



Refrigeration and Air Conditioning Mechanic Guide to Course Content



Online: www.saskapprenticeship.ca

Recognition:

To promote transparency and consistency, this document has been adapted from the 2024 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:

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. The Task Matrix is broken down into the following:

Major Work Activity: 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.

TRAINING REQUIREMENTS FOR THE REFRIGERATION AND AIR CONDITIONING MECHANIC TRADE

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 for the Refrigeration And Air Conditioning Mechanic trade, delivered by Saskatchewan Polytechnic at the Saskatoon Campus.

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 document 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.

Designated Trade Name	Math Credit at the Indicated Grade Level ^❶	Science Credit at Grade Level
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. For information about high school curriculum, including Math and Science course names, please see: http://www.curriculum.gov.sk.ca/# Individuals not meeting the entrance requirements will be subject to an assessment and any required training		

REFRIGERATION AND AIR CONDITIONING MECHANIC TASK MATRIX CHART

This chart outlines the major work activities, tasks and sub-tasks from the 2024 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.

A - Performs Common Occupational Skills

8%

A-1 Maintains safe and healthy workplace	1.01 Maintains safe work environment 1, In Context in 2,3,4	1.02 Performs lock-out, tag-out and isolation procedures 1, In Context in 2,3,4	1.03 Uses personal protective equipment (PPE) and safety equipment 1, In Context in 2,3,4	1.04 Participates in healthy and respectful work environment 1, In Context in 2,3,4
A-2 Maintains continuous learning	2.01 Upskills in new trade practices and procedures 3,4	2.02 Upskills in emerging technologies 3,4		
A-3 Uses communication and mentoring techniques	3.01 Uses communication techniques 1, 4	3.02 Uses mentoring techniques 4		

B – Performs Routine Trade Activities

16%

B-4 Uses tools and equipment	4.01 Uses hand tools 1, In Context in 2,3,4	4.02 Uses portable and stationary power tools 1, In Context in 2,3,4	4.03 Uses piping and tubing connecting tools and equipment 1, In Context in 2,3,4	4.04 Uses recovery, recycling and charging tools and equipment 1, In Context in 2,3,4	4.05 Uses evacuation tools and equipment 1, In Context in 2,3,4
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	4.06 Uses diagnostic and measuring tools and equipment 1, In Context in 2,3,4	4.07 Uses electrical tools and equipment 1, In Context in 2,3,4	4.08 Uses access equipment 1, In Context in 2,3,4	4.09 Uses rigging, hoisting and lifting equipment 1, In Context in 2,3,4	4.10 Uses digital technology 1, In Context in 2,3
B-5 Organizes work	5.01 Interprets drawings and specifications 2,3, 4	5.02 Uses reference material and documentation 1,2, 3, 4	5.03 Plans job tasks and procedures 1,2,3, 4		
B-6 Performs work site preparation	6.01 Prepares work site 1	6.02 Handles materials and supplies 1			
B-7 Performs trade-specific activities	7.01 Connects piping and tubing 1	7.02 Performs leak and pressure tests on systems 1	7.03 Evacuates systems 1	7.04 Uses refrigerants, gases and oils 1,2	7.05 Performs field wiring of systems 1,2
	7.06 Applies sealants, adhesives and insulation 1				

C – Plans Installation

13%

C-8 Plans installation of standard and high efficiency HVAC/R systems	8.01 Performs HVAC/R system design 3, 4	8.02 Selects HVAC/R equipment, components and accessories 1, 2,3, 4	8.03 Determines placement of HVAC/R equipment, components and accessories 1,2, 3, 4	8.04 Performs HVAC/R material take-off 2,3, 4
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C-9 Plans installation of control systems	9.01 Performs control system design 3,4	9.02 Selects control system components and accessories 2,3, 4	9.03 Determines placement of control system components and accessories 1,2,3, 4	9.04 Performs control system material take-off 2,3, 4	
C-10 Plans retrofits	10.01 Analyzes energy efficiency of current system 3,4	10.02 Determines requirements for retrofits 2,3, 4	10.03 Analyzes distribution requirements for retrofits 2,3, 4	10.04 Performs design and sizing of retrofit equipment and components 3,4	10.05 Plans retrofit control systems 3,4

D – Performs Installation

21%

D-11 Installs HVAC/R systems	11.01 Confirms system layout 3	11.02 Assembles HVAC/R equipment, components and accessories 2, 3	11.03 Places HVAC/R equipment, components and accessories 1,2, 3	11.04 Retrofits HVAC/R equipment, refrigerants and refrigerant oils 2,3	11.05 Retrofits HVAC/R equipment, components and accessories 2,3
	11.06 Installs fasteners, brackets and hangers 1	11.07 Installs HVAC/R piping and tubing 1,2,3	11.08 Applies HVAC/R holding charge 1		
D-12 Installs control systems	12.01 Places control system components 1,2, 3	12.02 Connects control systems 1,2, 3	12.03 Retrofits control systems 2, 3		

E – Performs Commissioning

17%

E-13 Commissions new and retrofitted HVAC/R and control system components	13.01 Performs pre-start-up checks for HVAC/R systems 3,4	13.02 Performs start-up of HVAC/R systems 3,4	13.03 Performs start-up checks for control systems 3,4	13.04 Completes HVAC/R system charge 3,4	13.05 Sets up primary and secondary HVAC/R system components 3,4
E-14 Verifies system performance	14.01 Verifies/sets operating parameters 2,3,4	14.02 Verifies system integration 2,3,4	14.03 Performs system optimization 2,3, 4	14.04 Completes commissioning documentation 2,3,4	

F – Performs Maintenance and Service

25%

F-15 Maintains HVAC/R systems	15.01 Inspects HVAC/R systems 1,2,3	15.02 Performs predictive and scheduled maintenance on HVAC/R systems 1,2,3, 4	15.03 Tests HVAC/R system components and accessories 1,2,3,4	15.04 Optimizes integrated system performance 3,4
F-16 Services HVAC/R systems	16.01 Troubleshoots HVAC/R systems 2,3,4	16.02 Repairs HVAC/R systems 2,3,4		
F-17 Maintains and services control systems	17.01 Performs maintenance and inspection on control systems 2,3,4	17.02 Troubleshoots control systems 2,3,4	17.03 Calibrates operating and safety controls 2,3,4	17.04 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	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 108	18
HVAC Basics	RFRG 105	16
		240

Level Two	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	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 System Analysis	RFRG 389	14
		240

Level Four	Transcript Code	Hours
Electrical	ELEC 482	18
Graphics	GRPH 480	12
Enthalpy and Psychrometrics	RFRG 481	32
Load Calculation and Equipment	RFRG 482	25
Advanced Commercial and Industrial Systems	RFRG 483	32
HVAC Systems and Refrigeration Systems	RFRG 484	34
Refrigeration Service Application	RFRG 485	30
HVAC Service Applications	RFRG 486	15
Control System Applications	RFRG 487	30
Trade Mentoring	RFRG 489	12
		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.

Level One	8 weeks	240 hours
Controls • identify electrical controls • install basic cycling controls • set up basic circuits • adjust basic cycling controls RSOS subtasks covered in this section of training: C-9 Plans installation of control systems C-9.03 Determines placement of control system components and accessories D-12 Installs control systems D-12.01 Places control system components D-12.02 Connects control systems		14 hours
Electrical • 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 subtasks covered in this section of training: B-7 Performs trade-specific activities B-7.05 Performs field wiring of systems D-12 Installs control systems D-12.01 Places control system components D-12.02 Connects control systems		24 hours

Graphics**14 hours**

- draw a 2-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 subtasks covered in this section of training:**A-3 Uses communication and mentoring techniques**

A-3.01 Uses communication techniques

B-5 Organizes work

B-5.02 Uses documentation and reference material

B-5.03 Plans job tasks and procedures

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 subtasks covered in this section of training:**C-8 Plans installation of HVAC/R systems**

C-8.03 Determines placement of HVAC/R equipment, components and accessories

F-15 Maintains HVAC/R systems

F-15.03 Tests HVAC/R system 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 subtasks covered in this section of training:

C-8 Plans installation of HVAC/R systems

C-8.03 Determines placement of HVAC/R equipment, components and accessories

F-15 Maintains HVAC/R systems

F-15.01 Inspects HVAC/R systems

F-15.03 Tests HVAC/R system components and accessories

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 subtasks covered in this section of training:

D-11 Installs HVAC/R systems

D-11.03 Places HVAC/R equipment, components and accessories

D-11.06 Installs fasteners, brackets and hangers

D-11.07 Installs HVAC/R piping and tubing

D-11.08 Applies HVAC/R holding charge

F-15 Maintains HVAC/R systems

F-15.01 Inspects HVAC/R systems

F-15.02 Performs predictive and scheduled maintenance on HVAC/R systems

F-15.03 Tests HVAC/R system components and accessories

Refrigerants

14 hours

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

RSOS subtasks covered in this section of training:

B-7 Performs trade-specific activities

B-7.02 Performs leak and pressure tests on system

B-7.04 Uses refrigerants, gases and oils

Basic System Applications

24 hours

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

RSOS subtasks covered in this section of training:

B-7 Performs trade-specific activities

- B-7.01 Connects piping and tubing
 - B-7.02 Performs leak and pressure tests on systems
 - B-7.03 Evacuates systems
 - B-7.04 Uses refrigerants, gases and oils
 - B-7.05 Performs field wiring of systems
 - B-7.06 Applies sealants, adhesives and insulation
-

Hand Skills and Service Techniques

24 hours

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

RSOS subtasks covered in this section of training:

B-6 Performs Work Site Preparation

- B-6.01 Prepares work site
- B-6.02 Handles materials and supplies

B-7 Performs trade-specific activities

- B-7.01 Connects piping and tubing
 - B-7.02 Performs leak and pressure tests on systems
 - B-7.03 Evacuates systems
 - B-7.04 Uses refrigerants, gases and oils
 - B-7.05 Performs field wiring of systems
 - B-7.06 Applies sealants, adhesives and insulation
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Welding

18 hours

- identify copper tubing
- 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 subtasks covered in this section of training:

B-7 Performs trade-specific activities

- B-7.01 Connects piping and tubing
 - B-7.02 Performs leak and pressure tests on systems
 - B-7.03 Evacuates systems
 - B-7.04 Uses refrigerants, gases and oils
 - B-7.05 Performs field wiring of systems
 - B-7.06 Applies sealants, adhesives and insulation
-

Hand Tools

18 hours

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

RSOS subtasks covered in this section of training:

B-4 Uses tools and equipment

- B-4.01 Uses hand tools
- B-4.02 Uses portable and stationary power tools
- B-4.03 Uses piping and tubing connecting tools and equipment
- B-4.04 Uses recovery, recycling and charging tools and equipment
- B-4.05 Uses evacuation tools and equipment
- B-4.06 Uses diagnostic and measuring tools and equipment
- B-4.07 Uses electrical tools and equipment
- B-4.08 Uses access equipment
- B-4.09 Uses rigging, hoisting and lifting equipment
- B-4.10 Uses digital technology

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 subtasks covered in this section of training:

A-1 Maintains safe and healthy workplace

- A-1.01 Maintains safe work environment
- A-1.02 Performs lock-out, tag-out and isolation procedures
- A-1.03 Uses personal protective equipment (PPE) and safety equipment
- A-1.04 Participates in healthy and respectful work environment

B-4 Uses tools and equipment

- B-4.08 Uses access equipment
- B-4.09 Uses rigging, hoisting and lifting equipment

HVAC Basics

16 hours

- discuss safe work practices
- examine air properties
- compare air conditioning systems
- select HVAC controls
- interpret air flow problems

RSOS subtasks covered in this section of training:

C-8 Plans installation of standard and high efficiency HVAC/R systems

C-8.03 Determines placement of HVAC/R equipment, components and accessories

D-12 Installs control systems

D-12.01 Places control system components

D-12.02 Connects control systems

F-15 Maintains HVAC/R systems

F-15.01 Inspects HVAC/R systems

F-15.03 Tests HVAC/R system components and accessories

Level Two

8 weeks

240 hours

Electricity and Electrical Applications

20 hours

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

RSOS subtasks covered in this section of training:

B-7 Performs trade-specific activities

B-7.05 Performs field wiring of systems

D-12 Installs control systems

D-12.01 Places control system components

Electricity

18 hours

- describe the differences between DC and AC electrical circuits
- perform circuit measurements
- describe reactance
- describe 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
- compare the operating characteristics of several single-phase AC motor types

RSOS subtasks covered in this section of training:

F-17 Maintains and services control systems

F-17.01 Performs maintenance and inspection on control systems

F-17.02 Troubleshoots control systems

F-17.03 Calibrates operating and safety controls

F-17.04 Repairs control systems

Trade Mathematics

12 hours

- use metric and imperial units
- perform trade calculations

RSOS subtasks covered in this section of training:

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

Intro to Commercial Applications

22 hours

- compare temperature applications
- compare defrost methods
- design piping arrangements
- select conversion procedures
- choose dehydration and evacuation methods

RSOS subtasks covered in this section of training:

B-7 Performs trade-specific activities

B-7.04 Uses refrigerants, gases and oils

C-8 Plans installation of HVAC/R systems

C-8.02 Selects HVAC/R equipment, components and accessories

C-8.03 Determines placement of HVAC/R equipment, components and accessories

C-8.04 Performs HVAC/R material take-off

C-10 Plans retrofits

C-10.02 Determines requirements for retrofits

C-10.03 Analyzes distribution requirements for retrofits

Refrigeration Flow Controls and Accessories

20 hours

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

RSOS subtasks covered in this section of training:

B-7 Performs trade-specific activities

B-7.04 Uses refrigerants, gases and oils

F-15 Maintains HVAC/R systems

F-15.01 Inspects HVAC/R systems

F-15.03 Tests HVAC/R system components and accessories

F-16 Services HVAC/R systems

F-16.01 Troubleshoots HVAC/R systems

F-16.02 Repairs HVAC/R systems

Drafting

12 hours

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

RSOS subtasks covered in this section of training:

B-5 Organizes work

B-5.01 Interprets drawings and specifications

B-5.02 Uses documentation and reference material

B-5.03 Plans job tasks and procedures

Motors and Motor Electrics

20 hours

- design Beams and Supports
- identify motor types
- examine motor starting devices
- examine motor protection devices
- conduct motor tests

RSOS subtasks covered in this section of training:

F-15 Maintains HVAC/R systems

F-15.01 Inspects HVAC/R systems

F-15.02 Performs predictive and scheduled maintenance on HVAC/R systems

F-15.03 Tests HVAC/R system components and accessories

Comprehensive Systems Analysis

20 hours

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

RSOS subtasks covered in this section of training:

E-14 Verifies system performance

E-14.01 Verifies/sets operating parameters

E-14.02 Verifies system integration

E-14.03 Performs system optimization

E-14.04 Completes commissioning documentation

F-15 Maintains HVAC/R systems

F-15.01 Inspects HVAC/R systems

F-15.02 Performs predictive and scheduled maintenance on HVAC/R systems

F-15.03 Tests HVAC/R system components and accessories

F-16 Services HVAC/R systems

F-16.01 Troubleshoots HVAC/R systems

F-16.02 Repairs HVAC/R systems

Commercial Applications

36 hours

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

RSOS subtasks covered in this section of training:

C-8 Plans installation of standard and high efficiency HVAC/R systems

C-8.02 Selects HVAC/R equipment, components and accessories

C-8.03 Determines placement of HVAC/R equipment, components and accessories

C-8.04 Performs HVAC/R material take-off

D-11 Installs HVAC/R systems

D-11.02 Assembles HVAC/R equipment, components and accessories

D-11.03 Places HVAC/R equipment, components and accessories

D-11.04 Retrofits HVAC/R equipment, refrigerants and refrigerant oils

D-11.05 Retrofits HVAC/R equipment, components and accessories

D-11.07 Installs HVAC/R piping and tubing

D-12 Installs control systems

D-12.01 Places control system components

D-12.02 Connects control systems

Medium Temp Applications**34 hours**

- construct refrigerated fixtures
- set up system controls
- manage system problems

RSOS subtasks covered in this section of training:**B-7 Performs trade-specific activities**

B-7.04 Uses refrigerants, gases and oils

B-7.05 Performs field wiring of systems

Control Systems**26 hours**

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

RSOS subtasks covered in this section of training:**C-9 Plans installation of control systems**

C-9.02 Selects control system components and accessories

C-9.03 Determines placement of control system components and accessories

C-9.04 Performs control system material take-off

D-12 Installs control systems

D-12.01 Places control system components

D-12.02 Connects control systems

D-12.03 Retrofits control systems

F-17 Maintains and services control systems

F-17.01 Performs maintenance and inspection on control systems

F-17.02 Troubleshoots control systems

F-17.03 Calibrates operating and safety controls

F-17.04 Repairs control systems

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 subtasks covered in this section of training:

F-17 Maintains and services control systems

F-17.01 Performs maintenance and inspection on control systems

F-17.02 Troubleshoots control systems

F-17.03 Calibrates operating and safety controls

F-17.04 Repairs control systems

Level Two topics from the RSOS that are taught in context:

A-1 Maintains Safe and Healthy Workplace

B-4 Uses Tools and Equipment

For details regarding the In Context Topic, see page 29

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

RSOS subtasks covered in this section of training:

F-17 Maintains and services control systems

F-17.01 Performs maintenance and inspection on control systems

F-17.02 Troubleshoots control systems

F-17.03 Calibrates operating and safety controls

F-17.04 Repairs control systems

Graphics

14 hours

- sketch an exploded isometric
- mechanical and architectural sets of plans
- interpret blueprints and manufacturer's drawings

RSOS subtasks covered in this section of training:

B-5 Organizes work

B-5.01 Interprets drawings and specifications

B-5.02 Uses documentation and reference material

B-5.03 Plans job tasks and procedures

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 subtasks covered in this section of training:

A-2 Maintains Continuous Learning

A-2.01 Upskills in new trade practices and procedures

A-2.02 Upskills in emerging technologies

C-10 Plans retrofits

C-10.02 Determines requirements for retrofits

F-16 Services HVAC/R systems

F-16.01 Troubleshoots HVAC/R systems

F-16.02 Repairs HVAC/R systems

Piping and Line Sizing

16 hours

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

RSOS subtasks covered in this section of training:

C-8 Plans installation of standard and high efficiency HVAC/R systems

C-8.01 Performs HVAC/R system design

C-8.02 Selects HVAC/R equipment, components and accessories

C-8.03 Determines placement of HVAC/R equipment, components and accessories

C-8.04 Performs HVAC/R material take-off

C-10 Plans retrofits

C-10.03 Analyzes distribution requirements for retrofits

D-11 Installs HVAC/R systems

D-11.01 Confirms system layout

Capacity and Head Pressure

16 hours

- compare capacity control methods
- examine head pressure control methods

RSOS subtasks covered in this section of training:

C-9 Plans installation of control systems

C-9.01 Performs control system design

C-9.02 Selects control system components and accessories

C-9.03 Determines placement of control system components and accessories

C-9.04 Performs control system material take-off

D-12 Installs control systems

D-12.01 Places control system components

D-12.02 Connects control systems

D-12.03 Retrofits control systems

E-14 Verifies system performance

E-14.01 Verifies/sets operating parameters

Commercial Refrigeration Systems and Service

18 hours

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

RSOS subtasks covered in this section of training:

D-11 Installs HVAC/R systems

D-11.04 Retrofits HVAC/R equipment, refrigerants and oils

D-11.05 Retrofits HVAC/R equipment, components and accessories

F-16 Services HVAC/R systems

F-16.01 Troubleshoots HVAC/R systems

F-16.02 Repairs HVAC/R systems

HVAC Systems

32 hours

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

RSOS subtasks covered in this section of training:

D-11 Installs HVAC/R systems

D-11.02 Assembles HVAC/R equipment, components and accessories

D-11.03 Places HVAC/R equipment, components and accessories

D-11.04 Retrofits HVAC/R equipment, refrigerants and oils

D-11.05 Retrofits HVAC/R equipment, components and accessories

Practical Refrigeration Applications

28 hours

- examine ice machines
- examine reach-ins
- examine walk-in coolers
- examine display cases

RSOS subtasks covered in this section of training:

E-14 Verifies system performance

E-14.01 Verifies/sets operating parameters

E-14.02 Verifies system integration

E-14.03 Perform system optimization

E-14.04 Completes commissioning documentation

F-16 Services HVAC/R systems

F-16.01 Troubleshoots HVAC/R systems

F-16.02 Repairs HVAC/R systems

Practical HVAC Applications

28 hours

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

RSOS subtasks covered in this section of training:

C-10 Plans retrofits

- C-10.01 Analyzes energy efficiency of current system
- C-10.04 Performs design and sizing of retrofit equipment and components

E-13 Commissions new and retrofitted HVAC/R and control system components

- E-13.01 Performs pre-start-up checks for HVAC/R systems
- E-13.02 Performs start-up of HVAC/R systems
- E-13.03 Performs start-up checks for control systems
- E-13.04 Completes HVAC/R system charge
- E-13.05 Sets up primary and secondary HVAC/R system components

E-14 Verifies system performance

- E-14.01 Verifies/sets operating parameters
- E-14.02 Verifies system integration
- E-14.03 Perform system optimization
- E-14.04 Completes commissioning documentation

Control System Wiring

30 hours

- determine electrical requirements
- wire electrical systems

RSOS subtasks covered in this section of training:

C-9 Plans installation of control systems

- C-9.04 Performs control system material take-off

C-10 Plans retrofits

- C-10.05 Plans retrofit of control systems

D-12 Installs control systems

- D-12.01 Places control system components
- D-12.02 Connects control systems
- D-12.03 Retrofits control systems

Troubleshooting and Systems Analysis

14 hours

- manage systems problems
- select system components
- select service procedures
- choose system accessories

RSOS subtasks covered in this section of training:

F-15 Maintains HVAC/R systems

- F-15.01 Inspects HVAC/R systems
- F-15.02 Performs predictive and scheduled maintenance on HVAC/R systems
- F-15.03 Tests HVAC/R system components and accessories
- F-15.04 Optimizes integrated system performance

F-17 Maintains and services control systems

F-17.01 Performs maintenance and inspection on control systems

F-17.02 Troubleshoots control systems

F-17.03 Calibrates operating and safety controls

F-17.04 Repairs control systems

Level Three topics from the RSOS that are taught in context:

A-1 Maintains Safe and Healthy Workplace

B-4 Uses Tools and Equipment

For details regarding the In Context Topic, see page 29

Level Four

8 weeks

240 hours

Electrical

18 hours

- describe a diode
- describe the operation of a DC power supply circuit
- explain the operation of a transistor
- explain the operation of thyristors
- describe the basic operation of programmable logic controllers
- explain power factor
- describe power factor correction

RSOS subtasks covered in this section of training:

F-17 Maintains and services control systems

F-17.01 Performs maintenance and inspection on control systems

F-17.02 Troubleshoots control systems

F-17.03 Calibrates operating and safety controls

F-17.04 Repairs control systems

Graphics

12 hours

- views/isometrics/oblique's/symbols
- spec reading questions
- detailed listing of all equipment

RSOS subtasks covered in this section of training:

B-5 Organizes work

B-5.01 Interprets drawings and specifications

B-5.02 Uses documentation and reference material

B-5.03 Plans job tasks and procedures

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 subtasks covered in this section of training:

C-8 Plans installation of standard and high efficiency HVAC/R systems

C-8.01 Performs HVAC/R system design

C-8.02 Selects HVAC/R equipment, components and accessories

C-8.03 Determines placement of HVAC/R equipment, components and accessories

C-8.04 Performs HVAC/R material take-off

E-14 Verifies system performance

E-14.01 Verifies/sets operating parameters

E-14.03 Performs system optimization

F-15 Maintains HVAC/R systems

F-15.04 Optimizes integrated system performance

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 subtasks covered in this section of training:

C-8 Plans installation of standard and high efficiency HVAC/R systems

C-8.01 Performs HVAC/R system design

C-8.02 Selects HVAC/R equipment, components and accessories

C-8.03 Determines placement of HVAC/R equipment, components and accessories

C-8.04 Performs HVAC/R material take-off

C-10 Plans retrofits

C-10.04 Performs design and sizing of retrofit equipment and components

Advanced Commercial and Industrial Systems

32 hours

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

RSOS subtasks covered in this section of training:

C-9 Plans installation of control systems

C-9.01 Performs control system design

C-9.02 Selects control system components and accessories

C-9.03 Determines placement of control system components and accessories

C-9.04 Performs control system material take off

HVAC Systems and Refrigeration Systems

34 hours

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

RSOS subtasks covered in this section of training:

E-13 Commissions new and retrofitted HVAC/R and control system components

E-13.01 Performs pre-start-up check for HVAC/R systems

E-13.02 Performs start-up of HVAC/R systems

E-13.03 Performs start-up checks for control systems

E-13.04 Completes HVAC/R system charge

E-13.05 Sets up primary and secondary HVAC/R system components

E-14 Verifies system performance

E-14.01 Verifies/sets operating parameters

E-14.02 Verifies system integration

E-14.03 Performs system optimization

E-14.04 Completes commissioning documentation

Refrigeration Service Application

30 hours

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

RSOS subtasks covered in this section of training:

D-11 Installs HVAC/R systems

D-11.04 Retrofits HVAC/R equipment, refrigerants and oils

D-11.05 Retrofits HVAC/R equipment, components and accessories

E-14 Verifies system performance

E-14.01 Verifies/sets operating parameters

E-14.02 Verifies system integration

E-14.03 Performs system optimization

E-14.04 Completes commissioning documentation

F-16 Services HVAC/R systems

F-16.01 Troubleshoots HVAC/R systems

F-16.02 Repairs HVAC/R systems

HVAC Service Applications

15 hours

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

RSOS subtasks covered in this section of training:

D-11 Installs HVAC/R systems

D-11.04 Retrofits HVAC/R equipment, refrigerants and oils

D-11.05 Retrofits HVAC/R equipment, components and accessories

F-17 Maintains and services control systems

F-17.01 Performs maintenance and inspection on control systems

F-17.02 Troubleshoots control systems

F-17.03 Calibrates operating and safety controls

F-17.04 Repairs control systems

Control System Applications

30 hours

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

RSOS subtasks covered in this section of training:

C-9 Plans installation of control systems

C-9.01 Performs control system design

C-9.02 Selects control system components and accessories

C-9.03 Determines placement of control system components and accessories

C-9.04 Performs control system material take off

C-10 Plans retrofits

C-10.05 Plans retrofit control systems

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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 subtasks covered in this section of training:

A-2 Maintains continuous learning

A-2.01 Upskills in new trade practices and procedures

A-2.02 Upskills in emerging technologies

A-3 Uses communication and mentoring techniques

A-3.01 Uses communication techniques

A-3.02 Uses mentoring techniques

Level Four topics from the RSOS that are taught in context:

A-1 Maintains Safe and Healthy Workplace

B-4 Uses Tools and Equipment

For details regarding the In Context Topic, see page 29

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 Maintains safe and healthy workplace

A-1.01 Maintains safe work environment

A-1.02 Performs lock-out, tag-out and isolation procedures

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

A-1.04 Participates in healthy and respectful work environment

B-4 Uses tools and equipment

B-4.01 Uses hand tools

B-4.02 Uses portable and stationary power tools

B-4.03 Uses piping and tubing connecting tools and equipment

B-4.04 Uses recovery, recycling and charging tools and equipment

B-4.05 Uses evacuation tools and equipment

B-4.06 Uses diagnostic and measuring tools and equipment

B-4.07 Uses electrical tools and equipment

B-4.08 Uses access equipment

B-4.09 Uses rigging, hoisting and lifting equipment

B-4.10 Uses digital technology