Refrigeration and Air Conditioning Mechanic

Guide to Course Content

2022-2023

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Recognition:
To promote transparency and consistency, this document has been adapted from the 2019 Refrigeration and Air Conditioning Mechanic Red Seal Occupational Standard (Employment and Social Development Canada).

A complete version of the Occupational Standard can be found at www.red-seal.ca

STRUCTURE OF THE GUIDE TO COURSE CONTENT

To facilitate understanding of the occupation, this guide to course content contains the following sections:

Description of the Refrigeration and Air Conditioning Mechanic trade: an overview of the trade's duties and training requirements.

Essential Skills Summary: an overview of how each of the nine essential skills is applied in this trade.

Elements of harmonization of apprenticeship training: includes adoption of Red Seal trade name, number of levels of apprenticeship, total training hours (on-the-job and in-school) and consistent sequencing of technical training content. Implementation for harmonization will take place progressively. Level one to be implemented in 2019/2020, level two 2020/2021, level three 2021/2022, and level four in 2022/2023.

Task Matrix: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard detailing the essential skills and the level of training where the content is covered.

Major Work Activity (MWA): the largest division within the standard that is comprised of a distinct set of trade activities.

Task: distinct actions that describe the activities within a major work activity.

Sub-task: distinct actions that describe the activities within a task.

Training Profile Chart: a chart which outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training.

Technical Training Course Content for the Refrigeration and Air Conditioning Mechanic trade: a chart which outlines the model for SATCC technical training sequencing. For the harmonized level of training, a cross reference to the Harmonized apprenticeship technical training sequencing, at the learning outcome level, is provided.

Appendix A: Post Harmonization Training Profile Chart: a chart which outlines the finalized model for SATCC technical training sequencing with a cross reference to the Harmonized apprenticeship technical training sequencing, at the topic level.

The Red Seal Refrigeration and Air Conditioning Mechanic Curriculum Outline, which provides additional detail of the Harmonized technical training, can be found at www.red-seal.ca

DESCRIPTION OF THE REFRIGERATION AND AIR CONDITIONING MECHANIC TRADE

Refrigeration and Air Conditioning Mechanics install, maintain and repair primary and secondary refrigeration and cooling systems, in residential, commercial and industrial settings.

Refrigeration and air conditioning mechanics install, maintain, service, and decommission residential, commercial, industrial and institutional heating, ventilation, air conditioning and refrigeration units and systems. They also connect to and service air delivery systems, install and service hydronic and secondary refrigerant systems and associated controls. Their duties include laying out reference points for installation, assembling and installing components, installing wiring and cabling, to connect components and equipment to an electric power supply and calibrating related controls. They also measure, cut, bend, thread and connect pipe to functional components and utilities.

Refrigeration and air conditioning mechanics maintain and service systems by inspecting and testing components, brazing or soldering parts to repair defective joints, adjusting and replacing worn or defective components and reassembling repaired components and systems. As part of service and commissioning, refrigeration and air conditioning mechanics start up, test, charge, adjust, calibrate, balance, measure, verify maintain and document systems.

In addition to their regular duties, some mechanics may also prepare work estimates and design systems for clients.

Refrigeration and air conditioning mechanics work with a range of tools and equipment including hand, power, charging, diagnostic and measuring, hoisting and rigging, and recovery and recycling tools and equipment.

They may be employed by heating, ventilation, air conditioning and refrigeration contractors and manufacturers, property owners, retail establishments, and institutional and public sector employers. They also may be self-employed. Refrigeration and air conditioning mechanics may work on systems and units in office buildings, restaurants, food and beverage processing plants, ice arenas, supermarkets, hospitals, the marine and mining sectors as well as bio-medical, scientific and research and development fields. They may also work on refrigerated trucks, automotive air conditioning systems, box cars and appliances.

In some jurisdictions, refrigeration and air conditioning mechanics may be required to work on fuel-fired equipment and therefore may require additional licencing.

Refrigeration and air conditioning mechanics work in various locations such as rooftops, mechanical rooms and computer rooms. The work may be performed indoors or outdoors year round and may require extensive travelling. Much of the work is performed independently.

Inherent risks in this trade include working at heights and in confined spaces, and working with compressed gases, flammable and toxic materials, and utilities such as electrical and hazardous chemicals. Hazardous work environments and weather conditions are also factors. Refrigeration and air conditioning mechanics must be aware of the physical demands and potential for personal injury when performing tasks.

Key attributes for people entering this trade are strong client service, writing, oral communication and problem solving skills, an eye for detail, and the ability to be independent and self-directed. Coordination and manual dexterity are also important, as are mechanical and mathematical abilities. Good physical condition and the strength to lift heavy components are also valuable.

This standard recognizes similarities and overlaps with the work of steamfitters/pipefitters, plumbers, gasfitters, sheet metal workers, industrial mechanics (millwrights), electricians, instrumentation and control technicians, riggers and stationary engineers.

With experience, refrigeration and air conditioning mechanics may act as mentors and trainers of apprentices in the trade. They may also become specialized in one area of the trade, advance to supervisory positions or become instructors.

Training Requirements: To graduate from each level of the apprenticeship program, an apprentice must successfully complete the required technical training and compile enough on-the-job experience to total at least 1800 hours each year. Total trade time required is 7200 hours and at least 4 years in the trade.

There are four levels of technical training delivered by Saskatchewan Polytechnic in Saskatoon:

Level One:	8 weeks
Level Two:	8 weeks
Level Three:	8 weeks
Level Four:	8 weeks

***Any person who is not a journeyperson Refrigeration and Air Conditioning Mechanic must become registered as an apprentice to work in this trade.**

The information contained in this guide to course content details the technical training delivered for each level of apprenticeship. An apprentice spends approximately 15% of their apprenticeship term in a technical training institute learning the technical and theoretical aspects of the trade. The hours and percentages of technical and practical training may vary according to class needs and progress.

The content of the technical training components is subject to change without notice.

Entrance Requirements for Apprenticeship Training

Your grade twelve transcripts (with no modified classes) or GED 12 is your guarantee that you meet the educational entrance requirements for apprenticeship in Saskatchewan. In fact, employers prefer and recommend apprentices who have completed high school. This ensures the individual has all of the necessary skills required to successfully complete the apprenticeship program and receive journeyperson certification.

Individuals with “modified” or “general” classes in math or science do not meet our entry requirements. These individuals are required to take an entrance assessment prescribed by the SATCC.

English is the language of instruction in all apprenticeship programs and is the common language for business in Saskatchewan. Before admission, all apprentices and/or “upgraders” must be able to understand and communicate in the English language. Applicants whose first language is not English must have a minimum Canadian Language Benchmark Assessment of six (CLB6).

Note: A CLB assessment is valid for a one-year period from date of issue.

GED 12 is acceptable; “modified” or “general” classes are not.

Designated Trade Name	**Math Credit** at the Indicated Grade Level❶	**Science Credit** at Grade Level (preferred class in brackets)
Refrigeration and Air Conditioning Mechanic	WA 20 or F 20 or P 20 or Math 20	Grade 10

❶ (One of the following) WA – Workplace and Apprenticeship; or F – Foundations; or P – Pre-calculus, or a Math at the indicated grade level (Modified and General Math credits are not acceptable.).

*Applicants who have graduated in advance of 2015-2016, or who do not have access to the revised Science curricula will require a Science at the minimum grade level indicated by trade.

Individuals not meeting the entrance requirements will be subject to an assessment and any required training

ESSENTIAL SKILLS SUMMARY

Essential skills are needed for work, learning and life. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Through extensive research, the Government of Canada and other national and international agencies have identified and validated nine essential skills. These skills are used in nearly every occupation and throughout daily life in different ways.

A series of CCDA-endorsed tools have been developed to support apprentices in their training and to be better prepared for a career in the trades. The tools can be used independently or with the assistance of a tradesperson, trainer, employer, teacher or mentor to

- understand how essential skills are used in the trades;
- learn about individual essential skills strengths and areas for improvement; and
- improve essential skills and increase success in an apprenticeship program.

The tools are available online or for order at: https://www.canada.ca/en/employment-social-development/programs/essential-skills/profiles.html.

The application of these skills may be described throughout this document within the skills and knowledge which support each sub-task of the trade. The most important essential skills for each sub-task have also been identified. The following are summaries of the requirements in each of the essential skills, taken from the essential skills profile. A link to the complete essential skills profile can be found at http://www.red-seal.ca/.

READING

Refrigeration and air conditioning mechanics read a variety of materials including technical bulletins, manufacturers' specifications and manuals to obtain detailed information on equipment installation and troubleshooting procedures. They read work orders to ensure that the correct piece of equipment is being installed or maintained according to client requirements. They may also refer to wholesaler catalogues to assist in the selection and ordering of parts and equipment.

DOCUMENT USE

As part of document use, refrigeration and air conditioning mechanics consult company and work site procedures. They interpret information in tables, charts and graphs, and codes and regulations, and apply that knowledge when performing a task. They also use drawings to understand job requirements. Refrigeration and air conditioning mechanics adhere to hazard signs and warning labels that are part of WHMIS to prevent injury to themselves and others.

WRITING

Refrigeration and air conditioning mechanics update logbooks and complete written documents such as service reports, work orders, warranty claim forms, permits, and legislated and company documents. They may prepare sketches and update as-built drawings.

NUMERACY

Refrigeration and air conditioning mechanics use numeracy in a range of tasks. For example, they measure lengths of ducting and piping. They calculate areas and volumes of ducting and piping assemblies to meet operating specifications. They use diagnostic and measurement tools to troubleshoot and verify the proper operation of equipment. They compare equipment temperature and pressure trend graphs to equipment specifications and operating parameters to monitor systems. They also estimate time and material costs.

ORAL COMMUNICATION

Refrigeration and air conditioning mechanics communicate with other tradespeople to coordinate the installation, maintenance and service of HVAC/R systems. They interact with clients to identify system requirements and to obtain problem descriptions. They may also call suppliers to order parts, speak with manufacturers' representatives to obtain technical information and engineers to discuss design specifications.

THINKING

Refrigeration and air conditioning mechanics use problem-solving skills to troubleshoot equipment problems and resolve client issues. They determine the most efficient and economical equipment for a job and repair options available. Refrigeration and air conditioning mechanics plan their work schedule considering factors such as priority, safety, time to complete and travelling time for a job. They schedule maintenance work to minimize down time.

WORKING WITH OTHERS

Refrigeration and air conditioning mechanics providing installation, maintenance and service can work independently or as part of a team alongside co-workers, subcontractors and other trades. They interact with clients and others in a professional manner. Refrigeration and air conditioning mechanics mentor apprentices.

DIGITAL TECHNOLOGY

Refrigeration and air conditioning mechanics adjust parameters on automated control systems. They use remote access and on-board functions to monitor and diagnose problems. Refrigeration and air conditioning mechanics use electronic instruments for diagnosis. They may use software, electronic devices and the Internet during the course of their work.

CONTINUOUS LEARNING

Continuous learning is important for refrigeration and air conditioning mechanics due to ongoing changes in technology and an increased emphasis on the environment and energy efficiency. They need to keep informed about new types of equipment, energy sources, materials, computer controls and available client options. They must also keep up-to-date on code and regulation changes that govern their work. Refrigeration and air conditioning mechanics learn through reading manufacturers' literature and trade journals, and by visiting manufacturers' websites. They can also take advantage of seminars and information sessions put on by equipment manufacturers, suppliers, unions and their employers.

ELEMENTS OF HARMONIZATION FOR APPRENTICESHIP TRAINING

At the request of industry, the Harmonization Initiative was launched in 2013 to *substantively align* apprenticeship systems across Canada by making training requirements more consistent in the Red Seal trades. Harmonization aims to improve the mobility of apprentices, support an increase in their completion rates and enable employers to access a larger pool of apprentices.

As part of this work, the Canadian Council of the Directors of Apprenticeship (CCDA) identified four main harmonization priorities in consultation with industry and training stakeholders:

1. Trade name

The official Red Seal name for this trade is Refrigeration and Air Conditioning Mechanic.

2. Number of Levels of Apprenticeship

The number of levels of technical training recommended for the Refrigeration and Air Conditioning Mechanic trade is four.

3. Total Training Hours during Apprenticeship Training

The total hours of training, including both on-the-job and in-school training for the Refrigeration and Air Conditioning Mechanic trade is 7200.

4. Consistent sequencing of training content (at each level) using the most recent Occupational Standard

Implementation for harmonization will take place progressively. Level one to be implemented in 2019/2020, level two 2020/2021, level three 2021/2022, and level four in 2022/2023. See Appendix A for the finalized curriculum comparisons.

White boxes are “Topics,” grey boxes are “In Context”. In context means learning that has already taken place and is being applied to the applicable task. Learning outcomes for in context topics are accomplished in other topics in that level.

Level 1 (2019/2020 Implementation)	Level 2 (2020/2021 Implementation)	Level 3 (2021/2022 Implementation)	Level 4 (2022/2023 Implementation)
Safety-Related Functions	Safety-Related Functions	Safety-Related Functions	Safety-Related Functions
Tools and Equipment	Tools and Equipment	Tools and Equipment	Tools and Equipment

		HVAC/R Systems (Maintain)	HVAC/R Systems (Maintain)
Organizes Work	Organizes Work	Organizes Work	Organizes Work
Communication			Communication and Mentoring
Work Site Preparation			
Trade Activities	Trade Activities		
Basic HVAC/R Systems (Plans Installation)	HVAC/R Systems (Plans Installation)	HVAC/R Systems (Plans Installation)	HVAC/R Systems (Plans Installation)
Basic Control Systems (Plans Installation)	Control Systems (Plans Installation)	Control Systems (Plans Installation)	Control Systems (Plans Installation)
Basic HVAC/R Systems (Installation)	HVAC/R Systems (Installs)	HVAC/R Systems (Installs)	
Basic Control Systems (Installation)	Control Systems (Installs)	Control Systems (Installs)	
		HVAC/R Systems (Commissions)	HVAC/R Systems (Commissions)
		Control Systems (Commissions)	Control Systems (Commissions)
HVAC/R Systems (Basic Maintenance)	HVAC/R Systems (Maintain)		
	HVAC/R Systems (Basic Service)	HVAC/R Systems (Service)	HVAC/R Systems (Service)
	Control Systems (Basic Maintenance and Service)	Control Systems (Maintain and Service)	Control Systems (Maintain and Service)

REFRIGERATION AND AIR CONDITIONING MECHANIC TASK MATRIX

This chart outlines the major work activities, tasks and sub-tasks from the 2019 Refrigeration and Air Conditioning Mechanic Red Seal Occupational Standard. Each sub-task details the corresponding essential skill and level of training where the content is covered. *

* Sub Tasks with numbers in the boxes is where the content will be delivered in training. The Task Matrix Chart will be updated every year until Harmonization implementation is complete. Implementation for harmonization will take place progressively. Level one to be implemented in 2019/2020, level two in 2020/2021, level three in 2021/2022, and level four in 2022/2023.

A – Performs common occupational skills

Task A-1 **Performs safety-related functions**	**A-1.01 Maintains safe work environment** **1** **(2, 3, 4 in context)**	**A-1.02 Performs lock-out, tag-out and isolation procedures** **1** **(2, 3, 4 in context)**	**A-1.03 Uses personal protective equipment (PPE) and safety equipment** **1** **(2, 3, 4 in context)**
Task A-2 **Uses tools and equipment**	**A-2.01 Uses hand tools** **1** **(2, 3, 4 in context)**	**A-2.02 Uses portable and stationary power tools** **1** **(2, 3, 4 in context)**	**A-2.03 Uses brazing and soldering equipment** **1** **(2, 3, 4 in context)**
	A-2.04 Uses recovery and recycling tools and equipment **1** **(2, 3, 4 in context)**	**A-2.05 Uses evacuation tools and equipment** **1** **(2, 3, 4 in context)**	**A-2.06 Uses charging tools and equipment** **1** **(2, 3, 4 in context)**
	A-2.07 Uses diagnostic and measuring tools and equipment **1** **(2, 3, 4 in context)**	**A-2.08 Uses access equipment** **1** **(2, 3, 4 in context)**	**A-2.09 Uses rigging, hoisting and lifting equipment** **1** **(2, 3, 4 in context)**
	A-2.10 Uses digital technology **1** **(2, 3, 4 in context)**		
Task A-3 **Organizes work**	**A-3.01 Interprets drawings and specifications** **2, 3, 4**	**A-3.02 Uses documentation and reference material** **1, 2, 3, 4**	**A-3.03 Plans job tasks and procedures** **1, 2, 3, 4**
Task A-4 **Uses communication and mentoring techniques**	**A-4.01 Uses communication techniques** **1, 4**	**A-4.02 Uses mentoring techniques** **4**	

B – Performs routine trade activities

Task B-5 Performs work site preparation	B-5.01 Prepares work site 1	B-5.02 Handles materials and supplies 1	
Task B-6 Performs trade activities	B-6.01 Performs brazing and soldering 1	B-6.02 Performs leak and pressure tests on system 1	B-6.03 Evacuates systems 1
	B-6.04 Uses refrigerants, gases and oils 1, 2	B-6.05 Performs field wiring of systems 1, 2	B-6.06 Applies sealants and adhesives 1

C – Plans installation

Task C-7 Plans installation of HVAC/R systems	C-7.01 Verifies HVAC/R system parameters and requirements 2, 3, 4	C-7.02 Selects HVAC/R equipment, components and accessories 2, 3, 4	C-7.03 Determines placement of HVAC/R equipment, components and accessories 1, 2, 3, 4
	C-7.04 Performs HVAC/R material take-off 2, 3, 4		
Task C-8 Plans installation of control systems	C-8.01 Verifies control system parameters and requirements 3, 4	C-8.02 Selects control system components and accessories 2, 3, 4	C-8.03 Determines placement of control system components and accessories 1, 2, 3, 4
	C-8.04 Performs control system material take-off 2, 3, 4		

D – Performs installation

Task D-9 Installs HVAC/R systems	D-9.01 Confirms system layout 1, 3	D-9.02 Assembles HVAC/R equipment, components and accessories 2, 3	D-9.03 Places HVAC/R equipment, components and accessories 1, 2, 3
	D-9.04 Installs fasteners, brackets and hangers 1	D-9.05 Installs HVAC/R piping and tubing 1	D-9.06 Applies HVAC/R holding charge 1
Task D-10 Installs control systems	D-10.01 Places control system components 1, 2, 3	D-10.02 Connects control systems 1, 2, 3	

E – Performs commissioning

Task E-11 **Commissions HVAC/R systems**	**E-11.01 Performs pre-start-up checks for HVAC/R systems** **3, 4**	**E-11.02 Performs start-up of HVAC/R systems** **3, 4**	**E-11.03 Completes HVAC/R system charge** **3, 4**
	E-11.04 Sets up primary and secondary HVAC/R system components **3, 4**		
Task E-12 **Commissions control systems**	**E-12.01 Performs start-up checks for control systems** **3, 4**	**E-12.02 Verifies/sets operating parameters** **3, 4**	

F – Performs maintenance and service

Task F-13 **Maintains HVAC/R systems**	**F-13.01 Inspects HVAC/R systems** **1, 2** **(3, 4 in context)**	**F-13.02 Performs predictive and scheduled maintenance on HVAC/R systems** **1, 2** **(3, 4 in context)**	**F-13.03 Tests HVAC/R system components and accessories** **1, 2** **(3, 4 in context)**
Task F-14 **Services HVAC/R systems**	**F-14.01 Troubleshoots HVAC/R systems** **2, 3, 4**	**F-14.02 Repairs HVAC/R systems** **2, 3, 4**	
Task F-15 **Maintains and services control systems**	**F-15.01 Performs maintenance and inspection on control systems** **2, 3, 4**	**F-15.02 Troubleshoots control systems** **2, 3, 4**	**F-15.03 Calibrates operating and safety controls** **2, 3, 4**
	F-15.04 Repairs control systems **2, 3, 4**		

TRAINING PROFILE CHART

This Training Profile Chart represents Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training at the topic level.

Level One (Harmonized)	Transcript Code	Hours
Controls	CNTR 181	14
Electrical	ELEC 132	24
Graphics	GRPH 182	14
Mathematics	MATH 109	14
Components and Accessories	RFRG 102	14
Fundamentals of Refrigeration	RFRG 196	14
Basic Refrigeration Cycle	RFRG 198	14
Refrigerants	RFRG 199	14
Basic System Applications	SYST 180	24
Hand Skills and Service Techniques	TOOL 105	24
Hand Tools	TOOL 133	18
Welding	WLDR 132	18
Safety	SFTY XXX	18
HVAC Basics	RFRG 203	16
		240

Level Two (Harmonized)	Transcript Code	Hours
Electricity and Electrical Applications	ELEC 204	20
Electricity	ELEC 207	18
Trade Mathematics	MATH 286	12
Intro to Commercial Applications	RFRG 201	22
Refrigeration Flow Controls and Accessories	RFRG 202	20
Drafting	GRPH 280	12
Motors and Motor Electrics	RFRG 204	20
Comprehensive Systems Analysis	RFRG 206	20
Commercial Applications	RFRG 207	36
Medium Temp Applications	RFRG 208	34
Control Systems	RFRG 209	26
		240

Level Three (Harmonized)	Transcript Code	Hours
Electricity	ELEC 384	18
Graphics	GRPH 380	14
Mathematics	MATH 382	12
Systems and Service Management	RFRG 381	14
Piping and Line Sizing	RFRG 382	16
Capacity and Head Pressure	RFRG 383	16
Commercial Refrigeration Systems and Service	RFRG 384	18
HVAC Systems	RFRG 385	32
Practical Refrigeration Applications	RFRG 386	28
Practical HVAC Applications	RFRG 387	28
Control Systems Wiring	RFRG 388	30
Troubleshooting and Systems Analysis	RFRG 389	14
		240

Level Four (Harmonized)	Transcript Code	Hours
Electrical	ELEC 482	18
Graphics	GRPH 480	12
Mathematics	MATH 480	12
Enthalpy and Psychrometrics	RFRG 481	32
Load Calculation and Equipment Selection	RFRG 482	25
Advanced Commercial and Industrial Systems	RFRG 483	32
HVAC Systems	RFRG 484	34
Refrigeration Service Application	RFRG 485	30
HVAC Service Applications	RFRG 486	15
Control Systems Applications	RFRG 487	30
		240

TECHNICAL TRAINING COURSE CONTENT

This chart outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training sequencing. For the harmonized level of training, a cross reference to the Red Seal Occupational Standard (RSOS) apprenticeship technical training sequencing, at the learning outcome level, is provided.

Sub-tasks listed are the minimum to be covered in a topic. Related sub-tasks not listed may be used as a reference and taught “in context” in other topics.

Implementation for harmonization will take place progressively. Level one to be implemented in 2019/2020, level two 2020/2021, level three 2021/2022, and level four in 2022/2023.

The Red Seal Refrigeration and Air Conditioning Mechanic Curriculum Outline, which provides additional detail of the Harmonized technical training, can be found at www.red-seal.ca

Level One — 8 weeks — 240 hours

Controls — 14 hours

- identify electrical controls
- install basic cycling controls
- set up basic circuits
- adjust basic cycling controls

RSOS topics covered in this section of training:

C-8 Plans Installation of Control Systems
C-8.03 Determines placement of control system components and accessories

- assess placement of control systems
- determine connection routing for control system components
- determine locations of mechanical and electrical controls

D-10 Installs Control Systems
D-10.01 Places control system components

- select and use tools and equipment
- perform pre-assembly check
- determine location and position of controls
- mount and secure control devices and components

D-10.02 Connects control systems

- select and use components
- plan layout
- determine installation requirements
- terminate control wiring according to system requirements

Electrical — 24 hours

- describe an electrical circuit
- explain electrical voltage
- explain electrical current

- explain electrical resistance
- use a multimeter
- perform electrical calculations using ohm's law
- describe the operation of series electric circuits
- describe the operation of parallel circuits

RSOS topics covered in this section of training:
B-6 Performs Trade Activities

B-6.05 Performs field wiring of systems
- verify voltage, phasing and motor wiring configurations
- select wire type and size
- route and secure wiring
- update wiring diagrams
- interpret electrical schematics and termination points

C-8 Plans Installation of Control Systems
C 8.03 Determines placement of control system components and accessories
- assess placement of control systems
- determine connection routing for control system components
- determine locations of mechanical and electrical controls

D-10 Installs Control Systems
D-10.01 Places control system components
- select and use tools and equipment
- perform pre-assembly check
- determine location and position of controls
- mount and secure control devices and components

D-10.02 Connects Control Systems
- prepare siring and tubing for final connection to control devices
- select termination points
- arrange wiring and tubing

Graphics — 14 hours

- draw a two-dimensional object
- use engineering lettering
- sketch orthographic views
- use compass-circles, curves, arcs
- use scales to reduce and enlarge drawings
- use basic dimensioning
- sketch isometric and oblique drawings
- prepare sectional drawings
- prepare detail working assembly drawings

RSOS topics covered in this section of training:

A-3 Organizes Work
A-3.02 Uses documentation and reference material
- verify detailed equipment information
- complete written documents

A-3.03 Plans job tasks and procedures
- prepare material list

Mathematics — 14 hours

- use basic mathematics
- perform trade calculations

This section of training exceeds the minimum sequencing as set out in the Refrigeration and Air Conditioning Mechanic RSOS.

Components and Accessories — 14 hours

- explain the function of a compressor
- compare metering devices
- explain the purpose and operation of an evaporator
- explain the purpose and operation of a condenser

RSOS topics covered in this section of training:

C-7 Plans Installation of HVAC/R Systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories

- determine placement of system and components
- knowledge of codes and regulations pertaining to HVAC/R equipment, components and accessories

Fundamentals of Refrigeration — 14 hours

- discuss trade terminology
- compare temperature and temperature measurement
- compare pressure and pressure measurement
- identify types of heat and heat transfer
- explain change of state of a substance
- compare types of latent heat

RSOS topics covered in this section of training:

C-7 Plans Installation of HVAC/R Systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories

- determine placement of system and components
- knowledge of codes and regulations pertaining to HVAC/R equipment, components and accessories

C-8 Plans Installation of Control Systems

C-8.03 Determines placement of control system components and accessories

- assess placement of control systems
- determine connection routing for control system components
- determine locations of mechanical and electrical controls

Basic Refrigeration Cycle — 14 hours

- sketch a basic cycle diagram
- describe refrigerant condition in each component
- explain the function of each system component
- solve refrigeration system problems

RSOS topics covered in this section of training:

F-13 Maintains HVAC/R Systems

F-13.01 Inspects HVAC/R systems
- perform inspection of system components
- identify source of problems

F-13.02 Performs predictive and scheduled maintenance on HVAC/R systems
- lubricate bearings, motors and linkages
- verify system operation
- inspect electrical connections
- update documents

F-13.03 Tests HVAC/R system components and accessories
- check refrigerant pressures and temperatures
- test electrical components
- test mechanical components

Refrigerants — 14 hours

- select refrigerants
- apply refrigerant safety practices
- choose acceptable refrigerant service techniques

RSOS topics covered in this section of training:

B-6 Performs Trade Activities

B-6.02 Performs leak and pressure tests on system
- prepare system for leak and/or pressure test
- remove or isolate devices that could be damaged from pressure test
- pressurize system with system compatible liquids and/or gases to perform pressure test
- interpret and record leak and pressure test results

B-6.04 Uses refrigerants, gases and oils
- select refrigerants, oils or gases based on system requirements
- recovery of refrigerants and oils
- selection of gases as required by system requirements
- transportation and disposal of refrigerants, gases and oils

Basic System Applications — 24 hours

- assemble a refrigeration system
- perform startup procedures
- conduct system analysis
- demonstrate knowledge of effective communication practices

RSOS topics covered in this section of training:

B-5 Performs Work Site Preparation

B-5.01 Prepares work site
- perform job hazard assessments
- determine location and layout of equipment and systems

B-5.02 Handles materials and supplies
- inspect materials and supplies

D-9 Installs HVAC/R systems
D-9.03 Places HVAC/R equipment, components and accessories
- install anchors and supports
- demonstrate knowledge of HVAC/R equipment, components and accessories

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Hand Skills and Service Techniques — 24 hours

- identify copper tubing
- demonstrate hand skills used for installation procedures
- choose service techniques and equipment

RSOS topics covered in this section of training:

B-6 Trade Activities
B-6.01 Performs brazing and soldering
- purge pipe for brazing
- prepare pipe for brazing
- solder and braze components

B-6.02 Performs leak and pressure tests on a system
- prepare system for leak testing
- isolate devices to protect from damage during leak testing

B-6.03 Evacuates systems
- perform evacuations
- perform vacuum tests
- ensure system is at atmospheric pressure

B-6.06 Applies sealants and adhesives
- inspect and prepare sealing surfaces
- use sealant and adhesive

Welding — 18 hours

- describe the safe assembly, operation and maintenance of oxy-fuel system
- demonstrate the safe assembly, operation and maintenance when torch brazing
- demonstrate the safe assembly, operation and maintenance when oxy-fuel cutting on gauge metal and plate.
- identify safety hazards

RSOS topics covered in this section of training:

A-2 Tools and Equipment
A-2.03 Uses brazing and soldering equipment
- inspect hoses, regulators, cylinders and torch tips
- perform brazing and soldering

Hand Tools — 18 hours

- select materials
- use hand tools
- use power tools
- identify safety issues
- perform measurements
- determine grinding wheel applications

RSOS topics covered in this section of training:

A-2 Tools and Equipment

A-2.01 Uses hand tools
- inspect hand tools for damage
- use hand tools that relate to the trade

A-2.02 Uses portable and stationary power tools
- inspect tools for unsafe or damaged conditions
- use power tools that relate to the trade

A-2.03 Uses brazing and soldering equipment
- inspect hoses, regulators, cylinders and torch tips

A-2.04 Uses recovery and recycling equipment
- inspect recovery equipment
- demonstrate knowledge of recovery and recycling equipment

A-2.05 Uses evacuation tool and equipment
- identify correct procedures in using evacuation tools and equipment

A-2.06 Uses charging tools and equipment
- identify correct procedures for using charging tools and equipment

A-2.07 Uses diagnostic and measuring tools and equipment
- inspect diagnostic tools
- use diagnostic and measuring tools and equipment that relate to the trade

A-2.10 Uses digital technology
- use electronic device to configure parameters
- monitor and diagnose problems

Safety — 18 hours

- discuss safe work practices
- discuss WHMIS
- demonstrate safe work practices
- demonstrate knowledge of access equipment applications, maintenance and procedures for proper use
- demonstrate knowledge of rigging, hoisting and lifting equipment applications, communication methods, maintenance and procedures for proper use.

RSOS topics covered in this section of training:

A-1 Safety-Related Functions

A-1.01 Maintains safe work environment
- follow safe operating procedures
- recognize hazards and report unsafe conditions
- participate in safety meetings

A-1.02 Performs lock-out, tag-out and isolation procedures
- isolate equipment and establish a zero-energy state

- apply locking devices to secure isolation
- verify isolation of equipment

A-1.03 Use personal protective equipment (PPE) and safety equipment

- select and wear PPE
- identify defective and damaged PPE and remove from service
- ensure proper fit of PPE

A-2 Uses Tools and Equipment

A-2.08 Uses access equipment

- select ladders and work platforms
- inspect ladders and scaffolding
- identify hazards when erecting ladders and scaffolding
- secure access equipment
- erect, level and dismantle scaffolding

A-2.09 Uses rigging, hoisting and lifting equipment

- select and use equipment
- inspect equipment
- identify hazards
- rig loads
- guide and position loads
- communicate with equipment operators
- tag and remove defective equipment from service

HVAC Basics — 16 hours

- examine air properties
- compare air conditioning systems
- select HVAC controls
- interpret air flow problems

RSOS topics covered in this section of training:

C-7 Plans Installation of HVAC/R Systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories

- determine placement of system and system components
- determine limitations for the placement of system equipment, components and accessories
- take measurements
- demonstrate knowledge of HVAC/R equipment, components and accessories

Level Two — 8 weeks — 240 hours

Electricity and Electrical Applications — 16 hours

- identify electrical components
- interpret wiring diagrams
- design electrical circuits
- apply troubleshooting techniques

RSOS topics covered in this section of training:

B-6 Performs trade activities
B-6.05 Performs field wiring of systems

- select and use tools, equipment and **components**
- verify circuit is de-energized
- verify voltage, phasing, and motor wiring configurations
- interpret electrical schematics and termination points
- identify correctly sized fusing and overloads
- terminate wiring to related equipment
- label or tag wiring with wire markers
- update wiring diagrams

D-10 Installs control systems
D-10.01 Places control system components

- configure hardware options
- determine locations, orientation and position of controls and devices
- assemble and install controls and devices
- mount and secure controls and devices

Electrical — 18 hours

- describe the differences between dc and ac electrical circuits
- perform circuit measurements
- describe reactance and phase shift
- describe the operation of various electrical switching circuits
- describe the operation of a transformer
- describe the operation of an electric relay
- describe the operation of various single phase electric motors and their operating characteristics

RSOS topics covered in this section of training:

B-6 Performs trade activities
B-6.05 Performs field wiring of systems

- select and use tools, equipment and components
- verify circuit is de-energized
- verify voltage, phasing, and motor wiring configurations
- interpret electrical schematics and termination points
- identify correctly sized fusing and overloads
- terminate wiring to related equipment
- label or tag wiring with wire markers
- update wiring diagrams

Trade Mathematics — 12 hours

- use metric and imperial units
- perform trade calculations

This section of training exceeds the minimum sequencing as set out in the Refrigeration and Air Conditioning Mechanic RSOS.

Intro to Commercial Applications — 20 hours

- compare temperature applications
- compare defrost methods
- design piping arrangements
- select refrigerant and oil conversion procedures
- identify dehydration and evacuation methods

RSOS topics covered in this section of training:

B-6 Performs trade activities

B-6.04 Uses refrigerants, gases and oils

- select and use tools, and equipment
- select refrigerants, refrigerant oils and gases
- recover and dispose of refrigerant and refrigerant oils
- transport and store refrigerants, gases and refrigerant oils
- charge system with refrigerant oil and refrigerants

C-7 Plans installation of HVAC/R systems

C-7.02 Selects HVAC/R equipment, components and accessories

- select equipment, HVAC/R components and accessories
- determine HVAC/R component limitations
- determine refrigeration component limitations
- determine alternative systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories

- determine placement of system and components
- determine limitations for the placement of system equipment, components and accessories
- take measurements

C-7.04 Performs HVAC/R material take-off

- determine pipe and insulation size and length needed
- establish material order list for components
- identify alternative options for materials

Refrigeration Flow Controls and Accessories — 18 hours

- select refrigerant system accessories
- select refrigerant flow controls
- calibrate refrigerant flow controls

RSOS topics covered in this section of training:

B-6 Performs trade activities

B-6.04 Uses refrigerants, gases and oils

- select and use tools, and equipment
- select refrigerants, refrigerant oils and gases
- recover and dispose of refrigerant and refrigerant oils
- transport and store refrigerants, gases and refrigerant oils
- charge system with refrigerant oil and refrigerants

F-13 Maintains HVAC/R systems

F-13.01 Inspects HVAC/R systems

- inspect monitoring equipment and system operational logs to identify operation history
- perform sensory inspection of system components
- perform safety and operational checks
- identify source of abnormalities
- identify non-system items that may affect the overall efficiency of operation
- identify system components that need to be further investigated
- determine additional service required

F-13.03 Tests HVAC/R system components and accessories

- check refrigerant pressures and temperatures
- check heat transfer fluids including water, air and brine
- test electrical supply and electrical components
- verify system requirements
- test mechanical components and accessories

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems

- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems
- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data
- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements

F-14.02 Repairs HVAC/r systems

- shut down and/or isolate failed component or accessory
- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite log books and operating and maintenance instructions
- present options for additional repair, replacement or improvement

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Drafting — 12 hours

- orthographic views
- basic dimensioning
- views/sketch
- true lengths
- basic symbols/layout
- isometric and oblique

RSOS topics covered in this section of training:

A-3 Organizes Work

A-3.01 Interprets drawings and specifications

- determine equipment specifications
- determine equipment required
- identify electrical, mechanical and communication equipment

- scale drawings
- interpret drawings, schematic and pictorial diagrams

A-3.02 Uses documentation and reference material

- determine installation procedures and requirements
- determine pipe and duct sizes, pressure/temperature (P/T) relationships and pressure/enthalpy relationships
- verify detailed equipment information
- verify warranties
- submit information in order to activate and claim warranties
- select and order parts and equipment
- maintain log sheets
- complete written documents

A-3.03 Plans job tasks and procedures

- prepare material list, confirm availability and order materials
- apply for and obtain permits

Motors and Motors Electrics — 18 hours

- identify motor types
- identify motor starting devices
- identify motor protection devices
- identify motor tests

RSOS topics covered in this section of training:

F-13 Maintains HVAC/R systems

F-13.01 Inspects HVAC/R systems

- inspect monitoring equipment and system operational logs to identify operation history
- perform sensory inspection of system components
- perform safety and operational checks
- identify source of abnormalities
- identify non-system items that may affect the overall efficiency of operation
- identify system components that need to be further investigated
- determine additional service required

F-13.02 Performs predictive and scheduled maintenance on HVAC/R systems

- lubricate bearings, motors and linkages
- replace oil in gear boxes and compressors
- clean equipment components
- perform motor winding insulation tests
- visually check and tighten electrical connections of system components
- verify operation and calibration of safety devices
- verify system operation
- update documents and on-site logbooks

F-13.03 Tests HVAC/R system components and accessories

- check refrigerant pressures and temperatures
- check heat transfer fluids including water, air and brine
- test electrical supply and electrical components
- verify system requirements
- test mechanical components and accessories

Comprehensive System Analysis — 16 hours

- manage system problems
- select system components and accessories
- select service procedure

RSOS topics covered in this section of training:

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems

- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems
- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data
- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements

F-14.02 Repairs HVAC/r systems

- shut down and/or isolate failed component or accessory
- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite log books and operating and maintenance instructions
- present options for additional repair, replacement or improvement

Commercial Applications — 36 hours

- design a two-temperature commercial system
- assemble a two-temperature system
- install the electrical system
- perform system start-up
- commission system

RSOS topics covered in this section of training:

C-7 Plans installation of HVAC/R systems

C-7.02 Selects HVAC/R equipment, components and accessories

- select equipment, HVAC/R components and accessories
- determine HVAC/R component limitations
- determine refrigeration component limitations
- determine alternative systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories

- determine placement of system and components
- determine limitations for the placement of system equipment, components and accessories
- take measurements

C-7.04 Performs HVAC/R material take-off

- determine quantity of materials required
- determine pipe and insulation size and length needed
- establish material order list for components
- identify alternative options for materials

D-9 Installs HVAC/R systems
D-9.02 Assembles HVAC/R equipment, components and accessories
- perform pre-assembly check of equipment, components and accessories
- modify or adjust equipment, components and accessories including orientation, flow direction, add- on kits and rotations
- confirm final assembly of components and accessories

D-9.03 Places HVAC/R equipment, components and accessories
- install anchors, supports, and isolation components
- secure equipment and components

D-10 Installs control systems
D-10.01 Places control system components
- configure hardware options
- determine locations, orientation and position of controls and devices
- assemble and install controls and devices
- mount and secure controls and devices

Medium Temp Applications — 34 hours

- construct refrigerated fixtures
- set up system controls
- manage system problems
- perform system start-up
- commission system

RSOS topics covered in this section of training:

C-7 Plans installation of HVAC/R systems
C-7.02 Selects HVAC/R equipment, components and accessories
- select equipment, HVAC/R components and accessories
- determine HVAC/R component limitations
- determine refrigeration component limitations
- determine alternative systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories
- determine placement of system and components
- determine limitations for the placement of system equipment, components and accessories
- take measurements

C-7.04 Performs HVAC/R material take-off
- determine quantity of materials required
- determine pipe and insulation size and length needed
- establish material order list for components
- identify alternative options for materials

D-9 Installs HVAC/R systems
D-9.02 Assembles HVAC/R equipment, components and accessories
- perform pre-assembly check of equipment, components and accessories
- modify or adjust equipment, components and accessories including orientation, flow direction, add- on kits and rotations
- confirm final assembly of components and accessories

D-9.03 Places HVAC/R equipment, components and accessories
- install anchors, supports, and isolation components
- secure equipment and components

D-10 Installs control systems
D-10.01 Places control system components
- configure hardware options
- determine locations, orientation and position of controls and devices
- assemble and install controls and devices
- mount and secure controls and devices

Control Systems — 26 hours

- design electrical systems
- select troubleshooting procedures
- solve electrical problems

RSOS topics covered in this section of training:

C-8 Plans installation of control systems
C-8.02 Selects control system components and accessories
- determine control system components
- determine control system component limitations

C-8.03 Determines placement of control system components and accessories
- assess placement of control systems
- determine connection routing for control system components
- determine location of mechanical and electrical control

C-8.04 Performs control system material take-off
- determine quantity of materials required
- identify alternative options for materials

D-10 Installs control systems
D-10.02 Connects control systems
- select, layout and install wiring, cabling and tubing
- determine circuitry and load requirements
- select termination points

F-15 Maintains and services control systems
F-15.01 Performs maintenance and inspection on control systems
- perform visual inspection of control systems and control system components
- perform run checks and test procedures
- identify components that need to be replaced or repaired
- present options for additional repair, replacement or improvement

F-15.02 Troubleshoot control systems
- use system documentation and schematics
- interpret system readings
- identify problems
- combine system readings and data
- identify components or accessories that need to be reconfigured, repaired or replaced
- present options for reconfigurations, repair, replacement or improvement

F-15.03 Calibrates operating and safety controls
- test and record conditions
- verify that operating and safety controls operate at system design settings
- adjust controls that are operating outside parameters
- identify and replace faulty controls that cannot be calibrated

F-15.04 Repairs control systems
- select compatible and acceptable replacement control system components

- adjust, repair or replace control system components, wiring, cabling and connections that are operating outside parameters
- test operation of repaired or replace control system components
- update control system schematics, documentation and on-site logbooks

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Systems and Service Analysis — 14 hours

- Interpret system problems
- Solve system problems
- Choose system components, accessories and refrigerant flow controls
- Select service procedure
- Analyze basic control systems

RSOS topics covered in this section of training:

F-13 Maintains HVAC/R systems

F-13.01 Inspects HVAC/R systems

- inspect monitoring equipment and system operational logs to identify operation history
- perform sensory inspection of system components
- perform safety and operational checks
- identify source of abnormalities
- identify non-system items that may affect the overall efficiency of operation
- identify system components that need to be further investigated
- determine additional service required

F-13.02 Performs predictive and scheduled maintenance on HVAC/R systems

- lubricate bearings, motors and linkages
- replace oil in gear boxes and compressors
- clean equipment components
- perform motor winding insulation tests
- visually check and tighten electrical connections of system components
- verify operation and calibration of safety devices
- verify system operation
- update documents and on-site logbooks

F-13.03 Tests HVAC/R system components and accessories

- check refrigerant pressures and temperatures
- check heat transfer fluids including water, air and brine
- test electrical supply and electrical components
- verify system requirements
- test mechanical components and accessories

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems

- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems
- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data
- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements
-

F-14.02 Repairs HVAC/R systems

- shut down and/or isolate failed component or accessory
- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite log books and operating and maintenance instructions
- present options for additional repair, replacement or improvement

Level Three | 8 weeks | 240 hours

Electricity **18 hours**

- describe the theory of operation of a transformer
- explain three phase electrical power circuits
- describe the operation of three phase electric motors
- explain the operation of various motor control circuits
- describe the operation of various three phase motor starting circuits
- identify capacity control methods
- identify head pressure control methods
- determine electrical requirements
- design the electrical system
- wire electrical systems
- evaluate the electrical system

RSOS topics covered in this section of training:

F-15 Maintains and services control systems

F-15.01 Performs maintenance and inspection on control systems

- perform visual inspection of control systems and control system components
- perform run checks and test procedures
- identify components that need to be replaced or repaired
- present options for additional repair, replacement or improvement

F-15.02 Troubleshoot control systems

- use system documentation and schematics
- interpret system readings
- identify problems
- combine system readings and data
- identify components or accessories that need to be reconfigured, repaired or replaced
- present options for reconfigurations, repair, replacement or improvement

F-15.03 Calibrates operating and safety controls

- test and record conditions
- verify that operating and safety controls operate at system design settings
- adjust controls that are operating outside parameters
- identify and replace faulty controls that cannot be calibrated

F-15.04 Repairs control systems

- select compatible and acceptable replacement control system components
- adjust, repair or replace control system components, wiring, cabling and connections that are operating outside parameters
- test operation of repaired or replace control system components
- update control system schematics, documentation and on-site logbooks

Graphics — 14 hours

- identify types of specification documents
- identify views used on blueprints and drawings
- sketch an exploded isometric
- interpret blueprints and manufacturer's drawings

RSOS topics covered in this section of training:

A-3 Organizes Work

A-3.01 Interprets drawings and specifications

- determine equipment specifications
- determine equipment required
- identify electrical, mechanical and communication equipment
- scale drawings
- interpret drawings, schematic and pictorial diagrams

A-3.02 Uses documentation and reference material

- determine installation procedures and requirements
- determine pipe and duct sizes, pressure/temperature (P/T) relationships and pressure/enthalpy relationships
- verify detailed equipment information
- verify warranties
- submit information in order to activate and claim warranties
- select and order parts and equipment
- maintain log sheets
- complete written documents

A-3.03 Plans job tasks and procedures

- prepare material list, confirm availability and order materials
- apply for and obtain permits

Mathematics — 12 hours

- use basic geometry and trigonometry
- perform trade calculations

This section of training exceeds the minimum sequencing as set out in the Refrigeration and Air Conditioning Mechanic RSOS.

Systems and Service Management — 14 hours

- manage system problems
- select refrigerant components, accessories and flow controls
- select service techniques
- analyze control systems

RSOS topics covered in this section of training:

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems

- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems

- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data
- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements

F-14.02 Repairs HVAC/r systems
- shut down and/or isolate failed component or accessory
- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite logbooks and operating and maintenance instructions
- present options for additional repair, replacement or improvement

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Piping and Line Sizing — 16 hours

- design piping arrangements
- select pipe size
- interpret the mechanical code

RSOS topics covered in this section of training:

C-7 Plans installation of HVAC/R systems

C-7.01 Verifies HVAC/R system parameters and requirements
- calculate HVAC/R and heat loads
- determine system capacity
- determine system parameters
- identify provisions for condensate drainage

C-7.02 Selects HVAC/R equipment, components and accessories
- select equipment, HVAC/R components and accessories
- determine HVAC/R component limitations
- determine refrigeration component limitations
- determine alternative systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories
- determine placement of system and components
- determine limitations for the placement of system equipment, components and accessories
- take measurements

C-7.04 Performs HVAC/R material take-off
- determine quantity of materials required
- determine pipe and insulation size and length needed
- establish material order list for components
- identify alternative options for materials

D-9 Installs HVAC/R systems

D-9.01 Confirms system layout
- verify that equipment matches material takeoffs
- determine modifications for system equipment, components and accessories
- verify site measurements and clearances

Capacity and Head Pressure — 16 hours

- identify capacity control methods
- identify head pressure control methods

RSOS topics covered in this section of training:

C-8 Plans installation of control systems

C-8.01 verifies control system parameters and requirements
- determine control system requirements
- determine regional considerations
- determine operating ranges required

C-8.02 Selects control system components and accessories
- determine control system components
- determine control system component limitations

C-8.03 Determines placement of control system components and accessories
- assess placement of control systems
- determine connection routing for control system components
- determine location of mechanical and electrical control

D-10 Installs control systems

D-10.01 Places control system components
- configure hardware options
- determine locations, orientation and position of controls and devices
- assemble and install controls and devices
- mount and secure controls and devices

D-10.02 Connects control systems
- select, layout and install wiring, cabling and tubing
- determine circuitry and load requirements
- select termination points

E-12 Commissions control systems

E-12.02 Verifies/sets operating parameters
- verify parameters
- program controllers to a defined set of parameters
- adjust operating controls
- calibrate components
- test operation

Commercial Refrigeration Systems and Service — 18 hours

- analyze refrigerant oil
- analyze compressor failure
- identify refrigeration flow problems
- select refrigerants and oils

RSOS topics covered in this section of training:

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems

- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems
- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data
- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements

F-14.02 Repairs HVAC/R systems

- shut down and/or isolate failed component or accessory
- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite logbooks and operating and maintenance instructions
- present options for additional repair, replacement or improvement

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HVAC Design and Applications — 32 hours

- select gas components
- compare HVAC designs
- interpret HVAC control systems
- identify the basics of pneumatic controls

RSOS topics covered in this section of training:

C-7 Plans installation of HVAC/R systems

C-7.01 Verifies HVAC/R system parameters and requirements

- calculate HVAC/R and heat loads
- determine system capacity
- determine system parameters
- identify provisions for condensate drainage

C-7.02 Selects HVAC/R equipment, components and accessories

- select equipment, HVAC/R components and accessories
- determine HVAC/R component limitations
- determine refrigeration component limitations
- determine alternative systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories

- determine placement of system and components
- determine limitations for the placement of system equipment, components and accessories
- take measurements

C-7.04 Performs HVAC/R material take-off

- determine quantity of materials required
- determine pipe and insulation size and length needed
- establish material order list for components
- identify alternative options for materials

Practical Refrigeration Applications — 28 hours

- examine ice machines
- examine reach-ins
- examine walk-in coolers
- examine display cases
- service refrigeration equipment

RSOS topics covered in this section of training:

D-9 Installs HVAC/R systems

D-9.01 Confirms system layout
- verify that equipment matches material takeoffs
- determine modifications for system equipment, components and accessories
- verify site measurements and clearances

D-9.02 Assembles HVAC/R equipment, components and accessories
- perform pre-assembly check of equipment, components and accessories
- modify or adjust equipment, components and accessories including orientation, flow direction, add- on kits and rotations
- confirm final assembly of components and accessories

D-9.03 Places HVAC/R equipment, components and accessories
- install anchors, supports, and isolation components
- secure equipment and components

HVAC Applications — 28 hours

- examine window air conditioners
- examine water cooler packages
- examine residential and commercial HVAC systems
- examine mechanical economizers
- service HVAC equipment

RSOS topics covered in this section of training:

D-9 Installs HVAC/R systems

D-9.01 Confirms system layout
- verify that equipment matches material takeoffs
- determine modifications for system equipment, components and accessories
- verify site measurements and clearances

D-9.02 Assembles HVAC/R equipment, components and accessories
- perform pre-assembly check of equipment, components and accessories
- modify or adjust equipment, components and accessories including orientation, flow direction, add- on kits and rotations
- confirm final assembly of components and accessories

D-9.03 Places HVAC/R equipment, components and accessories
- install anchors, supports, and isolation components
- secure equipment and components

E-11 Commissions HVAC/R systems

E-11.01 Performs pre-startup check and start up sequence for HVAC/R systems
- performs pre-startup checks and start up sequence for HVAC/R systems
- identify correct start up sequence
- explain methods used to determine the charge of a HVAC/R system

Control System Wiring — 30 hours

- determine electrical requirements
- wire electrical systems

RSOS topics covered in this section of training:

C-8 Plans installation of control systems

C-8.01 verifies control system parameters and requirements
- determine control system requirements
- determine regional considerations
- determine operating ranges required

C-8.02 Selects control system components and accessories
- determine control system components
- determine control system component limitations

C-8.03 Determines placement of control system components and accessories
- assess placement of control systems
- determine connection routing for control system components
- determine location of mechanical and electrical control

C-8.04 Performs control system material take off
- determine quantity of materials required
- identify alternative options for materials

D-10 Installs control systems

D-10.01 Places control system components
- configure hardware options
- determine locations, orientation and position of controls and devices
- assemble and install controls and devices
- mount and secure controls and devices

D-10.02 Connects control systems
- select, layout and install wiring, cabling and tubing
- determine circuitry and load requirements
- select termination points

E-12 Commissions control systems

E-12.01 Performs startup checks for control systems
- verify that electrical, pneumatic and electronic connections are completed
- confirm power is applied to the system
- confirm transformer output

E-12.02 Verifies/sets operating parameters
- verify parameters
- program controllers to a defined set of parameters
- adjust operating controls
- calibrate components and test operation

Troubleshooting and System Analysis — 14 hours

- manage system problems
- select system components and accessories
- select service procedures
- analyze control systems

RSOS topics covered in this section of training:

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems

- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems
- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data
- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements

F-14.02 Repairs HVAC/R systems

- shut down and/or isolate failed component or accessory
- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite logbooks and operating and maintenance instructions
- present options for additional repair, replacement or improvement

F-15 Maintains and services control systems

F-15.01 Performs maintenance and inspection on control systems

- perform visual inspection of control systems and control system components
- perform run checks and test procedures
- identify components that need to be replaced or repaired
- present options for additional repair, replacement or improvement

F-15.02 Troubleshoot control systems

- use system documentation and schematics
- interpret system readings
- identify problems
- combine system readings and data
- identify components or accessories that need to be reconfigured, repaired or replaced
- present options for reconfigurations, repair, replacement or improvement

F-15.03 Calibrates operating and safety controls

- test and record conditions
- verify that operating and safety controls operate at system design settings
- adjust controls that are operating outside parameters
- identify and replace faulty controls that cannot be calibrated

F-15.04 Repairs control systems

- select compatible and acceptable replacement control system components
- adjust, repair or replace control system components, wiring, cabling and connections that are operating outside parameters
- test operation of repaired or replace control system components
- update control system schematics, documentation and on-site logbooks

Level Four — 8 weeks — 240 hours

Electrical — 18 hours

- describe the operation of a dc power supply circuit and components
- describe the basic operation of programmable logic controllers
- explain power factor and power factor correction

RSOS topics covered in this section of training:

F-15 Maintains and services control systems

F-15.01 Performs maintenance and inspection on control systems

- perform visual inspection of control systems and control system components
- perform run checks and test procedures
- identify components that need to be replaced or repaired
- present options for additional repair, replacement or improvement

F-15.02 Troubleshoot control systems

- use system documentation and schematics
- interpret system readings
- identify problems
- combine system readings and data
- identify components or accessories that need to be reconfigured, repaired or replaced
- present options for reconfigurations, repair, replacement or improvement

F-15.03 Calibrates operating and safety controls

- test and record conditions
- verify that operating and safety controls operate at system design settings
- adjust controls that are operating outside parameters
- identify and replace faulty controls that cannot be calibrated

F-15.04 Repairs control systems

- select compatible and acceptable replacement control system components
- adjust, repair or replace control system components, wiring, cabling and connections that are operating outside parameters
- test operation of repaired or replace control system components
- update control system schematics, documentation and on-site logbooks

Graphics — 12 hours

- interpret blueprint and manufacturer's drawings
- perform take off from the blueprint and specifications
- prepare labour and materials estimate

RSOS topics covered in this section of training:

A-3 Organizes Work

A-3.01 Interprets drawings and specifications

- determine equipment specifications
- determine equipment required
- identify electrical, mechanical and communication equipment
- scale drawings
- interpret drawings, schematic and pictorial diagrams

A-3.02 Uses documentation and reference material
determine installation procedures and requirements

- determine pipe and duct sizes, pressure/temperature (P/T) relationships and pressure/enthalpy relationships
- verify detailed equipment information
- verify warranties
- submit information in order to activate and claim warranties
- select and order parts and equipment
- maintain log sheets
- complete written documents

A-3.03 Plans job tasks and procedures

- prepare material list, confirm availability and order materials
- apply for and obtain permits

Enthalpy and Psychrometrics — 32 hours

- interpret a pressure enthalpy diagram
- plot a system on a pressure enthalpy diagram
- compare system performance
- interpret a psychrometric process
- analyze system performance

RSOS topics covered in this section of training:

C-7 Plans installation of HVAC/R systems

C-7.01 Verifies HVAC/R system parameters and requirements

- calculate HVAC/R and heat loads
- determine system capacity
- determine system parameters
- identify provisions for condensate drainage

C-7.02 Selects HVAC/R equipment, components and accessories

- select equipment, HVAC/R components and accessories
- determine HVAC/R component limitations
- determine refrigeration component limitations
- determine alternative systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories

- determine placement of system and components
- determine limitations for the placement of system equipment, components and accessories
- take measurements

C-7.04 Performs HVAC/R material take-off

- determine quantity of materials required
- determine pipe and insulation size and length needed
- establish material order list for components
- identify alternative options for materials

Load Calculation and Equipment Selection — 25 hours

- apply heat transfer calculations
- determine refrigeration heat loads
- select refrigeration equipment
- determine air conditioning heat loads
- select air conditioning equipment

RSOS topics covered in this section of training:

C-7 Plans installation of HVAC/R systems

C-7.01 Verifies HVAC/R system parameters and requirements
- calculate HVAC/R and heat loads
- determine system capacity
- determine system parameters
- identify provisions for condensate drainage

C-7.02 Selects HVAC/R equipment, components and accessories
- select equipment, HVAC/R components and accessories
- determine HVAC/R component limitations
- determine refrigeration component limitations
- determine alternative systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories
- determine placement of system and components
- determine limitations for the placement of system equipment, components and accessories
- take measurements

C-7.04 Performs HVAC/R material take-off
- determine quantity of materials required
- determine pipe and insulation size and length needed
- establish material order list for components
- identify alternative options for materials

Advanced Commercial and Industrial Systems — 32 hours

- arrange system components
- design piping schematics
- analyze design variations

RSOS topics covered in this section of training:

C-8 Plans installation of control systems

C-8.01 verifies control system parameters and requirements
- determine control system requirements
- determine regional considerations
- determine operating ranges required

C-8.02 Selects control system components and accessories
- determine control system components
- determine control system component limitations

C-8.03 Determines placement of control system components and accessories
- assess placement of control systems
- determine connection routing for control system components
- determine location of mechanical and electrical control

C-8.04 Performs control system material take off
- determine quantity of materials required
- identify alternative options for materials

E-11 Commissions HVAC/R systems

E-11.01 Performs pre-startup check and correct start up sequence for HVAC/R systems
- performs pre-startup checks and correct start up sequence for HVAC/R systems
- explain methods used to determine the charge of a HVAC/R system
- demonstrate knowledge of codes and regulations pertaining to HVAC/R systems

E-11.02 Performs startup of HVAC/R systems
- demonstrate knowledge of performing startup of HVAC/R systems
- demonstrate knowledge of codes and regulations pertaining to HVAC/R systems

E-11.03 Completes HVAC/R system charge
- demonstrate knowledge of completing HVAC/R system charge
- demonstrate knowledge of refrigerants and their applications for use

E-11.04 Sets up primary and secondary HVAC/R system components
- measure and interpret readings from primary and secondary HVAC/R systems
- adjust and balance primary HVAC/R components
- Adjust and balance secondary HVAC/R components

E-12 Commissions control systems

E-12.01 Performs startup checks for control systems
- verify that electrical, pneumatic and electronic connections are completed
- confirm power is applied to the system
- confirm transformer output

E-12.02 Verifies/sets operating parameters
- verify parameters
- program controllers to a defined set of parameters
- adjust operating controls
- calibrate components
- test operation

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems
- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems
- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data
- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements

F-14.02 Repairs HVAC/R systems
- shut down and/or isolate failed component or accessory
- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite logbooks and operating and maintenance instructions
- present options for additional repair, replacement or improvement

HVAC Variations and Refrigeration Systems — 34 hours

- examine HVAC variations
- select air filters
- describe air conditioning and refrigeration chillers
- describe cooling towers

RSOS topics covered in this section of training:

C-7 Plans installation of HVAC/R systems

C-7.01 Verifies HVAC/R system parameters and requirements
- calculate HVAC/R and heat loads
- determine system capacity
- determine system parameters
- identify provisions for condensate drainage

C-7.02 Selects HVAC/R equipment, components and accessories
- select equipment, HVAC/R components and accessories
- determine HVAC/R component limitations
- determine refrigeration component limitations
- determine alternative systems

C-7.03 Determines placement of HVAC/R equipment, components and accessories
- determine placement of system and components
- determine limitations for the placement of system equipment, components and accessories
- take measurements

C-7.04 Performs HVAC/R material take-off
- determine quantity of materials required
- determine pipe and insulation size and length needed
- establish material order list for components
- identify alternative options for materials

C-8 Plans installation of control systems

C-8.01 verifies control system parameters and requirements
- determine control system requirements
- determine regional considerations
- determine operating ranges required

C-8.02 Selects control system components and accessories
- determine control system components
- determine control system component limitations

E-11 Commissions HVAC/R systems

E-11.01 Performs pre-startup check for HVAC/R systems
- performs pre-startup checks for HVAC/R systems
- identify correct start up sequence
- explain methods used to determine the charge of a HVAC/R system
- demonstrate knowledge of codes and regulations pertaining to HVAC/R systems

E-11.02 Performs startup of HVAC/R systems
- demonstrate knowledge of performing startup of HVAC/R systems
- demonstrate knowledge of codes and regulations pertaining to HVAC/R systems

E-11.03 Completes HVAC/R system charge
- demonstrate knowledge of completing HVAC/R system charge
- demonstrate knowledge of refrigerants and their applications for use

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems

- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems
- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data
- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements

F-14.02 Repairs HVAC/R systems

- shut down and/or isolate failed component or accessory
- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite logbooks and operating and maintenance instructions
- present options for additional repair, replacement or improvement

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Refrigeration Service Application — 30 hours

- service two stage and extra low temperature equipment
- service ice making equipment
- calibrate refrigeration control systems

RSOS topics covered in this section of training:

E-11 Commissions HVAC/R systems

E-11.01 Performs pre-startup check for HVAC/R systems

- performs pre-startup checks for HVAC/R systems
- identify correct start up sequence
- explain methods used to determine the charge of a HVAC/R system
- demonstrate knowledge of codes and regulations pertaining to HVAC/R systems

E-11.02 Performs startup of HVAC/R systems

- demonstrate knowledge of performing startup of HVAC/R systems
- demonstrate knowledge of codes and regulations pertaining to HVAC/R systems

E-11.03 Completes HVAC/R system charge

- demonstrate knowledge of completing HVAC/R system charge
- demonstrate knowledge of refrigerants and their applications for use

E-11.04 Sets up primary and secondary HVAC/R system components

- measure and interpret readings from primary and secondary HVAC/R systems
- adjust and balance primary HVAC/R components
- Adjust and balance secondary HVAC/R components

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems

- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems
- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data

- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements

F-14.02 Repairs HVAC/R systems

- shut down and/or isolate failed component or accessory
- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite logbooks and operating and maintenance instructions
- present options for additional repair, replacement or improvement

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HVAC Service Applications — 15 hours

- service rooftop heat-cool systems
- service large split systems
- service computer room systems

RSOS topics covered in this section of training:

E-11 Commissions HVAC/R systems

E-11.01 Performs pre-startup check for HVAC/R systems

- performs pre-startup checks for HVAC/R systems
- identify correct start up sequence
- explain methods used to determine the charge of a HVAC/R system
- demonstrate knowledge of codes and regulations pertaining to HVAC/R systems

E-11.02 Performs startup of HVAC/R systems

- demonstrate knowledge of performing startup of HVAC/R systems
- demonstrate knowledge of codes and regulations pertaining to HVAC/R systems

E-11.03 Completes HVAC/R system charge

- demonstrate knowledge of completing HVAC/R system charge
- demonstrate knowledge of refrigerants and their applications for use

E-11.04 Sets up primary and secondary HVAC/R system components

- measure and interpret readings from primary and secondary HVAC/R systems
- adjust and balance primary HVAC/R components
- Adjust and balance secondary HVAC/R components

F-14 Troubleshoots HVAC/R systems

F-14.01 Troubleshoots HVAC/R systems

- interpret temperature, pressure, concentration, flow rate and velocity readings from primary and secondary systems
- use electrical schematics and diagrams to diagnose problems
- perform troubleshooting procedures on primary and secondary systems
- interpret data
- identify components and accessories that need to be replaced or repaired
- present options for repair, replacement or improvement and complete documentation requirements

F-14.02 Repairs HVAC/R systems

- shut down and/or isolate failed component or accessory

- drain, store, dispose of and refill/recharge lubricants, fluids and heat transfer fluids including oils, water, brine and glycol
- protect system contamination
- select compatible replacements components
- repair or replace HVAC/R components and accessories
- test operation of the system
- update documents, onsite logbooks and operating and maintenance instructions
- present options for additional repair, replacement or improvement

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Control System Applications — 30 hours

- design advanced control systems
- assemble control wiring
- calibrate pneumatic controls
- conduct operational tests

RSOS topics covered in this section of training:

C-8 Plans installation of control systems

C-8.01 verifies control system parameters and requirements
- determine control system requirements
- determine regional considerations
- determine operating ranges required

C-8.02 Selects control system components and accessories
- determine control system components
- determine control system component limitations

C-8.03 Determines placement of control system components and accessories
- assess placement of control systems
- determine connection routing for control system components
- determine location of mechanical and electrical control

C-8.04 Performs control system material take off
- determine quantity of materials required
- identify alternative options for materials

E-12 Commissions control systems

E-12.01 Performs startup checks for control systems
- verify that electrical, pneumatic and electronic connections are completed
- confirm power is applied to the system
- confirm transformer output

E-12.02 Verifies/sets operating parameters
- verify parameters
- program controllers to a defined set of parameters
- adjust operating controls
- calibrate components
- test operation

Trade Mentoring 12 hours

- demonstrate knowledge of trade terminology
- demonstrate knowledge of effective communication practices
- demonstrate knowledge of strategies for learning and teaching skills in the workplace

RSOS topics covered in this section of training:

A-4 Uses Communication and Mentoring Techniques
A-4.01 Uses communication techniques

- demonstrate communication practices
- describe active listening practices
- receive and respond to feedback
- provide feedback
- use questioning to improve communication
- coordination with other trades

A-4.02 Uses mentoring techniques

- identify and communicate learning objective
- link lessons to other lessons learned on the job
- demonstrate skills to an apprentice or learner
- assess apprentice's ability to perform tasks
- assess employee suitability to the trade during probationary period

IN CONTEXT TOPICS

In context means learning that has already taken place and is being applied to the applicable task. Learning outcomes for in context topics are accomplished in other topics in that level.

A-1 Safety-Related Functions

A-1.01 Maintains safe work environment
- follow safe operating procedures
- recognize hazards and report unsafe conditions
- participate in safety meetings

A-1.02 Performs lock-out, tag-out and isolation procedures
- isolate equipment and establish a zero-energy state
- apply locking devices to secure isolation
- verify isolation of equipment

A-1.03 Use personal protective equipment (PPE) and safety equipment
- select and wear PPE
- identify defective and damaged PPE and remove from service
- ensure proper fit of PPE

A-2 Tools and Equipment

A-2.01 Uses hand tools
- inspect hand tools for damage
- use hand tools that relate to the trade

A-2.02 Uses portable and stationary power tools
- inspect tools for unsafe or damaged conditions
- use power tools that relate to the trade

A-2.03 Uses brazing and soldering equipment
- inspect hoses, regulators, cylinders and torch tips

A-2.04 Uses recovery and recycling equipment
- inspect recovery equipment
- demonstrate knowledge of recovery and recycling equipment

A-2.05 Uses evacuation tool and equipment
- identify correct procedures in using evacuation tools and equipment

A-2.06 Uses charging tools and equipment
- identify correct procedures for using charging tools and equipment

A-2.07 Uses diagnostic and measuring tools and equipment
- inspect diagnostic tools
- use diagnostic and measuring tools and equipment that relate to the trade

A-2.08 Uses access equipment
- select ladders and work platforms
- inspect ladders and scaffolding
- identify hazards when erecting ladders and scaffolding
- secure access equipment
- erect, level and dismantle scaffolding

A-2.09 Uses rigging, hoisting and lifting equipment
- select and use equipment
- inspect equipment
- identify hazards
- rig loads
- guide and position loads
- communicate with equipment operators

- tag and remove defective equipment from service

A-2.10 Uses digital technology
- use electronic device to configure parameters
- monitor and diagnose problems

F-13 Maintains HVAC/R systems

F-13.01 Inspects HVAC/R systems
- inspect monitoring equipment and system operational logs to identify operation history
- perform sensory inspection of system components
- perform safety and operational checks
- identify source of abnormalities
- identify non-system items that may affect the overall efficiency of operation
- identify system components that need to be further investigated
- determine additional service required

F-13.02 Performs predictive and scheduled maintenance on HVAC/R systems
- lubricate bearings, motors and linkages
- verify system operation
- inspect electrical connections
- update documents

F-13.03 Tests HVAC/R system components and accessories
- check refrigerant pressures and temperatures
- check heat transfer fluids including water, air and brine
- test electrical supply and electrical components
- verify system requirements
- test mechanical components and accessories

APPENDIX A: POST HARMONIZATION TRAINING PROFILE CHART

This chart which outlines the finalized model for SATCC technical training sequencing with a cross reference to the Harmonized apprenticeship technical training sequencing, at the topic level.

Implementation for harmonization will take place progressively. Level one to be implemented in 2019/2020, level two 2020/2021, level three 2021/2022, and level four in 2022/2023.

SATCC Level One	Transcript Code	Hours	Pan-Canadian Harmonized Level One
Safety	SFTY XXX	18	Safety-Related Functions
Hand Tools	TOOL 133	18	Tools and Equipment
Graphics	GRPH 182	14	Organizes Work
			Communication
Basic System Applications	SYST 180	24	Work Site Preparation
Hand Skills and Service Techniques	TOOL 105	24	Trade Activities
Welding	WLDR 132	18	
Refrigerants	RFRG 199	14	
HVAC Basic	RFRG 203	16	Basic HVAC/R Systems (Plans installation)
Components and Accessories	RFRG 102	14	
Fundamentals of Refrigeration	RFRG 196	14	
Electrical	ELEC 132	24	Basic Control Systems (Plans installation)
Basic Refrigeration cycle	RFRG 198	14	Basic HVAC/R Systems (Installation and Basic Maintenance)
Controls	CNTR 181	14	Basic Control Systems (Installations)
Mathematics	Math 109	14	Exceeds RSOS sequencing
		240	

SATCC Level Two	Transcript Code	Hours	Pan-Canadian Harmonized Level Two
In context			Safety-Related Functions
			Tools and Equipment
Drafting	GRPH 280	12	Organizes Work
Medium Temp Applications	RFRG 208	34	Trade Activities
Introduction to Commercial Applications	RFRG 201	20	HVAC/R Systems (Plans Installation)
Electricity and Electrical Applications	ELEC 204	16	Controls Systems (Plans Installation)
Commercial Applications	RFRG 207	36	HVAC/R Systems (Installs)
Controls Systems	RFRG 209	26	Control Systems (Installs)
Motors and Motor Electrics	RFRG 204	18	HVAC/R Systems (Maintains)
Comprehensive Systems Analysis	RFRG 206	16	
Refrigeration Flow Controls and Accessories	RFRG 202	18	HVAC/R Systems (Basic Service)
Electricity	ELEC 207	18	Control Systems (Basic Maintenance and Service)
Mathematics	MATH 286	12	Exceeds RSOS Sequencing
Systems and Service Analysis	RFRG 205	14	HVAC/R Systems (Maintains)
		240	

SATCC Level Three	Transcript Code	Hours	Pan-Canadian Harmonized Level Three
In Context			Safety-Related Functions
			Tools and Equipment
			HVAC/R Systems (Maintain)
Graphics	GRPH 380	14	Organizes Work
Piping and Line Sizing	RFRG 382	16	HVAC/R Systems (Plans Installation)
Controls System Wiring	RFRG 388	30	Controls Systems (Plans Installation)
HVAC Design and Applications	RFRG 385	32	HVAC/R Systems (Installs)
Capacity and Head Pressure Control	RFRG 383	16	Control Systems (Installs)
HVAC Applications	RFRG 387	28	HVAC/R Systems (Commissions)
Electricity	ELEC 384	18	Controls Systems (Commissions)
Systems and Service Management	RFRG 381	14	HVAC/R Systems (Service)
Commercial Refrigeration Systems and Service	RFRG 384	18	
Practical Refrigeration Applications	RFRG 386	28	
Troubleshooting and System Analysis	RFRG 389	14	Control Systems (Maintain and Service)
Mathematics	MATH 382	12	Exceeds RSOS sequencing
		240	

SATCC Level Four	Transcript Code	Hours	Pan-Canadian Harmonized Level Four
In context			Safety-Related Functions Tools and Equipment HVAC/R Systems (Maintains)
Graphics	GRPH 480	12	Organizes Work
Trade Mentoring	RFRG XXX	12	Communication and Mentoring
Enthalpy and Psychrometrics	RFRG 481	32	HVAC/R Systems (Plans Installation)
Load Calculation and Equipment Selection	RFRG 482	25	
Advanced Commercial and Industrial Systems	RFRG 483	32	Control Systems (Plans Installation)
Control Systems Applications	RFRG 487	30	
HVAC Service Applications	RFRG 486	15	HVAC/R Systems (Commissions)
HVAC Variations and Refrigeration Systems	RFRG 484	34	Control Systems (Commissions)
Refrigeration Service Application	RFRG 485	30	HVAC/R Systems (Service)
Electrical	ELEC 482	18	Control Systems (Maintain and Service)
		240	

Exceed Topics

Throughout this guide to course content there are topics which exceed the minimum scope of work as set out in the Refrigeration and Air Conditioning Mechanic RSOS. Industry in Saskatchewan has deemed certain topics to fall within the scope of work of the Refrigeration and Air Conditioning Mechanic trade in Saskatchewan and therefore require technical training to cover these topics.