

Refrigeration and Air Conditioning Mechanic (Commercial) Level 4

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: A16 Job Coordination

Level: Four

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

Upon completion of this unit of instruction the apprentice will demonstrate knowledge of effective job coordinating practices and of equipment and material acquisition.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Identify sources of information relevant to job coordinating.	20%
a. Trade-related documentation	
b. Related professionals	
c. Customers	
d. Co-workers	
2. Identify information gathering and communication techniques.	20%
a. Questioning	
b. Translating technical information	
c. Using communication equipment	
3. Identify and interpret regulatory requirements.	20%
a. Standards and regulations	
b. Codes and by-laws	
c. Permits	
d. Inspections	
4. Estimate work requirements.	20%
a. Tools and equipment	
b. Components and accessories	
c. Time and costs	

5. Describe the procedures used to coordinate work requirements

20%

- a. Conduct work area inspection
- b. Coordinate work requirements
- c. Maintain customer relations
- d. Clarify end user problems and concerns
- e. Complete work-related documentation
- f. General maintenance documentation
- g. Requisition equipment, components and accessories
- h. Receive equipment, components and accessories
- i. Transfer equipment to designated location

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: C5 Industrial Refrigeration Systems

Level: Four

Duration: 20 hours

Theory: 15 hours

Practical: 5 hours

Overview:

Upon completion of this unit of instruction the apprentice will demonstrate knowledge of industrial refrigeration systems, their components and operation, and of the procedures used to install, maintain and troubleshoot industrial refrigeration systems and their components.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with industrial refrigeration systems.	9%
2. Identify and interpret codes and regulations pertaining to industrial refrigeration systems.	9%
3. Identify hazards and safe work practices pertaining to industrial refrigeration systems.	9%
4. Identify types of industrial refrigeration systems and describe their characteristics and applications.	9%
5. Identify industrial refrigeration system components and describe their purpose and operation.	9%
6. Describe the procedures used to install industrial refrigeration systems and their components.	10%
7. Describe the procedures used to maintain and troubleshoot industrial refrigeration systems and their components.	10%
8. Describe the procedures used to start-up and shut-down industrial refrigeration systems.	10%
9. Perform the procedures to install, maintain and troubleshoot industrial refrigeration systems and their components.	25%

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: D5 Air Conditioning Load Calculations

Level: Four

Duration: 32 hours

Theory: 32 hours

Practical: 0 hours

Overview:

Upon completion of this unit of instruction the apprentice will demonstrate knowledge of performing air conditioning load calculations.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with air conditioning load calculations.	50%
2. Perform heat gain and heat loss calculations for air conditioning systems.	50%
a. Transmission	
• K, C, U and R values	
• Solar load	
b. Air change	
• Infiltration	
• Ventilation	
c. Heat gain/loss	
• Sensible	
• Latent	
d. Miscellaneous	
• Lighting	
• Occupancy	
• equipment	
e. BTU/hr total	

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: D6 Air Conditioning System Design

Level: Four

Duration: 32 hours

Theory: 32 hours

Practical: 0 hours

Overview:

Upon completion of this unit of instruction the apprentice will demonstrate knowledge of air conditioning system design principles, air volume requirements of air conditioning systems, air conditioning system components and their selection based on design criteria, air conditioning system capacity control, and of developing piping and electrical schematics.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with air conditioning system design.	8%
2. Identify and interpret codes and regulations pertaining to air conditioning system design.	8%
3. Explain fundamental principles of air conditioning system design.	8%
4. Interpret graphs and tables for air conditioning system design.	8%
5. Identify capacity ratings of air conditioning system components.	8%
6. Perform calculations for air conditioning system design.	8%
a. Air volumes and velocities	
b. Operating capacity	
c. Design capacity	
d. Heating load	
e. Cooling load	
f. Peak load	
g. Transfer rates	
h. Sizing of humidity control equipment	
7. Identify methods of zoning and describe their applications.	8%
8. Identify types of system design and their applications.	8%
a. Constant air volume	
b. Variable air volume	

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| 9. Describe the selection of components and ancillary devices for air conditioning systems based on design criteria. | 6% |
| 10. Describe the factors to consider in the design and layout of air conditioning systems. | 6% |
| a. Humidification | |
| b. Dehumidification | |
| c. Refrigeration piping | |
| d. Secondary refrigeration piping | |
| e. Drainage | |
| f. Condenser water piping | |
| 11. Describe the importance of balancing system capacity with system load. | 6% |
| 12. Describe the procedures used to size pipe for air conditioning piping systems. | 6% |
| 13. Develop piping schematics for air conditioning systems. | 6% |
| 14. Develop electrical schematics for air conditioning systems. | 6% |

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: D7 Duct Systems and Design

Level: Four

Duration: 30 hours

Theory: 20 hours

Practical: 10 hours

Overview:

Upon completion of this unit of instruction the apprentice will demonstrate knowledge of duct system design and duct systems, their components and operation, and of the procedures to install, maintain and troubleshoot them.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with duct systems and design.	6%
2. Identify hazards and describe safe work practices pertaining to duct systems.	6%
3. Identify and interpret codes and regulations pertaining to duct systems.	6%
4. Identify types of duct systems and describe their characteristics and applications.	6%
5. Identify duct system components and describe their purpose and operation.	6%
6. Describe the factors affecting duct system sizing, layout and design.	6%
7. Identify methods of sizing ducts and describe their associated procedures.	6%
8. Identify types of charts used to plan duct systems and describe their applications and procedures for use.	6%
9. Identify types of duct insulation and sealants and describe their applications.	6%
10. Identify potential problems in duct systems and design and describe their causes and remedies.	6%
11. Describe the procedures used to install duct systems and their components.	5%
12. Describe the procedures used maintain and troubleshoot duct systems and their components.	5%
13. Demonstrate the procedures to install, maintain and troubleshoot duct systems and their components.	30%

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: D8 Heating Systems

Level: Four

Duration: 20 hours

Theory: 15 hours

Practical: 5 hours

Overview:

Upon completion of this unit of instruction the apprentice will demonstrate knowledge of heating systems, their components and operation, and of the procedures used to install, maintain, and troubleshoot heating systems and their components.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with heating systems.	6%
2. Identify hazards and describe safe work practices when working with heating fuels.	6%
3. Describe the physical and chemical properties of heating fuels.	6%
4. Identify and interpret codes and regulations pertaining to heating systems.	6%
a. Jurisdictional certifications	
5. Identify types of heating systems and describe their characteristics and applications	6%
a. Gas	
b. Oil	
c. Electric	
6. Identify types of heating system components and describe their purpose and operation.	6%
7. Perform calculations for heating systems.	6%
8. Identify potential problems and describe their causes and remedies.	6%
9. Identify specialized tools and equipment and describe their applications and procedures for use.	6%
10. Describe the procedures used to install heating systems and their components.	7%
11. Describe the procedures used to maintain and troubleshoot heating systems and their components.	7%

- 12. Describe the procedures used to start-up and shut-down heating systems. 7%
- 13. Perform the procedures to start-up and shut-down heating systems. 25%

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: D9 Air Measuring Instruments and System Air Balancing

Level: Four

Duration: 12 hours

Theory: 7 hours

Practical: 5 hours

Overview:

Upon completion of this unit of instruction the apprentice will demonstrate knowledge of the principles of air measurement and air quality management; of the procedures used to measure air flow quantity; of air measuring instruments, their applications, and procedures for use; and of system air balancing procedures.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with air measuring instruments and system air balancing.	7%
2. Identify and interpret codes and regulations pertaining to air measurement and system air balancing.	7%
3. Explain fundamental principles of air movement and air quality management.	7%
4. Identify types of air measurement instruments and describe their applications and procedures for use.	7%
5. Identify types of charts used to monitor and balance air systems and describe their applications and procedures for use.	7%
6. Describe conditions affecting air properties.	7%
7. Perform calculations for system air balancing.	50%
8. Describe the procedures used in system air balancing.	8%

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: D10 Chillers and Chiller Systems

Level: Four

Duration: 37 hours

Theory: 32 hours

Practical: 5 hours

Overview:

Upon completion of this unit of instruction the apprentice will demonstrate knowledge of chillers and chiller systems, their components and operation, and of the procedures used to install, maintain and troubleshoot them.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with chillers and chiller systems.	6%
2. Identify hazards and describe safe work practices pertaining to chillers and chiller systems.	6%
3. Identify and interpret codes and regulations pertaining to chillers and chiller systems.	6%
4. Explain the operating principles of chiller systems.	6%
a. Primary	
b. Secondary	
5. Identify chiller applications and describe their characteristics.	6%
a. Air conditioning	
b. Ice rink/surface	
c. Process	
d. Supermarket	
6. Identify chiller components and describe their purpose and operation.	6%
7. Identify types of chiller systems and describe their characteristics and applications.	6%
a. Reciprocating	
b. Screw	
c. Scroll	
d. Rotary	
e. Centrifugal	
f. Absorption	

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| 8. Identify chiller system components and describe their purpose and operation. | 6% |
| 9. Interpret schematic diagrams for chiller systems. | 6% |
| 10. Describe the operating cycles of chiller systems. | 6% |
| a. Motor cooling | |
| b. Lubrication | |
| c. Refrigeration | |
| 11. Describe the methods of chiller capacity control. | 6% |
| 12. Describe the procedures used to install chillers and chiller systems and their components. | 6% |
| 13. Describe the procedures used to maintain and troubleshoot chillers and chiller systems and their components. | 6% |
| 14. Describe the procedures used to start-up and shut-down chiller systems. | 7% |
| 15. Perform the procedures to install, maintain and troubleshoot chillers, chiller systems and their components. | 15% |

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Unit: F5 Troubleshooting with Schematics and Wiring Diagrams

Level: Four

Duration: 20 hours

Theory: 20 hours

Practical: 0 hours

Overview:

Upon completion of this unit of instruction the apprentice will demonstrate knowledge of advanced schematic wiring diagrams and their use in troubleshooting complex systems.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Interpret advanced schematic wiring diagrams for use in troubleshooting complex systems.	50%
a. Manufacturers' drawings	
b. As-built drawings	
2. Identify troubleshooting techniques using advanced schematic wiring diagrams and describe their associated procedures.	50%

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: G4 Gas Code Review

Level: Four

Duration: 35 hours

Theory: 35 hours

Practical: 0 hours

Overview:

This unit offers apprentices a systematic review of Gas Code skills and knowledge required to undertake Level 5 (gasfitter training). No testing is prescribed for the theory section of this instruction unit. Instead, a “pass/fail” grade will be awarded upon completion of the unit.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe the Codes, Acts, Regulations and Governing bodies related to the use of gas and propane.	50%
2. Describe the procedures to maintain LP transport equipment and storage facilities, maintain and repair LP utility systems, pipeline and supply storage LP transport equipment and storage facilities, to install, service and maintain high and low pressure natural gas and LP gas supply systems.	50%

Refrigeration and Air Conditioning Mechanic (Commercial)

Unit: A17 Pre-Interprovincial Exam Review

Level: Four

Duration: 70 hours

Theory: 70 hours

Practical: 0 hours

Overview:

This unit offers senior apprentices a systematic review of skills and knowledge required to pass the Inter-Provincial Examination. It promotes a purposeful personal synthesis between on-the-job learning and the content of in-school technical training. The unit includes information about the significance of Inter-Provincial certification and the features of the Inter-Provincial Examination. No testing is prescribed for the theory section of this instruction unit. Instead, a “pass/fail” grade will be awarded upon completion of the unit.

Objectives and Content:

1. **Describe the significance, format and general content of Inter-Provincial Examinations for the trade of Refrigeration and Air Conditioning Mechanic (Commercial).**
 - a. Scope and aims of Inter-Provincial certification; value of certifications
 - b. Obligations of candidates for Inter-Provincial certification
 - Relevance of Inter-Provincial Examinations to current, accepted trade practices; industry-based provincial validation of test items
 - Supplemental policy (retesting)
 - Confidentiality of examination content
 - c. Multiple-choice format (four-option) item format, Apprenticeship Manitoba standards for acceptable test items
 - d. Government materials relevant to the Inter-Provincial Examinations for apprentice Refrigeration and Air Conditioning Mechanics (Commercial).
 - National Occupational Analysis (NOA); prescribed scope of the skills and knowledge with comprise the trade
 - NOA “pie-chart” and its relationship to content distribution of Inter-Provincial Examination items
 - Apprenticeship Manitoba Technical Training package

2. **Identify resources, strategies and other considerations for maximizing successful completion of written examinations.**
 - a. Personal preparedness
 - Rest
 - Nutrition
 - Personal study regimen
 - Prior experience in test situations (e.g., unit tests)

- b. Self-assessment, consultation and personal study plan
 - Self-assessment of individual strengths/weaknesses in trade related skills and knowledge
 - Approved textbooks
 - Study groups
- 3. **Review program content regarding occupational skills.**
- 4. **Review program content regarding trade mathematics and science.**
- 5. **Review program content regarding refrigeration and air cooling systems.**
- 6. **Review program content regarding heating, ventilation and air conditioning systems.**
- 7. **Review program content regarding refrigeration, heating, ventilation and air conditioning system components.**
- 8. **Review program content regarding control systems.**
