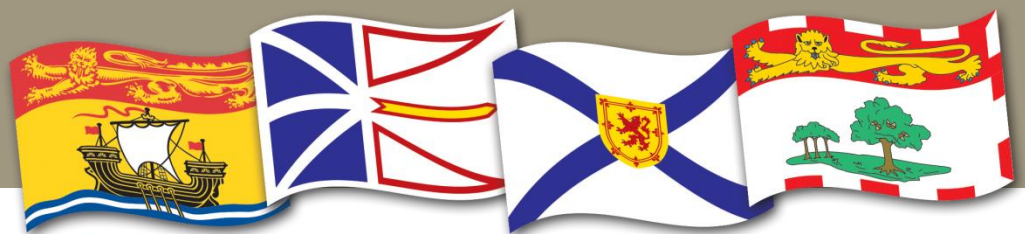


REFRIGERATION AND AIR CONDITIONING MECHANIC

Version: 2021

Revised: N/A



Atlantic Apprenticeship Curriculum Standard

Refrigeration and Air Conditioning Mechanic

Preface

This Atlantic Apprenticeship Curriculum Standard is intended to assist instructional staff in the design and delivery of technical, in-class training in support of Refrigeration and Air Conditioning Mechanic program.

This document contains all the technical training elements required to complete the Refrigeration and Air Conditioning Mechanic apprenticeship program and has been developed based on the 2019 Red Seal Occupational Standard (RSOS). The RSOS can be found on the Red Seal website (www.red-seal.ca).

Implementation of this AACCS for Apprenticeship training is outlined in the following table.

Level	Implementation Effective
Level 1	2022-2023
Level 2	2023-2024
Level 3	2024-2025
Level 4	2025-2026

**** The above implementation schedule was current at time of printing. Please confirm with Apprenticeship Staff prior to commencing training.**

Granting of credit or permission to challenge level examinations for pre-employment or pre-apprenticeship training for the Refrigeration and Air Conditioning Mechanic trade will be based on the content outlined in this standard. Training providers must contact their provincial apprenticeship authority for more information on the process and requirements for determining eligibility for credit towards an apprenticeship program. Programs which have been deemed acceptable by the jurisdictional apprenticeship authority will be identified in transfer credit matrix developed through the Atlantic Apprenticeship Harmonization Project.

Acknowledgements

The development of the Atlantic Apprenticeship Curriculum Standard (AACS) is an initiative of the Atlantic Apprenticeship Council's Atlantic Apprenticeship Harmonization Project (AAHP) through the Atlantic Workforce Partnership and Employment and Social Development Canada.

The Atlantic Apprenticeship Council wishes to acknowledge the contributions of the following industry and instructional representatives on the Atlantic Trade Advisory Committee (ATAC) who participated in the development of this document in October, 2020.

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User Guide

Atlantic Apprenticeship Curriculum Standards (AACS) are developed based on Red Seal Occupational Standards (RSOS), National Occupational Analyses (NOA), Interprovincial Program Guides (IPG), if available, and extensive industry consultation. This document represents the minimum content to be delivered as part of the harmonized Atlantic program for the Refrigeration and Air Conditioning Mechanic trade.

The AACS's are deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. They detail units of training, unit outcomes and objectives. They do not impose a delivery model or teaching format.

Jurisdictions and/or training providers will select and develop delivery materials and techniques that accommodate a variety of learning styles and delivery patterns. The AACS does not dictate study materials, textbooks or learning activities to be used in delivery.

The document includes a Level Structure to facilitate mobility for apprentices moving from one jurisdiction to another.

Structure

The content of the AACS is divided into units. Unit codes are used as a means of identification and are not intended to convey the order of delivery. It is at the discretion of the training provider to deliver the content in the required logical sequence of delivery within the level. Jurisdictions are free to deliver units one at a time or concurrently within a level, provided all outcomes are met.

The Learning Outcomes describe what the apprentice should know or be able to do at the end of training. Wording of the Learning Outcomes, "Demonstrate knowledge of..." acknowledges the broad spectrum of ways in which knowledge can be assessed, i.e, practical projects, multiple choice testing, presentations, etc.) by instructional staff within the training.

Summative evaluation will be through a multiple-choice Level Examination administered through the jurisdictional Apprenticeship Authority.

User Guide (continued)

The 2019 Red Seal Occupational Standard (RSOS) to AACS Comparison chart outlines the relation between each RSOS sub-task and the AACS units. RSOS References have also been detailed in each unit to highlight the direct link between the unit and relevant sub-tasks in the RSOS.

In the Level Structure section, the document identifies suggested hours in order to provide an indication of the time it should take to cover the material in the unit and is provided as a guide only. Adjustments to the suggested hours for each unit may be required to account for rate of apprentice learning, statutory holidays, storm days, registration and examinations. These suggested hours detailed for each unit will represent both theory and practical training (if relevant) and for consistency will be based on a standard of 30 hours per week of training. The true length of time required to deliver an outcome successfully will depend upon the learning activities and teaching methods used.

There are two types of objectives found in the AACS document: theoretical and practical.

The theoretical objectives represent the material that is to be covered during the technical training in order to convey the required knowledge to the apprentice.

The practical objectives represent the tasks or skills that have been deemed by the Atlantic Trade Advisory Committee as critical for the apprentices to receive exposure to while attending technical training. For example, exposure could be done through instructor demonstration or individual or group performance of the skill or task. Training providers are encouraged to use practical demonstration and opportunities for hands-on learning whenever possible. Practical objectives are not intended to replace the on-the-job training component of the apprentice's program or to mirror or replace the logbook skills that are to be taught and evaluated in the workplace.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided.

Glossary of Terms

These definitions are intended as a guide to how language is used in the document.

Adjust	To put in good working order; regulate; bring to a proper state or position.
Application	The use to which something is put and/or the circumstance in which an individual would use it.
Characteristic	A feature that helps to identify, tell apart or describe recognizably; a distinguishing mark or trait.
Component	A part that can be separated from or attached to a system; a segment or unit.
Define	To state the meaning of (a word, phrase, etc.).
Describe	To give a verbal account of; tell about in detail.
Explain	To make plain or clear; illustrate; rationalize.
Identify	To point out or name objectives or types.
Interpret	To translate information from observation, charts, tables, graphs and written material.
Maintain	To keep in a condition of good repair or efficiency.
Method	A means or manner of doing something that has procedures attached to it.
Operate	How an object works; to control or direct the functioning of.
Procedure	A prescribed series of steps taken to accomplish an end.
Purpose	The reason for which something exists or is done, made or used.

Glossary of Terms (continued)

Service

Routine inspection and replacement of worn or deteriorating parts.

An act or business function provided to a customer in the course of an individual's profession (e.g., haircut).

Technique

Within a procedure, the manner in which technical skills are applied.

Test

v) To subject to a procedure that ascertains effectiveness, value, proper function or other quality.

n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.

Essential Skills Profiles

Through extensive research, the Government of Canada and other national and international agencies have identified and validated key essential skills for the workplace. These skills are used in nearly every job and at different levels of complexity. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Essential Skills Profiles describe how workers in various occupations use each of the key essential skills. They include:

- a brief description of the occupation;
- examples of tasks that illustrate how each essential skill is applied; and,
- complexity ratings that indicate the level of difficulty of the example tasks.

Essential Skills profiles can be found on the Employment and Social Development Canada (ESDC) website at www.canada.ca/skills-success.

The development and improvement of these Essential Skills is inherent throughout the apprenticeship training program as apprentices work towards achieving journeyperson status.

Recommended Atlantic Level Structure

Level 1 - 8 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
RACM-100	Safety	9	28	1. Perform a lock-out tag-out procedure.
RACM-105	Tools and Equipment	6	32	N/A
RACM-110	Access Equipment	3	35	1. Inspect an extension ladder. 2. Set up an extension ladder.
RACM-115	Hoisting, Lifting and Rigging	9	37	1. Perform basic hand signals.
RACM-120	Refrigeration Fundamentals	21	40	1. Perform refrigeration calculations.
RACM-125	Refrigerants, Gases and Oils	21	43	N/A
RACM-130	Compressors I	12	46	N/A
RACM-135	Valves and Accessory Devices	12	48	N/A
RACM-140	Piping, Tubing, Soldering and Brazing	24	50	1. Cut, bend, flare, solder and braze tubing. 2. Connect and fasten tubing and fittings. 3. Fabricate a bracket or support.
RACM-145	Leak Testing, Evacuation and Charging	24	53	1. Perform a pressure and leak test. 2. Instructor demonstration of evacuation and charging the system.
RACM-150	Electrical Fundamentals	21	56	N/A
RACM-155	Motors I	15	58	1. Test motor winding resistance. 2. Test capacitors.
RACM-160	Trade Documentation	6	60	N/A
RACM-165	Basic Refrigeration and Air Conditioning Installation	30	62	N/A
RACM-170	Basic System Maintenance	12	66	N/A
RACM-175	Control Fundamentals	9	68	N/A
RACM-180	Communications	3	70	N/A
RACM-185	Workplace Mentoring I	3	73	N/A

Level 2 - 8 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
RACM-200	Drawings and Specifications	9	76	1. Perform a basic material take-off from a drawing.
RACM-205	Pressure Enthalpy Diagrams	24	78	N/A
RACM-210	Evaporators	18	80	N/A
RACM-215	Compressors II	18	83	1. Disassemble a compressor and diagnose cause of failure.
RACM-220	Condensers	18	86	1. Select condensers based on a given design criteria.
RACM-225	Metering Devices	18	88	1. Select metering devices based on given design criteria.
RACM-230	Refrigerant Flow Controls and Accessory Devices	18	90	N/A

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
RACM-235	Air Conditioning Fundamentals	18	92	N/A
RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners	21	94	N/A
RACM-245	Control Systems I	21	97	N/A
RACM-250	Motors II	21	99	N/A
RACM-255	Control Circuits and Wiring Diagrams	24	102	N/A
RACM-260	Refrigerant Recovery Techniques	12	104	N/A

Level 3 - 7 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
RACM-300	Refrigeration Load Calculations	30	108	N/A
RACM-305	Refrigeration System Design	18	110	1. Develop piping schematics for refrigeration systems. 2. Develop electrical schematics and wiring diagrams for refrigeration systems.
RACM-310	Compressors III (Large Commercial/Industrial Compressors)	18	112	N/A
RACM-315	Evaporative Condenser & Cool Towers	18	114	N/A
RACM-320	Fluid Dynamics and Circulating Pumps	15	116	N/A
RACM-325	Commercial Refrigeration Systems	24	118	N/A
RACM-330	Air Conditioning Systems	18	121	N/A
RACM-335	Packaged Air Conditioning Units	18	123	N/A
RACM-340	Heat Pump Systems	18	125	N/A
RACM-345	Control Systems II	18	128	N/A
RACM-350	Troubleshooting Refrigeration and Air Conditioning Electronics	15	131	N/A

Level 4 - 8 Weeks

Unit Code	Unit Title	Sugg Hrs*	Pg #	Practical Objectives*
RACM-400	Air Conditioning Load Calculations	24	134	1. Perform air condition. load calculations.
RACM-405	Air Conditioning System Design	24	135	1. Sketch pipe and electrical schematics for air conditioning systems.
RACM-410	Duct Systems and Design	24	137	N/A
RACM-415	Air Measurement & System Air Balance	24	139	1. Perform system air balance calculations.
RACM-420	Heating Systems	18	141	N/A
RACM-425	Chillers and Chiller Systems	24	143	1. Perform range & approach calculations.
RACM-430	Industrial Refrigeration Systems	24	147	N/A
RACM-435	Troubleshoot w/ Schem Wiring Diagrams	36	150	N/A
RACM-440	Job Coordination	6	151	N/A
RACM-445	Workplace Mentoring II	6	153	N/A
RACM-450	Program Review	30	155	N/A

***Suggested Hours:** The time it should take to cover the unit (a guide only).

***Practical Objectives:** The tasks/skills apprentices must be exposed to during technical training. An individual or group performance of the task/skill is recommended; if not possible, an instructor demonstration is acceptable. Training Providers should use practical, hands-on learning whenever possible, whether identified in the curriculum as a practical objective or not.

2019 RSOS Sub-Task to AACS Unit Comparison

RSOS Sub-Task		AACS Unit	
TASK A-1 – Performs safety-related functions.			
1.01	Maintains safe work environment.	RACM-100	Safety
1.02	Performs lock-out, tag-out and isolation procedures.	RACM-100	Safety
1.03	Uses personal protective equipment (PPE) and safety equipment.	RACM-100	Safety
Task A-2 – Uses tools and equipment.			
2.01	Uses hand tools.	RACM-105	Tools and Equipment
2.02	Uses portable and stationary power tools.	RACM-105	Tools and Equipment
2.03	Uses brazing and soldering equipment.	RACM-140	Piping, Tubing, Soldering and Brazing
2.04	Uses recovery and recycling tools and equipment.	RACM-125	Refrigerants, Gases and Oils
		RACM-260	Refrigerant Recovery Techniques
2.05	Uses evacuation tools and equipment.	RACM-145	Leak Testing, Evacuation and Charging
2.06	Uses charging tools and equipment.	RACM-145	Leak Testing, Evacuation and Charging
2.07	Uses diagnostic and measuring tools and equipment.	RACM-105	Tools and Equipment
		RACM-235	Air Conditioning Fundamentals
2.08	Uses access equipment.	RACM-110	Access Equipment
2.09	Uses rigging, hoisting and lifting equipment.	RACM-115	Hoisting, Lifting and Rigging
2.10	Uses digital technology.	RACM-105	Tools and Equipment
		RACM-180	Communications
		RACM-300	Refrigeration Load Calculations
		RACM-305	Refrigeration System Design
		RACM-345	Control Systems II
		RACM-405	Air Conditioning System Design
Task A-3 – Organizes work.			
3.01	Interprets drawings and specifications.	RACM-200	Drawings and Specifications
		RACM-300	Refrigeration Load Calculations
		RACM-440	Job Coordination
3.02	Uses documentation and reference material.	RACM-160	Trade Documentation
		RACM-200	Drawings and Specifications
		RACM-205	Pressure Enthalpy Diagrams
		RACM-235	Air Conditioning Fundamentals
		RACM-300	Refrigeration Load Calculations
		RACM-440	Job Coordination

RSOS Sub-Task		AACs Unit	
3.03	Plans job tasks and procedures.	RACM-180	Communications
		RACM-440	Job Coordination
Task A-4 - Uses communication and mentoring techniques.			
4.01	Uses communication techniques.	RACM-185	Workplace Mentoring I
		RACM-180	Communications
		RACM-440	Job Coordination
4.02	Uses mentoring techniques.	RACM-185	Workplace Mentoring I
		RACM-445	Workplace Mentoring II
Task B-5 - Performs work site preparation.			
5.01	Prepares work site.	RACM-100	Safety
		RACM-165	Basic Refrigeration and Air Conditioning Installation
		RACM-300	Refrigeration Load Calculations
5.02	Handles materials and supplies.	RACM-100	Safety
		RACM-165	Basic Refrigeration and Air Conditioning Installation
Task B-6 - Performs trade activities.			
6.01	Performs brazing and soldering.	RACM-140	Piping, Tubing, Soldering and Brazing
6.02	Performs leak and pressure tests on system.	RACM-145	Leak Testing, Evacuation and Charging
6.03	Evacuates systems.	RACM-145	Leak Testing, Evacuation and Charging
6.04	Uses refrigerants, gases and oils.	RACM-125	Refrigerants, Gases and Oils
		RACM-260	Refrigerant Recovery Techniques
6.05	Performs field wiring of systems.	RACM-150	Electrical Fundamentals
		RACM-255	Control Circuits and Wiring Diagrams
6.06	Applies sealants and adhesives.	RACM-140	Piping, Tubing, Soldering and Brazing
Task C-7 - Plans installation of HVAC/R systems.			
7.01	Verifies HVAC/R system parameters and requirements.	RACM-120	Refrigeration Fundamentals
		RACM-235	Air Conditioning Fundamentals
		RACM-300	Refrigeration Load Calculations
		RACM-305	Refrigeration System Design
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-400	Air Conditioning Load Calculations
RACM-405	Air Conditioning System Design		

RSOS Sub-Task		AACS Unit	
		RACM-410	Duct Systems and Design
		RACM-430	Industrial Refrigeration Systems
7.02	Selects HVAC/R equipment, components and accessories.	RACM-130	Compressors I
		RACM-135	Valves and Accessory Devices
		RACM-150	Electrical Fundamentals
		RACM-210	Evaporators
		RACM-155	Motors I
		RACM-215	Compressors II
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II
		RACM-305	Refrigeration System Design
		RACM-310	Compressors III (Large Commercial/ Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-340	Heat Pump Systems
		RACM-405	Air Conditioning System Design
		RACM-410	Duct Systems and Design
RACM-420	Heating Systems		
RACM-425	Chillers and Chiller Systems		
RACM-430	Industrial Refrigeration Systems		
7.03	Determines placement of HVAC/R equipment, components and accessories.	RACM-165	Basic Refrigeration and Air Conditioning Installation
		RACM-210	Evaporators
		RACM-215	Compressors II
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II
RACM-305	Refrigeration System Design		

RSOS Sub-Task		AACS Unit	
		RACM-310	Compressors III (Large Commercial/ Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-340	Heat Pump Systems
		RACM-405	Air Conditioning System Design
		RACM-410	Duct Systems and Design
		RACM-420	Heating Systems
		RACM-425	Chillers and Chiller Systems
		RACM-430	Industrial Refrigeration Systems
7.04	Performs HVAC/R material take-off.	RACM-210	Evaporators
		RACM-215	Compressors II
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II
		RACM-305	Refrigeration System Design
		RACM-310	Compressors III (Large Commercial/ Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
Task C-8 - Plans installation of control systems.			
8.01	Verifies control system parameters and requirements.	RACM-305	Refrigeration System Design
		RACM-325	Commercial Refrigeration Systems
		RACM-345	Control Systems II
		RACM-350	Troubleshooting Refrigeration and Air Conditioning Electronics
		RACM-405	Air Conditioning System Design
		RACM-430	Industrial Refrigeration Systems
8.02	Selects control system components and accessories.	RACM-175	Control Fundamentals
		RACM-250	Motors II

RSOS Sub-Task		AACS Unit	
		RACM-255	Control Circuits and Wiring Diagrams
		RACM-325	Commercial Refrigeration Systems
		RACM-345	Control Systems II
		RACM-405	Air Conditioning System Design
		RACM-430	Industrial Refrigeration Systems
8.03	Determines placement of control system components and accessories.	RACM-175	Control Fundamentals
		RACM-245	Control Systems I
		RACM-250	Motors II
		RACM-255	Control Circuits and Wiring Diagrams
		RACM-325	Commercial Refrigeration Systems
		RACM-345	Control Systems II
		RACM-405	Air Conditioning System Design
8.04	Performs control system material take-off.	RACM-250	Motors II
		RACM-255	Control Circuits and Wiring Diagrams
		RACM-325	Commercial Refrigeration Systems
		RACM-345	Control Systems II
		RACM-430	
Task D-9 - Installs HVAC/R systems.			
9.01	Confirms system layout.	RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
9.02	Assembles HVAC/R equipment, components and accessories.	RACM-210	Evaporators
		RACM-215	Compressors II
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II
		RACM-310	Compressors III (Large Commercial/ Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
		RACM-320	Fluid Dynamics and Circulating Pumps

RSOS Sub-Task		AACS Unit	
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-340	Heat Pump Systems
		RACM-410	Duct Systems and Design
		RACM-420	Heating Systems
		RACM-425	Chillers and Chiller Systems
		RACM-430	Industrial Refrigeration Systems
9.03	Places HVAC/R equipment, components and accessories.	RACM-165	Basic Refrigeration and Air Conditioning Installation
		RACM-215	Compressors II
		RACM-210	Evaporators
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II
		RACM-310	Compressors III (Large Commercial/ Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-340	Heat Pump Systems
		RACM-410	Duct Systems and Design
		RACM-420	Heating Systems
RACM-425	Chillers and Chiller Systems		
RACM-430	Industrial Refrigeration Systems		
9.04	Installs fasteners, brackets and hangers.	RACM-140	Piping, Tubing, Soldering and Brazing
9.05	Installs HVAC/R piping and tubing.	RACM-140	Piping, Tubing, Soldering and Brazing
		RACM-165	Basic Refrigeration and Air Conditioning Installation
9.06	Applies HVAC/R holding charge.	RACM-145	Leak Testing, Evacuation and Charging

RSOS Sub-Task		AACs Unit	
Task D-10 - Installs control systems			
10.01	Places control system components.	RACM-175	Control Fundamentals
		RACM-245	Control Systems I
		RACM-250	Motors II
		RACM-255	Control Circuits and Wiring Diagrams
		RACM-345	Control Systems II
		RACM-430	Industrial Refrigeration Systems
10.02	Connects control systems.	RACM-175	Control Fundamentals
		RACM-245	Control Systems I
		RACM-250	Motors II
		RACM-255	Control Circuits and Wiring Diagrams
		RACM-345	Control Systems II
		RACM-430	Industrial Refrigeration Systems
Task E-11 - Commissions HVAC/R systems			
11.01	Performs pre-start-up checks for HVAC/R systems.	RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-430	Industrial Refrigeration Systems
11.02	Performs start-up of HVAC/R systems.	RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-420	Heating Systems
		RACM-425	Chillers and Chiller Systems
11.03	Completes HVAC/R system charge.	RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-430	Industrial Refrigeration Systems
11.04	Sets up primary and secondary HVAC/R system components.	RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units

RSOS Sub-Task		AACS Unit	
		RACM-425	Chillers and Chiller Systems
		RACM-430	Industrial Refrigeration Systems
Task E-12 - Commissions control systems.			
12.01	Performs start-up checks for control systems.	RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-345	Control Systems II
		RACM-415	Air Measurement and System Air Balancing
		RACM-430	Industrial Refrigeration Systems
12.02	Verifies/sets operating parameters.	RACM-130	Compressors I
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-345	Control Systems II
		RACM-415	Air Measurement and System Air Balancing
		RACM-430	Industrial Refrigeration Systems
Task F-13 - Maintains HVAC/R systems.			
13.01	Inspects HVAC/R systems.	RACM-170	Basic System Maintenance
		RACM-210	Evaporators
		RACM-215	Compressors II
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II
		RACM-310	Compressors III (Large Commercial/ Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-340	Heat Pump Systems
		RACM-410	Duct Systems and Design
RACM-420	Heating Systems		
RACM-425	Chillers and Chiller Systems		

RSOS Sub-Task		AACS Unit	
13.02	Performs predictive and scheduled maintenance on HVAC/R systems.	RACM-430	Industrial Refrigeration Systems
		RACM-130	Compressors I
		RACM-170	Basic System Maintenance
		RACM-210	Evaporators
		RACM-215	Compressors II
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II
		RACM-310	Compressors III (Large Commercial/Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-340	Heat Pump Systems
		RACM-420	Heating Systems
		RACM-425	Chillers and Chiller Systems
RACM-430	Industrial Refrigeration Systems		
13.03	Tests HVAC/R system components and accessories.	RACM-120	Refrigeration Fundamentals
		RACM-150	Electrical Fundamentals
		RACM-155	Motors I
		RACM-170	Basic System Maintenance
		RACM-210	Evaporators
		RACM-215	Compressors II
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-235	Air Conditioning Fundamentals
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II

RSOS Sub-Task		AACS Unit	
		RACM-310	Compressors III (Large Commercial/Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-340	Heat Pump Systems
		RACM-140	Duct Systems and Design
		RACM-415	Air Measurement and System Air Balancing
		RACM-420	Heating Systems
		RACM-425	Chillers and Chiller Systems
		RACM-430	Industrial Refrigeration Systems
Task F-14 – Services HVAC/R systems.			
14.01	Troubleshoots HVAC/R systems.	RACM-205	Pressure Enthalpy Diagrams
		RACM-210	Evaporators
		RACM-215	Compressors II
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II
		RACM-300	Refrigeration Load Calculations
		RACM-310	Compressors III (Large Commercial/ Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-340	Heat Pump Systems

RSOS Sub-Task		AACS Unit	
		RACM-350	Troubleshooting Refrigeration and Air Conditioning Electronics
		RACM-410	Duct Systems and Design
		RACM-415	Air Measurement and System Air Balancing
		RACM-420	Heating Systems
		RACM-425	Chillers and Chiller Systems
		RACM-430	Industrial Refrigeration Systems
		RACM-435	Troubleshooting with Schematic Wiring Diagrams
14.02	Repairs HVAC/R systems.	RACM-210	Evaporators
		RACM-215	Compressors II
		RACM-220	Condensers
		RACM-225	Metering Devices
		RACM-230	Refrigerant Flow Controls and Accessory Devices
		RACM-240	Fans, Mechanical Drives, Air Filters and Air Cleaners
		RACM-250	Motors II
		RACM-260	Refrigerant Recovery Techniques
		RACM-310	Compressors III (Large Commercial/ Industrial Compressors)
		RACM-315	Evaporative Condensers and Cooling Towers
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-325	Commercial Refrigeration Systems
		RACM-330	Air Conditioning Systems
		RACM-335	Packaged Air Conditioning Units
		RACM-340	Heat Pump Systems
		RACM-410	Duct Systems and Design
RACM-420	Heating Systems		
RACM-425	Chillers and Chiller Systems		
RACM-430	Industrial Refrigeration Systems		
Task F-15 Maintains and services control systems.			
15.01	Performs maintenance and inspection on control systems.	RACM-250	Motors II
		RACM-255	Control Circuits and Wiring Diagrams
		RACM-320	Fluid Dynamics and Circulating Pumps

RSOS Sub-Task		AACs Unit	
		RACM-345	Control Systems II
15.02	Troubleshoots control systems.	RACM-250	Motors II
		RACM-255	Control Circuits and Wiring Diagrams
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-345	Control Systems II
		RACM-350	Troubleshooting Refrigeration and Air Conditioning Electronics
		RACM-435	Troubleshooting with Schematic Wiring Diagrams
15.03	Calibrates operating and safety controls.	RACM-250	Motors II
		RACM-255	Control Circuits and Wiring Diagrams
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-345	Control Systems II
		RACM-430	Industrial Refrigeration Systems
15.04	Repairs control systems.	RACM-250	Motors II
		RACM-255	Control Circuits and Wiring Diagrams
		RACM-320	Fluid Dynamics and Circulating Pumps
		RACM-345	Control Systems II
		RACM-430	Industrial Refrigeration Systems

Level 1

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RACM-100 Safety

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 1.01 Maintains safe work environment.
- 1.02 Performs lock-out, tag-out and isolation procedures.
- 1.03 Uses personal protective equipment (PPE) and safety equipment.
- 5.01 Prepares work site (introduction).
- 5.02 Handles materials and supplies (introduction).

Suggested Hours:

9 Hours

Theoretical Objectives:

1. Define terminology associated with PPE and safety equipment.
2. Interpret codes and regulations pertaining to workplace hazards and safe work practices.
 - i) Occupational Health and Safety (OHS)
 - ii) fall protection
 - iii) confined spaces
 - iv) jurisdictional
 - v) transportation of dangerous goods (TDG)
 - vi) Globally Harmonized System of Classification & Labelling of Chemicals (GHS)
 - vii) Workplace Hazardous Materials Information System (WHMIS)
3. Identify workplace hazards and describe safe work practices.
 - i) high voltage
 - ii) corrosive chemicals

- iii) toxicity
 - iv) combustion reactions
 - v) fire
 - vi) rotating equipment
 - vii) working at heights
 - viii) confined spaces
 - ix) noisy locations
 - x) pressure hazards
 - xi) refrigerants
 - xii) ozone depleting substances
 - xiii) greenhouse gases
 - xiv) weather
 - xv) overhead obstacles
4. Identify standards and regulations pertaining to PPE and safety equipment.
5. Identify energy sources to be locked out.
- i) electrical circuits
 - ii) valves
 - iii) capacitors
 - iv) rotating fans
 - v) rotating wheels
 - vi) motors
 - vii) conveyor belts
 - viii) hydraulics
 - ix) pneumatics
 - x) pressurized tanks
 - xi) heat exchangers
 - xii) thermal equipment
6. Identify the potential of stored energy.
7. Identify types of PPE and safety equipment, their applications and procedures for use.
- i) PPE
 - hard hats
 - safety glasses
 - hearing protection
 - respirators
 - safety footwear
 - gloves
 - safety vests
 - harnesses
 - lanyards
 - anchor points

- life line
 - ii) Safety equipment
 - first aid kits
 - eye wash stations
 - fire extinguishers
 - spill kits
 - caution/danger tape
 - barricades
8. Identify types of lock out devices, their application and procedures for use.
- i) locks
 - ii) blocks
 - iii) chains
 - iv) hasps
 - v) plugs
 - vi) caps
 - vii) blanks-off plates
9. Describe the procedures used to maintain and store PPE and safety equipment.
- i) excessively worn footwear
 - ii) damaged safety glasses
 - iii) expired safety equipment
10. Describe procedures used to maintain a safe work environment and to remediate potential dangers relating to workplace hazards.
11. Describe the procedures used to conduct a job hazard assessment.
- i) identify job tasks
 - ii) identify hazards
 - iii) identify controls
 - iv) identify PPE
12. Describe the considerations for handling materials and supplies.
13. Describe the procedures used to handle, store, transport and dispose of hazardous materials.
14. Describe procedures used to lock-out, tag-out and isolate equipment and confirm zero energy.
15. Determine when a lock-out procedure is required.

Practical Objectives:

1. Perform a lock-out tag-out procedure.

RACM-105 Tools and Equipment

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 2.01 Uses hand tools.
- 2.02 Uses portable and stationary power tools.
- 2.07 Uses diagnostic and measuring tools and equipment.
- 2.10 Uses digital technology (introduction).

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with tools and equipment.
 - i) hand tools
 - ii) portable and stationary power tools
 - iii) diagnostic and measuring tools and equipment
2. Identify hazards and describe safe work practices.
 - i) hand tools
 - ii) portable and stationary power tools
 - iii) diagnostic and measuring tools and equipment
3. Identify types of hand tools and describe their applications and procedures for use.
 - i) flaring tools
 - ii) pipe cutters
 - iii) benders
 - iv) wrenches
 - v) screwdrivers
4. Identify types of portable and stationary power tools and describe their applications and procedures for use.
 - i) pneumatic

- ii) electric
 - iii) hydraulic
 - iv) gas
 - v) generators
5. Identify types of diagnostic and measuring tools and equipment and describe their applications and procedures for use.
- i) measuring tapes and rules
 - ii) thermometers
 - iii) weigh scales
 - iv) refrigerant leak detectors
 - v) meters
 - digital multi-meter
 - clamp-on ammeter
 - megohmmeter
 - analog meter
 - vi) calipers
 - vii) micrometers
 - viii) gauge manifolds
 - ix) manometers
 - x) hygrometers
 - xi) refractometers
 - xii) sound level meters
 - xiii) data loggers
6. Describe the procedures used to store and maintain hand tools.
- i) clean
 - ii) lubricate
 - iii) sharpen
 - iv) tighten
 - v) drain
7. Describe the procedures used to store and maintain portable and stationary power tools.
- i) clean
 - ii) lubricate
 - iii) sharpen
 - iv) tighten
 - v) drain
8. Describe the procedures used to store and maintain diagnostic and measuring tools and equipment.

9. Describe digital technology and electronic devices and their use in diagnosing equipment and components.

Practical Objectives:

N/A

RACM-110 Access Equipment

Learning Outcomes:

- Demonstrate knowledge of access equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of regulatory requirements pertaining to access equipment.

2019 Red Seal Occupational Standard Reference:

2.08 Uses access equipment.

Suggested Hours:

3 Hours

Theoretical Objectives:

1. Define terminology associated with access equipment.
2. Identify hazards and describe safe work practices pertaining to the use of access equipment.
3. Interpret codes and regulations pertaining to access equipment.
4. Interpret information pertaining to access equipment found on drawings and specifications.
5. Identify types of access equipment and describe their applications, limitations and procedures for use.
 - i) ladders
 - ii) scaffolding
 - iii) lifts
 - iv) staging
6. Identify factors to consider when selecting access equipment.
 - i) safety
 - ii) load characteristics
 - iii) environment
 - iv) application
7. Describe the procedures used to inspect, store and maintain access equipment.

Practical Objectives:

1. Inspect an extension ladder.
2. Set up an extension ladder.

RACM-115 Hoisting, Lifting and Rigging

Learning Outcomes:

- Demonstrate knowledge of rigging, hoisting and lifting equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of regulatory requirements pertaining to rigging, hoisting and lifting equipment.
- Demonstrate knowledge of communication methods used during rigging, hoisting and lifting operations.

2019 Red Seal Occupational Standard Reference:

2.09 Uses rigging, hoisting and lifting equipment.

Suggested Hours:

9 Hours

Theoretical Objectives:

1. Define terminology associated with rigging, hoisting and lifting equipment.
2. Identify hazards and describe safe work practices pertaining to rigging, hoisting and lifting equipment.
 - i) power lines
 - ii) excavations
 - iii) excessive loads
 - iv) center of gravity
 - v) weather
 - vi) equipment damage
 - vii) uneven ground
 - viii) slippery surfaces
3. Interpret codes and regulations pertaining to rigging, hoisting, lifting and access equipment.
4. Interpret information pertaining to rigging, hoisting and lifting equipment found on drawings and specifications.
5. Identify types of rigging, hoisting and lifting equipment and describe their applications, limitations and procedures for use.
 - i) slings
 - ii) come-alongs/chain falls

- iii) shackles
 - iv) jacks
 - v) hoists
 - vi) belts
 - vii) ropes
 - viii) cables
 - ix) spreader bars
 - x) pry bars
6. Identify types of knots, hitches and bends, and describe their applications and associated procedures.
7. Identify factors to consider when selecting hoisting, lifting and rigging equipment.
- i) safety
 - ii) load characteristics
 - iii) environment
 - iv) application
8. Identify factors to consider when rigging a load (materials and/or equipment) for lifting and hoisting.
- i) load characteristics
 - ii) equipment and accessories
 - iii) environment
 - iv) anchor points/attachment locations
 - v) sling angles
 - vi) machine capacity/load chart
9. Identify and interpret communication methods used during hoisting, lifting, rigging, and describe their associated procedures.
- i) standard crane and hoist hand signals
 - ii) two-way radios
 - iii) video
 - iv) radio
 - v) mobile phones
10. Describe the procedures used to rig and secure a load (materials and/or equipment) for lifting and hoisting.
11. Describe the procedures used to perform a basic lift.
12. Describe the procedures used to inspect, store and maintain rigging, hoisting and lifting equipment.

Practical Objectives:

1. Perform basic hand signals.

RACM-120 Refrigeration Fundamentals

Learning Outcomes:

- Demonstrate knowledge of fundamental concepts of refrigeration.
- Demonstrate knowledge of the refrigeration cycle.

2019 Red Seal Occupational Standard Reference:

- 7.01 Verifies HVAC/R system parameters and requirements (introduce concepts associated with refrigeration).
- 13.03 Tests HVAC/R system components and accessories (introduce factors that affect capacity and performance).

Suggested Hours:

21 Hours

Theoretical Objectives:

1. Define terminology associated with refrigeration.
2. Explain concepts associated with refrigeration.
 - i) states of matter
 - ii) volume
 - iii) mass and weight
 - iv) density
 - v) specific volume
 - vi) specific gravity
 - vii) temperature
 - viii) heat
 - sensible
 - latent
 - specific
 - ix) ton of refrigeration
 - x) pressure and vacuum
 - xi) critical point
 - xii) transcritical point
 - xiii) triple point
 - xiv) energy, work and power
 - xv) enthalpy and entropy
3. Identify pressure and temperature scales and describe the procedures used to perform conversion calculations.

4. Identify states of matter and describe their characteristics.
5. Describe heat flow and identify methods of heat transfer.
6. Describe basic gas laws associated with refrigeration and perform calculations to demonstrate relationships.
7. Explain the effects of pressure on evaporating, condensing, freezing and melting temperatures.
8. Describe the pressure/temperature chart and its use in determining refrigerant conditions.
 - i) saturated
 - ii) dew point
 - iii) bubble point
 - iv) subcooled
 - v) superheated
 - vi) triple point
9. Explain the operation of the vapour compression cycle.
10. Identify components of a vapour compression cycle and describe their purpose and operation.
 - i) compressor
 - ii) discharge line
 - iii) condenser
 - iv) condensate line
 - v) liquid line
 - vi) metering device
 - vii) evaporator
 - viii) suction line
 - ix) system accessories
11. Describe superheat and subcooling and their significance in the refrigeration cycle.
12. Describe the physical changes of the refrigerant as it circulates through the system.
13. Describe the pressure enthalpy diagram and its applications.
14. Explain how to plot the basic cycle using a pressure enthalpy diagram.
15. Identify factors that affect system capacity and performance.
 - i) condensing pressure/temperature
 - ii) evaporating pressure/temperature

- iii) heat of compression
- iv) subcooling
- v) superheat
- vi) ambient conditions
- vii) system design
- viii) system load
- ix) fluid flow rate
- x) velocity
- xi) pressures
- xii) temperatures

Practical Objectives:

1. Perform refrigeration calculations.

RACM-125 Refrigerants, Gases and Oils

Learning Outcomes:

- Demonstrate knowledge of refrigerants, gases and refrigerant oils, their characteristics and applications.
- Demonstrate knowledge of regulatory requirements pertaining to refrigerants, gases and refrigerant oils.
- Demonstrate knowledge of Canada's Ozone Layer Protection Awareness Training Program and certification requirements for handling refrigerants.
- Demonstrate knowledge of the Environmental Code of Practice for the Elimination of Fluorocarbon Emissions.
- Demonstrate knowledge of recovery and recycling tools and equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of the procedures used to recover and recycle refrigerants and refrigerant oils.

2019 Red Seal Occupational Standard Reference:

- 2.04 Uses recovery and recycling tools and equipment.
6.04 Uses refrigerants, gases and oils.

Suggested Hours:

21 Hours

Theoretical Objectives:

1. Define terminology associated with refrigerants, gases and refrigerant oils.
2. Identify hazards and describe safe work practices pertaining to refrigerants, gases and refrigerant oils.
3. Interpret codes, regulations and training/certification requirements pertaining to refrigerants, gases and refrigerant oils.
4. Identify the safety classifications of refrigerants.
 - i) toxicity
 - ii) flammability
5. Explain the effects of refrigerants, gases and oils on the environment.
 - i) ozone depletion potential
 - ii) global warming potential
 - iii) pollution

- iv) contamination
6. Identify methods of recovery and describe their associated procedures.
- i) liquid
 - ii) vapour
 - iii) push-pull
 - iv) migration
 - v) absorption
7. Identify types of refrigerants and describe their characteristics and applications.
- i) single component, azeotrope, near azeotrope and zeotrope
 - ii) primary
 - Chlorofluorocarbon (CFC)
 - Hydrochlorofluorocarbon (HCFC)
 - Hydrofluorocarbon (HFC)
 - Hydrofluoroolefin (HFO)
 - Hydrocarbons (HC)
 - iii) natural
 - R-744 - Carbon Dioxide
 - R-717 - Ammonia
 - R-290 - Propane
 - R-600a - Isobutane
 - iv) secondary
 - water – R-718
 - glycol solutions
 - brine solutions
 - secondary solutions
8. Identify types of refrigerant containers and colour coding classifications.
9. Identify types of refrigerant oils and other lubricants and describe their characteristics and applications.
- i) refrigeration oils
 - Mineral- MO
 - Alkyl Benzene - AB
 - Polyol Ester - POE
 - Poly Vinyl Ether – PVE
 - Polyalkylene Glycol - PAG
 - ii) vacuum pump oils
 - iii) cutting oils
 - iv) bearing oils
 - v) bearing greases
10. Identify types of gases and describe their characteristics and applications.

- i) Nitrogen
 - ii) Acetylene
 - iii) Oxygen
 - iv) Carbon Dioxide
 - v) Argon
 - vi) Helium
11. Identify types of recovery and recycling tools and equipment and describe their applications and procedures for use.
- i) recovery unit
 - ii) hoses
 - iii) cylinders
 - iv) gauge manifolds
 - v) weigh scales
 - vi) filter driers
 - vii) core recovery tools
 - viii) service and access valves
12. Describe training and certification requirements for handling refrigerants.
13. Describe the procedures used to perform refrigerant and refrigerant oil conversions.
14. Describe the procedures used to recover and recycle refrigerants and refrigerant oils.
15. Describe the procedures used to store and transport refrigerants, gases and refrigerant oils.

Practical Objectives:

N/A

RACM-130 Compressors I

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
13.02 Performs predictive and scheduled maintenance on HVAC/R systems.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with compressors.
2. Identify hazards and describe safe work practices pertaining to compressors.
3. Explain the purpose and operating principles of the compressor in the refrigeration system.
4. Identify types of compressors and describe their characteristics and applications.
 - i) reciprocating
 - ii) scroll
 - iii) rotary
 - iv) screw
 - v) centrifugal
 - vi) linear
5. Identify compressor components and describe their purpose and operation.
6. Explain compressor efficiency and how it is determined.
7. Identify methods of compressor lubrication.
8. Identify methods used to cool compressors and describe their associated procedures.
9. Identify common compressor failures and describe their causes and remedies.
 - i) mechanical
 - ii) electrical

Practical Objectives:

N/A

RACM-135 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.

2019 Red Seal Occupational Standard Reference:

7.02 Selects HVAC/R equipment, components and accessories.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with valves and accessory devices.
2. Identify hazards and describe safe work practices pertaining to valves and accessory devices.
3. Interpret codes and regulations pertaining to valves and accessory devices.
4. Interpret information pertaining to valves and accessory devices found on drawings and specifications.
5. Explain the purpose and operation of valves and accessory devices.
6. Identity types of valves and describe their characteristics and applications.
 - i) safety
 - ii) metering
 - iii) service/access
 - iv) flow controls
 - v) water regulating valves
7. Identify types of accessory devices and describe their characteristics and applications.
 - i) 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 Objectives:

N/A

RACM-140

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 components.
- Demonstrate knowledge of the procedures used to solder and braze piping and tubing.
- Demonstrate knowledge of insulation, sealants and adhesives, their applications and procedures for use.
- Demonstrate knowledge of fasteners, brackets and hangers, their applications and procedures for use.

2019 Red Seal Occupational Standard Reference:

- 2.03 Uses brazing and soldering equipment.
- 6.01 Performs brazing and soldering.
- 6.06 Applies sealants and adhesives.
- 9.04 Installs fasteners, brackets and hangers.
- 9.05 Installs HVAC/R piping and tubing (Introduction).

Suggested Hours:

24 Hours

Theoretical Objectives:

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) reaming
 - iv) joining

- flaring
 - swaging
 - brazing
 - soldering
 - threading
 - crimping
6. Identify types of refrigeration piping, tubing and fittings, and describe their characteristics and applications.
 7. Identify types of pipe materials, fittings and accessories.
 - i) copper
 - ii) stainless steel
 - iii) steel
 - iv) copper-iron alloy
 - v) brass
 - vi) aluminum
 8. Identify types of soldering and brazing materials and fillers, and describe their characteristics and applications.
 9. Identify types of pipe hangers, brackets and fasteners, and describe their characteristics and applications.
 10. Identify types of pipe and tubing insulation, and describe their characteristics and applications.
 11. Identify types of sealants and adhesives, and describe their characteristics and applications.
 - i) sealants
 - silicone
 - spray foam
 - thread seal
 - fire stop
 - ii) adhesives
 - insulation glues
 - primers
 - pipe adhesives
 12. Identify factors to consider when selecting piping system components for installation.
 13. Describe the procedures used to fabricate a piping bracket or support.
 14. Describe the procedures used to install piping systems.

- i) cutting
- ii) reaming
- iii) bending
- iv) joining
 - flaring
 - swaging
 - brazing
 - soldering
 - threading
 - crimping
- v) supporting
 - hangers
 - brackets/fasteners
- vi) insulating
- vii) applying sealants and adhesives

Practical Objectives:

1. Cut, bend, flare, solder and braze tubing.
2. Connect and fasten tubing and fittings.
3. Fabricate a bracket or support.

RACM-145 Leak Testing, Evacuation and Charging

Learning Outcomes:

- Demonstrate knowledge of the procedures used to leak and pressure test refrigeration and air conditioning systems.
- Demonstrate knowledge of the procedures used to evacuate refrigeration and air conditioning systems.
- Demonstrate knowledge of the procedures used to charge refrigeration and air conditioning systems.

2019 Red Seal Occupational Standard Reference:

- 2.05 Uses evacuation tools and equipment.
- 2.06 Uses charging tools and equipment.
- 6.02 Performs leak and pressure tests on system.
- 6.03 Evacuates systems.
- 9.06 Applies HVAC/R holding charge

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Define terminology associated with pressure and leak testing, evacuation and charging of refrigeration and air conditioning systems.
2. Identify hazards and describe safe work practices pertaining to pressure and leak testing, evacuation and charging of systems.
3. Interpret codes and regulations pertaining to pressure and leak testing, evacuation and charging of systems.
4. Identify tools and equipment used to pressure and leak test, evacuate and charge systems, and describe their applications and procedures for use.
 - i) pressure and leak testing
 - electronic leak detectors
 - refrigerant
 - ultrasonic
 - certified gauges
 - regulators
 - leak detection solutions
 - soap

- dyes
 - ii) evacuation
 - compound gauges
 - vacuum/micron gauges
 - vacuum pumps
 - vacuum manifolds
 - core removal tools
 - cold traps
 - iii) holding charge
 - service valve wrenches
 - charging scales
 - gauge manifold
 - transfer pumps
5. Identify types of gases and liquids required for system pressure tests.
- i) gases
 - nitrogen
 - air (secondary systems)
 - helium
 - argon
 - carbon dioxide
 - inert gases
 - ii) liquids (secondary systems)
 - water
 - glycol
 - brine
6. Calculate volume of gases and liquids required to pressure test systems.
7. Describe the procedures used to pressure and leak test systems.
8. Describe the procedures used to evacuate and dehydrate systems.
- i) single evacuation
 - ii) multiple evacuation
9. Describe the procedures used to charge systems.
- i) refrigerant
 - liquid
 - vapour
 - R-744
 - ii) oil
 - pumps
 - vacuum

10. Describe the methods used to verify the system charge.
 - i) superheat
 - ii) subcooling
 - iii) critical charge
 - iv) charge charts
 - v) sight glass

11. Describe the procedures used to pressurize a system with refrigerant to achieve a positive pressure.

Practical Objectives:

1. Perform a **pressure and** leak test.
2. Instructor demonstration of evacuation and charging the system.

RACM-150 Electrical Fundamentals

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 6.05 Performs field wiring systems.
- 7.02 Selects HVAC/R equipment, components and accessories (introduction).
- 13.03 Tests HVAC/R system components and accessories (introduction).

Suggested Hours:

21 Hours

Objectives and Content:

Theoretical Objectives:

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 factors to consider when selecting resistors using rating and coding information.
7. Identify types of conductors and describe their characteristics and applications.
8. Identify factors used to determine conductor ampacity rating.

9. Identify types of wire insulating materials and describe their characteristics and applications.
10. Identify types of electrical circuits and describe their characteristics and applications.
 - i) series
 - ii) parallel
 - iii) series-parallel
11. Identify types of distribution panels and wiring configurations used in single-phase and three-phase systems, and describe their characteristics and applications.
12. Identify types of over-current and overload protection devices, and describe their characteristics, applications and operation.
13. Identify types of relays, switches and contactors, and describe their characteristics, applications and operation.
14. Identify types of transformers and describe their characteristics, applications and operation.
15. Identify types of electronic controls and sensors, and describe their purpose and operation.
16. Identify types of electrical wiring diagrams and describe their purpose.
17. Describe an overloaded, grounded, open and short circuit.
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, resistance and power in series, parallel and combination circuits.

Practical Objectives:

1. Measure voltage, current, resistance and power.

RACM-155 Motors I

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories (introduce types of motors).
- 13.03 Tests HVAC/R system components and accessories.

Suggested Hours:

15 Hours

Theoretical Objectives:

1. Define terminology associated with single-phase motors and motor controls.
2. Identify hazards and describe safe work practices pertaining to single-phase motors and motor controls.
3. Interpret information found on motor nameplates.
4. Explain the principles of single-phase motor operation.
5. Explain the effects of load and voltage changes on motor operation.
6. Identify types of motors and describe their characteristics, components and operation.
 - i) single phase
 - ii) three phase
 - iii) dual voltage
 - iv) multi speed
 - v) electrically commutated motor (ECM)
 - vi) variable frequency drive (VFD)
7. Identify types of starting devices for single-phase motors and describe their characteristics, wiring configuration and operation.
8. Identify types of capacitors and describe their characteristics and applications.
9. Identify types of motor overload protection devices and describe their applications.

10. Identify common motor failures and describe their causes and remedies.
 - i) mechanical
 - ii) electrical
11. Describe the procedures used to test capacitors.
12. Describe the procedures used to change speed and rotation of single-phase motors.
13. Describe the effects of motor pulley selection, adjustment and alignment.
14. Calculate voltage, resistance, current and power in motor circuits.

Practical Objectives:

1. Test motor winding resistance.
2. Test capacitors.

RACM-160 Trade Documentation

Learning Outcomes:

- Demonstrate knowledge of trade documentation and reference material, its purpose, and use.
- Demonstrate knowledge of the procedures used to complete and interpret documentation.

2019 Red Seal Occupational Standard Reference:

3.02 Uses documentation and reference material.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Identify types and sources of trade related documentation.
 - i) manufacturers' specifications
 - ii) drawings and specifications
 - iii) employer-specific forms and reports
 - iv) codes and standards
 - v) preventative/predictive maintenance sheets
 - vi) technical bulletins
 - vii) service records
 - viii) warranties
 - ix) estimates
 - x) refrigerant management records
 - energy efficiency guide
 - xi) manuals
 - safety
 - installation
 - service
 - operating
 - xii) permits
 - xiii) material take-off lists

2. Describe the procedures used to access, interpret and apply information found in documentation and reference material.

3. Describe the procedures used to complete trade-related documentation.
 - i) repair orders

- ii) purchase orders
- iii) preventative/predictive maintenance sheets
- iv) inspection forms
- v) service records
- vi) refrigerant management records
- vii) time cards/sheets
- viii) bill of materials
- ix) site safety survey
- x) start-up sheet

Practical Objectives:

N/A

RACM-165

Basic 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 refrigeration and air conditioning systems and their components.

2019 Red Seal Occupational Standard Reference:

- 5.01 Prepares work site.
- 5.02 Handles materials and supplies.
- 7.03 Determines placement of HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 9.05 Installs HVAC/R piping and tubing.

Suggested Hours:

30 Hours

Theoretical Objectives:

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 on 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 types of refrigeration systems and describe their characteristics and basic operation.
 - i) coolers

- ii) freezers
 - iii) plate freezers
 - iv) chillers
 - v) process refrigeration systems
 - vi) ice machines
 - vii) ultra-low
 - viii) cryogenic
7. Identify types of air conditioning systems and describe their basic operating principles.
- i) split system
 - ii) heat pumps
 - iii) ductless splits
 - iv) variable refrigerant flow (VRF)
 - v) package units
 - vi) heat reclaim
 - vii) chillers
 - viii) humidifiers
 - ix) dehumidifiers
 - x) energy recovery ventilator (ERV)
 - xi) heat recovery ventilator (HRV)
8. Identify types of energy sources required for the HVAC/R installation.
- i) electric
 - ii) natural gas
 - iii) propane
 - iv) fossil fuel
 - v) solar
 - vi) pneumatics
 - vii) alternative fuels
9. Identify components of refrigeration and air conditioning systems, and describe their purpose and applications.
10. Identify factors to consider when selecting refrigeration and air conditioning system components for installation.
11. Identify factors to consider when installing refrigeration and air conditioning systems.
- i) material list
 - ii) scheduling
 - iii) component placement
12. Describe the procedures used to install refrigeration and air conditioning systems and accessories.
- i) piping and tubing

- ii) accessory devices
 - flow controls
 - oil separators
 - liquid and suction filter driers
 - isolation valves
 - liquid receivers
 - pressure relief devices
 - heat exchangers
 - suction accumulators
 - spring isolators
 - cork/rubber pads
 - canvas connectors
 - vibration eliminators
 - liquid/moisture indicators
 - iii) wiring
 - iv) pressure and leak testing
 - v) evacuation
 - vi) charging
13. Identify factors to consider when modifying system components and accessories or their location.
- i) piping
 - ii) duct work
 - iii) supports
 - iv) thermostats
 - v) economizers
 - vi) flow switches
 - vii) head pressure controls
 - viii) dampers
 - ix) louvers
14. Identify documentation requirements for system installation and start-up.
15. Identify factors to consider when performing a system start-up.
- i) phasing, voltage imbalance and amperage
 - ii) refrigerant charge adjustments
 - iii) oil levels
 - iv) operating pressures and temperatures
 - v) system control adjustments
 - vi) manufacturers' recommendations
 - vii) air movement requirements
16. Identify system problems at start-up and describe their causes and remedies.

17. Describe the procedures used to start-up and shut-down refrigeration and air conditioning systems.

Practical Objectives:

N/A

RACM-170 Basic System Maintenance

Learning Outcomes:

- Demonstrate knowledge of performing basic system maintenance.

2019 Red Seal Occupational Standard Reference:

13.01 Inspects HVAC/R systems.

13.02 Performs predictive and scheduled maintenance on HVAC/R systems.

13.03 Tests HVAC/R system components and accessories.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with refrigeration and air conditioning system maintenance.
2. Identify hazards and describe safe work practices pertaining to refrigeration and air conditioning system maintenance.
3. Identify types of tools and test equipment used to inspect refrigeration and air conditioning systems.
 - i) thermometers
 - ii) gauges
 - iii) hand tools
 - iv) electrical meters
 - v) psychrometers
 - vi) refractometers
4. Identify issues that affect the overall efficiency of operation.
 - i) door gaskets worn or torn
 - ii) anti-sweat heaters not working
 - iii) plugged condensate drains
 - iv) dirty coils, ducts, grilles, diffusers
 - v) defective fan blades
 - vi) defective blower wheels
5. Identify additional service requirements for refrigeration and air conditioning systems.
 - i) cleaning coils
 - ii) filter change

- iii) chemical treatment
 - iv) corrosion testing of heat exchange systems
6. Identify refrigeration and air conditioning system and component defects and describe their causes and procedures for repair.
- i) belts
 - ii) pulleys
 - iii) bearings
 - iv) sight glasses
 - v) refrigeration piping
 - vi) incorrect refrigerant charge
 - vii) plugged/fouled heat exchangers
 - viii) incorrect valve operation
 - ix) insufficient system capacity
 - x) dirty or plugged filter driers
 - xi) leaking compressor valves
7. Describe the procedures used to perform basic maintenance and operational checks required for refrigeration and air conditioning systems.
- i) oil levels
 - ii) motor operation and rotation
 - iii) fan cycling operation
 - iv) actuator and damper operation
 - v) variable frequency drive (VFD) operation
8. Describe predictive and scheduled maintenance on refrigeration and air conditioning systems.

Practical Objectives:

N/A

RACM-175 Control Fundamentals

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 8.02 Selects control system components and accessories (introduction of types).
- 8.03 Determines placement of control system components and accessories (introduction).
- 10.01 Places control system components (introduction).
- 10.02 Connects control systems (introduction).

Suggested Hours:

9 Hours

Theoretical Objectives:

1. Define terminology associated with system control.
2. Explain the purpose and operation of control systems, devices and components.
3. Explain open and closed loop control.
4. Identify types of control systems and describe their components and operation.
 - i) electromechanical
 - ii) electronic
 - iii) pneumatic
 - iv) direct digital control (DDC)
5. Identify types of control devices and describe their applications and operation.
 - i) relays
 - ii) switches
 - iii) actuators
6. Identify types of control circuits and describe their applications, components and operation.
7. Identify types of monitoring/sensing controls and describe their applications and operation.
 - i) temperature
 - ii) humidity

- iii) pressure
 - iv) flow
 - v) liquid level
 - vi) gas detection
8. Describe control and control actions with respect to loads, switches and circuits.
- i) normally closed
 - ii) normally open
 - iii) analog
 - iv) direct acting
 - v) reverse acting

Practical Objectives:

N/A

RACM-180 Communications

Learning Outcomes:

- Demonstrate knowledge of effective communication practices.

2019 Red Seal Occupational Standard Reference:

- 2.10 Uses digital technology (introduction).
- 3.03 Plans job tasks and procedures (introduction).
- 4.01 Uses communication techniques.

Suggested Hours:

3 Hours

Theoretical Objectives:

1. Define terminology associated with communication and e-communications.

2. Describe the importance of using effective verbal and non-verbal communication with people in the workplace.
 - i) customers
 - ii) supervisors
 - iii) apprentices
 - iv) colleagues/co-workers
 - v) authorities having jurisdiction (AHJ)
 - vi) suppliers
 - vii) manufacturers
 - viii) other tradespeople

3. Identify types of electronic communication devices, and describe their applications and procedures.
 - i) computers
 - software
 - email
 - internet
 - ii) mobile phones and tablets
 - apps

4. Explain the importance of appropriate and effective use of electronic communication devices and sources of information.

5. Describe the coaching and mentoring relationship between journeyperson and apprentice.
6. Describe the importance of communicating with others to organize materials and supplies on site and effectively plan work tasks.
7. Identify communication and learning styles.
 - i) visual
 - ii) auditory
 - iii) reading/writing
 - iv) kinesthetic
8. Describe effective listening and speaking skills.
9. Identify personal responsibilities and attitudes that contribute to on-the-job success.
 - i) working safely
 - ii) asking questions
 - iii) accepting constructive feedback
 - iv) time management and punctuality
 - v) respect for authority
 - vi) good stewardship of materials, tools and property
 - viii) efficient work practice
10. Identify the value of diversity in the workplace.
11. Identify communication that constitutes harassment and discrimination.
 - i) harassment
 - objectionable conduct
 - comments or actions made either on a one time or continuous basis that threatens, demeans, belittles or causes humiliation or embarrassment to the recipient
 - ii) discrimination
 - race
 - national or ethnic origin
 - colour
 - religion
 - age
 - sex
 - sexual orientation
 - gender identity
 - marital status
 - family status
 - disability
 - conviction for which a pardon has been granted

Practical Objectives:

N/A

RACM-185 Workplace Mentoring I

Learning Outcomes:

- Demonstrate knowledge of strategies to assist in learning skills in the workplace.

2019 Red Seal Occupational Reference:

- 4.01 Uses communications techniques.
- 4.02 Uses mentoring techniques.

Suggested Hours:

3 Hours

Theoretical Objectives:

1. Describe the importance of your own experiences.
2. Identify partners involved in apprenticeship.
3. Describe the shared responsibilities for workplace learning.
4. Determine your own learning preferences and explain how these relate to learning new skills.
5. Describe the importance of different types of skills in the workplace.
6. Describe the importance of essential skills in the trade.
7. Identify different ways of learning.
8. Identify learning preferences.
9. Identify different learning needs and strategies to meet learning goals.
10. Identify techniques for effective communication.
11. Identify strategies to assist in learning a skill.

Practical Objectives:

N/A

Level 2

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RACM-200 Drawings and Specifications

Learning Outcomes:

- Demonstrate knowledge of drawings and specifications and their applications.

2019 Red Seal Occupational Standard Reference:

- 3.01 Interprets drawings and specifications.
- 3.02 Uses documentation and reference material.

Suggested Hours:

9 Hours

Theoretical Objectives:

1. Define terminology associated with drawings and specifications.

2. Identify and interpret information found on drawings.
 - i) lines
 - ii) legend
 - iii) symbols and abbreviations
 - mechanical
 - electrical
 - architectural
 - iv) title block
 - v) notes and specifications
 - vi) schedules
 - vii) units of measurements (metric/imperial)
 - viii) seismic

3. Identify types of specification documents and describe their applications.
 - i) manufacturer
 - ii) engineer
 - iii) contractor
 - iv) client

4. Identify types of drawings and describe their applications.
 - i) civil/site
 - ii) architectural
 - iii) mechanical
 - iv) structural
 - v) electrical

- vi) shop drawings
 - vii) sketches
 - viii) as-built
 - ix) isometric
 - x) elevation
 - xi) plan views
5. Identify the views used on drawings.
- i) elevation
 - ii) plan
 - iii) section
 - iv) detail
 - v) auxiliary
 - vi) 3-D/isometric
6. Describe the use of drawings and measurement scales.
7. Describe the procedures used to convert metric and imperial units of measurement.
8. Describe the procedures used to interpret and extract information from drawings and specifications.
9. Describe the procedures to perform a basic material take-off from a drawing.

Practical Objectives:

1. Perform a basic material take-off from a drawing.

RACM-205 Pressure Enthalpy Diagrams

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 3.02 Uses documentation and reference material.
14.01 Troubleshoots HVAC/R systems.

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Define terminology associated with pressure enthalpy diagrams and system analysis.
2. Locate and interpret information found on pressure enthalpy diagrams.
3. Identify factors affecting system capacity and explain their effect.
 - i) saturated condensing temperature
 - ii) saturated evaporating temperature
 - iii) liquid subcooling
 - iv) suction superheat
 - v) suction to liquid heat exchanger
 - vi) high and low side pressure drops
4. Explain the effects of pressure drop in refrigeration piping.
5. Explain the concept of system equilibrium and the factors that determine system balance.
6. Explain the effects of an unbalanced system on system performance.
7. Plot a refrigeration cycle using a pressure enthalpy diagram.
8. Describe theoretical horsepower and brake horsepower.
9. Describe the procedures to troubleshoot systems using refrigeration cycle diagrams.

10. Perform calculations to determine refrigeration values using pressure enthalpy diagrams.
- i) net refrigeration effect
 - ii) mass flow rate
 - iii) heat of compression
 - iv) total heat of rejection
 - v) system capacity
 - vi) ton of refrigeration
 - vii) coefficient of performance (COP)
 - viii) theoretical horsepower
 - ix) brake horsepower
 - x) horsepower per ton

Practical Objectives:

N/A

RACM-210 Evaporators

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components, and accessories.
- 7.03 Determines placement of HVAC/R equipment, components, and accessories.
- 7.04 Performs HVAC/R material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R systems components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with evaporators.
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. Explain the purpose and operation of evaporators and their components.
6. Identify specialized tools and equipment used with evaporators and their components, and describe their applications and procedures for use.

7. Identify types of evaporators and describe their characteristics and applications.
 - i) primary and secondary surface
 - ii) counter, cross and parallel flow
 - iii) forced and induced
 - iv) direct expansion, flooded and liquid overfeed
 - v) brazed plate/plate and frame
 - vi) chiller barrel (fluid cooler)
 - vii) plate or eutectic
 - viii) plate and shell
8. Identify factors and conditions that determine evaporator capacity and efficiency.
9. Identify factors to consider when selecting evaporators and their components for installation.
10. Identify evaporator components, and describe their characteristics and applications.
 - i) evaporator fans and controls
 - ii) defrost systems
 - iii) drain pan heaters
 - iv) condensate lines
 - v) flow switches
11. Identify evaporator and component failures, and describe their causes and prevention.
12. Describe defrost methods and identify their associated electrical and piping considerations.
13. Describe the procedures used to size evaporators.
14. Describe the procedures used to install evaporators and their components.
15. Describe the procedures used to calibrate evaporator operating and safety controls.
16. Describe the procedures used to start-up and shut down evaporators and their components.
17. Describe the procedures used to maintain evaporators and their components.
18. Describe the procedures used to troubleshoot and repair evaporators and their components.

Practical Objectives:

N/A

RACM-215 Compressors II

Learning Outcomes:

- Demonstrate knowledge of the procedures used to install hermetic and semi-hermetic compressors and their components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair hermetic and semi-hermetic compressors and their components.

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines location of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with hermetic and semi-hermetic compressors.
2. Identify hazards and describe safe work practices pertaining to hermetic and semi-hermetic compressors.
3. Identify and interpret codes and regulations pertaining to hermetic and semi-hermetic compressors.
4. Interpret information pertaining to hermetic and semi-hermetic compressors found on drawings and specifications.
5. Explain the purpose and operation of hermetic and semi-hermetic compressors and their components.
6. Explain compressor efficiency and how it is determined.

7. Identify factors that affect compressor efficiency.
 - i) compression ratio
 - ii) clearance volume
 - iii) wear
 - iv) types of valves
8. Identify specialized tools and equipment used with hermetic and semi-hermetic compressors and describe their applications and procedures for use.
9. Identify hermetic and semi-hermetic compressor components and describe their purpose and operation.
10. Identify types of hermetic and semi-hermetic compressors and describe their characteristics and applications.
 - i) hermetic
 - reciprocating
 - scroll
 - rotary
 - screw
 - ii) semi-hermetic
 - reciprocating
 - centrifugal
 - screw
11. Describe compressor classifications according to temperature ranges and displacement.
12. Identify factors to consider when selecting hermetic and semi-hermetic compressors and their components for installation.
13. Describe the procedures used to install hermetic and semi-hermetic compressors and their components.
14. Describe the procedures used to start up and shut down hermetic and semi-hermetic compressors.
15. Describe the procedures used to maintain hermetic and semi-hermetic compressors and their components.
16. Describe the procedures used to troubleshoot and repair hermetic and semi-hermetic compressors and their components.
17. Identify compressor failures and describe their causes and prevention.

18. Describe control strategies for compressor protection and liquid refrigerant control.
 - i) solenoid drop
 - ii) pump out cycle
 - iii) pump down cycle
 - iv) pressure controls

Practical Objectives:

1. Disassemble a compressor and diagnose cause of failure.

RACM-220 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, troubleshoot and repair condensers and their components.

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

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. Explain the purpose and operation of condensers and their components.
6. Identify specialized tools and equipment used with condensers, and describe their applications and procedures for use.
7. Identify types of condensers and describe their characteristics and applications.
 - i) air-cooled

- ii) water-cooled
 - iii) evaporative
 - iv) gas cooler (R-744)
8. Identify condenser components and describe their purpose and operation.
 9. Identify factors and conditions that determine condenser capacity and efficiency.
 10. Identify factors to consider when selecting condensers and their components for installation.
 11. Identify condenser failures and describe their causes and prevention.
 12. Describe heat reclaim strategies.
 13. Describe head pressure control strategies.
 14. Describe the procedures used to size condensers.
 15. Describe the procedures used to install condensers and their components.
 16. Describe the procedures used to start-up and shut-down condensers and their components.
 17. Describe the procedures used to maintain condensers and their components.
 18. Describe the procedures used to troubleshoot and repair condensers and their components.

Practical Objectives:

1. Select condensers based on a given design criteria.

RACM-225 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, troubleshoot and repair metering devices and their components.

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

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. Explain the purpose and operation of metering devices and their components.
6. Identify specialized tools and equipment used with metering devices, and describe their applications and procedures for use.

7. Identify types of metering devices and describe their characteristics and applications.
 - i) direct expansion
 - ii) flooded

8. Identify metering device components and describe their purpose and operation.
 - i) hand expansion valve
 - ii) capillary tube
 - iii) orifice/piston
 - iv) automatic expansion valve
 - v) thermostatic expansion valve
 - vi) thermal electric expansion valve
 - vii) electronic expansion valve
 - viii) low side float valve
 - ix) high side float valve
 - x) orifice plate

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

10. Identify metering device failures and describe their causes and prevention.

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

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

13. Describe the procedures used to troubleshoot and adjust metering devices and their components.

Practical Objectives:

1. Select metering devices based on given design criteria.

RACM-230

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, troubleshoot, and repair refrigerant flow controls and accessory devices and their components.

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

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

6. Identify specialized tools and equipment used with refrigerant flow controls and accessory devices, and describe their applications and procedures for use.
7. Identify types of refrigerant flow controls and accessory devices and describe their characteristics and applications.
 - i) direct acting
 - ii) pilot operated
 - iii) reverse acting
 - iv) inlet pressure regulator
 - v) outlet pressure regulator
 - vi) differential pressure regulator
 - vii) two, three and four-way solenoid valves
8. Identify refrigerant flow control and accessory device components and describe their purpose and operation.
 - i) pressure regulators
 - ii) solenoid valves
 - iii) reversing valves
9. Identify factors to consider when selecting and installing refrigerant flow controls and accessory devices.
10. Identify refrigerant flow controls and accessory devices failures and describe their causes and prevention.
11. Describe the procedures used to install refrigerant flow controls and accessory devices.
12. Describe the procedures used to maintain, refrigerant flow controls and their components.
13. Describe the procedures used to troubleshoot and repair refrigerant flow controls and accessory devices.

Practical Objectives:

N/A

RACM-235 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.

2019 Red Seal Occupational Standard Reference:

- 2.07 Uses diagnostic and measuring tools and equipment.
- 3.02 Uses documentation and reference material.
- 7.01 Verifies HVAC/R parameters and requirements.
- 13.03 Tests HVAC/R system components and accessories (introduction).

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with air conditioning.
2. Explain air circulation, air quality and ventilation.
3. Explain the fundamentals of psychrometrics.
4. Identify specialized tools and instruments used to determine air circulation, ventilation and air quality.
5. Identify factors that affect human comfort with respect to air quality.
6. Identify types of air conditioning systems and their components, and describe their characteristics, applications and operation.
7. Describe indoor, outdoor and seasonal design conditions.
8. Plot air properties on a psychrometric chart.
9. Plot the psychrometric processes and perform calculations.
 - i) sensible cooling
 - ii) evaporative cooling
 - iii) humidification
 - iv) heating and humidification

- v) sensible heating
- vi) heating and dehumidification
- vii) dehumidification
- viii) cooling and dehumidification
- ix) air mixtures

Practical Objectives:

N/A

RACM-240

Fans, Mechanical Drives, Air Filters and Air Cleaners

Learning Outcomes:

- Demonstrate knowledge of fans, mechanical drives, air filters and air cleaners, their components and operation.
- Demonstrate knowledge of the procedures used to install fans, mechanical drives, air filters and air cleaners, and their components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair fans, mechanical drives, air filters and air cleaners, and their components.

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

21 Hours

Theoretical Objectives:

1. Define terminology associated with fans, mechanical drives, air filters and air cleaners.
2. Identify hazards and describe safe work practices pertaining to fans, mechanical drives, air filters and air cleaners.
3. Interpret codes and regulations pertaining to fans, mechanical drives, air filters and air cleaners.
4. Interpret information pertaining to fans, mechanical drives, air filters and air cleaners found on drawings, specifications and curve charts.
5. Identify specialized tools and equipment used with fans, mechanical drives, air filters and air cleaners, and describe their applications and procedures for use.

6. Identify types of fans and describe their characteristics and applications.
 - i) axial
 - propeller
 - vane axial
 - ii) radial (centrifugal)
 - forward curved
 - backward curved
 - straight

7. Identify types of mechanical drives and describe their characteristics and applications.
 - i) bearings
 - ii) shafts
 - iii) lubrication
 - iv) alignment
 - v) pulleys and belts

8. Identify types of air filters and air cleaners and describe their characteristics and applications.

9. Identify fan, mechanical drive, air filter and air cleaner components and describe their purpose and operation.

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

11. Describe factors that affect fan performance.

12. Describe the procedures used to install fans, mechanical drives, air filters and air cleaners, and their components.

13. Describe the procedures used to start up and shut down fans and mechanical drives.

14. Describe the procedures used to maintain, fans, mechanical drives, air filters and air cleaners and their components.

15. Identify fans and mechanical drive component failures and describe their causes and prevention.

16. Describe the procedures used to troubleshoot and repair fans, mechanical drives, air filters and air cleaners and their components.

17. Perform pulley and fan law calculations.
 - i) belt drive
 - ii) direct drive

iii) gear drive

Practical Objectives:

N/A

RACM-245 Control Systems I

Learning Outcomes:

- Demonstrate knowledge of controls and devices, their applications and operation.
- Demonstrate knowledge of the procedures used to install basic control systems and their components.
- Demonstrate knowledge of connecting system wiring and control tubing.

2019 Red Seal Occupational Standard Reference:

- 8.03 Determines placement of control system components and accessories.
10.01 Places control system components.
10.02 Connects control systems.

Suggested Hours:

21 Hours

Theoretical Objectives:

1. Define terminology associated with basic control systems.
2. Identify hazards and describe safe work practices pertaining to basic control systems.
3. Interpret codes and regulations pertaining to refrigeration and air conditioning control systems.
4. Interpret information pertaining to basic control systems found on drawings, wiring diagrams, and schematic diagrams.
5. Identify two position system control strategies and describe their characteristics and applications.
6. Interpret information pertaining to be the placement of basic control systems found on drawings and specifications.
7. Identify types of controls and explain their purpose and operation.
 - i) mechanical
 - ii) electronic
 - iii) pneumatic
8. Identify types of wiring diagrams and describe their characteristics and applications.
 - i) pictorial

- ii) schematic
 - iii) ladder
 - iv) component location
 - v) installation
9. Describe the procedures used to install and configure basic control systems.
10. Describe the sequence of operation of a basic control circuit and explain its relationship to its physical wiring and tubing configuration.

Practical Objectives:

N/A

RACM-250

Motors II

Learning Outcomes:

- Demonstrate knowledge of the procedures used to install single and three-phase motors and their components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair single and three-phase motors and their components.
- Demonstrate knowledge of the procedures used to install motor controls.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair motor controls.

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 8.02 Selects control system components and accessories.
- 8.03 Determines placement of control system components and accessories.
- 8.04 Performs control system material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 10.01 Places control system components.
- 10.02 Connects control systems.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.
- 15.01 Performs maintenance and inspection on control systems.
- 15.02 Troubleshoots control systems.
- 15.03 Calibrates operating and safety controls.
- 15.04 Repairs control systems.

Suggested Hours:

21 Hours

Theoretical Objectives:

1. Define terminology associated with single and three-phase motors and motor controls.

2. Identify hazards and describe safe work practices pertaining to single and three-phase motors and motor controls.
3. Interpret codes and regulations pertaining to single and three-phase motors and motor controls.
4. Interpret information pertaining to single and three-phase motors and motor controls found on drawings and specifications.
5. Explain the purpose and operation of single and three-phase motors and motor controls and their components.
6. Identify specialized tools and equipment used with single and three-phase motors and motor controls, and describe their applications and procedures for use.
7. Identify types of motors and their components, and describe their characteristics and applications.
 - i) shaded pole
 - ii) resistive start induction run (RSIR)
 - iii) capacitive start induction run (CSIR)
 - iv) permanent split capacitor (PSC)
 - v) capacitor start capacitor run (CSCR)
 - vi) multi-tap
 - vii) electronically commutated motor (ECM)
 - viii) 3 phase
 - ix) multi-lead
 - x) dual voltage
 - single phase
 - multi-phase
 - xi) variable frequency drive (VFD) (Inverter drive)
8. Identify types of motor controls for single and three-phase motors, and describe their characteristics, applications and wiring configuration.
9. Identify types of starting devices for single and three-phase motors and describe their characteristics, wiring configuration and operation.
10. Identify single and three-phase motors and component failures and describe their causes and prevention.
11. Identify factors to consider when selecting and installing single and three-phase motors, their components and motor controls.
12. Identify motor control failures and describe their causes and prevention.

13. Describe methods used to change speed and rotation of single and three-phase motors.
 - i) wiring configuration
 - ii) multi-tap
 - iii) electronic commutated motor (ECM)
 - iv) variable frequency drive (VFD)
14. Describe the procedures used to install single and three-phase motors and their components.
 - i) single phase
 - ii) three phase
 - iii) electrically commutated motors (ECM)
 - iv) variable frequency drive (VFD)
15. Describe the procedures used to maintain, single and three-phase motors and their components.
16. Describe the procedures used to troubleshoot and repair single and three-phase motor components.
17. Describe the procedures used to assemble and install motor controls.
18. Describe the procedures used to maintain motor controls.
19. Describe the procedures used to troubleshoot and repair motor controls.

Practical Objectives:

N/A

RACM-255

Control Circuits and Wiring Diagrams

Learning Outcomes:

- Demonstrate knowledge of the procedures used to install control circuits.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair control circuits.
- Demonstrate knowledge of wiring diagrams and their use.

2019 Red Seal Occupational Standard Reference:

- 6.05 Performs field wiring of systems.
- 8.02 Selects control system components and accessories.
- 8.03 Determines placement of control system components and accessories.
- 8.04 Performs control system material take-off.
- 10.01 Places control system components.
- 10.02 Connects control systems.
- 15.01 Performs maintenance and inspection on control systems.
- 15.02 Troubleshoots control systems.
- 15.03 Calibrates operating and safety controls.
- 15.04 Repairs control systems.

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Define terminology associated with control circuits and wiring diagrams.
2. Identify hazards and describe safe work practices pertaining to control circuits systems.
3. Interpret codes and regulations pertaining to control circuits.
4. Interpret information pertaining to control circuits found in drawings, wiring diagrams, and schematic diagrams.
5. Explain the purpose and operation of control circuits and their components.
6. Identify specialized tools and equipment used with control circuits, and describe their applications and procedures for use.

7. Identify types of control circuits and their components, and describe their characteristics and applications.
 - i) operating
 - ii) safety
 - iii) electric
 - iv) electronic
 - v) pneumatic
8. Identify types of wiring diagrams and describe their characteristics and applications.
 - i) pictorial
 - ii) schematic
 - iii) ladder
9. Identify factors to consider when selecting and installing control circuit components.
10. Describe the sequence of operation of a control circuit and explain its relationship to its physical wiring configuration.
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 Objectives:

N/A

RACM-260

Refrigerant Recovery Techniques

Learning Outcomes:

- Demonstrate knowledge of codes and regulations pertaining to the recovery and recycling of low, medium and high-pressure refrigerants.
- Demonstrate knowledge of recovery and recycling tools and equipment for low, medium and high-pressure refrigerants, their applications maintenance and procedures.
- Demonstrate knowledge of the procedures used to recover and recycle flammable refrigerants.

2019 Red Seal Occupational Standard Reference:

- 2.04 Uses recovery and recycling equipment.
6.04 Uses refrigerants, gases and oils.
14.02 Repairs HVAC/R systems.

Suggested Hours:

12 Hours

Theoretical Objectives:

1. Define terminology associated with advanced Refrigerant Recovery Techniques and tools and equipment.
2. Interpret provincial and federal codes and regulations pertaining to refrigerants.
3. Identify hazards and describe safe work practices pertaining to advanced refrigeration recover techniques and tools and equipment.
4. Identify types of recovery and recycling tools and equipment and describe their applications and procedures for use.
 - i) recovery units
 - air cooled
 - water cooled
 - pump unit
 - ignition proof
 - ii) very high-pressure refrigerant recovery system
 - iii) liquid refrigerant pumps
 - iv) vapour refrigerant pumps
 - v) hoses
 - oversize

- braided
- flexible steel
- vacuum rated
- vi) recovery cylinders
 - construction standards
 - pressure rating
 - tare weight (TW)
 - water capacity (WC)
 - refrigerant valves
 - single port
 - dual port
 - dip tube
 - liquid and vapour
- vii) storage vessels
- viii) recovery receivers
- ix) gauge manifolds
 - analog
 - digital
 - apps
- x) weigh scales
 - digital
 - wireless
- xi) filter driers
 - solids
 - moisture
 - acids
 - leak sealants
- xii) wireless solenoids
- xiii) core removal tools
 - vacuum rated
 - non-vacuum rated
- xiv) schrader valve and service valve systems
- xv) line piercing tools
- xvi) pinch off tools
- xvii) liquid sub-cooler
- xviii) refrigerant charging/recovery machines

5. Describe the procedures used to store and transport large amounts of refrigerants.

6. Describe the procedures used to recover and recycle refrigerants.

- i) active
 - liquid
 - vapour
 - push-pull

- liquid pump
 - ii) passive
 - absorption
 - migration
 - iii) low, medium and high-pressure refrigerants
 - iv) naturals
 - v) flammables
 - vi) heat sources while recovering refrigerant
- 7. Describe the procedures used to test and analyze the purity of refrigerants.
- 8. Describe the procedures used to distill refrigerant.
 - i) system to recovery cylinder
 - ii) recovery cylinder to recovery cylinder
- 9. Describe the procedures used to cool cylinders, storage containers and refrigerant receivers warm/hot recovered refrigerant to allow further recovery.
- 10. Describe the procedures used to store recovered refrigerant in the system and start-up procedures after repair.
- 11. Describe the procedures used to separate refrigerant and oil after recovery.
- 12. Describe the procedures used to store and maintain recovery and recycling tools and equipment.
- 13. Calculate and verify the capacity of large recovery cylinders prior to recovery, recycling and reusing refrigerants.

Practical Objectives:

N/A

Level 3

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RACM-300 Refrigeration Load Calculations

Learning Outcomes:

- Demonstrate knowledge of performing refrigeration load calculations.

2019 Red Seal Occupational Standard Reference:

- 2.10 Uses digital technology.
- 3.01 Interprets blueprints, drawings and specifications.
- 3.02 Uses documentation and reference material.
- 5.01 Verifies control system parameters and requirements.
- 7.01 Verifies HVAC/R system parameters and requirements.
- 14.01 Troubleshoots HVAC/R systems.

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with refrigeration load calculations.
2. Describe the procedures used to perform a refrigeration load survey.
3. Describe the procedures used to perform load calculations and determine total loads for refrigeration systems.
 - i) transmission
 - K, C, U and R values
 - wall, floor and ceiling
 - solar load
 - glass doors
 - ii) air change
 - usage – door openings
 - air changes per hour
 - air infiltration
 - air exfiltration
 - iii) product load
 - sensible heat
 - latent heat
 - heat of respiration
 - iv) miscellaneous
 - fans
 - lights

- motors
- people
- equipment
- v) defrost load
 - air
 - electric
 - hot gas
- vi) BTU/hr total
 - safety factor
 - run time
 - pull down time

Practical Objectives:

N/A

RACM-305 Refrigeration System Design

Learning Outcomes:

- Demonstrate knowledge of refrigeration system design principles.
- Demonstrate knowledge of refrigeration system components and their selection based on design criteria.
- Demonstrate knowledge of refrigeration system capacity control.
- Demonstrate knowledge of developing piping schematics.
- Demonstrate knowledge of developing electrical schematics and wiring diagrams.

2019 Red Seal Occupational Standard Reference:

- 2.10 Uses digital technology.
- 7.01 Verifies HVAC/R system parameters and requirements.
- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 8.01 Verifies control system parameters and requirements.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with refrigeration system design.
2. Identify and interpret codes and regulations pertaining to refrigeration system design.
3. Interpret graphs and tables for refrigeration system design.
4. Identify capacity ratings of refrigeration system components.
5. Explain fundamental principles of refrigeration system design.
6. Describe the factors to consider in the design and layout of refrigeration systems.
7. Describe the importance of balancing system capacity with system load.
8. Describe the selection of refrigerant based on design criteria.
9. Describe the selection of components and accessory devices for refrigeration systems based on design criteria.

10. Describe the factors to consider when sizing pipe for refrigeration piping systems.
11. Describe the procedures used to size pipe for refrigeration piping systems.
12. Perform calculations for refrigeration system design.
 - i) horsepower per ton
 - low temperature system
 - medium temperature system
 - high temperature system

Practical Objectives:

1. Develop piping schematics for refrigeration systems.
2. Develop electrical schematics and wiring diagrams for refrigeration systems.

RACM-310

Compressors III (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, troubleshoot and repair large commercial/industrial compressors and their components.

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

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. Identify specialized tools and equipment used with large commercial/industrial compressors and describe their applications and procedures for use.
5. Identify methods used to cool compressors.
6. Identify methods of forced compressor lubrication.
7. Identify methods of compressor capacity control.

8. Identify methods of piping single and multiple large commercial/industrial compressors.
9. Identify types of multiple compressor lubrication systems.
10. Identify compressor and component failures and describe their causes and prevention.
 - i) mechanical
 - ii) electrical
11. Describe the procedures used to install large commercial/industrial compressors and their components.
12. Describe the procedures used to start-up and shut-down large commercial/industrial compressors.
13. Describe procedures used to maintain, large commercial/industrial compressors and their components.
14. Describe procedures used to troubleshoot and repair large commercial/industrial compressors and their components.

Practical Objectives:

N/A

RACM-315 Evaporative Condensers and Cooling Towers

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with evaporative condensers and cooling towers.
2. Describe the purpose and operating principles of evaporative condensers.
3. Identify types of evaporative condensers and describe their characteristics and applications.
4. Identify types of cooling towers and describe their characteristics and applications.
5. Identify types of closed circuit cooling towers and their components and describe their characteristics and applications.
6. Identify evaporative condenser components and describe their purpose and operation.

7. Identify cooling tower components and describe their purpose and operation.
8. Identify methods to control head pressure and describe their associated procedures.
9. Identify evaporative condenser problems and describe their causes and procedures for repair.
10. Describe the factors that influence the effectiveness of evaporative condensers.
11. Describe and determine the capacity of an evaporative condenser using psychometric processes.
12. Describe the procedures used to install evaporative condensers.
13. Describe the procedures used to start-up, operate and shut-down evaporative condensers.
14. Describe the procedures used to maintain, evaporative condensers.
15. Describe the procedures used to troubleshoot and repair evaporative condensers.
16. Describe the purpose and operating principles of cooling towers.
17. Describe the factors that influence the effectiveness of cooling towers.
18. Describe and determine the capacity of a cooling tower using psychometric processes.
19. Describe the procedures used to install cooling towers.
20. Describe the procedures used to start-up, operate and shut-down cooling towers.
21. Describe the procedures used to maintain cooling towers.
22. Describe the procedures used to troubleshoot and repair cooling towers.

Practical Objectives:

N/A

RACM-320

Fluid Dynamics and Circulating Pumps

Learning Outcomes:

- Demonstrate knowledge of fluid dynamics within piping systems.
- Demonstrate knowledge of circulating 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, troubleshoot and repair pumps and their components.

2019 Red Seal Occupational Standard Reference:

- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 11.01 Performs pre-start-up checks for HVAC/R systems.
- 11.02 Performs start-up of HVAC/R systems.
- 11.03 Completes HVAC/R system charge.
- 11.04 Sets up primary and secondary HVAC/R system components.
- 12.01 Performs start-up checks for control systems.
- 12.02 Verifies/sets operating parameters.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.
- 15.01 Performs maintenance and inspection on control systems.
- 15.02 Troubleshoots control systems.
- 15.03 Calibrates operating and safety controls.
- 15.04 Repairs controls systems.

Suggested Hours:

15 Hours

Theoretical Objectives:

1. Define terminology associated with fluid dynamics and circulating 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. Explain principles of fluid dynamics.
6. Identify specialized tools and equipment used with fluid dynamics and pumps, and describe their applications and procedures for use.
7. Identify types of circulating pumps and describe their characteristics and applications.
8. Identify circulating pump components and describe their purpose and operation.
9. Identify pump and component failures and describe their causes and prevention.
10. Describe the factors to consider when selecting a circulating pump.
 - 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 fill, start up and shut down circulating pump systems.
13. Describe the procedures used to maintain pumps and their components.
14. Describe the procedures used to troubleshoot and repair pumps and their components.
15. Describe the procedures to purge air from an open or closed system.
16. Perform calculations for fluid dynamics and pump sizing.

Practical Objectives:

N/A

RACM-325

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, troubleshoot and repair commercial refrigeration systems and their components.

2019 Red Seal Occupational Standard Reference:

- 7.01 Verifies HVAC/R system parameters and requirements.
- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 8.01 Verifies control system parameters and requirements.
- 8.02 Selects control system components and accessories.
- 8.03 Determines placement of control system components and accessories.
- 8.04 Performs control system take-off.
- 9.01 Confirms system layout.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 11.01 Performs pre-start-up checks for HVAC/R systems.
- 11.02 Performs start-up of HVAC/R systems.
- 11.03 Completes HVAC/R system charge.
- 11.04 Sets primary and secondary HVAC/R system components.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Define terminology associated with commercial refrigeration systems.
2. Identify hazards and describe safe work practices pertaining to commercial refrigeration systems.

3. Identify and interpret codes and regulations pertaining to commercial refrigeration systems.
4. Interpret information pertaining to commercial refrigeration systems found on drawings and specifications.
5. Explain the purpose and operation of commercial refrigeration systems and their components.
6. Identify specialized tools and equipment used with commercial refrigeration systems, and describe their applications and procedures for use.
7. Identify types of commercial refrigeration systems and describe their characteristics and applications.
 - i) coolers
 - ii) freezers
 - iii) process chillers
 - iv) process refrigeration
 - v) beverage coolers
 - vi) ice-machine
 - ice cubes
 - ice flakers
 - block ice
 - slush machine
 - vii) ice cream machines
 - cone
 - shake
 - viii) plate freezers
 - ix) blast freezer
 - x) immersion freezers
 - xi) supermarket equipment
 - cases
 - open
 - closed
8. Identify types of specialty systems and describe their characteristics and applications.
 - i) ultra-low
 - ii) cryogenic
 - iii) expendable
 - iv) compound
 - v) cascade
9. Identify commercial refrigeration system components and describe their purpose and operation.

- i) oil separators
- ii) oil filters
- iii) oil reservoirs
- iv) oil level controls
- v) heated receiver
- vi) heat reclaim
- vii) piping relief valve systems
- viii) fade out vessel
- ix) flash tank
- x) liquid refrigerant pumps

10. Identify commercial refrigeration system and component failures, and describe their causes and prevention.
11. Identify factors that optimize shelf life and quality of refrigerated and frozen products.
12. Describe the procedures used to install commercial refrigeration systems and their components.
13. Describe the procedures used to start-up and shut-down commercial refrigeration systems and their components.
14. Describe the procedures used to maintain commercial refrigeration systems and their components.
15. Describe the procedures used to troubleshoot and repair commercial refrigeration systems and their components.

Practical Objectives:

N/A

RACM-330

Air Conditioning Systems

Learning Outcomes:

- Demonstrate knowledge of residential and commercial air conditioning systems, their components and operation.
- Demonstrate knowledge of the procedures used to install residential and commercial air conditioning systems and their components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair residential and commercial air conditioning systems and their components.

2019 Red Seal Occupational Standard Reference:

- 7.01 Verifies HVAC/R system parameters and requirements.
- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 9.01 Confirms system layout.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 11.01 Performs pre-start-up checks for HVAC/R systems.
- 11.02 Performs start-up of HVAC/R systems.
- 11.03 Completes HVAC/R system charge.
- 11.04 Sets primary and secondary HVAC/R system components.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with residential and commercial air conditioning systems.
2. Identify hazards and describe safe work practices pertaining to residential and commercial air conditioning systems.
3. Identify and interpret codes and regulations pertaining to residential and commercial air conditioning systems.

4. Interpret information pertaining to residential and commercial air conditioning systems found on drawings and specifications.
5. Identify specialized tools and equipment used with residential and commercial air conditioning systems, and describe their applications and procedures for use.
6. Identify types of residential and commercial air conditioning systems and describe their characteristics and applications.
 - i) package units
 - ii) central splits
 - iii) ductless splits
 - iv) heat pumps
 - v) humidifiers
 - vi) dehumidifiers
 - vii) energy recovery ventilations (ERV)
 - viii) heat recovery ventilation (HRV)
 - ix) variable refrigerant flow (VRF)
 - x) chillers
 - xi) heat reclaim
7. Identify residential and commercial air conditioning system and component failures, and describe their causes and prevention.
8. Describe the procedures used to install residential and commercial air conditioning equipment and their components.
9. Describe the procedures used to start up and shut-down residential and commercial air conditioning equipment and their components.
10. Describe the procedures used to maintain commercial air conditioning equipment and their components.
11. Describe the procedures used to troubleshoot and repair residential and commercial air conditioning equipment and their components.
12. Describe the procedures used to calibrate and adjust air conditioning system components.

Practical Objectives:

N/A

RACM-335

Packaged Air Conditioning Units

Learning Outcomes:

- Demonstrate knowledge of packaged air conditioning units, their components and operation.
- Demonstrate knowledge of the procedures used to install packaged air conditioning units and their components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair packaged air conditioning units and their components.

2019 Red Seal Occupational Standard Reference:

- 7.01 Verifies HVAC/R system parameters and requirements.
- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 9.01 Confirms system layout.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 11.01 Performs pre-start-up checks for HVAC/R systems.
- 11.02 Performs start-up of HVAC/R systems.
- 11.03 Completes HVAC/R system charge.
- 11.04 Sets primary and secondary HVAC/R system components.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with packaged air conditioning units.
2. Identify hazards and describe safe work practices when working with packaged air conditioning units.
3. Identify and interpret codes and regulations pertaining to packaged air conditioning units.

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. Identify types of packaged air conditioning units and describe their characteristics and applications.
7. Identify packaged air conditioning unit components and describe their purpose and operation.
 - i) economizer
 - ii) powered exhaust
 - iii) relief damper
 - iv) P-trap
 - v) electric heat
 - vi) controls
8. Identify factors to consider when selecting packaged air conditioning systems and their components.
9. Identify packaged air conditioning system and component failures, and describe their causes and prevention.
10. Describe the procedures used to install packaged air conditioning units and their components.
11. Describe the procedures used to start-up and shut-down packaged air conditioning units.
12. Describe the procedures used to maintain packaged air conditioning units and their components.
13. Describe the procedures used to troubleshoot and repair packaged air conditioning units and their components.
14. Perform calculations for packaged air conditioning units.
 - i) percentage of outside air
 - ii) mixed air temperature

Practical Objectives:

N/A

RACM-340 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, troubleshoot and repair heat pump systems and their components.

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with heat pump systems.
2. Identify hazards and describe safe work practices pertaining to heat pump systems.
3. Identify and interpret codes and regulations pertaining to heat pump systems.
4. Interpret information pertaining to heat pump systems found on drawings and specifications.
5. Explain the operating principles of heat pump systems.
6. Explain control sequences for heat pumps.
7. Identify specialized tools and equipment used with heat pump systems and describe their applications and procedures for use.

8. Identify types of heat pumps and describe their characteristics and applications.
 - i) air-to-air
 - ii) liquid-to-air
 - iii) air-to-liquid
 - iv) liquid-to-liquid
 - v) geothermal
 - vi) solar
 - vii) variable refrigerant flow (VRF)
9. Identify heat pump components and describe their purpose and operation.
10. Identify 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
11. Identify heat pump system failures and describe their causes and prevention.
12. Describe the operation of the defrost cycle as it relates to heat pumps.
13. Describe water/fluid quality as it relates to open and closed loop systems.
14. Describe the procedures used to install heat pumps and their components.
15. Describe the procedures used to start-up and shut down heat pumps systems.
16. Describe the procedures used to maintain heat pumps and their components.
17. Describe the procedures used to troubleshoot and repair heat pumps and their components.
18. Perform calculations for heat pump systems.
 - i) balance point
 - ii) coefficient of performance (COP)
 - iii) seasonal energy efficiency ratio (SEER)
 - iv) heating seasonal performance factor (HSPF)

Practical Objectives:

N/A

RACM-345 Control Systems II

Learning Outcomes:

- Demonstrate knowledge of control systems, their components and operation.
- Demonstrate knowledge of the procedures used to assemble and install control systems and their components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair control systems and their components.
- Demonstrate knowledge of digital technology used with control systems.

2019 Red Seal Occupational Standard Reference:

- 2.10 Uses digital technology.
- 8.01 Verifies control system parameters and requirements.
- 8.02 Selects control system components and accessories.
- 8.03 Determines placement of control system components and accessories.
- 8.04 Performs control system take-off.
- 10.01 Places control system components.
- 10.02 Connects control systems.
- 12.01 Performs start-up checks for control systems.
- 12.02 Verifies/sets operating parameters.
- 15.01 Performs maintenance and inspection on control systems.
- 15.02 Troubleshoots control systems.
- 15.03 Calibrates operating and safety controls.
- 15.04 Repairs control systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

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 control principles and describe their operation.
 - i) two position
 - ii) timed two position
 - iii) floating
 - iv) proportional (P)
 - v) proportional plus intergral (PI)
 - vi) proportional plus intergral plus derivative (PID)
 - vii) pulse width modulation (PWM)

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

8. Identify control system components and describe their purpose and applications.

9. Identify types of digital technology used to set up operation of systems.
 - i) direct digital control (DDC)
 - ii) programmable logic controller (PLC)
 - iii) microprocessor
 - iv) software

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

11. Identify control system failures and describe their causes and prevention.

12. Describe the procedures used to install and configure control systems and their components.

13. Describe the procedures used to start-up and shut-down control systems.

14. Describe the procedures used to set-up and calibrate control systems and components.

15. Describe the procedures used to connect and communicate with automated control systems.
 - i) refer to manufacturers' operating procedures
 - ii) program parameters on digital technology and user interface panel to set up operation of system
 - iii) use on board functions to monitor and diagnose problems
 - iv) network protocols
 - BACnet
 - LonWorks

- MSTP
- Modbus
- v) wireless connectivity
 - Wi-Fi
 - Bluetooth
 - ZigBee

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

Practical Objectives:

N/A

RACM-350 Troubleshooting Refrigeration and Air Conditioning Electronics

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.

2019 Red Seal Occupational Standard Reference:

8.01 Verifies control system parameters and requirements.

14.01 Troubleshoots HVAC/R systems.

15.02 Troubleshoots control systems.

Suggested Hours:

15 Hours

Theoretical Objectives:

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 electronic components 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 electronic components and control boards.

8. Describe the procedure used to verify and troubleshoot the sequence of operation of a control board.

Practical Objectives:

N/A

Level 4

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RACM-400 Air Conditioning Load Calculations

Learning Outcomes:

- Demonstrate knowledge of performing air conditioning load calculations.

2019 Red Seal Occupational Standard Reference:

7.01 Verifies HVAC/R system parameters and requirements.

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Define terminology associated with air conditioning load calculations.
2. Perform heat gain and heat loss calculations for air conditioning systems.
 - i) design conditions
 - cooling
 - heating
 - ii) transmission
 - K, C, R and U values
 - solar load
 - iii) air change
 - infiltration
 - exfiltration
 - ventilation
 - iv) heat gain/loss
 - sensible
 - latent
 - v) miscellaneous
 - lighting
 - occupancy
 - equipment
 - duct heat loss/gain
 - vi) peak load
 - vii) btu/hr total

Practical Objectives:

1. Perform air conditioning load calculations.

RACM-405

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 components and their selection based on design criteria.
- Demonstrate knowledge of air conditioning system capacity control.
- Demonstrate knowledge of sketching piping schematics for air conditioning systems.
- Demonstrate knowledge of sketching electrical schematics for air conditioning systems.

2019 Red Seal Occupational Standard Reference:

- 2.10 Uses digital technology.
- 7.01 Verifies HVAC/R system parameters and requirements.
- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 8.01 Verifies control system parameters and requirements.
- 8.02 Selects control system components and accessories.
- 8.03 Determines placement of control system components and accessories.

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Define terminology associated with air conditioning system design.
2. Identify and interpret codes and regulations pertaining to air conditioning system design.
3. Interpret information pertaining to air conditioning system design found on drawings, specifications, graphs and tables.
4. Explain fundamental principles of air conditioning system design.
5. Explain the importance of balancing air conditioning system capacity with system load.
6. Identify capacity ratings of air conditioning system components.
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)
 - iv) dual duct
8. Identify methods of zoning and describe their applications.
- i) hydronic system
 - ii) dual duct system
 - iii) terminal reheat system
 - iv) induction reheat system
 - v) variable volume and temperature system (VVT)
 - vi) variable air volume system (VAV)
 - vii) variable refrigerant flow (VRF)
9. Identify factors to consider when selecting equipment, components and accessory devices for air conditioning systems based on design criteria.
- i) economizers
 - ii) humidifiers
 - iii) dehumidifiers
 - iv) energy recovery ventilators (ERV)
 - v) heat recovery ventilators (HRV)
10. Identify factors to consider when sizing pipe for air conditioning systems.
- i) refrigeration piping
 - ii) secondary refrigerant piping
 - iii) condenser water piping
 - iv) condensate drain piping
11. Describe the procedures used to size pipe for air conditioning piping systems.
12. Develop piping schematics for air conditioning systems.
13. Develop electrical schematics for air conditioning systems.
14. Perform calculations for air conditioning system design.
- i) air volumes and velocities
 - ii) operating capacity
 - iii) design capacity
 - iv) transfer rates
 - v) sizing of humidity control equipment

Practical Objectives:

1. Sketch pipe and electrical schematics for air conditioning systems.

RACM-410 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 used to install duct systems and their components.
- Demonstrate knowledge of the procedures to maintain, troubleshoot and repair duct systems and their components.

2019 Red Seal Occupational Standard Reference:

- 7.01 Verifies HVAC/R systems parameters and requirements.
- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 13.01 Inspects HVAC/R systems.
- 13.03 Tests HVAC/R systems.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

24 Hours

Theoretical Objectives:

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. Explain the purpose and operation of duct systems and their components.
6. Identify specialized tools and equipment used with duct systems and components, and describe their applications and procedures for use.
7. Identify types of duct systems and describe their characteristics and applications.

8. Identify types of duct insulation and sealants, and describe their characteristics and applications.
9. Identify duct system components and describe their characteristics and applications.
10. Identify factors to consider when selecting and installing duct system components.
11. Identify factors affecting duct system sizing, layout and design.
12. Identify methods of sizing duct and describe their associated procedures.
13. Identify potential problems in duct systems and describe their causes and prevention.
14. Describe the procedures used to assemble and install duct systems and their components.
15. Describe the procedures used to maintain duct systems and their components.
16. Describe the procedures used to troubleshoot and repair duct systems and their components.

Practical Objectives:

N/A

RACM-415 Air Measurement and System Air Balancing

Learning Outcomes:

- Demonstrate knowledge of the principles of air measurement and air quality management.
- Demonstrate knowledge of air measuring instruments, their applications and procedures for use.
- Demonstrate knowledge of system air balancing procedures.

2019 Red Seal Occupational Standard Reference:

- 12.01 Performs start-up checks for control systems.
- 12.02 Verifies/sets operating parameters.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.

Suggested Hours:

24 Hours

Theoretical Objectives:

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. Identify and interpret codes, standards 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. Explain the principles of air movement and air balancing.
6. Identify types of air measuring instruments, and describe their applications and procedures for use.
7. Identify types of charts and tables used to monitor and balance air systems, and describe their applications and procedures for use.
 - i) friction chart
 - ii) manufacturer specific charts

8. Describe conditions affecting air properties.
9. Describe the procedures used in system air balancing.

Practical Objectives:

1. Perform calculations for system air balancing.

RACM-420 Heating Systems

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment.
- 7.04 Performs HVAC/R material take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 11.02 Performs start-up of HVAC/R systems.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

18 Hours

Theoretical Objectives:

1. Define terminology associated with heating systems.
2. Identify hazards and describe safe work practices when working with heating systems and fuels.
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. Identify types of heating systems and describe their characteristics and applications.

- i) gas
 - ii) oil
 - iii) electric
7. Identify types of heating system equipment, components and accessories, and describe their characteristics and applications.
- i) heating system equipment
 - forced air
 - hydronic
 - combination
 - infrared
 - radiant
 - solar
 - ii) components and accessories
 - fans
 - blowers
 - pumps
 - motors
 - dampers
 - temperature/pressure controls
 - safety controls
 - safety components
 - valves
8. Identify factors to consider when selecting and installing heating system equipment, components and accessories.
9. Identify heating system problems and describe their causes and prevention.
10. Describe the physical and chemical properties of heating fuels.
11. Describe the procedures used to assemble and install heating systems and their components.
12. Describe the procedures used to start-up and shut-down heating systems.
13. Describe the procedures used to maintain heating systems and their components.
14. Describe the procedures used to troubleshoot and repair heating systems and their components.
15. Perform calculations for heating systems.

Practical Objectives:

N/A

RACM-425 Chillers and Chiller Systems

Learning Outcomes:

- Demonstrate knowledge of chillers and chiller systems, their components and operation.
- Demonstrate knowledge of the procedures used to assemble and install chillers, chiller systems and their components.
- Demonstrate knowledge of the procedures to maintain, troubleshoot and repair chillers, chiller systems and their components.

2019 Red Seal Occupational Standard Reference:

- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of equipment, components and accessories.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 11.02 Performs starts-up for HVAC/R systems.
- 11.04 Sets up primary and secondary HVAC/R system components.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.

Suggested Hours:

24 Hours

Theoretical Objectives:

1. Define terminology associated with chillers and chiller systems.
2. Identify hazards and describe safe work practices pertaining to chillers and chiller systems.
3. Identify and interpret codes, standards 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. Explain the purpose and operation of chillers and chiller systems, and their associated components.

- i) primary
 - ii) secondary
6. Identify specialized tools and equipment used with chillers and chiller systems, and describe their applications and procedures for use.
 7. Identify types of chiller systems and describe their characteristics and applications.
 - i) direct expansion
 - ii) flooded
 - iii) absorption
 8. Identify chiller components and describe their characteristics and applications.
 - i) compressor
 - ii) pumps
 - iii) condenser
 - air cooled
 - fluid cooled
 - evaporative cooled
 - iv) metering devices
 - v) chiller barrel
 - flooded
 - direct expansion
 - vi) plate heat exchanger
 - vii) purge unit
 - viii) cooling coils
 - ix) valves
 - x) air handlers
 - xi) economizer
 9. Identify chiller applications and describe their characteristics and applications.
 - i) air conditioning
 - ii) ice-rink/surface
 - iii) process
 - iv) supermarket
 - v) seafood storage
 - vi) beverage chiller
 10. Identify factors to consider when selecting and installing chillers, chiller systems and their associated components.
 11. Identify chiller and chiller system failures and describe their causes and prevention.
 12. Describe the operating cycles of chiller systems.
 - i) refrigeration

- ii) lubrication
 - iii) motor cooling
13. Describe the methods of chiller capacity control.
 14. Describe the procedures used to assemble and install chillers and chiller systems and their components.
 15. Describe the procedures used to start-up and shut-down chiller systems.
 16. Describe the procedures used to maintain chillers and chiller systems and their components.
 17. Describe the procedures used to troubleshoot and repair chillers and chiller systems and their components.

Practical Objectives:

1. Perform range and approach calculations.

RACM-430

Industrial Refrigeration Systems

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 7.01 Verifies HVAC/R system parameters and requirements.
- 7.02 Selects HVAC/R equipment, components and accessories.
- 7.03 Determines placement of HVAC/R equipment, components and accessories.
- 8.01 Verifies control system parameters and requirements.
- 8.02 Selects control system components and accessories.
- 8.03 Determines placement of control system components and accessories.
- 8.04 Performs control system take-off.
- 9.02 Assembles HVAC/R equipment, components and accessories.
- 9.03 Places HVAC/R equipment, components and accessories.
- 10.01 Places control system components.
- 10.02 Connects control systems.
- 11.01 Performs pre-start-up checks for HVAC/R systems.
- 11.02 Performs start-up of HVAC/R systems.
- 11.03 Completes HVAC/R system charge.
- 11.04 Sets up primary and secondary HVAC/R system components.
- 12.01 Performs start-up checks for control systems.
- 12.02 Verifies/sets operating parameters.
- 13.01 Inspects HVAC/R systems.
- 13.02 Performs predictive and scheduled maintenance on HVAC/R systems.
- 13.03 Tests HVAC/R system components and accessories.
- 14.01 Troubleshoots HVAC/R systems.
- 14.02 Repairs HVAC/R systems.
- 15.03 Calibrates operating and safety controls.
- 15.04 Repairs control systems.

Suggested Hours:

24 Hours

Theoretical Objectives:

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. Explain the purpose and operation of industrial refrigeration systems and their components.
6. Identify specialized tools and equipment used with industrial refrigeration systems, and describe their applications and procedures for use.
7. Identify types of industrial refrigeration systems and describe their characteristics and applications.
 - i) parallel
 - ii) compound
 - iii) cascade
 - iv) flooded
 - v) liquid recirculation
8. Identify industrial refrigeration system components and describe their characteristics and applications.
9. Identify factors to consider when handling ammonia and carbon dioxide.
10. Identify factors to consider when selecting and installing industrial refrigeration systems and their components.
11. Identify industrial refrigeration system and component failures, and describe their causes and prevention.
12. Describe the procedures used to assemble and install industrial refrigeration systems and their components.
13. Describe the start-up and shut-down procedures used for industrial refrigeration systems.
14. Describe the procedures used to maintain industrial refrigeration systems and their components.

15. Describe the procedures used to troubleshoot and repair industrial refrigeration systems and their components.

Practical Objectives:

N/A

RACM-435 Troubleshooting with Schematic Wiring Diagrams

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

14.01 Troubleshoots HVAC/R systems.

15.02 Troubleshoots control systems.

Suggested Hours:

36 Hours

Theoretical Objectives:

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.

Practical Objectives:

N/A

RACM-440 Job Coordination

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

- 3.01 Interprets drawings and specifications.
- 3.02 Uses documentation and reference material.
- 3.03 Plans job tasks and procedures.
- 4.01 Uses communication techniques.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Define terminology associated with job coordination.
2. Identify sources of information relevant to job coordinating.
 - i) trade-related documentation
 - warranties
 - manufacturers' specifications
 - model number
 - serial number
 - wholesaler catalogues
 - log sheets
 - permits
 - reports
 - work orders
 - purchase orders
 - ii) related professionals
 - iii) customers
 - iv) co-workers
 - dispatchers
 - sales staff
 - managers
3. Identify and interpret regulatory requirements.
 - i) standards and regulations

- ii) codes and by laws
 - iii) permits
 - iv) inspections
4. Identify information gathering and communication techniques.
- i) questioning
 - ii) translating technical information
 - iii) using communication equipment
5. Describe the procedures used to coordinate job tasks and work requirements.
- i) job site analysis/hazard assessment
 - ii) prepare material list
 - iii) requisition equipment, components and accessories
 - iv) arrange for delivery and storage of equipment/materials
 - v) coordinate access to work site
 - vi) conduct work area inspection
 - vii) coordinate activities with customer and other professionals
6. Describe the procedures used to estimate work requirements.
- i) tools and equipment
 - ii) components and accessories
 - iii) time and costs

Practical Objectives:

N/A

RACM-445 Workplace Mentoring II

Learning Outcomes:

- Demonstrate knowledge of strategies for teaching workplace skills.

2019 Red Seal Occupational Standard Reference:

4.02 Uses mentoring techniques.

Suggested Hours:

6 Hours

Theoretical Objectives:

1. Describe the importance of individual experience.
2. Describe the shared responsibilities for workplace learning.
3. Determine one's own learning preferences and explain how these relate to learning new skills.
4. Describe the importance of different types of skills in the workplace.
5. Describe the importance of essential skills in the workplace.
 - i) reading
 - ii) writing
 - iii) document use
 - iv) oral communication
 - v) numeracy
 - vi) thinking
 - vii) working with others
 - viii) digital technology
 - ix) continuous learning
6. Identify different learning styles.
 - i) seeing it
 - ii) hearing it
 - iii) trying it
7. Identify different learning needs and strategies to meet learning needs.
 - i) learning disabilities
 - ii) learning preferences

- iii) language proficiency
8. Identify strategies to assist in learning a skill.
 - i) understanding the principles of instruction
 - ii) developing coaching skills
 - iii) being mature and patient
 - iv) providing feedback
 9. Identify different roles played by a workplace mentor.
 10. Describe teaching skills.
 11. Explain the importance of identifying the point of a lesson.
 12. Identify how to choose a good time to present a lesson.
 13. Explain the importance of linking the lessons.
 14. Identify the components of the skill (context).
 15. Describe considerations in setting up opportunities for skill practice.
 16. Explain the importance of providing feedback.
 17. Identify techniques for giving effective feedback.
 18. Describe a skills assessment.
 19. Identify methods of assessing progress.
 20. Explain how to adjust a lesson to different situations.

Practical Objectives:

N/A

RACM-450 Program Review

Learning Outcomes:

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

2019 Red Seal Occupational Standard Reference:

Entire Red Seal Occupational Standard.

Suggested Hours:

30 Hours

Theoretical Objectives:

1. Define terminology associated with a Red Seal Occupational Standard (RSOS).
 - i) major work activities (MWA)
 - ii) tasks
 - iii) sub-tasks
2. Explain how a RSOS is developed and the link it has to the Interprovincial Examination.
 - i) development
 - ii) validation
 - iii) MWA and task weighting
 - iv) examination breakdown
3. Identify Red Seal products and describe their use when preparing for the Interprovincial Examination.
 - i) Red Seal website
 - ii) examination preparation guide
 - iii) examination counselling sheets
 - iv) sample questions
 - v) preparation checklists
4. Explain the relationship between the RSOS and the Curriculum Standard.
5. Review Common Occupational Skills for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
 - i) safety-related functions
 - ii) tools and equipment

- iii) organizes work
 - iv) communication and mentoring
6. Review process to perform routine trade activities for the for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
 - i) work site preparation
 - ii) trade activities
 7. Review process to plan installations for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
 - i) HVAC/R systems
 - ii) control systems
 8. Review process to perform installations for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
 - i) HVAC/R systems
 - ii) control systems
 9. Review process to perform commissioning for the for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
 - i) HVAC/R systems
 - ii) control systems
 10. Review process to perform maintenance and service for the Refrigeration and Air Conditioning Mechanic trade as identified in the RSOS.
 - i) HVAC/R systems
 - ii) control systems

Practical Objectives:

N/A

Feedback and Revisions

This AACs will be amended periodically; comments or suggestions for improvements should be directed to:

New Brunswick:

Apprenticeship and Occupational
Certification
Post-Secondary Education, Training and
Labour
470 York St., Rm. 110, PO Box 6000
Fredericton, NB E3B 5H1
Tel: 506-453-2260
Toll Free in NB: 1-855-453-2260
www.gnb.ca

Prince Edward Island:

Apprenticeship, Training and Certification
Atlantic Technology Centre
212-176 Great George St., PO Box 2000
Charlottetown, PE C1A 7N8
Tel: 902-368-4460
www.apprenticeship.pe.ca

Newfoundland and Labrador:

Apprenticeship and Trades Certification
Immigration, Population Growth and Skills
Confederation Bldg., West Block
Prince Philip Dr., PO Box 8700
St. John's, NL A1B 4J6
Toll Free: 1-877-771-3737
www.gov.nl.ca/atcd

Nova Scotia:

Nova Scotia Apprenticeship Agency
1256 Barrington St.
Halifax, NS B3J 1Y6
Tel: 902-424-5651
Toll Free in NS: 1-800-494-5651
www.nsapprenticeship.ca

Any comments or suggestions received will be reviewed and considered to determine the course of action required. If the changes are deemed to be minor, they will be held for implementation during the next review cycle. If immediate change is deemed appropriate and approved by the Atlantic Trade Advisory Committee, it will result in a revision to this version of the AACs and will be detailed in the following section.

Version Changes

Revision Date	Section	Description of Change