

**Refrigeration and Air Conditioning Mechanic/  
Refrigeration and Air Conditioning Mechanic (Residential)  
Common Core - Level 2**

### **Refrigeration and Air Conditioning Mechanic/ Refrigeration and Air Conditioning Mechanic (Residential)**

**Unit:** B1 Drawings, Blueprints and Specifications

**Level:** Two

**Duration:** 21 hours

Theory: 11 hours

Practical: 10 hours

#### **Overview:**

This unit is designed to provide the apprentice with the knowledge and skills of blueprints, drawings and specifications. Beginning with terminology, apprentices will interpret codes, blueprints, drawings and specifications. Topics will include: blueprint types, views, documentation, and drawing conventions. Apprentices will apply this knowledge by reproducing various drawing types and using basic drawing techniques. Finally, apprentices will perform quantity surveying using various types of working documents to interpret and extract information from blueprints, drawings and specifications on both a residential and commercial application.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
<b>1. Define terminology associated with blueprints, drawings and specifications.</b>	<b>10%</b>
<b>2. Interpret codes and specifications pertaining to blueprints, drawings and specifications.</b>	<b>15%</b>
a. Manufacturers	
b. Engineers	
c. Contractors	
d. Clients	
<b>3. Describe and demonstrate the use of working documents.</b>	<b>25%</b>
a. Blueprint types	
• Architectural	
• Structural	
• Mechanical	
• Electrical	
• Shop drawings	
• Seismic	
b. Views	
• Plan view	
• Elevation	
• Sections	
• Details	
• 3-D	
c. Documentation	
• Specifications	

- Addendums
- Change orders
- Request for information (RFI)
- d. Drawing conventions
  - Line types
  - Reference numbers, symbols and abbreviations
  - Units of measurement (metric/imperial)
  - Scaling
  - Title block and legend
  - Notes, specifications and schedules

- 4. Demonstrate and perform basic drawing techniques. 20%**
- a. Sketching
  - b. Perspective
  - c. Orthographic projection
  - d. Isometric
  - e. Other
- 5. Perform quantity surveying using various types of working documents to interpret and extract information from blueprints, drawings and specifications. 30%**
- a. Residential
  - b. Commercial

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## Refrigeration and Air Conditioning Mechanic/ Refrigeration and Air Conditioning Mechanic (Residential)

**Unit:** B2 HVAC/R Activities II

**Level:** Two

**Duration:** 28 hours

Theory: 18 hours

Practical: 10 hours

### Overview:

This unit is designed to provide the apprentice with the knowledge and skills to perform advanced heating, ventilation, air conditioning and refrigeration (HVAC/R) activities. Building on *A8 HVAC/R Activities I* in Level One, this unit continues to introduce terminology, hazards, and safe work practices and procedures as well as review refrigerants, gases and oils. Apprentices will describe and demonstrate the procedures associated with HVAC/R Activities. Finally, apprentices will perform HVAC/R activities using various projects and techniques.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
<b>1. Define terminology associated with HVAC/R activities.</b>	<b>20%</b>
<b>2. Identify hazards and describe safe work practices and equipment pertaining to HVAC/R activities.</b>	<b>10%</b>
a. Refrigerants, gases and oils	
b. Electricity	
<b>3. Interpret jurisdictional codes and manufacturers' specifications pertaining to HVAC/R activities.</b>	<b>10%</b>
a. Refrigerants, gases and oils	
b. Wiring of systems	
<b>4. Review HVAC/R activities.</b>	<b>10%</b>
a. Refrigerants, gases and oils	
• Types	
• Safety classifications	
• Effects on environment	
<b>5. Describe the procedures used to perform HVAC/R activities.</b>	<b>10%</b>
a. Refrigerants, gases and oils	
• Conversions with refrigerants and oils	
• Storage and transport of recovered or recycled refrigerants and oils	
• Purging and pressure testing	
b. Adapt to new refrigerant requirements	

- 6. Demonstrate the procedures associated with HVAC/R activities. 15%**
- a. Conversions with refrigerants and oils
  - b. Storage and transport of recovered or recycled refrigerants and oils
- 7. Perform the procedures associated with HVAC/R activities. 25%**
- a. Wiring of equipment
  - b. Refrigerant
    - Pressure testing
    - Evacuation
    - Charging and recovery
  - c. System testing and commissioning
  - d. Pump down activities

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## Refrigeration and Air Conditioning Mechanic/ Refrigeration and Air Conditioning Mechanic (Residential)

**Unit:** B3 HVAC/R Systems Installation

**Level:** Two

**Duration:** 70 hours

Theory: 40 hours

Practical: 30 hours

### Overview:

This unit is designed to provide the apprentice with knowledge and skills of HVAC/R systems installation. Beginning with terminology, hazards, and safe work practices, the unit will include jurisdictional codes and manufactures' specifications pertaining to HVAC/R systems installation. Topics include: HVAC systems, HVAC system components, refrigeration systems and alternative systems. Apprentices will identify and describe HVAC/R system factors when selecting, assembling and placing HVAC/R equipment, components and accessories. Apprentices will also describe, demonstrate and perform the procedures to install HVAC/R systems.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
<b>1. Define terminology associated with HVAC/R systems installation.</b>	<b>5%</b>
<b>2. Identify hazards and describe safe work practices of HVAC/R systems installation.</b>	<b>5%</b>
<b>3. Interpret jurisdictional codes and manufacturers' specifications pertaining to HVAC/R systems installation.</b>	<b>10%</b>
a. Drawings	
b. Specifications	
c. Graphs	
d. Tables.	
<b>4. Identify and describe HVAC/R systems installation and their applications and procedures to select, assemble and place.</b>	<b>30%</b>
a. HVAC systems	
• Heat pumps	
• Split	
• Ductless split	
• Package units	
• Heat reclaim	
• Chillers	
• Humidifiers	
• Dehumidifiers	
• Energy recovery ventilation (ERVs)	
• Heat recovery ventilation (HRVs)	
b. HVAC system components	

- Compressors
  - Condensers
  - Evaporators
  - Liquid pumps
  - Metering devices
  - Valves
  - Heat exchangers
  - Pressure vessels
  - Temperature sensors
  - Transducers
  - Valves and regulators
- c. Refrigeration systems
- Coolers
  - Freezers
  - Chillers
  - Process refrigeration systems
  - Ultralow
  - Ice machines
  - Plate freezers
- d. Alternative systems
- Heat reclaim units

**5. Identify and describe HVAC/R system factors when selecting, assembling and placing HVAC/R equipment, components and accessories. 20%**

- a. Installation considerations
- Tools and equipment needed
  - Component limitations
  - Environmental issues
  - Materials and pipe required
  - Components used
- b. Capacity ratings of HVAC/R system components
- c. Effects of pressure loss in refrigeration piping
- d. Methods of zoning
- e. Balancing system capacity with system load

**6. Describe and demonstrate the procedures to install HVAC/R systems. 15%**

- a. Determine requirements and select systems
- Equipment
  - Components
  - Accessories
- b. Material take-off
- c. Assemble and place equipment
- d. Confirm system operation

**7. Perform the procedures to install HVAC/R systems. 15%**

- a. Material take-off
- b. Confirm system operation

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## Refrigeration and Air Conditioning Mechanic/ Refrigeration and Air Conditioning Mechanic (Residential)

**Unit:** B4 Control Systems Installation I

**Level:** Two

**Duration:** 42 hours

Theory: 27 hours

Practical: 15 hours

### Overview:

This unit is designed to provide the apprentice with knowledge and skills of control systems installation. This unit builds on and is a continuation of *A10 Electrical and Control Fundamentals* in Level One. Beginning with terminology, hazards and safe work practices, the unit will interpret codes and regulations pertaining to control systems installation. Apprentices will identify and describe the operation of control systems and their components, field wiring equipment and their application for use. Finally, apprentices will perform various control system tasks using various projects and techniques applying codes and regulations.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
<b>1. Define terminology associated with control systems installation.</b>	<b>5%</b>
<b>2. Identify hazards and safe work practices pertaining to control systems installation.</b>	<b>5%</b>
<b>3. Interpret codes and regulations pertaining to control systems installation.</b>	<b>20%</b>
a. Control systems	
b. Components	
c. Drawings and specifications	
d. Building automation system (BAS) systems	
e. Direct digital control (DDC) systems	
<b>4. Identify and describe control systems, their components and operation.</b>	<b>10%</b>
a. Types	
b. Devices	
c. Components	
d. Transformers	
e. Contactors	
f. Relays	
<b>5. Identify and describe field wiring equipment and their application for use.</b>	<b>20%</b>
a. Types	
• Wire gauge	
• Wiring terminations	



- Wiring components

- 6. Describe and demonstrate control system take-off procedures. 15%**
- 7. Perform various control system tasks using various projects and techniques applying codes and regulations. 25%**
- a. Install control wiring systems
  - b. Connect control components and accessories
  - c. Confirm control operation

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## Refrigeration and Air Conditioning Mechanic/ Refrigeration and Air Conditioning Mechanic (Residential)

**Unit:** B5 HVAC/R Systems Service

**Level:** Two

**Duration:** 66 hours

Theory: 38 hours

Practical: 28 hours

### Overview:

This unit is designed to provide the apprentice with knowledge and skills of HVAC/R systems service. Beginning with terminology, hazards, and safe work practices, the unit will interpret jurisdictional codes and manufacturer's specifications pertaining to HVAC/R systems service. Apprentices will identify and describe tools and test equipment for HVAC/R systems and material considerations. Apprentices will also describe and demonstrate the procedures to inspect, maintain, test, troubleshoot and repair HVAC/R systems, components and accessories. Finally, apprentices will perform the procedures to service HVAC/R Systems.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
1. Define terminology associated with HVAC/R systems service.	5%
2. Identify hazards and safe work practices pertaining to HVAC/R systems service.	5%
a. HVAC/R system operation	
b. HVAC/R components	
3. Interpret jurisdictional codes and manufacturers' specifications pertaining to HVAC/R systems service.	5%
4. Identify and describe tools and test equipment for HVAC/R systems, electrical components, and mechanical components and accessories.	15%
a. Types	
• Inspection tools	
• Troubleshooting tools	
• Maintaining tools	
• Repairing tools	
5. Identify and describe HVAC/R systems service factors and material considerations.	10%
a. System capacity	
• Saturated discharge temperature	
• Saturated suction temperature	
• Liquid sub-cooling	
• Suction superheat	
• Suction to liquid heat exchanger	
• High and low side pressure drops	

- b. Pressure enthalpy diagrams
  - Terminology
  - System analysis
  - Interpretation of information
- c. Calculations

**6. Describe and demonstrate the procedures to inspect, maintain, test, troubleshoot and repair HVAC/R systems, components and accessories. 30%**

- a. HVAC/R systems
  - System
  - Components
  - Component abnormalities
  - Electrical components
  - Sequence of operation
- b. Retrofit refrigerants, gases and oils
  - Recover
  - Recycle
  - Store
  - Transport
- c. Air and secondary refrigerant distribution systems
  - Types
  - Components
- d. Troubleshoot HVAC/R system and component abnormalities
- e. Pressure and temperature scales conversion calculations
- f. Troubleshoot using cycle diagrams

**7. Perform the procedures to service HVAC/R systems. 30%**

- a. Inspect
- b. Maintain
- c. Test
- d. Troubleshoot
- e. Repair
- f. Commission

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## Refrigeration and Air Conditioning Mechanic/ Refrigeration and Air Conditioning Mechanic (Residential)

**Unit:** B6 Control Systems Service I

**Level:** Two

**Duration:** 21 hours

Theory: 15 hours

Practical: 6 hours

### Overview:

This unit is designed to provide the apprentice with knowledge and skills of control systems service. Beginning with terminology, hazards and safe work practices, the unit will interpret codes and regulations pertaining to control systems service. Apprentices will identify and describe setting start-up and operating parameter procedures using service tools and equipment. Apprentices will also interpret HVAC/R information sourced from drawings, specifications and service manuals to demonstrate the procedures to verify basic electrical control circuit systems and components using schematic wiring diagrams. Finally, apprentices will perform service of components for control systems.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
1. Define terminology associated with control systems service.	5%
2. Identify hazards and safe work practices pertaining to control systems service.	5%
3. Interpret codes and regulations pertaining to control systems service.	10%
a. HVAC/R control systems	
b. Verifying and setting safety parameters	
4. Identify and describe tools and equipment pertaining to control systems service.	10%
a. Start-up	
b. Setting operating parameters	
5. Interpret HVAC/R information sourced from drawings, specifications and service manuals.	10%
6. Describe and demonstrate the procedures to verify basic electrical control circuit systems and components using schematic wiring diagrams.	45%
a. Control boards	
b. Diagnosis	
c. Calibration	
d. Troubleshooting	
• Electrical control circuits	
• Electrical components	
• Electronic metering devices	

- Reversing valve controls

**7. Perform servicing of components for control systems.**

**15%**

- a. Wire control systems
- b. Electronic and mechanical controls
  - Set
  - Adjust
  - Test
- c. Test and record under load
  - Voltage
  - Resistance
  - Amperage

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## Refrigeration and Air Conditioning Mechanic/ Refrigeration and Air Conditioning Mechanic (Residential)

**Unit:** B7 Motors I

**Level:** Two

**Duration:** 21 hours

Theory: 16 hours

Practical: 5 hours

### Overview:

This unit is designed to provide the apprentice with knowledge and skills of motors, motor controls and their operation. Beginning with terminology, hazards and safe work practices, the unit will interpret codes and regulations pertaining to motors. Apprentices will identify and describe motor characteristics, applications and the principles and effects of single-phase motor operation. Apprentices will also describe and demonstrate the procedures to test capacitors. Finally, apprentices will perform service of motors and their components.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
<b>1. Define terminology associated with motors.</b>	<b>10%</b>
a. Single-phase	
b. Permanent Split Capacitor (PSC)	
c. Variable frequency drive motors (VFD)	
d. Electrically commutated motors (ECM)	
<b>2. Identify hazards and safe work practices pertaining to motors.</b>	<b>5%</b>
<b>3. Interpret codes and regulations pertaining to motors.</b>	<b>20%</b>
a. Canadian Electrical Code	
b. Demonstrate and perform motor calculations	
<b>4. Identify and describe motors and their characteristics and applications.</b>	<b>30%</b>
a. Types	
• Single-phase motors	
• Electrically commutated motors (ECM)	
• Motor controls	
b. Motor nameplates	
c. Capacitors	
• Types	
d. Components	
e. Starting devices	
• Wiring configuration	
• Operation	
f. Methods to change speed and rotation	

- 5. Describe the principles and effects of single-phase motor operation. 10%**
- a. Single-phase motor operation
  - b. Theoretical horsepower and brake horsepower
  - c. Load and voltage changes on motor operation.
- 6. Describe and demonstrate the procedures to test capacitors. 5%**
- 7. Perform service of motors and their components. 20%**
- a. Test phases
  - b. Test capacitors
    - Energized
    - Non-energized
  - c. Test voltage, resistance, and amperages
  - d. Motor calculations
  - e. Megohmmeter tests and readings

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## Refrigeration and Air Conditioning Mechanic/ Refrigeration and Air Conditioning Mechanic (Residential)

**Unit:** B8 Pipe Threading and Assembly

**Level:** Two

**Duration:** 21 hours

Theory: 4 hours

Practical: 17 hours

### Overview:

This unit is designed to provide the apprentice with knowledge and skills of pipe threading and assembly. Beginning with terminology, hazards and safe work practices, the unit will interpret codes and regulations pertaining to pipe threading and assembly. Apprentices will identify and describe pipe threading tools and equipment and describe their selection, application and procedures for use. Apprentices will also describe and demonstrate the procedures to assemble and fasten piping layouts utilizing proper offset techniques, thread allowance as published in trade manuals and basic hanger installation. Finally, apprentices will perform the procedures of pipe threading and assembly using various techniques.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
1. Define terminology associated with pipe threading and assembly.	5%
2. Identify hazards and safe work practices pertaining to pipe threading and assembly.	5%
3. Interpret codes and regulations pertaining to pipe threading and assembly.	5%
4. Identify and describe pipe threading tools and equipment, their selection, application and procedures for use. a. Threader types <ul style="list-style-type: none"><li>• Components</li></ul> b. Pipe stands c. Hand tools d. Hand and machine threading <ul style="list-style-type: none"><li>• Cutting</li><li>• Deburring</li><li>• Lubricating</li><li>• Threading</li></ul>	25%
5. Describe the procedures to select and use steel welding tools and equipment required for pipe threading and assembly.	5%
6. Describe and demonstrate the procedures to assemble and fasten piping layouts	15%



**utilizing proper offset techniques and thread allowance as published in trade manuals and basic hanger installation.**

- 7. Perform the procedures of pipe threading and assembly using various techniques. 40%**
- a. Measurement and layout
  - b. Cutting
  - c. Threading
  - d. Fitting
  - e. Assembly
  - f. Hanging
    - Brackets
    - Fasteners

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### **Refrigeration and Air Conditioning Mechanic/ Refrigeration and Air Conditioning Mechanic (Residential)**

**Unit:** B9 Gas Code II

**Level:** Two

**Duration:** 25 hours

Theory: 20 hours

Practical: 5 hours

#### **Overview:**

Upon completion of this unit of instruction, the apprentice will gain a good, practical grasp of intermediate level gas code content.

<b>Objectives and Content:</b>	<b><u>Percent of Unit Mark (%)</u></b>
1. Describe and interpret gas code B149.1 section 8. a. Air supply b. Gas venting	80%
2. Demonstrate air supply and gas system controls.	10%
3. Troubleshoot gas system controls.	10%

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