



Boiler & Pressure Vessel

Syllabus

for

Ice Facility Operator's

Certificate of Qualification Examination

July, 2004

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Prerequisites to obtain an Ice Facility Operator's Certificate of Qualification

An applicant for an ice facility operator's certificate of qualification must

- (a) be employed at, and have experience in the operation of an ice facility plant for a period of not less than 30 days,
- (b) have successfully completed an ice facility operator's course that has been approved by a provincial safety manager, and
- (c) have passed the ice facility operator's certificate of qualification examination.

What an ice facility operator may do

An ice facility operator's certificate of qualification entitles the holder to operate an ice facility plant that

- (a) does not exceed 1 000 kW prime mover nameplate rating, and
- (b) has a fifth class power engineer (refrigeration endorsement) or a fourth class power engineer as the chief engineer of the plant.

General Knowledge & Certification Scope

The topics listed below make up the core requirements of the Ice facility Operators scope as it applies to the positions commonly used in the recreation fields through out the province of BC. The scope is not intended to be easier than the 5th class refrigeration endorsement currently in place, but rather more relevant to the operation of an artificial ice plant. Industry believes a specific "**Ice facility Operator's Scope**" will improve safety in the industry and provide more appropriate "**industry specific**" training opportunities.

At this level of certification the candidate will be able to answer examination questions as they relate to the safe and efficient operation of typical artificial ice refrigeration plants.

The candidate is expected to be able to identify and fully explain the inherent hazards of operating an ammonia refrigeration plant in a public assembly setting, as well as be able to identify steps to be taken to reduce the risks and minimize dangers to the public and the staff. Inherent dangers also include those associated with working with electrical motors, electrical components including a basic understanding of the following; circuit breakers, relays, fuses, switches and cut-outs.

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The candidate will be expected to describe the compression refrigeration cycle including the functions of the compressor, condenser, evaporator, and the metering device. Describe the operating principals of the following; indirect and double indirect refrigeration systems. Correctly identify the qualities of primary and secondary refrigerants as well as the safety precautions required.

The candidate will have a sound knowledge of all controls and accessories used in the typical artificial ice refrigeration plant, with extra attention placed on limiting and safety controls.

The candidate will be able to answer detailed questions about start up procedures, emergency and regular shut down procedures, and purging air from the system, adding refrigerant to the system, adding oil to a running compressor and checking secondary refrigerant levels.

Application to Undertake Examination

A candidate must submit an application and the prescribed fee at least thirty days before the date of examination.

The examination consists of one paper, 3 ½ hour duration and 150 multiple choice questions. The candidate is allowed to bring the following items into the examination room:

- a. Safety Standards Act and Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation.
- b. C.S.A. B-52.
- c. A non-programmable calculator.

Note: The items referenced above are the responsibility of the candidate and must be shown to the Examiner for approval. Mathematical Tables will be provided. No other reference material will be allowed. The candidate must show picture I.D. at the examination.

Pass Mark

Ice Facility Operator candidates are required to obtain 65% minimum grade in order to receive a passing mark.

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Subject Areas of study

Please refer to each of the following subsections for the examination weighting of questions.

1. B.C. Refrigeration Safety Legislation and Code Knowledge: (10%)
 - 1.1 *Safety Standards Act* and applicable regulation;
 - 1.2 Responsibilities of an ice facility operator's certified person;
 - 1.3 Responsibilities of a plant safety committee;
 - 1.4 General Plant Safety; types of accidents and accident prevention, safety measures, WCB guidelines;
 - 1.5 Reporting of accidents and incidents;
 - 1.6 CSA B52 general code knowledge; and
 - 1.7 Log books and records, why signed and dated, and their use.

2. Basic Arithmetic and Applied Mathematics: (5%)
 - 2.1 Basic introduction to arithmetic, addition, subtraction, multiplication, division, percentages, averages, simple equations;
 - 2.2 Basic refrigeration and plant operation calculations needed to solve volume, horsepower ratings, kW hours, joules, system tonnage, BTU's, capacity; and
 - 2.3 Types of calculations required to complete the day to day operations in an artificial ice making plant. (SI or Imperial units acceptable)

3. Basic Principles of Refrigeration, (Identify and explain basic refrigeration terms and fundamentals); (15%)
 - 3.1 Temperatures; ambient temperature, dew point, flash point, temperature measurement tools and tables;
 - 3.2 Pressures; absolute, gauge, pressure measurement tools and tables;
 - 3.3 Energy; BTU's, calories;

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- 3.4 Heat transfers; latent heat, enthalpy;
 - 3.5 Composition of primary refrigerants common in artificial ice operations, refrigerant tables;
 - 3.6 Composition of the secondary refrigerant, how the freezing point is controlled and why the pH must be controlled; and
 - 3.7 How does the system work and adjustments that may be made on pressure and temperature of the components.
4. Refrigeration System Components: (50%)
- 4.1 Types of refrigeration systems; indirect, double indirect, direct expansion, (compression, positive displacement and centrifugal systems);
 - 4.2 Refrigeration Components; identify all components and describe their purpose including location of valves and floats;
 - 4.3 Compressor; basic types and basic operational properties, functions of compressors, reciprocating and screw compressor components and standard operating parameters, preventative maintenance of compressors, and trouble shooting common problems of compressors;
 - 4.4 Evaporator; basic types, functions of evaporator, direct expansion and flooded evaporator components and standard operation parameters, preventative maintenance for evaporators chillers, and trouble shooting common problems of evaporators;
 - 4.5 Condenser; functions of condenser, surface type and evaporative condensers, water cooled, glycol loop and air cooled condensers components and operating parameters, preventative maintenance for condensers, and trouble shooting common problems of condensers;
 - 4.6 Expansion valve (EV) metering device; functions of expansion valves, automatic EV, thermostatic EV, and hand operated EV components and operation parameters, preventative maintenance for EV, and trouble shooting common problems of expansion valves;
 - 4.7 Pumps and motors; functions of pumps and motors used in refrigeration systems, (brine, water, oil pumps and motors that drive the pumps), types of pumps, (components and operation parameters), types of motors,

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- (components and operating parameters), preventative maintenance for pumps, and trouble shooting common problems with pumps;
- 4.8 Operating controls and safety devices; (functions and components of operating controls and safety devices commonly found in a refrigeration plant), high side float, low side float, oil pressure failure switches, relief valves, shut off valves, thermostats, safety controls and resets, cooling water valves, solenoid valves, temperature controls, preventative maintenance for floats and valves, and trouble shooting common problems with high and low side floats, valves and safety devices;
 - 4.9 Refrigeration Accessories and Controls; (functions and components of the following accessories commonly found in a refrigeration plant), filtration systems, humidity systems, king valve, emergency discharge and procedures, purging and charging valves, oil separators, pressure gauges, strainers, sight glasses, heat exchangers, crankcase heaters, and oil coolers;
 - 4.10 Piping; Identify the standards of piping required in a refrigeration plant;
 - 4.11 Refrigeration Oil and the System; lubricants used in the system, and oil management within the primary refrigerant loop; and
 - 4.12 Digital Control Systems; computer control systems and management of plants, remote access, limitations of DDC systems, benefits of DDC systems, and review of common programs used.
5. Floor Systems: (5%)
- 5.1 Design and construction of floor cooling systems; sand based, concrete, no sub heating, and sub heating;
 - 5.2 Sub floor heating systems, standard operating parameters; and
 - 5.3 Trouble shooting common problems with arena slab floors.

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6. Electrical: (5%)
- 6.1 Identify the use and function of the following; circuit breakers, fuses, electrical switches, cut outs;
 - 6.2 Identify the dangers inherent with working with electrical equipment and motors; and
 - 6.3 Identify the care and safety procedures required when working with electrical equipment and motors.
7. Safety; Equipment, Procedures, and Precautions in a refrigeration plant: (10%)
- 7.1 Eye, ear, head, respiratory devices, drench showers, eye wash stations, steel toed boots, hazards of wearing jewellery;
 - 7.2 Classes of fires and fire protection equipment;
 - 7.3 Emergency breathing apparatus;
 - 7.4 Safety Procedures and safe work practices associated with working around refrigeration equipment including; compressors, condensers, evaporators, receivers, primary and secondary refrigerants and electrical equipment;
 - 7.5 Identify precautions to be taken to minimize or prevent dangers associated with operating a refrigeration plant;
 - 7.6 Identify precautions to be taken when working with primary and secondary refrigerants, review WHMIS and relevant first aid;
 - 7.7 Emergency shutdown procedures, emergency shutdown devices and safety alarms;
 - 7.8 Safety controls, purpose and location; and
 - 7.9 Evacuation procedures.