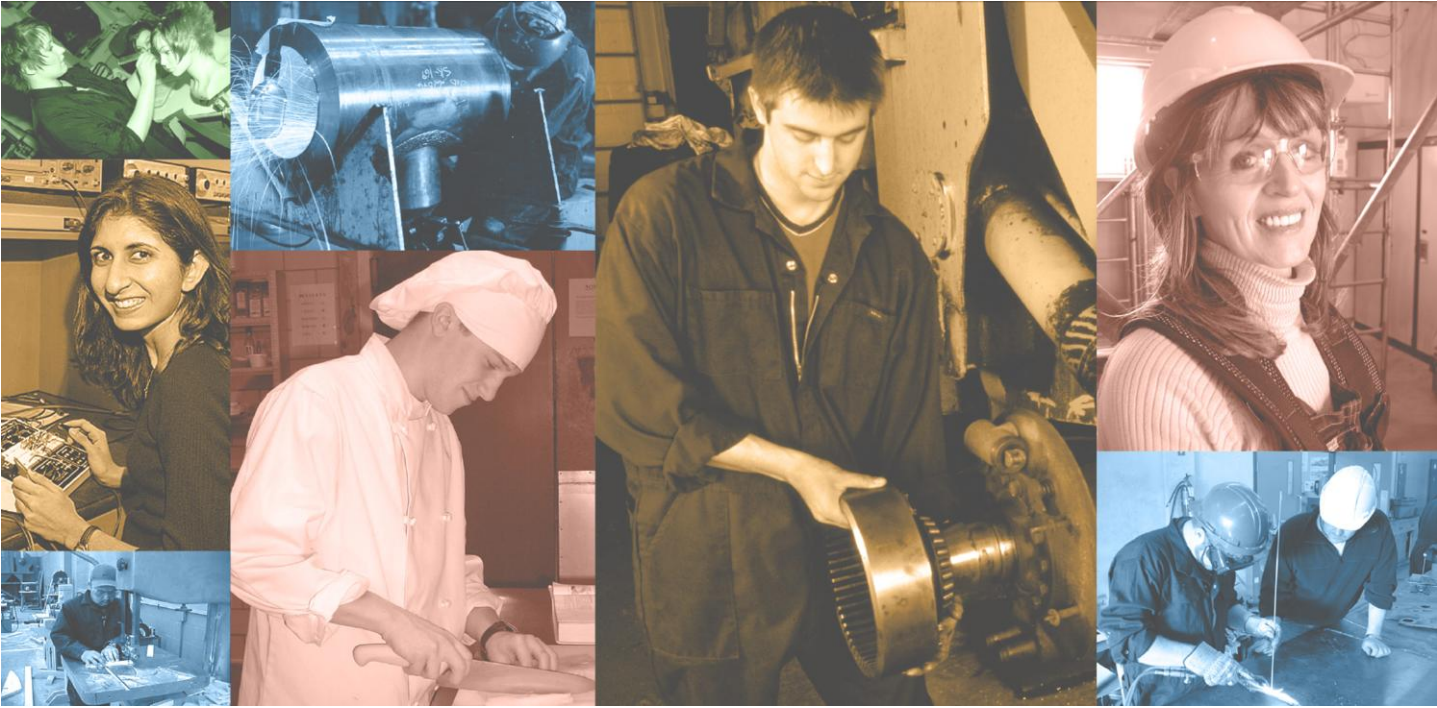

Plan of Training



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

PLAN OF TRAINING

Refrigeration and Air Conditioning Mechanic

March 2015



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

Approved by:

A handwritten signature in blue ink, appearing to read "J. Brantley", written over a horizontal line.

Chairperson, Provincial Apprenticeship and Certification Board

Date: March 20, 2015

Preface

This Apprenticeship Standard is based on the 2014 edition of the National Occupational Analysis and the 2014 Interprovincial Program Guide for the Refrigeration and Air Conditioning Mechanic trade.

This document describes the curriculum content for the Refrigeration and Air Conditioning Mechanic apprenticeship training program and outlines each of the technical training units necessary for the completion of apprenticeship.

Acknowledgements

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Mike Kenny

Without their dedication to quality apprenticeship training, this document could not have been produced.

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A. Profile Chart

COMMON OCCUPATIONAL SKILLS			
RF1161 Safety	RF1341 Hoisting, Lifting, Rigging and Access/ Egress Equipment	RF1171 Tools and Equipment	RF1180 Communication and Trade-Related Documentation
RF1810 Blueprints/Drawings and Specifications	RF4000 Job Coordination		
ROUTINE TRADE ACTIVITIES			
RF1241 Refrigerants, Gases and Oils	RF1211 Piping, Tubing, Soldering and Brazing	RF1261 Leak Testing, Evacuation and Charging	RF1481 Control Circuits and Wiring Diagrams
INSTALLATION PLANNING			
RF1221 Refrigeration Fundamentals	RF1361 Compressors Fundamentals	RF1271 Electrical Fundamentals	RF1281 Motor Fundamentals
RF1351 Pressure Enthalpy Diagrams and System Analysis	RF1331 Air Conditioning Fundamentals	RF1321 Control Fundamentals	RF2520 Refrigeration Load Calculations

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RF2530 Refrigeration System Design	RF3550 Refrigeration Capacity Control	RF1660 Air Conditioning Load Calculations	RF3590 Air Conditioning System Design
RF3670 Duct Systems and Design			
INSTALLATION			
RF1251 Valves and Accessory Devices	RF1451 Refrigeration and Air Conditioning Installation	RF1381 Evaporators	RF1190 Residential and Commercial Compressors
RF1371 Condensers	RF1390 Metering Devices	RF1401 Refrigerant Flow Controls and Accessory Devices	RF2000 Large Commercial/ Industrial Compressors
RF2010 Heating Systems	RF2730 Commercial Refrigeration Systems	RF2510 Split Air Conditioning Systems	RF2540 Packaged Air Conditioning Systems
RF1600 Heat Pumps	RF1430 Fluid Dynamics and Pumps	RAMC-355 Advanced Motors	RF4420 Evaporative Condensers, Cooling Towers and Fluid Coolers
RF4720 Chillers and Chiller Systems	RF4790 Industrial Refrigeration Systems		
COMMISSIONING			
RF1611 Air Movement and Indoor Air Quality	RF3750 Control Systems	RF4620 Air Measurement and System Air Balancing	

MAINTENANCE AND SERVICE		
RF3030 Troubleshooting Refrigeration and Air Conditioning Electronic Controls	RF4640 Troubleshooting with Schematics Wiring Diagrams	

B. NOA Comparison Chart

2014 NOA Task		2015 POT	
Task 1 – Performs safety-related functions.			
1.01	Maintains safe work environment.	RF1341	Safety
1.02	Performs lock-out, tag-out and isolation procedures.	RF1341	Safety
1.03	Uses personal protective equipment (PPE) and safety equipment.	RF1341	Safety
Task 2 – Uses and maintains tools and equipment.			
2.01	Maintains hand tools.	RF1171	Tools and Equipment
2.02	Maintains portable and stationary power tools.	RF1171	Tools and Equipment
2.03	Maintains brazing and soldering equipment.	RF1171	Tools and Equipment
2.04	Maintains recovery and recycling equipment.	RF1171	Tools and Equipment
2.05	Maintains evacuation tools and equipment.	RF1171	Tools and Equipment
2.06	Maintains charging tools and equipment.	RF1171	Tools and Equipment
2.07	Maintains diagnostic and measuring tools and equipment.	RF1171	Tools and Equipment
2.08	Uses access equipment.	RF1341	Hoisting, Rigging, Lifting and Access/Egress Equipment
2.09	Uses rigging, hoisting and lifting equipment.	RF1341	Hoisting, Rigging, Lifting and Access/Egress Equipment
2.10	Uses digital technology.	RF1180	Communication and Trade-Related Documentation
		RF3030	Troubleshooting Refrigeration and Air Conditioning Electronics
Task 3 – Organizes work.			
3.01	Interprets codes, regulations and procedures.		Throughout
3.02	Interprets blueprints and specifications.	RF1810	Blueprints and Specifications
3.03	Uses documentation and reference material.	RF1180	Communication and Trade-Related Documentation
		RF4000	Job Coordination
3.04	Plans job tasks and procedures.	RF4000	Job Coordination

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2014 NOA Task		2015 POT	
3.05	Communicates with others.	RF1180	Communication and Trade-Related Documentation
		RF4000	Job Coordination
Task 4 – Performs work site preparation.			
4.01	Prepares work site.	RF1341	Safety
		RF4000	Job Coordination
4.02	Handles materials and supplies.		Throughout
4.03	Installs fasteners, brackets and hangers.	RF1211	Piping, Tubing, Soldering and Brazing
		RF1451	Refrigeration and Air Conditioning Installation
Task 5 – Performs routine trade activities.			
5.01	Uses refrigerants, gases and oils.	RF1241	Refrigerants, Gases and Oils
5.02	Performs brazing and soldering.	RF1211	Piping, Tubing, Soldering and Brazing
5.03	Performs leak and pressure tests on systems.	RF1261	Leak Testing, Evacuation and Charging
		RF1451	Refrigeration and Air Conditioning Installation
5.04	Evacuates systems.	RF1261	Leak Testing, Evacuation and Charging
		RF1451	Refrigeration and Air Conditioning Installation
5.05	Performs field wiring of systems.	RF1271	Electrical Fundamentals
		RF1481	Control Circuits and Wiring Diagrams
		RF3750	Control Systems
5.06	Applies sealants and adhesives.	RF1211	Piping, Tubing, Soldering and Brazing
Task 6 – Plans installation of HVAC/R systems.			
6.01	Verifies HVAC/R system parameters and requirements.	RF1361	Compressor Fundamentals
		RF2520	Refrigeration Load Calculations
		RF2530	Refrigeration System Design
		RF1660	Air Conditioning Load Calculations
		RF3590	Air Conditioning System Design
		RF3670	Duct Systems and Design
		RF4420	Evaporative Condensers, Cooling Towers and Fluid Coolers

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2014 NOA Task		2015 POT	
6.02	Selects HVAC/R equipment, components and accessories.	RF1361	Compressor Fundamentals
		RF1381	Evaporators
		RF1190	Residential and Commercial Compressors
		RF1401	Refrigerant Flow Controls and Accessory Devices
		RF1611	Air Movement and Indoor Air Quality
		RF2530	Refrigeration System Design
		RF2000	Large Commercial/Industrial Compressors
		RF3590	Air Conditioning System Design
		RF3670	Duct Systems and Design
		RF4420	Evaporative Condensers, Cooling Towers and Fluid Coolers
6.03	Determines placement of HVAC/R equipment, components and accessories.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
		RF1381	Evaporators
		RF1190	Residential and Commercial Compressors
		RF1401	Refrigerant Flow Controls and Accessory Devices
		RF1611	Air Movement and Indoor Air Quality
		RF2530	Refrigeration System Design
		RF2000	Large Commercial/Industrial Compressors
		RF3590	Air Conditioning System Design
		RF3670	Duct Systems and Design
6.04	Performs HVAC/R material take-off.	RF1451	Refrigeration and Air Conditioning Installation
		RF1361	Compressor Fundamentals
Task 7 – Plans installation of control systems.			
7.01	Verifies control system parameters and requirements.	RF1321	Control Fundamentals
		RF1481	Control Circuits and Wiring Diagrams
		RF3750	Control Systems
7.02	Selects control system components	RF1481	Control Circuits and Wiring

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2014 NOA Task		2015 POT	
	and accessories.		Diagrams
		RF3750	Control Systems
7.03	Determines placement of control system components and accessories.	RF1481	Control Circuits and Wiring Diagrams
		RF3750	Control Systems
7.04	Performs control system take-off.	RF1481	Control Circuits and Wiring Diagrams
		RF3750	Control Systems
Task 8 – Installs HVAC/R systems.			
8.01	Confirms system layout.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
		RF2730	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems
8.02	Assembles HVAC/R equipment, components and accessories.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
		RF2730	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems
8.03	Places HVAC/R equipment, components and accessories.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
		RF2730	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems
8.04	Installs HVAC/R piping and tubing.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
		RF2730	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems
8.05	Applies HVAC/R holding charge.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
		RF2730	Commercial Refrigeration Systems

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2014 NOA Task		2015 POT	
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems
Task 9 – Installs control systems.			
9.01	Places control system components.	RF1481	Control Circuits and Wiring Diagrams
		RF3750	Control Systems
9.02	Connects system wiring and control tubing.	RF1481	Control Circuits and Wiring Diagrams
		RF3750	Control Systems
Task 10 – Commissions HVAC/R systems.			
10.01	Performs pre start-up checks for HVAC/R systems.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
10.02	Performs start-up of HVAC/R systems.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
10.03	Completes HVAC/R system charge.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
10.04	Sets up primary and secondary HVAC/R components.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
Task 11 – Commissions control systems.			
11.01	Performs start-up checks for control systems.	RF3750	Control Systems
11.02	Verifies/sets operating parameters.	RF3750	Control Systems
Task 12 – Maintains HVAC/R systems.			
12.01	Inspects HVAC/R systems.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
		RF2730	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems
12.02	Performs predictive and scheduled maintenance on HVAC/R systems.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
		RF2730	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design

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2014 NOA Task		2015 POT	
		RF2010	Heating Systems
12.03	Tests HVAC/R system components and accessories.	RF1361	Compressor Fundamentals
		RF1451	Refrigeration and Air Conditioning Installation
		RF2730	Commercial Refrigeration Systems
		RF2510	Air Conditioning Systems
		RF3590	Air Conditioning System Design
		RF2010	Heating Systems
Task 13 – Services HVAC/R systems.			
13.01	Troubleshoots HVAC/R systems.	RF1361	Compressor Fundamentals
		RF1351	Pressure Enthalpy Diagrams
		RF3030	Troubleshooting Refrigeration and Air Conditioning Electronics
		RF4640	Troubleshooting with Schematics Wiring Diagrams
13.02	Repairs HVAC/R systems.	RF1361	Compressor Fundamentals
Task 14 – Maintains and services control systems.			
14.01	Performs maintenance on control systems.	RF3750	Control Systems
14.02	Troubleshoots control systems.	RF1481	Control Circuits and Wiring Diagrams
		RF3750	Control Systems
		RF3030	Troubleshooting Refrigeration and Air Conditioning Electronics
		RF4640	Troubleshooting with Schematics and Wiring Diagrams
14.03	Repairs control systems.	RF3750	Control Systems
14.04	Calibrates operating and safety controls.	RF3750	Control Systems

C. 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 block can be determined by the educational agency, 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.

Block I				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
TS1510	-	OH&S	6	None
TS1520	-	WHMIS	6	None
TS1530	-	Standard First Aid	14	None
RF1290	-	Ozone-Depletion Substances	6	None
RF1161	RACM-100	Safety	12	None
RF1341	RACM-105	Hoisting, Lifting, Rigging and Access/Egress Equipment	18	RF1341
RF1171	RACM-110	Tools and Equipment	36	RF1341
RF1221	RACM-115	Refrigeration Fundamentals	90	RF1171
RF1241	RACM-120	Refrigerants, Gases and Oils	42	RF1290;RF1221
RF1361	RACM-125	Compressor Fundamentals	30	RF1221
RF1251	RACM-130	Valves and Accessory Devices	30	RF1221
RF1211	RACM-135	Piping, Tubing, Soldering and Brazing	42	RF1221
RF1261	RACM-140	Leak Testing, Evacuation and Charging	36	RF1221; RF1241

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Block I				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
RF1271	RACM-145	Electrical Fundamentals	60	RF1341
RF1281	RACM-150	Motor Fundamentals	42	RF1271
RF1180	RACM-160	Communication and Trade-Related Documentation	12	None
RF1451	RACM-165	Refrigeration and Air Conditioning Installation	112	RF1221
RF1351	RACM-200	Pressure Enthalpy Diagrams and System Analysis	24	RF1221
RF1381	RACM-205	Evaporators	24	RF1221
RF1190	RACM-210	Residential and Commercial Compressors	48	RF1221
RF1371	RACM-215	Condensers	24	RF1221
RF1390	RACM-220	Metering Devices	30	RF1221
RF1401	RACM-225	Refrigerant Flow Controls and Accessory Devices	30	RF1221
RF1331	RACM-230	Air Conditioning Fundamentals	18	RF1221
RF1611	RACM-235	Air Movement and Indoor Air Quality	30	RF1221
RF1321	RACM-240	Control Fundamentals	24	RF1281
RF1481	RACM-250	Control Circuits and Wiring Diagrams	54	RF1281
RF1810	RACM-255	Blueprints/Drawings and Specifications	30	None
AP1101	-	Introduction to Apprenticeship	15	None
*AM1100	-	Math Essentials	30	None
AM11290	-	Refrigeration Math Fundamentals	30	AM1100
CM2160	-	Communication Essentials	45	None
SD1760	-	Workplace Essentials	45	None

Block I				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
MC1060	-	Computer Essentials	15	None
Total Hours			1110	

***A student who can meet the mathematics requirement through an ACUPLACER® test may be exempted from AM1100 - Math Essentials. Please check with your training institution.**

Required Work Experience

Block II				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
RF2520	RACM-300	Refrigeration Load Calculations	24	Block I
RF2530	RACM-305	Refrigeration System Design	36	Block I
RF2000	RACM-310	Large Commercial/Industrial Compressors	24	Block I
RF2010	RACM-315	Heating Systems	30	Block I
RF2730	RACM-320	Commercial Refrigeration Systems	36	Block I
RF2510	RACM-325	Split Air Conditioning Systems	30	Block I
RF2540	RACM-330	Packaged Air Conditioning Units	30	Block I
RF1600	RACM-335	Heat Pump Systems	30	Block I
Total Hours			240	

Required Work Experience

Block III				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
RF1430	RACM-340	Fluid Dynamics and Pumps	15	Block II
RF3750	RACM-345	Control Systems	42	Block II
RF3030	RACM-350	Troubleshooting Refrigeration and Air Conditioning Electronic Controls	42	Block II
RF3040	RACM-355	Advanced Motors	30	Block II
RF3550	RACM-360	Refrigeration Capacity Control	30	Block II
RF1660	RACM-400	Air Conditioning Load Calculations	15	Block II
RF3590	RACM-405	Air Conditioning System Design	36	Block II
RF3670	RACM-410	Duct Systems and Design	30	Block II
Total Hours			240	

Required Work Experience

Block IV				
Course No.	IPG No.	Course Name	Hours	Pre-Requisite(s)
RF4420	RACM-415	Evaporative Condensers, Cooling Towers and Fluid Coolers	36	Block III
RF4620	RACM-420	Air Measurement and System Air Balancing	30	Block III
RF4720	RACM-425	Chillers and Chiller Systems	48	Block III
RF4790	RACM-430	Industrial Refrigeration Systems	48	Block III
RF4640	RACM-435	Troubleshooting with Schematic Wiring Diagrams	54	Block III
RF4000	RACM-440	Job Coordination	24	Block III
Total Hours			240	
Total Course Credit Hours				

BLOCK I

TS1510 Occupational Health and Safety

Learning Outcomes:

- Demonstrate knowledge of interpreting the Occupational Health and Safety Act, laws and regulations.
- Demonstrate knowledge of understanding the designated responsibilities within the laws and regulations such as the right to refuse dangerous work; and the importance of reporting accidents.
- Demonstrate knowledge of how to prevent accidents and illnesses.
- Demonstrate knowledge of how to improve health and safety conditions in the workplace.

Duration: 6 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Interpret the Occupational Health and Safety Act laws and regulations.
 - i. explain the scope of the act
 - application of the act
 - Federal/Provincial jurisdictions
 - Canada Labour Code
 - rules and regulations
 - private home application
 - conformity of the Crown by the Act
2. Explain responsibilities under the Act and Regulations.
 - i. duties of employer, owner, contractors, sub-contractors, employees, and suppliers

3. Explain the purpose of joint health and safety committees.
 - i. formation of committee
 - ii. functions of committee
 - iii. legislated rights
 - iv. health and safety representation
 - v. reporting endangerment to health
 - vi. appropriate remedial action
 - vii. investigation of endangerment
 - viii. committee recommendation
 - ix. employer's responsibility in taking remedial action

4. Examine right to refuse dangerous work.
 - i. reasonable grounds for refusal
 - ii. reporting endangerment to health
 - iii. appropriate remedial action
 - iv. investigation of endangerment
 - v. committee recommendation
 - vi. employer's responsibility to take appropriate remedial action
 - vii. action taken when employee does not have reasonable grounds for refusing dangerous work
 - viii. employee's rights
 - ix. assigning another employee to perform duties
 - x. temporary reassignment of employee to perform other duties
 - xi. collective agreement influences
 - xii. wages and benefits

5. State examples of work situations where one might refuse work.

6. Describe discriminatory action.
 - i. definition
 - ii. filing a complaint procedure
 - iii. allocated period of time a complaint can be filed with the Commission
 - iv. duties of an arbitrator under the Labour Relations Act
 - v. order in writing inclusion
 - vi. report to commission Allocated period of time to request Arbitrator to deal with the matter of the request
 - vii. notice of application
 - viii. failure to comply with the terms of an order
 - ix. order filed in the court

7. Explain duties of commission officers.
 - i. powers and duties of officers
 - ii. procedure for examinations and inspections
 - iii. orders given by officers orally or in writing
 - iv. specifications of an order given by an officer to owner of the place of employment, employer, contractor, sub-contractor, employee, or supplier
 - v. service of an order
 - vi. prohibition of persons towards an officer in the exercise of his/her power or duties
 - vii. rescinding of an order
 - viii. posting a copy of the order
 - ix. illegal removal of an order

8. Interpret appeals of others.
 - i. allocated period of time for appeal of an order
 - ii. person who may appeal order
 - iii. action taken by Commission when person involved does not comply with the order
 - iv. enforcement of the order
 - v. notice of application
 - vi. rules of court

9. Explain the process for reporting of accidents.
 - i. application of act
 - ii. report procedure
 - iii. reporting notification of injury
 - iv. reporting accidental explosion or exposure
 - v. posting of act and regulations

Practical Requirements:

1. Conduct an interview with someone in your occupation on two or more aspects of the act and report results.

2. Conduct a safety inspection of shop area.

**TS1520 Workplace Hazardous Materials Information System
(WHMIS)**

Learning Outcomes:

- Demonstrate knowledge of interpreting and applying the Workplace Hazardous Materials Information System (WHMIS) Regulation under the Occupational Health and Safety Act.

Duration: 6 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define WHMIS safety.
 - i. rational and key elements
 - ii. history and development of WHMIS
 - iii. WHMIS legislation
 - iv. WHMIS implementation program
 - v. definitions of legal and technical terms

2. Examine hazard identification and ingredient disclosure.
 - i. prohibited, restricted and controlled products
 - ii. classification and the application of WHMIS information requirements
 - iii. responsibilities for classification
 - the supplier
 - the employer
 - the worker - Classification: rules and criteria
 - information on classification
 - classes, divisions and subdivision in WHMIS
 - general rules for classification
 - class A - compressed gases
 - class B - flammable and combustible materials
 - class C - oxidizing material
 - class D - poisonous and infectious material
 - class E - corrosive material
 - class F - dangerously reactive material

- iv. products excluded from the application of WHMIS legislation
 - consumer products
 - explosives
 - cosmetics, drugs, foods and devices
 - pest control products
 - radioactive prescribed substances
 - wood or products made of wood
 - manufactured articles
 - tobacco or products of tobacco
 - hazardous wastes
 - products handled or transported pursuant to the Transportation of Dangerous Goods (TDG) Act
 - v. comparison of classification systems - WHMIS and TDG
 - vi. general comparison of classification categories
 - vii. detailed comparison of classified criteria
3. Explain labeling and other forms of warning.
- i. definition of a WHMIS label
 - ii. supplier label
 - iii. workplace label
 - iv. other means of identification
 - v. responsibility for labels
 - supplier responsibility
 - employer responsibility
 - worker responsibility
 - vi. introduce label content, design and location
 - supplier labels
 - workplace labels
 - other means of identification
4. Introduce material safety data sheets (MSDS).
- i. definition of a material safety data sheet
 - ii. purpose of the data sheet
 - iii. responsibility for the production and availability of data sheets
 - iv. supplier responsibility
 - v. employer responsibility
 - vi. workers responsibility

Practical Requirements:

1. Locate WHMIS label and interpret the information displayed.
2. Locate a MSDS sheet for a product used in the workplace and determine what personal protective equipment and other precautions are required when handling this product.

TS1530 Standard First Aid

Learning Outcomes:

- Demonstrate knowledge of recognizing situations requiring emergency action.
- Demonstrate knowledge of making appropriate decisions concerning first aid.

Duration: 14 Hours

Pre-Requisite(s): None

Practical Requirements:

1. Complete a **St. John Ambulance or Canadian Red Cross** Standard First Aid Certificate course.

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 Act 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.

RF1161 Safety

Learning Outcomes:

- Demonstrate knowledge of personal protective equipment (PPE) and safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of the procedures used to lock-out, tag-out and isolate equipment.
- Demonstrate knowledge of regulatory requirements pertaining to safety.

Duration: 12 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 and equipment.
 - i. personal
 - ii. workplace environment
 - electrical
 - confined spaces
 - working from heights
 - noise
 - fire
 - refrigerants
 - pressurized gases
 - iii. environmental
 - ozone depleting substances
 - hazardous materials
 - greenhouse gases
3. Interpret codes and regulations pertaining to workplace hazards and safe work practices.

4. Identify types of PPE and safety equipment, and describe their applications and procedures for use.
5. Describe the procedures used to care for, maintain and store PPE and safety equipment.
6. Describe the procedures used to lock-out, tag-out and isolate equipment.
7. Describe the procedures used to utilize, store, transport and dispose of hazardous materials.
8. Describe the procedures used to maintain a safe work environment and to remediate the potential dangers related to workplace hazards.

Practical Requirements:

1. Perform a lock-out/tag-out procedure on an operating refrigeration system.

RF1341 Hoisting, Lifting, Rigging and Access/Egress Equipment

Learning Outcomes:

- Demonstrate knowledge of hoisting, lifting, rigging and access/egress equipment, their applications and procedures for use.
- Demonstrate knowledge of basic hand signals.

Duration: 18 Hours

Pre-Requisite(s): RF1341

Objectives and Content:

1. Define terminology associated with hoisting, lifting, rigging and access/egress.
2. Identify hazards and safe work practices pertaining to hoisting, lifting, rigging and using access/egress equipment.
3. Interpret codes and regulations pertaining to hoisting, lifting, rigging and using access/egress equipment.
4. Interpret information pertaining to hoisting, lifting, rigging and using access/egress equipment found on drawings and specifications.
5. Identify types of rigging 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

6. Identify types of hoisting and lifting equipment and accessories, and describe their applications, limitations and procedures for use.
 - i. jacks
 - ii. hoists
 - iii. come-a-longs/tuggers
 - iv. chainfalls

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

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

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

10. 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

11. Identify the methods of communication used during hoisting, lifting, rigging and using access/egress equipment, and describe their associated procedures.
 - i. visual
 - hand signals
 - video
 - ii. audible
 - radio
 - mobile phones
12. Describe the procedures used to inspect, store and maintain hoisting, lifting and rigging equipment.
13. Describe the procedures used to inspect, store and maintain access/egress equipment.
14. Describe the procedures used to rig and secure a load (material and/or equipment) for lifting and hoisting.
15. Describe the procedures used to perform a lift.
16. Perform and interpret basic hand signals.

Practical Requirements:

1. Tie various knots for lifting and securing loads.
2. Perform crane hand signals.
3. Perform setup and use of ladders.

RF1171 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 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.

Duration: 36 Hours

Pre-Requisite(s): RF1341

Objectives and Content:

1. Define terminology associated with tools and equipment.
2. Identify hazards and describe safe work practices pertaining to tools and equipment.
3. Interpret codes, regulations and specifications pertaining to tools and equipment.
 - i. licensing
 - ii. training
4. 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
5. Describe the procedures used to care for, store and maintain hand 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
7. Describe the procedures used to care for, store and maintain portable and stationary power tools.
8. Identify types of brazing and soldering equipment, and describe their applications and procedures for use.
9. Describe the procedures used to care for, store and maintain brazing and soldering equipment.
10. Identify types of recovery and recycling equipment, and describe their applications and procedures for use.
11. Describe the procedures used to care for, store and maintain recovery and recycling equipment.
12. 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
13. Describe the procedures used to care for, store and maintain evacuation and charging tools and equipment.
14. Identify types of diagnostic and measuring tools and equipment, and describe their applications and procedures for use.
15. Describe the procedures used to care for, store and maintain diagnostic and measuring tools and equipment.

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

Practical Requirements:

1. Install various types of fasteners and torque to specifications.
2. Assemble and dis-assemble equipment using various tools.
3. Test systems with various test instruments, tools and accessories.

RF1221 Refrigeration Fundamentals

Learning Outcomes:

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

Duration: 90 Hours

Pre-Requisite(s): RF1171

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
 - iii. triple point
13. Explain superheat and sub-cooling, and their significance in the refrigeration cycle.
14. Describe the pressure enthalpy diagram and its applications.
15. Explain how to plot the basic cycle using a pressure enthalpy diagram.
16. Identify factors that affect system capacity.
- i. condensing pressure/temperature
 - ii. evaporating pressure/temperature
 - iii. heat of compression
 - iv. sub-cooling
 - v. superheat
17. Perform calculations to determine refrigeration values using pressure enthalpy diagrams.
- i. mass flow rate
 - ii. heat of compression
 - iii. net refrigeration effect
 - iv. system capacity
 - v. ton of refrigeration
 - vi. coefficient of performance (COP)
 - vii. horsepower per ton

Practical Requirements:

1. Operate and monitor a refrigeration system.
 - i. measure operating temperatures
 - ii. obtain operating pressures
 - iii. plot the operating characteristics on a pressure enthalpy diagram
 - iv. determine the amount of superheat
 - v. determine the amount of subcooling
 - vi. 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

RF1241 Refrigerants, Gases and Oils

Learning Outcomes:

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

Duration: 42 Hours

Pre-Requisite(s): RF1290; RF1221

Objectives and Content:

1. Define terminology associated with refrigerants, gases and oils.
2. Identify hazards and safe work practices pertaining to refrigerants, gases and oils.
3. Interpret codes and regulations pertaining to refrigerants, gases and oils.
 - i. environmental certification
 - ii. leak/spill reporting
 - iii. record keeping
4. Identify types of refrigerants and describe their characteristics and applications.
 - i. primary
 - ii. secondary
5. Identify the safety classifications of refrigerants.
 - i. toxicity
 - ii. flammability
6. Identify types of refrigerant containers and colour coding classifications.
7. Identify types of oils and describe their characteristics and applications.

8. Identify types of gases and describe their characteristics and applications.
 - i. nitrogen
 - ii. acetylene
 - iii. oxygen
 - iv. carbon dioxide

9. Explain the effects of refrigerants, gases and oils on the environment.
 - i. ozone depletion potential (ODP)
 - ii. global warming potential (GWP)
 - iii. leaks
 - iv. spills

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

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

12. 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.

7. Perform an oil conversion test.

8. Use a refractrometer.

RF1361 Compressor Fundamentals

Learning Outcomes:

- Demonstrate knowledge of the fundamental principles of compressors.
- Demonstrate knowledge of compressors, their components and operation.

Duration: 30 Hours

Pre-Requisite(s): RF1221

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.
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.

RF1251 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.

Duration: 30 Hours

Pre-Requisite(s): RF1221

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. Identify 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:

1. Sketch then explain the purpose of various system valves and accessories on operating refrigeration and air conditioning systems.

RF1211 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 the procedures used to solder and braze piping and tubing.

Duration: 42 Hours

Pre-Requisite(s): RF1221

Objectives and Content:

1. Define terminology associated with piping, tubing, soldering and brazing.
2. Identify hazards and describe safe work practices pertaining to piping, tubing, soldering and brazing.
3. Interpret codes and regulations pertaining to piping, tubing, soldering and brazing.
4. Interpret information pertaining to piping, tubing, soldering and brazing found on drawings and specifications.
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 soldering and brazing materials and fillers, and describe their characteristics and applications.
8. Identify types of pipe hangers, brackets and fasteners, and describe their characteristics and applications.
9. Identify types of pipe and tubing insulation, and describe their characteristics and applications.
10. Identify types of sealants and adhesives, and describe their characteristics and applications.
11. Identify the factors to consider when selecting piping system components for installation.
12. 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
13. Describe the use, care and application of nitrogen when brazing copper tubing.

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. Fabricate various pipe hangers and supports.
5. Assemble, ignite and adjust air-acetylene and oxy-acetylene equipment and demonstrate safe use.

RF1261 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.

Duration: 36 Hours

Pre-Requisite(s): RF1221; RF1241

Objectives and Content:

1. Define terminology associated with leak testing, evacuation and charging of refrigeration systems.
2. Identify hazards and describe safe work practices pertaining to leak testing, evacuation and charging of refrigeration systems.
3. Interpret codes and regulations pertaining to leak testing, evacuation and charging of refrigeration systems.
4. Identify specialized tools and equipment used to leak test, evacuate and charge a refrigeration system, and describe their applications and procedures for use.
5. Describe the procedures used to leak test a refrigeration system.
6. Describe the procedures used to evacuate and dehydrate a refrigeration system.

7. Describe the procedures used to charge a refrigeration system.
 - i. refrigerant
 - liquid
 - vapour
 - ii. oil
 - pumps
 - vacuum

8. 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

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.

RF1271 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.

Duration: 60 Hours

Pre-Requisite(s): RF1341

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. Describe the procedures used to perform a basic diagnosis of electronic controls.
20. Calculate voltage, current and resistance in series, parallel and combination circuits.

21. Describe the use, application and procedures of electrical test instruments.
 - i. ammeter
 - ii. multimeter
 - iii. ohmmeter
 - iv. voltmeter
 - v. megohmmeter

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.
4. Troubleshoot and wire switching relays.
5. Troubleshoot transformers.

RF1281 Motor Fundamentals

Learning Outcomes:

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

Duration: 42 Hours

Pre-Requisite(s): RF1271

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 basic motors and describe their characteristics and applications.
 - i. single-phase
 - ii. three-phase
 - iii. electrically commutated motors (ECM)
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.

RF1180 Communication and Trade-Related Documentation

Learning Outcomes:

- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of trade-related documentation and their use.
- Demonstrate knowledge of the procedures used to complete and interpret trade related documentation.

Duration: 12 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define terminology associated with communication and trade-related documentation.
2. Explain the importance of effective verbal and non-verbal communication.
 - i. interpersonal interactions
 - other tradespersons
 - co-workers
 - supervisors
 - clients
 - apprentices
 - ii. conflict resolution
3. Identify types of electronic communication devices, and describe their applications and procedures for use.
 - i. computers
 - software
 - email
 - internet
 - ii. smart phones
 - applications
 - iii. point of sale equipment
 - iv. global positioning system (GPS)

4. Identify types and sources of trade-related documentation, and describe their applications.
 - i. codes and standards
 - ii. energy efficiency guides
 - iii. manuals
 - safety
 - service
 - operating
 - iv. permits
 - v. drawings and specifications
 - vi. employer-specific forms and reports
 - vii. preventative/predictive maintenance sheets
 - viii. technical bulletins
 - ix. service records
 - x. warranties
 - xi. estimates
 - xii. refrigerant management records
5. Explain the importance of appropriate and effective use of electronic devices and sources of information.
6. Describe the procedures used to complete trade-related documentation.
7. Describe the procedures used to access, interpret and apply information found on trade-related documentation.

Practical Requirements:

None

RF1451 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 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.

Duration: 112 Hours

Pre-Requisite(s): RF1221

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.
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 specialized 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 refrigeration and air conditioning system installations.
10. Describe the procedures used to install refrigeration and air conditioning systems.
11. 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. liquid or air requirements
12. Identify documentation requirements for system installation, start up and commissioning.
13. Identify system problems at start-up and describe their causes and remedies.
14. Describe the procedures used to start up and commission refrigeration and air conditioning systems.

Practical Requirements:

1. Install refrigeration and air conditioning systems and components.
2. Commission an operating refrigeration/AC system.
 - i. create a complete bill of material.
3. Complete a startup report.

RF1351 Pressure Enthalpy Diagrams and System Analysis

Learning Outcomes:

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

Duration: 24 Hours

Pre-Requisite(s): RF1221

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

RF1381 Evaporators

Learning Outcomes:

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

Duration: 24 Hours

Pre-Requisite(s): RF1221

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 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

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

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

11. Describe the procedures used to size evaporators.

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

13. Describe the procedures used to install evaporators and their components.

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

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

Practical Requirements:

1. Select evaporators based on given design criteria.
2. Perform cleaning procedures on evaporator coils.

RF1190 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: 48 Hours

Pre-Requisite(s): RF1221

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
 - rotary
 - swing
 - 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. solenoid drop
 - ii. pump out cycle
 - iii. pump down cycle
 - iv. pressure controls
15. Describe the procedures used to start up, commission and shut down residential and commercial compressors.

16. Describe the difference between oil 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. Measure net oil pressure.
6. Disassemble compressors to identify failure.
7. Test compressor for pumping efficiency.

RF1371 Condensers

Learning Outcomes:

- Demonstrate knowledge of condensers, their components 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: 24 Hours

Pre-Requisite(s): RF1221

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.
2. Perform cleaning procedures on condensers.
3. Adjust water regulating valve on water cooled condenser.

RF1390 Metering Devices

Learning Outcomes:

- Demonstrate knowledge of metering devices, their components 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: 30 Hours

Pre-Requisite(s): RF1221

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. Install, adjust and repair expansion valves on operating systems.
3. Troubleshoot systems operating with:
 - i. high load conditions
 - ii. low load conditions
 - iii. refrigerant overcharge
 - iv. refrigerant undercharge
 - v. restricted expansion valve

RF1401 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.

Duration: 30 Hours

Pre-Requisite(s): RF1221

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
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.

RF1331 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: 18 Hours

Pre-Requisite(s): RF1221

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.

RF1611 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: 30 Hours

Pre-Requisite(s): RF1221

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:

1. Replace blower belt, adjust and align.
2. Remove pulley/sheave, replace, align and adjust.
3. Troubleshoot electronic air cleaners.
4. Adjust blower fan speed.

RF1321 Control Fundamentals

Learning Outcomes:

- Demonstrate knowledge of control fundamentals.
- Demonstrate knowledge of controls, their components, applications and operation.

Duration: 24 Hours

Pre-Requisite(s): RF1281

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.

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.

RF1481 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.

Duration: 54 Hours

Pre-Requisite(s): RF1281

Objectives and Content:

1. Define terminology associated with control circuits and wiring diagrams.
2. Identify hazards and describe safe work practices pertaining to control circuits.
3. Interpret codes and regulations pertaining to control circuits.
4. Interpret information pertaining to control circuits found in drawings, wiring diagrams, and schematic diagrams.
5. Identify specialized tools and equipment used with control circuits, and describe their applications and procedures for use.
6. Explain the purpose and operation of control circuits and their components.
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
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. Sketch a schematic wiring diagram based on a written sequence of control events.
14. Sketch a schematic wiring diagram from a pictorial diagram.
15. Sketch a pictorial diagram from a schematic wiring diagram.

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.
3. Wire control circuits.

RF1810 Blueprints/Drawings and Specifications

Learning Outcomes:

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

Duration: 30 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'
3. Identify types of blueprints/drawings and describe their applications.
 - i. civil/site
 - ii. architectural
 - iii. mechanical
 - iv. structural
 - v. electrical
 - vi. shop drawings
 - vii. sketches
 - viii. as-built
4. Identify views used on blueprints/drawings.
 - i. elevation
 - ii. plan
 - iii. section
 - iv. 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. Perform conversions between the metric and imperial systems of measurement.
10. Perform a basic take-off from a blueprint/drawing.

Practical Requirements:

1. Sketch and interpret basic drawings and diagrams.

AP1101 Introduction to Apprenticeship

Learning Outcomes:

- Demonstrate knowledge of how to become a registered apprentice.
- Demonstrate knowledge of the steps to complete an apprenticeship program.
- Demonstrate knowledge of various stakeholders in the apprenticeship process.
- Demonstrate knowledge of the Red Seal Program.

Duration: 15 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define the following terms:
 - i. apprenticeship
 - ii. apprentice vs. registered apprentice
 - iii. Journeyperson vs. Certified Journeyperson
 - iv. Certificate of Apprenticeship
 - v. Certificate of Qualification
 - vi. Recognition of Prior Learning
 - vii. dual certification

2. Explain the apprenticeship system in Newfoundland and Labrador and the roles and responsibilities of those involved.
 - i. registered apprentice
 - ii. training institution
 - iii. employer
 - iv. Journeyperson
 - v. Department of Advanced Education and Skills
 - Industrial Training Section
 - Standards and Curriculum Section
 - vi. Provincial Trade Advisory Committees
 - vii. Provincial Apprenticeship and Certification Board

3. Identify the Conditions Governing Apprenticeship.
4. Describe the training and educational requirements.
 - i. pre-employment (entry level) training
 - ii. block release
 - iii. on-the-job
5. Explain the steps in the registered apprenticeship process.
 - i. criteria for eligibility
 - entrance requirements as per Conditions of Apprenticeship
 - employment
 - ii. registration process
 - application requirements
 - iii. Memorandum of Understanding
 - probation period
 - cancellation
 - iv. Record of Occupational Progress (Logbook)
 - signing off skills
 - recording hours
 - updating PDO on progress
 - v. class calls
 - schedule
 - EI Eligibility
 - Direct Entry
 - advanced level
 - vi. Block Exams
 - vii. progression
 - schedule
 - wage rates
 - viii. cancellation of apprenticeship
 - ix. Practical Examinations
 - x. Provincial and Interprovincial examinations
 - xi. certification
 - Certification of Apprenticeship
 - Certification of Qualification
 - Provincial certification
 - Interprovincial Red Seal endorsement

6. Explain the Interprovincial Standards Red Seal Program.
 - i. designated Red Seal trade
 - ii. the National Occupational Analysis (NOA)
 - iii. Interprovincial (IP) Red Seal Endorsement Examination
 - iv. relationship of NOA to IP Examination
 - v. qualification recognition and mobility
7. Identify the current financial incentives available to apprentices.
8. Explain the NL apprenticeship and trades certification division's out-of- province apprenticeship policy.

Practical Requirements:

1. Use the Provincial Apprenticeship and Trades Certification web site at www.gov.nl.ca/app to:
 - i. locate, download, and complete the Application for Apprenticeship and Memorandum of Understanding (MOU)
 - ii. locate, download, and complete the Out of Province registration forms
 - Application for Apprenticeship (out of province)
 - Letter of Understanding (LOU)
 - Acceptance of Conditions Letter
 - iii. locate, download, and complete the Work Experience Credits form
 - iv. identify the locations of all Industrial Training offices
 - v. locate and review the following learning resources relevant to the trade:
 - Study Guide
 - Exam Preparation Guide
 - Plan of Training
2. Use a logbook for this trade to:
 - i. identify the hours for the trade (in-school and on-the-job)
 - ii. identify the number of blocks
 - iii. identify the courses in each block
 - iv. identify the workplace skills to be completed and verified

3. Use the Red Seal Web site, <http://www.red-seal.ca> to retrieve the National Occupational Analyses (NOA) for this trade.
 - i. identify the following components of the NOA:
 - Trends
 - Scope
 - Key Competencies
 - Blocks
 - Tasks
 - Subtasks
 - Pie Charts
 - Table of Specifications

AM1100 Math Essentials

Note: It is recommended that AM1100 be delivered in the first semester of the Entry Level training program.

Learning Outcomes:

- Demonstrate knowledge of the numeracy skills required to begin the 2nd level math course.
- Demonstrate knowledge of mathematics as a critical element of the trade environment.
- Demonstrate knowledge of mathematical principles in trade problem solving situations.
- Demonstrate the ability to solve simple mathematical word problems.

Duration: 30 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor should use trade specific examples to reinforce the course objectives

1. Use multiplication tables from memory.
2. Perform whole number operations.
 - i. read, write, count, round off, add, subtract, multiply and divide whole numbers
3. Apply the order of operations in math problems.
4. Perform fraction and mixed number operations.
 - i. read, write, add, subtract, multiply and divide fractions

5. Perform decimal operations.
 - i. read, write, round off, add, subtract, multiply and divide decimals
6. Perform percent/decimal/fraction conversion and comparison.
 - i. convert between fractions, decimals and percents
7. Perform percentage operations.
 - i. read and write percentages
 - ii. calculate base, rates and percentages
8. Perform ratio and proportion operations.
 - i. use a ratio comparing two quantities with the same units
 - ii. use a proportion comparing two ratios
9. Use the imperial measurement system in math problems.
 - i. identify units of measurement for:
 - length
 - mass
 - area
 - volume
 - capacity
10. Use the metric measurement system in math problems.
 - i. identify units of measurement for:
 - length
 - mass
 - area
 - volume
 - capacity

Practical Requirements:

1. To emphasize or further develop specific knowledge objectives, students will be asked to complete practical demonstrations which confirm proper application of mathematical theory to job skills.

AM1290 Refrigeration Math Fundamentals

Learning Outcomes:

- Demonstrate knowledge of mathematical concepts in the performance of trade practices.
- Demonstrate knowledge of mathematics as a critical element of the trade environment.
- Demonstrate knowledge of solving mathematical word problems.
- Demonstrate knowledge of mathematical principles for the purposes of problem solving, job and materials estimation, measurement, calculation, system conversion, diagram interpretation and scale conversions, formulae calculations, and geometric applications.

Duration: 30 Hours

Pre-Requisite(s): AM1100

Objectives and Content:

The instructor is required to use trade specific examples to reinforce the course objectives.

1. Employ percent/decimal/fraction conversion and comparison in trade specific situations.
2. Apply ratios and proportions to trade specific problems.
3. Use the Imperial Measurement system in trade specific applications.
4. Use the Metric Measurement system in trade specific applications.
5. Complete Imperial/Metric conversions in trade specific situations.
 - i. convert between imperial and metric measurements
 - ii. convert to another unit within the same measurement system

6. Manipulate formulas using cross multiplication, dividing throughout, elimination, and substitution to solve trade specific problems, such as:
 - i. right angle triangles
 - ii. area
 - iii. volume
 - iv. perimeter

7. Perform calculations involving geometry that are relevant to the trade, such as:
 - i. angle calculations
 - ii. circle calculations

8. Use practical math skills to complete administrative trade tasks.
 - i. material estimation
 - ii. material costing
 - iii. time & labour estimates
 - iv. taxes & surcharges
 - v. markup & projecting revenue

Practical Requirements:

1. To emphasize or further develop specific knowledge objectives, students will be asked to complete practical demonstrations which confirm proper application of mathematical theory to job skills.

Note:

This course has been designated as NON-TRANSFERABLE to other trades programs, and NOT ELIGIBLE FOR PRIOR LEARNING ASSESSMENT. Students completing training in this trade program are required to complete this math course.

CM2160 Communication Essentials

Learning Outcomes:

- Demonstrate knowledge of the importance of well-developed writing skills in the workplace and in career development.
- Demonstrate knowledge of the purpose of various types of workplace correspondence.
- Demonstrate knowledge of the principles of effective workplace writing.
- Demonstrate knowledge of standard formats for letters and memos.
- Demonstrate knowledge of principles related to writing effective letters and memos.
- Demonstrate the ability to prepare and deliver an oral presentation.
- Demonstrate knowledge of the importance of effective interpersonal skills in the workplace.

Duration: 45 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor is expected to use trade specific examples to reinforce the course objectives.

1. Identify the principles for writing clear, concise, complete sentences and paragraphs which adhere to the conventions of grammar, punctuation, and mechanics.

2. Identify the principles of effective workplace writing.
 - i. describe the value of well-developed writing skills to career success
 - ii. discuss the importance of tone, and language or word choice in workplace communication, regardless of the circumstances
 - iii. demonstrate an awareness of cultural differences when preparing workplace correspondence
 - iv. describe the writing process as it applies to workplace communication
 - planning
 - writing

- editing/revising
 - v. identify the parts of a business letter and memo, and when each should be used in the workplace
 - vi. identify the standard formats for business letters and memos
 - vii. identify guidelines for writing sample letters and memos which convey:
 - acknowledgment
 - routine request
 - routine response
 - complaint
 - refusal
 - persuasive request
 - letters of appeal
- 3. Identify types of informal workplace documents.
 - i. identify types & purposes of reports
 - incident
 - process
 - progress
 - ii. identify common trade specific forms
 - iii. describe primary and secondary methods used to gather information
 - iv. discuss the importance of accuracy and completeness in reports and forms
- 4. Identify the elements of presentations used in the workplace.
 - i. identify presentation types
 - impromptu
 - informative
 - demonstration
 - persuasive
 - ii. identify the components of an effective presentation
 - eye contact
 - body language
 - vocal qualities
 - audience analysis
 - multimedia tools
 - keeping on topic

5. Demonstrate an understanding of interpersonal communications in the workplace.
 - i. identify listening techniques
 - ii. demonstrate an understanding of group dynamics
 - iii. describe the importance of contributing information and expertise in the workplace
 - iv. describe the importance of respectful and open communication in the workplace
 - v. identify methods to accept and provide feedback in a constructive and considerate manner
 - vi. explain the role of conflict in a group to reach solutions

6. Identify acceptable workplace uses of communication technologies.
 - i. cell / Smart Phone etiquette
 - ii. voice mail
 - iii. e-mail
 - iv. teleconferencing / videoconferencing for meetings and interviews
 - v. social networking
 - vi. other emerging technologies

Practical Requirements:

1. Write well-developed, coherent, unified paragraphs.
2. Write sample letters and memos.
3. Write one short informal report.
4. Complete a selection of at least 3 trade-related forms.
5. Deliver an effective oral presentation.

SD1760 Workplace Essentials

Note: It is recommended that SD1760 be delivered in the second half of the Entry Level training program.

Learning Outcomes:

- Demonstrate knowledge of workplace essentials in the areas of meetings, unions, workers compensation, workers' rights, and human rights.
- Demonstrate knowledge of good customer service practices.
- Demonstrate knowledge of effective job search techniques.

Duration: 45 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor is expected to use trade specific examples to reinforce the course objectives.

1. Identify common practices related to workplace meetings.
 - i. identify and discuss meeting format and preparation required for a meeting
 - ii. explain the purpose of an agenda
 - iii. explain the expected roles, responsibilities, and etiquette of meeting participants

2. Define unions and identify their role in the workplace.
 - i. identify the purpose of unions
 - ii. identify a common union structure
 - iii. identify the function of unions in this trade

3. Demonstrate an understanding of the Worker’s Compensation process.
 - i. describe the aims, objectives, regulations and benefits of the Workplace Health, Safety and Compensation Commission
 - ii. explain the role of the Workers Advisor
 - iii. explain the internal review process

4. Demonstrate an understanding of workers’ rights.
 - i. define labour standards
 - ii. identify regulations, including:
 - hours of work & overtime
 - termination of employment
 - minimum wages & allowable deductions
 - statutory holidays, vacation time, and vacation pay

5. Demonstrate an understanding of Human Rights issues.
 - i. examine the Human Rights Code and explain the role of the Human Rights Commission
 - ii. define harassment in various forms and identify strategies for prevention
 - direct
 - systemic
 - adverse effect
 - iii. identify gender and stereotyping issues in the workplace
 - iv. define basic concepts and terms related to workplace diversity including age, race, culture, religion, socio-economic status, and sexual orientation

6. Demonstrate an understanding of quality customer service.
 - i. explain why quality service is important
 - ii. identify barriers to quality customer service
 - iii. identify customer needs & common methods for meeting them
 - iv. identify and discuss the characteristics & importance of a positive attitude
 - v. identify the importance of demonstrating good communication skills including body language, listening, questioning, and when using electronic communication devices
 - vi. identify techniques for interacting with challenging customers to address complaints and resolve conflict

7. Demonstrate an understanding of effective job search techniques.
 - i. identify and explain employment trends, opportunities, and sources of employment
 - ii. identify and discuss essential skills for the trades as outlined by Human Resources and Skills Development Canada
 - iii. review job ads and identify the importance of fitting qualifications to job requirements
 - iv. identify the characteristics of effective resumes, the types of resumes, and principles of resume formatting
 - v. identify the characteristics of an effective cover letter
 - vi. identify the components of a portfolio, and discuss the value of establishing and maintaining a personal portfolio
 - vii. identify the common characteristics of the job interview process:
 - pre-interview preparation
 - interview conduct
 - post-interview follow up

Practical Requirements:

1. Create a resume.
2. Create a cover letter.
3. Participate in a mock job interview.

MC1060 Computer Essentials

Learning Outcomes:

- Demonstrate knowledge of computer systems and their operation.
- Demonstrate knowledge of popular software packages and their applications.
- Demonstrate knowledge of security issues related to computers.

Duration: 15 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor is expected to use trade specific examples to reinforce the course objectives.

1. Identify the major external components of a microcomputer system.
 - i. input devices
 - ii. output devices
 - iii. central control unit

2. Use operating system software.
 - i. start and quit a program
 - ii. use the help function
 - iii. use the find function
 - iv. maximize and minimize a window
 - v. use the task bar
 - vi. adjust desktop settings such as screen savers, screen resolution, and backgrounds
 - vii. shut down a computer

3. Perform file management commands.
 - i. create folders
 - ii. copy files and folders
 - iii. move files and folders
 - iv. rename files and folders
 - v. delete files and folders

4. Use word processing software to create documents.
 - i. enter text
 - ii. indent and tab text
 - iii. change text attributes (bold, underline, font, etc.)
 - iv. change layout format (margins, alignment, line spacing)
 - v. spell check and proofread
 - vi. edit text
 - vii. save document
 - viii. print document
 - ix. close document
 - x. retrieve documents

5. Use spreadsheet software to create spreadsheets.
 - i. enter data in cells
 - ii. create formulas to add, subtract, multiply and divide
 - iii. save spreadsheet
 - iv. print spreadsheet
 - v. close spreadsheet
 - vi. retrieve spreadsheet

6. Access the Internet.
 - i. access websites using the world wide web(www)
 - ii. identify examples of web browsers
 - iii. use search engines with common searching techniques
 - iv. describe security issues

7. Use electronic mail.
 - i. describe e-mail etiquette
 - grammar and punctuation
 - privacy and legal issues when sharing and forwarding e-mail
 - work appropriate content
 - awareness of employer policies
 - ii. manage e-mail using the inbox, sent, and deleted folders
 - iii. send an e-mail message with attachment(s)
 - iv. print e-mail

Practical Requirements:

None.

BLOCK II

RF2520 Refrigeration Load Calculations

Learning Outcomes:

- Demonstrate knowledge of refrigeration load calculations.

Duration: 24 Hours

Pre-Requisite(s): Block I

Objectives and Content:

1. Define terminology associated with refrigeration load calculations.
2. 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 and BTU/h load required for:
 - i. air defrost
 - ii. electric defrost
 - iii. hot gas defrost

RF2530 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.

Duration: 36 Hours

Pre-Requisite(s): Block I

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

8. Identify the factors to consider when designing and laying out refrigeration systems.
9. Identify the factors to consider when selecting equipment, components and accessory devices for refrigeration systems based on design criteria.
10. Explain the importance of balancing system capacity with system load.
11. Identify the factors to consider when selecting refrigerant based on design criteria.
12. Identify the factors to consider when sizing pipe for refrigeration piping systems.
13. Describe the procedures used to size pipe for refrigeration piping systems.
14. Sketch piping schematics for refrigeration systems.
15. Sketch electrical schematics for refrigeration systems.

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 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): Block I

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 screw

- iii. open drive
 - iv. semi-hermetic
 - v. magnetic bearing
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): Block I

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 heating systems and describe their characteristics and applications.
 - i. forced-air
 - ii. hydronic
 - iii. electric

8. Identify types of heating system equipment, components and accessories, and describe their characteristics and applications.
9. Identify the factors to consider when selecting and installing heating system equipment, components and accessories.
10. Describe the procedures used to install heating system equipment, components and accessories.
11. Describe the procedures used to maintain and troubleshoot heating systems and their equipment, components and accessories.
12. Identify heating system failures and describe their causes and procedures for repair.
13. Describe the procedures used to start up, commission and shut down heating systems.

Practical Requirements:

None

RF2730 Commercial Refrigeration Systems

Learning Outcomes:

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

Duration: 36 Hours

Pre-Requisite(s): Block I

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 specialized tools and equipment used with commercial refrigeration systems, and describe their applications and procedures for use.
6. Explain the purpose and operation of commercial refrigeration systems and their components.
7. 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
8. Identify types of commercial refrigeration system components, and describe their characteristics and applications.
 9. Identify types of commercial refrigeration defrost systems, and describe their characteristics and applications.
 - i. hot gas
 - ii. electric
 - iii. latent heat
 10. Identify commercial refrigeration defrost system components, and describe their characteristics and applications.
 11. Identify the factors that optimize shelf life and quality of refrigerated and frozen products.
 12. Identify the factors to consider when selecting and installing commercial refrigeration systems and their components.
 13. Describe the procedures used to install commercial refrigeration systems and their components.
 14. Describe the procedures used to maintain and troubleshoot commercial refrigeration systems and their components.
 15. Identify commercial refrigeration system and component failures, and describe their causes and procedures for repair.
 16. Describe the procedures used to start up, commission and shut down commercial refrigeration systems.

Practical Requirements:

None

RF2510 Split Air Conditioning Systems

Learning Outcomes:

- Demonstrate knowledge of split air conditioning systems, their components and operation.
- Demonstrate knowledge of the procedures used to 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): Block I

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 specialized tools and equipment used with split air conditioning systems, and describe their applications and procedures for use.
6. Explain the purpose and operation of split air conditioning systems and their components.
7. Identify types of split air conditioning systems, and describe their characteristics and applications.
 - i. residential
 - ii. commercial
 - iii. industrial

8. Identify types of split air conditioning system components, and describe their characteristics and applications.
9. Identify the factors to consider when selecting and installing split air conditioning systems and components.
10. Describe the procedures used to install split air conditioning systems and their components.
11. Describe the procedures used to maintain and troubleshoot split air conditioning systems and their components.
12. Identify split air conditioning system and component failures, and describe their causes and procedures for repair.
13. Describe the procedures used to start up, commission and shut down split air conditioning systems.

Practical Requirements:

None

RF2540 Packaged Air Conditioning Systems

Learning Outcomes:

- Demonstrate knowledge of packaged air conditioning systems, their components and operation.
- Demonstrate knowledge of the procedures used to 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.

Duration: 30 Hours

Pre-Requisite(s): Block I

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.
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 specialized tools and equipment used with packaged air conditioning systems, and describe their applications and procedures for use.
6. Explain the purpose and operation of packaged air conditioning systems and their components.
7. Identify types of packaged air conditioning systems and describe their characteristics and applications.
 - i. residential
 - ii. commercial
 - iii. industrial

8. Identify packaged air conditioning system components and describe their characteristics and applications.
 - i. economizer
 - ii. indoor air quality components
9. Identify the factors to consider when selecting and installing packaged air conditioning systems and their components.
10. Describe the procedures used to install packaged air conditioning systems and their components.
11. Describe the procedures used to maintain and troubleshoot packaged air conditioning systems and their components.
12. Identify packaged air conditioning system and component failures, and describe their causes and procedures for repair.
13. Describe the procedures used to start-up, commission and shut-down packaged air conditioning systems.

Practical Requirements:

None

RF1600 Heat Pump Systems

Learning Outcomes:

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

Duration: 30 Hours

Pre-Requisite(s): Block I

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
8. Identify heat pump equipment and components 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. Identify the environmental considerations when installing heat pumps.
14. Describe the procedures used to install heat pump systems and their components.
15. Describe the procedures used to maintain and troubleshoot heat pumps and their components.
16. Identify heat pump system failures and describe their causes and procedures for repair.

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

Practical Requirements:

None

BLOCK III

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): Block II

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 specialized tools and equipment used with fluid dynamics and pumps, and describe their applications and procedures for use.
6. Explain the principles of fluid dynamics.
7. Explain the purpose and operation of liquid pumps and their components.
8. Identify types of pumps and describe their characteristics and applications.

9. Identify pump components and describe their characteristics and applications.
10. Identify the factors to consider when selecting and installing pumps and their components.
 - i) system parameters
 - ii) pump curves
 - iii) circuit configurations
11. Describe the procedures used to install pumps and their components.
12. Describe the procedures used to maintain and troubleshoot pumps and their components.
13. Identify pump and component failures and describe their causes and procedures for repair.
14. Describe the procedures used to fill, start up and commission pump systems.
15. Describe the procedures used to purge air from an open or closed pump system.

Practical Requirements:

None

RF3750 Control Systems

Learning Outcomes:

- Demonstrate knowledge of control systems, their components and operation.
- 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.

Duration: 42 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with control systems.
2. Identify hazards and describe safe work practices pertaining to control systems.
3. Interpret codes and regulations pertaining to control systems.
4. Interpret information pertaining to control systems found on drawings and specifications.
5. Identify specialized tools and equipment used with control systems, and describe their applications and procedures for use.
6. Identify system control strategies and describe their characteristics and applications.
 - i. two position control
 - ii. floating control
 - iii. pulse width modulation
 - iv. proportional (P)
 - v. proportional plus integral (PI)
 - vi. proportional plus integral plus derivative (PID)

7. Explain how to incorporate various control strategies into control systems.
 - i. electric
 - ii. electronic
 - iii. pneumatic
 - iv. direct digital control (DDC)
8. Identify the factors to consider when selecting and installing control systems and their components.
9. Describe the procedures used to install control systems and their components.
10. Describe the procedures used to maintain and troubleshoot control systems and their components.
11. Identify control system failures and describe their causes and procedures for repair.
12. Describe the procedures used to calibrate operating and safety controls.
13. Describe the procedures used to start up and commission control systems.
14. Describe the application, operation, service, maintenance and troubleshooting of an economizer.

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.

Duration: 42 Hours

Pre-Requisite(s): Block II

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.

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.

Duration: 30 Hours

Pre-Requisite(s): Block II

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 specialized tools and equipment used with complex motors and motor controls, and describe their applications and procedures for use.
6. Explain the purpose and operation of complex motors and motor controls and their components.

7. Identify types of complex motors and their components, and describe their characteristics and applications.
 - i. multi-lead
 - ii. dual-voltage
 - iii. multi-speed
8. Identify types of motor controls for complex motors, and describe their characteristics, applications and wiring configuration.
9. Describe the methods used to change the speed of a motor.
 - i. multi-tap
 - ii. variable frequency drive (VFD)
10. Identify the factors to consider when selecting and installing complex motors, their components and motor controls.
11. Describe the procedures used to install complex motors and their components.
12. Describe the procedures used to maintain and troubleshoot complex motors and their components.
13. Describe the procedures used to install motor controls.
14. Describe the procedures used to maintain and troubleshoot motor controls.
15. Identify complex motor and motor control failures, and describe their causes and procedures for repair.
16. 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.

Duration: 30 Hours

Pre-Requisite(s): Block II

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.

Practical Requirements:

None

RF1660 Air Conditioning Load Calculations

Learning Outcomes:

- Demonstrate knowledge of air conditioning load calculations.

Duration: 15 Hours

Pre-Requisite(s): Block II

Objectives and Content:

1. Define terminology associated with air conditioning load calculations.
2. 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. dehumidification
 - viii. humidification
 - ix. sensible cooling
 - x. sensible heating
4. Describe the changes in air properties for the following situations:
- i. sensible heating and cooling
 - ii. heating and humidification
 - iii. cooling and dehumidification
 - iv. air mixing
 - v. evaporative cooling

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.

Duration: 36 Hours

Pre-Requisite(s): Block II

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. Interpret information pertaining to air conditioning system design found on drawings, specifications, graphs and tables.
5. Identify capacity ratings of air conditioning system components.
6. Identify methods of zoning and describe their applications.

7. 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
8. Identify the factors to consider for the design and layout of air conditioning systems.
9. Identify the factors to consider when selecting equipment, components and accessory devices for air conditioning systems based on design criteria.
10. Explain the importance of balancing system capacity with system load.
11. Identify the factors to consider when sizing pipe for air conditioning systems.
12. Describe the procedures used to size pipe for air conditioning systems.
13. Sketch piping schematics for air conditioning systems.
14. Sketch electrical schematics for air conditioning systems.
15. Describe ventilation air and discuss the recommended ventilation air quantities required for various applications.
16. 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)
17. Describe the effect on air conditioning system efficiency including:
 - i. capacity control
 - ii. system control

- iii. economizers
 - outside air temperature changeover
 - enthalpy control changeover
 - iv. heat recovery
 - run around loop
 - heat wheel
 - heat pipes
18. 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

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.

Duration: 30 Hours

Pre-Requisite(s): Block II

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 install duct system components.
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.

Practical Requirements:

1. Size a duct system.

BLOCK IV

RF4420 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: 36 Hours

Pre-Requisite(s): Block III

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.

Duration: 30 Hours

Pre-Requisite(s): Block III

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. 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

8. Describe the procedures used in system air balancing.
9. Perform calculations for system air balancing.

Practical Requirements:

None

RF4720 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.

Duration: 48 Hours

Pre-Requisite(s): Block III

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 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 install chillers, chiller systems, and their associated components.

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

15. Identify chiller and chiller system failures, and describe their causes and procedures for repair.
16. Describe the procedures used to start up, commission and shut down chillers and chiller systems.

Practical Requirements:

None

RF4790 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: 48 Hours

Pre-Requisite(s): Block III

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.
13. Describe the procedures used to install industrial refrigeration systems and their components.
14. Describe the procedures used to maintain and troubleshoot industrial refrigeration systems and their components.
15. Identify industrial refrigeration system and component failures, and describe their causes and procedures for repair.
16. Describe the procedures used to start up, commission and shut down industrial refrigeration 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.

RF4640 Troubleshooting With Schematic Wiring Diagrams

Learning Outcomes:

- Demonstrate knowledge of advanced schematic wiring diagrams and their use in troubleshooting complex systems.

Duration: 54 Hours

Pre-Requisite(s): Block III

Objectives and Content:

1. Define terminology associated with schematic wiring diagrams.
2. Interpret advanced schematic wiring diagrams for use in troubleshooting complex systems.
 - i. manufacturers' drawings
 - ii. as-built drawings
3. Identify troubleshooting techniques using advanced schematic wiring diagrams and describe their associated procedures.
4. Describe the difference between a pictorial wiring diagram and a schematic (ladder) wiring diagram.

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.

RF4000 Job Coordination

Learning Outcomes:

- Demonstrate knowledge of effective job coordinating practices.
- Demonstrate knowledge of equipment and material acquisition.

Duration: 24 Hours

Pre-Requisite(s): Block III

Objectives and Content:

1. Define terminology associated with job 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

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

D. 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			
Year	Wage Rate At This Level	Requirements for progression to next level of apprenticeship	When requirements are met, the apprentice will progress to...
1 st	60 %	<ul style="list-style-type: none"> ▪ Completion of Block 1 training ▪ Pass Block 1 exam ▪ Minimum 1800 hours of combined relevant work experience and training 	2 nd Year
2 nd	70%	<ul style="list-style-type: none"> ▪ Completion of Block 2 training ▪ Pass Block 2 exam ▪ Minimum 3600 hours of combined relevant work experience and training 	3 rd Year
3 rd	80%	<ul style="list-style-type: none"> ▪ Completion of Block 3 training ▪ Pass Block 3 exam ▪ Minimum 5400 hours of combined relevant work experience and training 	4 th Year
4 th	90%	<ul style="list-style-type: none"> ▪ Completion of Block 4 training ▪ Minimum 7200 hours of combined relevant work experience and training ▪ Sign-off of all workplace skills in apprentice logbook ▪ Pass certification exam 	Journey person Certification
<p>Wage Rates</p> <ul style="list-style-type: none"> ▪ Rates are percentages of the prevailing journey person'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. <p>Block Exams</p> <ul style="list-style-type: none"> ▪ This program may not currently contain Block Exams, in which case this requirement will be waived until such time as Block Exams are available. 			

Refrigeration and Air Conditioning Mechanic - 7200 Hours		
CLASS CALLS		
Call Level	Requirements for Class Call	Hours awarded for In-School Training
Direct Entry Apprentice: PLA & / or Block 1	<ul style="list-style-type: none"> ▪ Minimum of 1000 hours of relevant work experience ▪ Prior Learning Assessment (PLA) at designated college (if applicable) 	To be determined by the number of courses completed after each class call
Block 2	<ul style="list-style-type: none"> ▪ Minimum of 3000 hours of relevant work experience and training 	240
Block 3	<ul style="list-style-type: none"> ▪ Minimum of 5000 hours of relevant work experience and training 	240
Block 4	<ul style="list-style-type: none"> ▪ Minimum of 7000 hours of relevant work experience and training 	240
<p>Direct Entry Apprentice</p> <ul style="list-style-type: none"> ▪ Must complete Block 1 courses through PLA and / or in-school training. ▪ Block 1 training is to be completed via class calls; up to 16 weeks of training per calendar year. ▪ Must attend in-school training until Block 1 is complete before attending Blocks 2 or higher <p>Class Calls at Minimum Hours</p> <ul style="list-style-type: none"> ▪ 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 Advanced Education and Skills within 30 days of the decision.

E. 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 9000 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.

F. 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 journeyman.
- 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 journeyman is currently on staff in the same trade area as the apprentice and whose certification is recognized by the NL Department of Advanced Education and Skills.

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 block, 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.