



April 2007

# REFERENCE SYLLABUS

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For

**REFRIGERATION OPERATOR**

**CERTIFICATE of COMPETENCY  
EXAMINATION**



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**1. Act, Regulations and Codes:**

The candidate is expected to be able to locate information relating to the staffing, operation, maintenance, inspection, and testing of the refrigeration plant and its equipment using reference material such as:

- 1.1. Relevant Provincial Jurisdictional legislation.
- 1.2. CSA B52 (current edition) Mechanical Refrigeration code.
- 1.3. CSA Z94.4 Selection, Care and use of Respirators. And
- 1.4. CEPA E2 Regulations.

**2. Safety:**

The candidate is expected to be able to fully understand the dangers associated with the operation of a refrigeration plant and the precautions to be taken to minimize or prevent such dangers:

- 2.1. gas detection and monitoring
- 2.2. gas exposure limits
- 2.3. personal protective equipment
- 2.4. basic WHMIS
- 2.5. isolation, confined space and fall protection
- 2.6. basic first aid and CPR
- 2.7. plant fire protection

**3. Administration:**

- 3.1. mechanical drawing
- 3.2. maintenance planning
- 3.3. materials and welding
- 3.4. basic communications

**4. Fundamentals:**

Candidates must demonstrate an understanding of refrigeration fundamentals including:

- 4.1. identifying Basic Thermodynamic Principles.
- 4.2. a Basic understanding of gas Behaviour.
- 4.3. differentiating between CFC's, HCFC's, and HFC refrigerants.
- 4.4. an awareness of the environmental impact that each type of refrigerant can pose.
- 4.5. a thorough understanding of the purpose of the components of a vapour compression refrigeration cycle.
- 4.6. a thorough understanding of the compression refrigeration cycle including the function of the:
  - 4.6.1. compressor.
  - 4.6.2. condenser.
  - 4.6.3. metering device. And
  - 4.6.4. evaporator.
- 4.7. the basic operating principle of an absorption refrigeration system.
- 4.8. direct, and indirect, refrigeration system.
- 4.9. the use of secondary refrigerants, the mediums used, and the applications of such coolants as used in the commercial and the industrial sector.



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- 4.10. the essential qualities of a good refrigerant such as the main properties of:
  - 4.10.1. R-134a.
  - 4.10.2. R-22. And
  - 4.10.3. R-717.
- 4.11. types of refrigeration systems and their associated equipment
  - 4.11.1. direct expansion
  - 4.11.2. flooded
  - 4.11.3. liquid overfeed
    - 4.11.3.1. low pressure receivers
    - 4.11.3.2. liquid recirculation pumps

**5. Compressors:**

Candidates must demonstrate an understanding of compressors including the:

- 5.1. main types of refrigeration compressors and have a basic understanding of each type including packaged types.
- 5.2. application and the types of “booster” compressors used within a two–stage or compound refrigeration system.
- 5.3. main types of prime movers used to drive refrigeration compressors.
- 5.4. difference between *hermetic*, *semi-hermetic*, and *open-type* compressors.
- 5.5. methods used to prevent leakage of refrigerant at the compressor shaft, and prevent liquid refrigerant from entering the compressor.
- 5.6. different methods employed to control the “capacity” of the various types of refrigeration compressors including: stop start, slide valves (variable clearance volume), variable frequency drives, etc.
- 5.7. two-stage centrifugal chillers.
- 5.8. compressor cooling.

**6. Controls and Instrumentation:**

Candidates must demonstrate an understanding of the controls and accessories including:

- 6.1. basic computer control and instrumentation
- 6.2. six commonly used types of refrigerant flow metering devices used to control the flow of refrigerants.
- 6.3. the operation of a thermostatic expansion valve.
- 6.4. the function, principle of operation, and the location(s) of the following operational controllers:
  - 6.4.1. temperature and/or pressure actuated.
  - 6.4.2. humidity actuated.
  - 6.4.3. evaporator pressure regulator. And
  - 6.4.4. cooling water regulating valve.
- 6.5. the safety controls used in a refrigeration system, and the operation of each type such as:
  - 6.5.1. high pressure cut-out.
  - 6.5.2. low pressure cut-out.
  - 6.5.3. oil failure protection devices.
  - 6.5.4. high discharge cut-outs.
  - 6.5.5. high oil cut-outs. And
  - 6.5.6. motor overload devices.



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- 6.6. the function and the location of the following components in a system:
  - 6.6.1. oil separators as applied to:
    - 6.6.1.1. reciprocating compressors. And
    - 6.6.1.2. screw compressors.
  - 6.6.2. suction strainers and scale traps.
  - 6.6.3. filter-driers.
  - 6.6.4. moisture indicators.
  - 6.6.5. crankcase heaters in reciprocating compressors and oil heaters in screw compressors.
  - 6.6.6. oil stills.
  - 6.6.7. purge, charging valves. And
  - 6.6.8. pressure relief devices.
- 6.7. the type of piping/tubing allowed for the different types of refrigerants.
- 6.8. the use of receivers in a refrigeration system, their location, and the Code required safety fittings attached including:
  - 6.8.1. high pressure receivers.
  - 6.8.2. low pressure receivers. And
  - 6.8.3. intermediate or controlled pressure receivers.
- 6.9. the methods employed to control humidity.

**7. Condensers and Cooling Towers:**

Candidates must demonstrate an understanding of condensers and cooling towers including the:

- 7.1. different types of air-cooled and water-cooled condensers.
- 7.2. evaporative type condenser and the effects of humidity on this type of condenser's operation.
- 7.3. main factors on which the rate of heat transfer is dependent on in a cooling tower.
- 7.4. evaporative cooling effect and its consequences.
- 7.5. need for water treatment and the water tests required. And the
- 7.6. ability to recognize bacteria concerns associated with water sumps and what can be done to prevent associated risks.

**8. Evaporators and Cooling Coils:**

Candidates must demonstrate an understanding of evaporators and cooling coils including the:

- 8.1. construction and application for each of the following:
  - 8.1.1. bare tube construction.
  - 8.1.2. fin and tube construction.
  - 8.1.3. plate type construction.
  - 8.1.4. chillers including:
    - 8.1.4.1. shell & tube construction. And
    - 8.1.4.2. plate and frame construction.
- 8.2. differences between a "dry expansion" (also called "direct expansion") and a "flooded expansion" and "liquid overfeed" evaporators.
- 8.3. thermal storage systems.



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**9. Operation and Maintenance:**

Candidates must demonstrate an understanding of operation and maintenance including:

- 9.1. the refrigeration leak test methods used to find refrigerant leaks.
- 9.2. how you would start-up and shut down a single-stage refrigeration system.
- 9.3. how air is removed from an operating system and including both manual and automatic purging.
- 9.4. how to add oil to a running compressor and an understanding of basic refrigerant charging.
- 9.5. some common reasons for the following conditions:
  - 9.5.1. failure of a compressor to start.
  - 9.5.2. causes for compressor short cycling.
  - 9.5.3. causes of continuous operation of the compressor under light loads and while system cooling is not required.
  - 9.5.4. discharge pressure too high, or too low; suction pressure too high, or too low.
- 9.6. the maintenance requirements for compressors, system pumps, valves, metering devices, evaporators, and condensers to ensure safe and continuous operation.
- 9.7. the precautions to be taken when draining oil separators to prevent unsafe conditions.
- 9.8. the methods used to defrost evaporators. Emphasis will be on industrial/commercial refrigeration defrost methods.
- 9.9. an understanding of what crystallization is with respect to absorption refrigeration systems.
- 9.10. defrosting evaporators.
- 9.11. oil removal from systems.
- 9.12. pumping down systems.
- 9.13. equipment isolation.
- 9.14. low temperature receivers.
- 9.15. low temperature liquid recirculation (liquid overfeed).
- 9.16. chemical treatment for condensers and cooling towers.

**10. Electrical:**

Candidates must demonstrate a basic understanding of electricity including:

- 10.1. the use and function of the following electrical components: circuit breakers, relays, rheostats, fuses, electrical switches, and cut-outs.
- 10.2. the dangers and maintenance requirements of electric motors.
- 10.3. the basic differences with motor starters and the application of different types.

**11. Air Conditioning:**

Candidates must demonstrate an understanding of air conditioning including:

- 11.1. the psychrometrics of air, and the air conditioning factors that affect comfort.
- 11.2. the ability to analyze/demonstrate on a psychrometric chart the behaviour of air when subjected to cooling, humidification and dehumidification.
- 11.3. the different categories of air conditioning systems.
- 11.4. how Legionnaires Disease can be drawn into ventilation systems and recognize the effects thereof.



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**12. Mathematic and Science:**

The candidate should be able to perform basic refrigeration calculations:

- 12.1 elementary mathematics.
- 12.2 elementary mechanics and dynamics.
- 12.3 elementary thermodynamics.

**13. Practical Experience:**

The candidate is expected to be able to answer examination questions as they relate to the equipment they have gained refrigeration plant experience on including:

- 13.1. schematic flow diagrams of systems including:
  - 13.1.1. types of compressors used.
  - 13.1.2. compressor size.
  - 13.1.3. compressor capacities.
  - 13.1.4. pressures and temperatures. And
  - 13.1.5. methods of capacity control.
- 13.2. safety devices and operational controls installed on systems to ensure safe and efficient operation.
- 13.3. the compressor and refrigeration system maintenance procedures to be in place to ensure safe refrigeration plant operation as well as ensuring compliance with the required Act, Regulations and Codes.