Refrigeration and Air Conditioning Mechanic

Course Outline

2022-2023

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Saskatchewan Apprenticeship and Trade Certification Commission

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	16
Electricity	ELEC 207	18
Trade Mathematics	MATH 286	12
Intro to Commercial Applications	RFRG 201	20
Refrigeration Flow Controls and Accessories	RFRG 202	18
Drafting	GRPH 280	12
Motors and Motor Electrics	RFRG 204	18
Comprehensive Systems Analysis	RFRG 206	16
Commercial Applications	RFRG 207	36

Medium Temp Applications	RFRG 208	34
Systems and Service Analysis	RFRG 205	14
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.

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

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

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

Mathematics — 14 hours

- use basic mathematics
- perform trade calculations

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

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

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

Refrigerants **14 hours**

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

Basic System Applications **24 hours**

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

Hand Skills and Service Techniques **24 hours**

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

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

Hand Tools **18 hours**

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

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

HVAC Basics **16 hours**

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

Level Two — 8 weeks — 240 hours

Electricity and Electrical Applications — 16 hours

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

Electrical — 18 hours

- describe the differences between dc and ac electrical circuits
- perform ac and dc 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

Trade Mathematics — 12 hours

- use metric and imperial units
- perform trade calculations

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

Refrigeration Flow Controls and Accessories — 18 hours

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

Drafting — 12 hours

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

Motors and Motors Electrics — 18 hours

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

Comprehensive System Analysis **16 hours**

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

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

Medium Temp Applications **34 hours**

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

Control Systems **26 hours**

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

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

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

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

Mathematics — 12 hours
- use basic geometry and trigonometry
- perform trade calculations

Systems and Service Management — 14 hours
- manage system problems
- select refrigerant components, accessories and flow controls
- select service techniques
- analyze control systems

Piping and Line Sizing — 16 hours
- design piping arrangements
- select pipe size
- interpret the mechanical code

Capacity and Head Pressure — 16 hours
- identify capacity control methods
- identify head pressure control methods

Commercial Refrigeration Systems and Service — 18 hours
- analyze refrigerant oil
- analyze compressor failure
- identify refrigeration flow problems
- select refrigerants and oils

HVAC Design and Applications — 32 hours
- select gas components
- compare HVAC designs
- troubleshoot HVAC control systems

Practical Refrigeration Applications — 28 hours
- examine refrigeration equipment
- service refrigeration equipment

HVAC Applications **28 hours**

- examine HVAC equipment
- service HVAC equipment

Control System Wiring **30 hours**

- determine electrical requirements
- design the electrical system
- wire electrical systems
- evaluate the electrical system

Troubleshooting and System Analysis **14 hours**

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

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

Graphics — 12 hours

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

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

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

Advanced Commercial and Industrial Systems — 32 hours

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

HVAC Variations and Refrigeration Systems — 34 hours

- examine HVAC variations
- identify air distribution systems
- describe air conditioning and refrigeration chillers
- describe cooling towers

Refrigeration Service Application — 30 hours

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

HVAC Service Applications — 15 hours

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

Control System Applications **30 hours**

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

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

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.

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** 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**		

***The Refrigeration and Air Conditioning Mechanic Red Seal Occupational Standard (RSOS), describing the "full scope" of the trade, can be found at** www.red-seal.ca

***For more detailed information on course content, please refer to the Refrigeration and Air Conditioning Mechanic Guide to Course Content at** www.saskapprenticeship.ca.