

PROGRAM OF STUDY

REFRIGERATION (DVS 5886)

TRAINING SECTOR: BUILDINGS AND PUBLIC WORKS

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Introduction to the Program

In vocational training, a program of study presents the competencies required to practise a given trade or occupation at entry level on the job market. The training provided allows students to acquire a degree of versatility that will be useful in their career and personal development.

A program is a coherent set of competencies to be developed. It outlines the knowledge and broad orientations to be favoured during training. The competencies correspond to the tasks of the trade or occupation or to activities related to work, vocational or personal life, depending on the case. Learning is acquired in a specific achievement context and targets the ability to act, succeed and evolve.

According to the *Education Act*,¹ every program “shall include compulsory objectives and contents and may include optional objectives and contents that shall be enriched or adapted according to the needs of students who receive the services.” For behavioural competencies, the compulsory components include the statement of the competency, the elements of the competency, the achievement context and the performance criteria; for situational competencies, they include the corresponding components.

For information purposes, programs also provide a grid of competencies, educational aims, a summary of competency-related knowledge and know-how, and guidelines. They also specify the suggested duration of each competency. All optional components of a program may be enriched or adapted according to the needs of the students, the environment and the workplace.

Program Components

Program Goals

Program goals consist of the expected outcome at the end of training as well as a general description of a given trade or occupation. They also include the four general goals of vocational training.

Educational Aims

Educational aims are broad orientations to be favoured during training in order to help students acquire intellectual or motor skills, work habits or attitudes. Educational aims usually address important aspects of career and personal development that have not been explicitly included in the program goals or competencies. They serve to orient appropriate teaching strategies to contextualize students’ learning, in keeping with the dimensions underlying the practice of a trade or occupation. They help guide educational institutions in implementing the program.

Competency

A competency is the ability to act, succeed and evolve in order to adequately perform tasks or activities related to one’s working or personal life, based on an organized body of knowledge and skills from a variety of fields, perceptions, attitudes, etc.

A competency in vocational training can be defined in terms of a behaviour or a situation, and includes specific practical guidelines and requirements for learning.

¹ *Education Act*, CQLR, c. I-13.3, s. 461

1. Behavioural Competency

A behavioural competency describes the actions and the results expected of the student. It consists of the following characteristics:

- The *statement of the competency* is the result of the job analysis, the orientations and general goals of vocational training and other determinants.
- The *elements of the competency* correspond to essential details that are necessary in order to understand the competency and are expressed in terms of specific behaviours. They refer to the major steps involved in performing a task or to the main components of the competency.
- The *achievement context* corresponds to the situation in which the competency is exercised at entry-level on the job market. The achievement context attempts to recreate an actual work situation but does not describe a learning or evaluation situation.
- The *performance criteria* define the requirements to be respected. They may refer to elements of the competency or to the competency as a whole. When associated with a specific element, performance criteria are used to judge whether a competency has been acquired. When associated with the competency as a whole, the criteria describe the requirements for performing a task or activity and provide information on the expected level of performance or the overall quality of a product or service.

2. Situational Competency

A situational competency describes the situation in which students are placed to acquire learning, and allows for actions and results to vary from one student to another. It consists of the following characteristics:

- The *statement of the competency* is the result of the job analysis, the orientations and general goals of vocational training and other determinants.
- The *elements of the competency* outline the essential aspects of the competency and ensure a better understanding of the competency with respect to the expected outcome. The elements of the competency are fundamental to the implementation of the learning situation.
- The *learning context* provides a broad outline of the learning situation designed to help the students develop the required competency. It is normally divided into three key phases of learning: information, participation and synthesis.
- The *instructional guidelines* provide reference points and means for teachers to ensure that learning takes place and that the context in which it occurs is always the same. These guidelines may include general principles or specific procedures.
- The *participation criteria* describe requirements that the students must meet when participating in learning activities. They focus on how the students take part in the activities rather than on the results obtained. Participation criteria are normally provided for each phase of the learning situation.

Competency-Related Knowledge and Know-How

Competency-related knowledge and know-how, together with related guidelines, are provided for information purposes. Competency-related knowledge and know-how define the essential and meaningful learning that students must acquire in order to apply and continue to develop the competency. They are in keeping with the job market and are accompanied by guidelines that provide information about the field of application, level of complexity and learning content. They generally encompass learning associated with knowledge, skills, strategies, attitudes, perceptions, etc.

Duration

The total duration of the program is compulsory and must be observed. It consists of teaching time, which includes time for the evaluation of learning and for enrichment or remedial activities, depending on the students' needs. The duration indicated for a given competency refers to the amount of time needed to develop the competency.

The amount of teaching time corresponds to the amount of time allotted to training, which is established during program development as the average amount of time needed to acquire a competency and evaluate learning. This duration is helpful in organizing training.

Credit

A credit is a unit used for expressing the quantitative value of each competency. One credit corresponds to 15 hours of training.

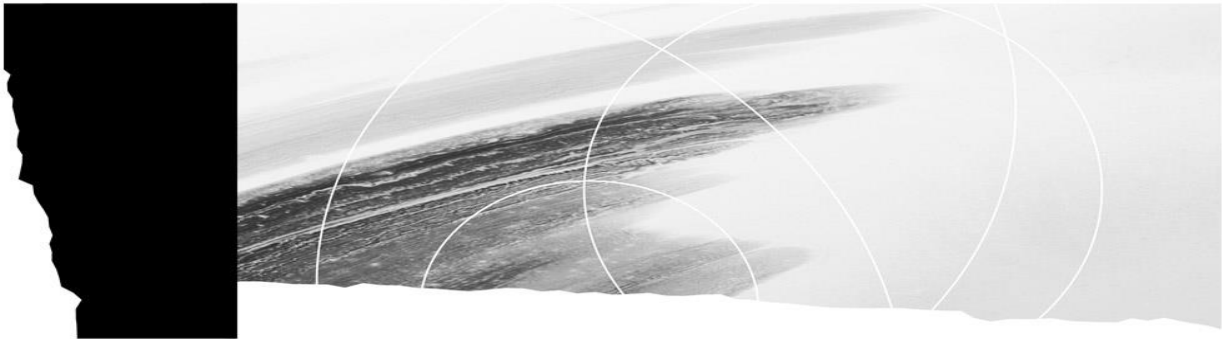
Aspects of Program Implementation

Program-Based Approach

The program-based approach is founded on a comprehensive view of a program of study and its components (e.g. goals, educational aims, competencies). It requires concerted action among all players involved, from the initial stages of program design and development to program implementation and evaluation. It consists in ensuring that all of the actions and activities proposed are based on the same aims and take into account the same orientations. For students, the program-based approach makes training more meaningful, since it presents learning as a coherent whole.

Competency-Based Approach

In vocational training, the competency-based approach is based on a teaching philosophy that is designed to help students mobilize their own individual sets of resources in order to act, succeed and evolve in different contexts, according to established performance levels with all the required knowledge and know-how (e.g. skills, strategies, attitudes, perceptions). The competency-based approach is carried out in situations that are relevant to the students' working life and personal life



5886

Refrigeration

Year of approval: 2023

Certification:	Diploma of Vocational Studies
Number of credits:	120
Number of competencies:	25
Total duration:	1800 hours

To be eligible for admission to the *Refrigeration* program, candidates must meet one of the following requirements:

- Persons holding a Secondary School Diploma or its recognized equivalent.

OR

- Persons who are at least 16 years of age on September 30 of the school year in which they begin their training must have obtained Secondary IV credits in language of instruction, second language and mathematics in programs established by the Minister, or have been granted recognition of equivalent learning.

OR

- Persons who are at least 18 years of age upon entry into the program must have the following functional prerequisites: the successful completion of the general development test and ENG-2102-4 and MTH-4151-1 and MTH-4153-2, or recognition of equivalent learning.

OR

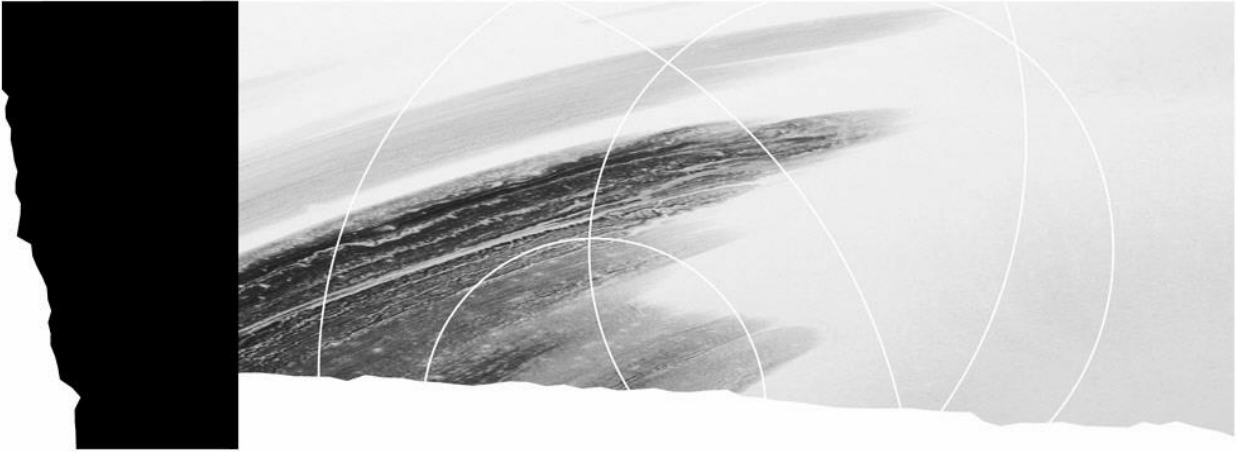
- Persons who have obtained Secondary III credits in language of instruction, second language and mathematics in programs established by the Minister are required to pursue, concurrently with their vocational training, Secondary Cycle Two general education courses in programs established by the Minister.

The duration of the program is 1800 hours, which includes 945 hours spent on the specific competencies required to practise the trade or occupation and 855 hours on general, work-related competencies. The program of study is divided into 25 competencies which vary in length from 15 to 120 hours. The total hours allocated to the program include time devoted to teaching, evaluation of learning and enrichment or remedial activities.

Specific Features of the Program

In accordance with the laws and regulations currently in effect, some of the competencies in this program of study may qualify the student for a certificate issued by a recognized institution or organization.

Competency	Code	Number	Duration	Credits
The Trade and the Training Process	938001	1	15	1
Health and Safety on Construction Sites	754992	2	30	2
Assembling and Disassembly of Piping	938016	3	90	6
Inspection of Refrigeration Systems	938025	4	75	5
Basic Electricity	938036	5	90	6
Recovery and Charging of Refrigerants	938044	6	60	4
Installation and Commissioning of a Small-Capacity Refrigeration System	938056	7	90	6
Drawings and Specifications	938062	8	30	2
Access and Handling Equipment	938073	9	45	3
Installation and Commissioning of Electric Motors and Control Circuits	938088	10	120	8
Installation of a Large-Capacity Refrigeration System	938096	11	90	6
Commissioning of a Large-Capacity Refrigeration System	938104	12	60	4
Installation and Commissioning of Electronic Motor Control Devices	938114	13	60	4
Compressor Maintenance	938125	14	75	5
Installation and Commissioning of Digital Control Systems	938138	15	120	8
Optimization of a Heating, Ventilation, Air Conditioning and Refrigeration (HVAC/R) System	938146	16	90	6
Servicing of a Refrigeration System	938157	17	105	7
Installation of a Split Air Conditioning System	938164	18	60	4
Commissioning of an Air Conditioning System or Liquid Chiller	938174	19	60	4
Servicing of a Packaged Air Conditioning System	938186	20	90	6
Servicing of a Split Air Conditioning System	938197	21	105	7
Servicing of a Liquid Chiller	938206	22	90	6
Servicing of a Central Air Conditioning System	938218	23	120	8
Construction Industry Organizations	754991	24	15	1
Job Search Techniques	938221	25	15	1



Part I

Program Goals

Educational Aims

Statements of the Competencies

Grid of Competencies

Harmonization

Program Goals

The *Refrigeration* program prepares students to practise the trade of refrigeration specialist. Refrigeration specialists work in various sectors in the construction industry and elsewhere.

They install, commission, maintain, repair and optimize air conditioning systems (central, packaged or split) and refrigeration systems (high or low capacity).

They are also responsible for converting these systems, recovering refrigerants and dismantling installations.

This work is done in accordance with drawings, specifications, environmental standards and the certificates in effect (Commission de la construction du Québec [CCQ] competency certificate and Emploi-Québec certificate of qualification), as well as the *Regulation respecting occupational health and safety*.

Refrigeration specialists use tools and equipment for access, handling, cutting, brazing and tack-welding jobs. They also use measuring instruments such as manometers and multimeters.

They are required to know how units work, such as electric motors, compressors, condensers, expansion valves, evaporators, automatic controllers and digital control systems.

The program goals of the *Refrigeration* program are based on the general goals of vocational training. These goals are as follows:

- To help students develop effectiveness in the practice of a trade or occupation, that is:
 - to teach students to perform roles, functions, tasks and activities associated with the trade or occupation upon entry into the job market
 - to prepare students to progress satisfactorily on the job (which implies having the technical and technological knowledge and skills in such areas as communication, problem solving, decision making, ethics, health and safety)
- To help students integrate into the workforce, that is:
 - to familiarize students with the job market in general, and with the specific context of their chosen trade or occupation
 - to familiarize students with their rights and responsibilities as workers
- To foster students' personal development and acquisition of occupational knowledge, skills, perceptions and attitudes, that is:
 - to help students develop their autonomy and ability to learn, and acquire effective work methods
 - to help students understand the principles underlying the techniques and the technology used in the trade or occupation
 - to help students develop self-expression, creativity, initiative and entrepreneurial spirit
 - to help students adopt the attitudes required to successfully practise the trade or occupation, and instill in them a sense of responsibility and a concern for excellence
- To promote job mobility, that is:
 - to help students develop positive attitudes toward change
 - to help students develop the means to manage their careers by familiarizing them with entrepreneurship

Educational Aims

The aim of the *Refrigeration* program is to help students develop attitudes and behaviours that representatives from education and the field deem essential to the practice of the trade:

- Foster the development of teamwork skills.
- Develop an open mind with respect to technological change.
- Promote sustainable development and recycling.
- Develop diligence.
- Develop a sense of pride in a job well done.

Statements of the Competencies

List of Competencies

Determine their suitability for the trade and the training process.

- Prevent risks to health, safety and physical well-being on construction sites.
- Assemble and disassemble refrigeration system piping.
- Verify the operation of refrigeration systems.
- Perform basic electrical operations.
- Handle refrigerants.
- Install and commission a small-capacity refrigeration system.
- Process information in drawings and specifications.
- Use access and handling equipment.
- Install and commission electric motors and control circuits.
- Install a large-capacity refrigeration system.
- Commission a large-capacity refrigeration system.
- Install and commission electronic motor control devices.
- Maintain a compressor.
- Install and commission digital control systems.
- Establish the optimal operating conditions for an HVAC/R system.
- Service a refrigeration system.
- Install a split air conditioning system.
- Commission an air conditioning system or liquid chiller.
- Service a packaged air conditioning system.
- Service a split air conditioning system.
- Service a liquid chiller.
- Service a central air conditioning system.
- Be familiar with construction industry organizations.
- Use job search techniques.

Grid of Competencies

The grid of competencies shows the relationship between general competencies, which correspond to professional activities, and specific competencies, which are required to practise the particular trade or occupation.

The general competencies appear on the horizontal axis, and the specific competencies, on the vertical axis. The symbol (◦) indicates a correlation between a general and a specific competency. Shaded symbols indicate that these relationships have been taken into account in the acquisition of specific competencies. The logic used in constructing the grid influences the course sequence. Generally speaking, this sequence follows a logical progression in terms of the complexity of the learning involved and the development of the students' autonomy. The vertical axis presents the specific competencies in the order in which they should be acquired and serves as a point of departure for determining how all of the competencies will be taught.

Harmonization

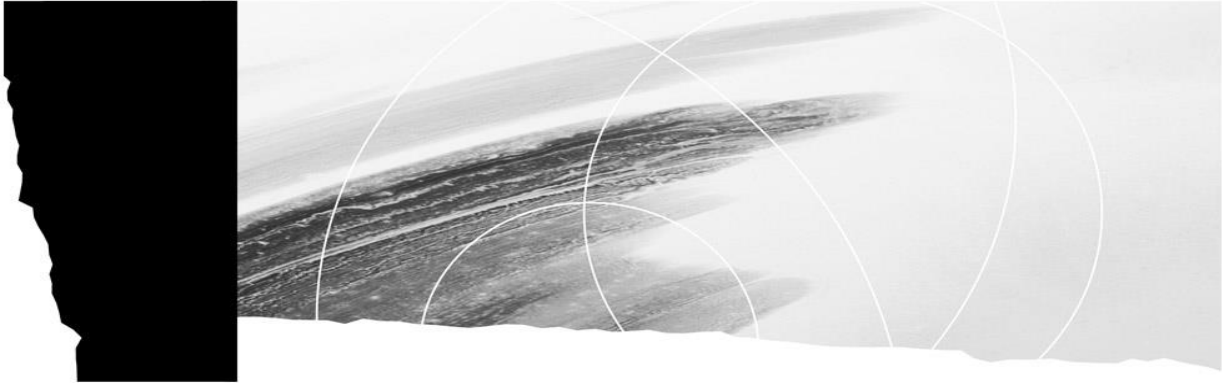
The Ministère de l'Éducation harmonizes its vocational and technical programs by establishing similarities and continuity between secondary- and college-level programs within a particular sector or between sectors in order to avoid overlap in program offerings, to recognize prior learning and to optimize the students' progress.

Harmonization establishes consistency between training programs and is especially important in ensuring that the tasks of a trade or occupation are clearly identified and described. Harmonization makes it possible to identify tasks requiring competencies that are common to more than one program. Even if there are no common competencies, training programs are still harmonized.

Harmonization is said to be “inter-level” when it focuses on training programs at different levels, “intra-level” when it focuses on programs within the same educational level, and “inter-sector” when carried out between programs in various sectors.

An important aspect of harmonization is that it allows the common characteristics of competencies to be identified and updated as needed. Common competencies are those that are shared by more than one program; once acquired in one program, they can be recognized as having been acquired in another. Competencies with exactly the same statement and elements are said to be identical. Common competencies that are not identical but have enough similarities to be of equal value are said to be equivalent.

Harmonization of the *Refrigeration* program has resulted in identifying competencies that are shared with other programs. Detailed information on the harmonization of this program and its results is presented in the document entitled *Tableaux d'harmonisation, Réfrigération*



Part II

Program Competencies

Competency 1 Duration 15 hours Credit 1

Situational Competency

Statement of the Competency

Determine their suitability for the trade and the training process.

Elements of the Competency

- Be familiar with the nature of the trade.
- Understand the training process.
- Confirm their career choice.

Learning Context

Information Phase

- Learning about the job market in refrigeration.
- Learning about the nature and requirements of the job.
- Learning about the training process.

Participation Phase

- Sharing the information gathered during a group discussion and discussing their perception of the trade: advantages, disadvantages, requirements.
- Discussing the skills, aptitudes and knowledge required to practise the trade.
- Discussing the program of study as it relates to the trade.

Synthesis Phase

- Producing a report in which they:
 - sum up their interests and aptitudes
 - assess their career choice by comparing different aspects and requirements of the trade with their aptitudes and interests.

Instructional Guidelines

- Create a climate in which students can express themselves freely.
- Provide the relevant information.
- Help the students acquire an accurate perception of the trade.
- Motivate the students to take part in the suggested activities.
- Provide the students with the means of assessing their career choice objectively.

Participation Criteria

Information Phase

- Gather information on most of the topics to be covered.

Participation Phase

- Participate actively in the activities organized.
- Express their perception of the program of study.
- Give their opinions on some requirements for practising the trade.

Synthesis Phase

- Produce a report in which they:
 - summarize their interests and aptitudes with respect to the trade
 - explain their career choice, clearly making the required connections.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to the learning context.

Information Phase

- Characteristics of the job market in refrigeration: job prospects, certificates issued by institutions or recognized organizations, working conditions, hiring criteria and remuneration, opportunities for advancement or transfer, etc.
- Nature and requirements of the trade: tasks, responsibilities, professional ethics, standards and regulations, etc.
- Characteristics and requirements of the training process: program of study, evaluation, certification of studies, volume of work required, rules, student services, schedule, etc.

Participation Phase

- Relationships between the program competencies and the tasks, operations, knowledge and skills associated with the trade.

Synthesis Phase

- Presentation methods: notes, summaries and presentations.
- Report on their strengths and weaknesses as they relate to the requirements of the trade.
- Justification of their career choice.

Competency 2 Duration 30 hours Credits 2

Situational Competency

Statement of the Competency

Prevent risks to health, safety and physical well-being on construction sites.

Elements of the Competency

- Adopt a responsible attitude regarding risks to health and safety.
- Be aware of the importance of complying with occupational health and safety standards and regulations.
- Recognize dangerous situations or unsafe behaviours and applicable preventive measures.

Learning Context

Information Phase

- Learning about the risks inherent in construction sites.
- Learning about the health and safety standards and regulations on construction sites.
- Finding out about emergency measures.
- Reflecting on the importance of developing occupational health and safety skills.

Participation Phase

- Experiencing situations in which it is necessary to prevent risks and eliminate hazards associated with the environment, facilities, equipment, machinery, tools, materials, energy sources, etc.
- Participating in activities that allow students to recognize risks associated with transporting loads and working in constricted postures.
- Participating in activities that allow students to recognize safety signs and symbols (e.g. hazardous products, roadwork, transportation of hazardous materials).
- Comparing different high-risk behaviours observed on a construction site and identifying the basic principles underlying safe behaviour.

Synthesis Phase

- Producing a report containing:
 - a summary of their newly acquired knowledge and skills
 - an evaluation of their attitude toward occupational health and safety
 - objectives and means of improving their behaviour.

Instructional Guidelines

- Provide the required sources of information.
- Invite, as needed, resource persons specialized in certain areas of occupational health and safety to speak to the class.
- Make effective use of audiovisual materials.
- Make extensive use of learning situations that are representative of conditions on construction sites.
- Ensure that students avoid dangerous behaviours during simulation exercises.

- Encourage all students to participate in discussions.
- Guide the students' evaluation process by providing them with appropriate tools (e.g. questionnaire) to help them analyze their experience and set objectives.

Participation Criteria

Information Phase

- Consult available sources of information.
- Describe the advantages of complying with health and safety standards and regulations.

Participation Phase

- Participate responsibly in the suggested activities.
- State the principles underlying safe behaviour.
- List the risks inherent in construction sites and the applicable preventive measures.

Synthesis Phase

- Produce a report containing:
 - a summary of their newly acquired knowledge and skills
 - an evaluation of their attitude toward occupational health and safety
 - objectives and means of protecting their health, safety and physical well-being, as well as that of others, on a construction site.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to the learning context.

Information Phase

- Importance of information about health and safety on construction sites.
- Most common risks to health, safety and physical well-being on construction sites.
- Sources of information about health and safety on construction sites and information searches.
- Roles and responsibilities respecting health and safety on construction sites.
- Health and safety regulatory framework.
- Advantages of complying with health and safety rules.
- Prevention of illness and accidents.

Participation Phase

- Risks inherent in the site itself and in the practice of the trade.
- Preventive measures to apply depending on the risks.
- Hazardous materials identification systems.

Competency 3 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency

Assemble and disassemble refrigeration system piping.

Achievement Context

- Working with copper, steel and plastic piping.
- Given instructions.
- Incorporating earthquake standards.
- Using measuring and scribing instruments: tape measure, ruler, square, micrometer, vernier calliper, centre punch, etc.
- Using assembly components and products: anchors, hangers, pipe fittings, glue, filler metal for brazing, etc.
- Using hand tools: drill/driver, stud gun, impact hammer, hacksaw, pipe cutter, reamer, flaring kit, manual and hydraulic benders, bending spring, swaging tool, pipe crimper, adjustable wrench, torque wrench, etc.
- Using an air-acetylene brazing kit and a welding set-up.
- Using the necessary protective equipment.

Elements of the Competency

1. Measure and mark out pipes.

- Accurate interpretation of instructions and earthquake standards.
- Accurate conversion of imperial and metric units of measurement.
- Precise measurement and marking out.

2. Install hangers.

- Choice of hangers based on the piping and the building's structure.
- Precise drilling of holes.
- Appropriate use of anchors.
- Compliance with requirements for using a stud gun.
- Solid assembly.

3. Prepare the pipes for assembly.

- Proper positioning of pipes.
- Precise cutting of pipes.
- Appropriate use of bending techniques.
- Proper preparation of pipe ends.

4. Perform mechanical assemblies of pipes and accessories.

- Precise positioning of pipes and accessories.
- Precise mechanical assembly of pipes and accessories using mechanical joints, compression joints and glue.

- Solidity and leaktightness of mechanical assemblies.
5. Assemble pipes and accessories using brazing techniques.
 - Proper determination of brazing technique.
 - Compliant assembly and inspection of air-acetylene brazing kit.
 - Appropriate use of brazing techniques.
 - Appropriate penetration of filler metal.
 - Solidity and leaktightness of brazed joints.
 6. Assemble pipes using tack-welding techniques.
 - Proper determination of welding procedure.
 - Compliant assembly and inspection of welding set-up.
 - Appropriate use of tacking techniques.
 - Solid tack welds.
 7. Dismantle piping.
 - Appropriate use of cutting and heating techniques.
 - Proper disassembly of mechanical assemblies.
 - Appropriate salvage of materials.
 8. Finish the job.
 - Compliant disassembly of air-acetylene brazing kit and welding set-up.
 - Proper storage of tools, measuring and scribing instruments and products.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate choice and use of tools and measuring and scribing instruments.
- Compliance with instructions.
- Compliance with earthquake standards.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Measure and mark out pipes.
 - Earthquake standards: level of earthquake protection (depending on the region, type of building, etc.), special provisions for refrigeration work, etc.
 - Imperial and metric measurements, conversion of units.
 - Addition, subtraction, multiplication and division of whole numbers, decimals and fractions.
 - Use of a measure tape, ruler, square, micrometer, vernier calliper, centre punch, etc.

2. Install hangers.
 - Types of surfaces: concrete, wood, metal, drywall, etc.
 - Types of anchors: mechanical expansion anchors, quick-release anchors, beam anchors, bolt anchors, clamp anchors, screw-in anchors, crimp anchors, stud gun anchors, etc.
 - Hand tools: drill/driver, stud gun, impact hammer, etc.
3. Prepare the pipes for assembly.
 - Types of pipes: copper, steel and plastic.
 - Other metals present in the systems.
 - Types of pipe fittings: copper, steel, plastic and brass.
 - Fitting types: union, elbow, T, etc.
 - Hand tools: hacksaw, pipe cutter, reamer, flaring kit, manual and hydraulic benders, bending spring, swaging tool, etc.
4. Perform mechanical assemblies of pipes and accessories.
 - Types of assemblies: flare union or dudgeon, mechanical joints, crimping and gluing.
 - Hand tools: pipe crimper, adjustable wrench, torque wrench, etc.
5. Assemble pipes and accessories using brazing techniques.
 - Types of brazing: silver phosphorus, silver and tin.
 - Determination of type of brazing based on the metal and requirements.
 - Air-acetylene brazing kit: cylinder, regulator, hose, torch, types of nozzles, inspection for leaks, opening and closing procedures, use of kit and safety measures, etc.
 - Brazing techniques: cleaning, application of brazing flux or brazing paste, adjustment of flame, heating, application of filler metal and inspection.
6. Assemble pipes using tack-welding techniques.
 - Determination of type of welding based on the metal and requirements.
 - GTAW, SMAW or other welding set-up: welding cable, electrode holder, types of nozzles, ground clamp, inspection for leaks, opening and closing procedures, use of welding set-up and safety measures, etc.
 - Assembly of welding set-up based on type of material, type of assembly, thicknesses, etc.
 - Adjustment of flame and gas flow.
 - Tacking techniques: striking the arc, arc length, torch angle, etc.
7. Dismantle piping.
 - Use of a hacksaw, pipe cutter, etc.
 - Use of an air-acetylene brazing kit.
 - Sorting of metals and recycling.
8. Finish the job.
 - Disassembly of air-acetylene brazing kit and welding set-up.
 - Importance of proper storage of equipment and cleanliness of work area.

For the competency as a whole:

- Appropriate choice and use of mathematical formulas.
- Accurate conversion of imperial and metric units of measurement.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Gather technical information about a refrigeration system.
 - Units: compressor, condenser, expansion valve, evaporator.
 - Lines: discharge, condensate, fluid, suction.
 - Direction of flow of refrigerant.
 - Basic accessories: receiver, drier, sight glass, suction accumulator.
 - Types of applications: refrigeration, air conditioning.
 - Technical information: rating plates, technical specifications (evaporation and condensation temperatures, types of refrigerants, etc.), graphic representation of a system.
 - Relationships between pressure, temperature and heat: characteristics of refrigerant at unit inlets and outlets, changes of phase and state, mode of heat transfer (conduction, convection, radiation).
 - Operating principles of the system: compression, condensation, expansion, evaporation.
2. Plan the tests.
 - Superheating phenomena in the evaporator and increase in temperature beyond the refrigerant's saturation point.
 - Subcooling phenomena in the condenser and decrease in temperature beyond the refrigerant's saturation point.
 - Types of measurements: pressure, temperature.
 - Units of measurement for temperature: Celsius, Fahrenheit, Kelvin, Rankine.
 - Units of measurement for pressure: gauge pressure in pounds per square inch gauge (PSIG), absolute pressure in pounds per square inch absolute (PSIA), inch of mercury (mmHg and inHg), bar, kilopascal, etc.
 - Pressure measurement points: at the inlet and outlet of the compressor.
 - Temperature measurement points: at the inlet and outlet of the compressor, condenser, expansion valve, evaporator.
3. Read a refrigeration system's operational data.
 - Data on the refrigerant charge: pressure, temperature.
 - Use of infrared and electronic thermometers: positioning, insulation, duration, precautions to take.
 - Measurements: high temperature, low temperature, high pressure (condensing pressure), low pressure (evaporating pressure).

4. Analyze the results.

- Formulas for calculating superheating, subcooling, TD and delta T (ΔT) data.
- Use of enthalpy diagrams for the different types of refrigerants.
- Compressor refrigerant and pressure variations:
 - low pressure, low temperature and superheated steam at the inlet
 - decrease in volume and increase in pressure in the compressor
 - high pressure, high temperature and superheated steam at the outlet
- Condenser refrigerant and heat rejection:
 - high pressure, high temperature and superheated steam at the inlet (desuperheating)
 - high pressure, high temperature and vaporization in the condenser (latent heat)
 - high pressure, high temperature and subcooled liquid at the outlet (subcooling)
- Expansion valve refrigerant and pressure variations:
 - high pressure, high temperature and subcooled liquid at the inlet
 - loss of pressure and flash gas in the expansion valve
 - low pressure, low temperature and vaporization at the outlet
- Evaporator refrigerant and heat absorption:
 - low pressure, low temperature and vaporization at the inlet
 - low pressure, low temperature and superheated steam at the outlet

5. Convey the results.

- Information about the system, operational data, observations.
- English and French technical terminology.

Competency 5 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency

Perform basic electrical operations.

Achievement Context

- Given instructions.
- Using the components of an electrical circuit: electrical boxes, switches, isolating switches, conductors, connectors, etc.
- Using hand tools.
- Using instruments for measuring electricity: multimeter, ammeter, ohmmeter.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Draw a ladder diagram and a block diagram of an electrical circuit. 2. Plan the work. 3. Install the components of the electrical circuit. 4. Connect the components of the electrical circuit. 5. Apply power to the electrical circuit and verify that it works. 6. Finish the job. | <ul style="list-style-type: none"> • Accurate interpretation of instructions. • Appropriate use of symbols. • Logical and operational relationships between the circuit components. • Clarity of diagrams. • Appropriate selection of components. • Appropriate choice of tools and measuring instruments. • Proper positioning of circuit components. • Secure anchoring of circuit components. • Proper installation of conductors. • Precise determination of connection points. • Appropriate connection of conductors. • Proper performance of continuity tests. • Correct energization of circuit. • Accurate measurement of voltage, amperage and resistance. • Careful determination of malfunctions and their causes. • Relevant corrective measures taken. • Proper storage of tools and measuring instruments. • Neatness and cleanliness of work area. |
|---|--|

For the competency as a whole:

- Appropriate use of tools and measuring instruments.
- Compliance with instructions.
- Compliance with electrical codes.
- Observance of lockout procedures.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions, and guidelines related to each element of the competency.

1. Draw a ladder diagram and a block diagram of an electrical circuit.
 - Series, parallel and series-parallel circuits.
 - Symbols and configuration of electrical circuit wiring (ladder diagram).
 - Representation of the main parts or functions of an electrical circuit in a block diagram, showing their relationships through blocks linked by lines.
 - Electrical code requirements.
2. Plan the work.
 - Lockout procedures depending on the type of circuit.
 - Occupational health and safety rules for live-line work: electric shock, arc flash.
 - Components of an electrical circuit: electrical boxes, switches, isolating switches, conductors, connectors, etc.
 - Tools: electrician's pliers, adjustable pliers, crimper, screwdriver, electrician's knife, etc.
 - Electrical measuring instruments: multimeter, ammeter, ohmmeter.
3. Install the components of the electrical circuit.
 - Electrical boxes: junction box for electrical device, pull box, splitter box, cover plate, etc.
 - Switches: single-pole single-throw (SPST); single-pole double-throw (SPDT); double-pole single-throw (DPST); etc.
 - Isolating switches: low-voltage, high-voltage, etc.
 - Location of circuit components based on the diagram.
 - Anchoring: screws, anchors, etc.
4. Connect the components of the electrical circuit.
 - Conductors: gauge, amperage, number of strands, sheath, etc.
 - Connection points: power source, return (neutral), ground.
 - Method of removing conductor sheaths and insulation.
 - Methods of screwing, splicing and crimping conductors, and use of insulated and non-insulated connectors (wire nuts, terminals, etc.) .
 - Methods of identifying conductors: colour, number, etc.

5. Apply power to the electrical circuit and verify that it works.
 - Use of measuring instruments.
 - Conductor continuity tests.
 - Reading of 120- and 240-volt voltages, amperage and resistance.
 - Use of Ohm's law and calculation of wattage.
 - Malfunctions: open circuit, short circuit, defective electrical components, etc.
6. Finish the job.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 6 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Handle refrigerants.

Achievement Context

- Working with synthetic and natural refrigerants.
- Given instructions.
- Using halocarbon regulations.
- Using recovery equipment: refrigerant recovery machines, recovery vessels, refrigerant vessels, etc.
- Using instruments for measuring liquid: manometer, electronic scale and leak detector
- Using hand tools.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Learn the environmental requirements for using halocarbons. 2. Recover refrigerant. 3. Check for leaks in a circuit. 4. Evacuate a circuit. 5. Charge refrigerant. | <ul style="list-style-type: none"> • Identification of environmental problems caused by the use of halocarbons. • Accurate interpretation of the legal provisions and protocols respecting the use and recovery of halocarbons. • Accurate distinction of type of refrigerant. • Careful determination of recovery method. • Appropriate use of recovery equipment. • Complete recovery of refrigerant. • Appropriate verification of the circuit's leaktightness under nitrogen pressure. • Proper performance of leak tests under nitrogen pressure. • Appropriate use of leak detection techniques. • Proper nitrogen purge. • Appropriate use of vacuum pump. • Appropriate verification of the circuit's leaktightness after evacuation. • Compliant evacuation. • Accurate decision concerning the use of the original refrigerant or a conversion refrigerant. • Appropriate choice of charging method. • Appropriate choice and installation of charging equipment. |
|---|---|

- Appropriate use of charging equipment.
 - Compliant refrigerant charging.
6. Fill out the halocarbon log.
- Accurate information.
 - Legibility of information.

For the competency as a whole:

- Appropriate choice and use of hand tools and instruments for measuring liquid.
- Appropriate choice and use of recovery equipment.
- Compliance with instructions.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Learn the environmental requirements for using halocarbons.
 - Halocarbons: man-made synthetic halogen compounds not found in nature:
 - halocarbons grouped under ozone-depleting substances (ODS): chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC), bromofluorocarbons (also called halons), methyl chloroform (1,1,1-trichloroethane), tetrachloromethane (CCl₄), methyl bromide (CH₃Br)
 - halocarbons grouped under non-ozone-depleting substances: hydrofluorocarbons (HFC), perfluorocarbons (PFC), hydrofluoroolefins (HFO), hydrochlorofluoroolefins (HCFO).
 - Halocarbon-related environmental problems: depletion of the ozone layer and climate change:
 - ozone-depleting substances: migration of halocarbons to the stratosphere and photochemical reactions with the ozone there; increase in the natural greenhouse effect and climate change; impact on atmospheric temperature, rainfall patterns in some parts of the globe, ocean currents and agricultural yields
 - non-ozone-depleting substances (HFC and PFC): no effect on the ozone layer; increase in the natural greenhouse effect and very high global warming potential
 - Kyoto protocol
 - effect on ozone depletion potential (ODP) and global warming potential (GWP).
 - Use of halocarbons in different sectors of activity: refrigeration and air conditioning, production of foam plastics, fire protection, production of solvents and aerosols.

- Regulatory measures respecting halocarbons:
 - controls on the ODSs targeted in the Montreal Protocol and replacement substances: HFC, PFC, HCFO, HFO
 - total ban on the use of CFCs and halons in Québec
 - ban on the installation of refrigeration or air conditioning equipment that uses HCFC
 - gradual ban on the installation of refrigeration equipment using halocarbons with high global warming potential (GWP)
 - obligation to recover (or confine) halocarbons contained in refrigeration, air conditioning and fire extinction systems (fixed or portable extinguishers) being repaired
 - obligation of wholesalers and distributors to take back halocarbons at their point of sale
 - marketing of refrigerant gases in rechargeable pressurized vessels
 - obligation of all halocarbon users to obtain environmental qualification.
2. Recover refrigerant.
- Types of synthetic and natural refrigerants.
 - Specifications, use and risks associated with ammonia and carbon dioxide.
 - Specifications, use and risks associated with propane and butane.
 - Recovery methods: in the vapour phase, in the liquid phase, push-and-pull.
 - Use of analog and digital manometers.
 - Recovery equipment: types of refrigerant recovery machines, types of recovery vessels and capacities, connection of equipment based on the recovery method, positioning of manometer (test tank) and service valves, sequence of operations, etc.
 - Sources of refrigerant contamination (air, moisture, particles, etc.) and precautions to take.
 - Disposal of contaminated refrigerants in accordance with halocarbon regulations.
3. Check for leaks in a circuit.
- Sources of leaks: welded and screwed joints, units and accessories.
 - Impact of leaks on the system's operation: temperature difference in the condenser and evaporator, decrease in operating pressure, temperature variations in the lines, etc.
 - Signs of malfunctions: traces of oil, refrigerant level (sight glass), hissing, etc.
 - Leak tests under nitrogen pressure and manufacturer's recommendations.
 - Nitrogen pressurization and use of equipment: adjustment of nitrogen pressure regulator, positioning of manometer (test tank) and service valves, etc.
 - Types of leak detectors: electronic, ultrasound, halogen, soap, ultraviolet, etc.
 - Nitrogen purge and precautions to take.
4. Evacuate a circuit.
- Use of vacuum pump: pump maintenance, oil change, connection method.
 - Evacuation: positioning of micron gauge, manometer (test tank) and service valves, etc.
 - Use of alternate dilution.
 - Use of the micron gauge, and evacuation compliant with the specifications of the refrigeration system manufacturer.

5. Charge refrigerant.
 - Use of the original refrigerant or choice of a conversion refrigerant based on halocarbon regulations.
 - Compatibility of oil with refrigerant.
 - Charging methods: vapour injection, liquid injection.
 - Charging equipment: precautions to take depending on the type of refrigerant, system compatibility, connection of equipment depending on the charging method, refrigerant vessels, positioning of manometer (test tank) and service valves, sequence of operations, use of electronic scale, etc.
 - Charging compliant with the specifications of the refrigeration system manufacturer.
6. Fill out the halocarbon log.
 - Data to include based on halocarbon regulations.

Competency 7 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency

Install and commission a small-capacity refrigeration system.

Achievement Context

- Given instructions.
- Using technical information: rating plates, technical specifications, earthquake standards.
- Using the units of a small-capacity refrigeration system: condensing unit, evaporator, expansion valve.
- Using pipes, accessories, components and assembly products.
- Using a thermostat.
- Using hand tools.
- Using brazing equipment.
- Using measuring and scribing instruments, instruments for measuring liquids and electrical measuring instruments.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

1. Plan the installation.
2. Install the refrigeration system units.
3. Install the piping.

Performance Criteria

- Accurate interpretation of instructions and technical information.
- Appropriate selection of system components.
- Appropriate choice of tools, equipment and measuring and scribing instruments.
- Precise determination of positioning of units.
- Precise installation and alignment of units.
- Precise levelling of units.
- Proper, solid anchoring of units.
- Appropriate connection of units.
- Precise determination of the positioning of the pipes and accessories.
- Precise installation and alignment of pipes and accessories.
- Proper, solid anchoring of pipes and accessories.
- Appropriate verification of the installation's leaktightness.
- Compliant evacuation of circuit.

4. Install the thermostat.
 - Precise determination of positioning of thermostat.
 - Proper installation and anchoring of thermostat.
 - Appropriate connection of thermostat.
5. Perform a pre-operational inspection of the system.
 - Appropriate check for ground faults and short circuits.
 - Appropriate verification of voltage at the isolating switch inlet.
6. Start up the refrigeration system.
 - Correct energization of circuit.
 - Accurate measurement of voltage, amperage and resistance.
 - Appropriate charging of refrigerant.
 - Appropriate verification of the refrigeration system's operation.
7. Adjust the refrigeration system.
 - Proper adjustment of control points.
 - Proper operation of system.
8. Finish the job.
 - Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Accurate recording of information in the commissioning report.
 - Proper storage of tools, brazing equipment and measuring and scribing instruments.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools, equipment and measuring and scribing instruments.
- Relevant corrective measures taken.
- Compliance with instructions.
- Compliance with earthquake standards.
- Observance of lockout procedures.
- Observance of shutdown and restart procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions, and guidelines related to each element of the competency.

1. Plan the installation.
 - Characteristics of a small-capacity refrigeration system:
 - single installation
 - cooling processes: types of evaporators, speed
 - air defrost
 - Technical information: rating plates, technical specifications, earthquake standards (see Competency 3).
 - System components: units, piping, thermostat.
 - Tools, equipment and measuring and scribing instruments to use based on installation requirements (see competencies 3, 4, 5 and 6).
2. Install the refrigeration system units.
 - Units: condensing unit, evaporator, expansion valve (capillary, thermostatic, automatic).
 - Positioning of units compliant with manufacturer's requirements (clearance, dimensions, air circulation, ambient temperature, etc.).
 - Installation, alignment and levelling of units: manufacturer's requirements and use of measuring and scribing instruments.
 - Anchoring of units: screws, anchors, etc.
 - Connection of units (see Competency 5).
3. Install the piping.
 - Flexible pipes.
 - Accessories: drier, sight glass, etc.
 - Positioning of pipes and accessories based on the position of the units.
 - Installation, alignment and anchoring of pipes and accessories (see Competency 3).
 - Verification of the installation's leaktightness and evacuation (see Competency 6).
4. Install the thermostat.
 - Mechanical thermostats, electric thermostats, etc.
 - Positioning of thermostat sensor near the air return, evaporator, etc.
 - Connection of thermostat (see Competency 5)
5. Perform a pre-operational inspection of the system.
 - Check for ground faults and short circuits and verification of voltage at the isolating switch inlet (see Competency 5).
6. Start up the refrigeration system.
 - Measurement of voltage, amperage, and resistance (see Competency 5).
 - Adjustment of refrigerant charge based on the type of system.
 - Verification of the refrigeration system's operation (see Competency 4).
7. Adjust the refrigeration system.
 - Control points: temperature, pressure.

8. Finish the job.

- Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
- Recording of information in the halocarbon log (see Competency 6).
- Recording of information in the commissioning report: information about the system, operational data, materials used, work done, labour, etc.
- Importance of proper storage of equipment and cleanliness of work area.

Competency 8 Duration 30 hours Credits 2

Behavioural Competency

Statement of the Competency

Process information in drawings and specifications.

Achievement Context

- Given drawings and specifications.
- Using measuring and scribing instruments: levels, tape measures, chalk lines, etc.

Elements of the Competency

1. Identify the information in drawings.
2. Identify, in a drawing and specifications, the components of an air conditioning, refrigeration, heating and ventilation system.
3. Locate, on site, the components of an air conditioning, refrigeration, heating, and ventilation system.

Performance Criteria

- Accurate interpretation of dimensions, units of measurement and scales.
- Accurate recognition of symbols.
- Accurate recognition of types of views.
- Relevant connections between the views.
- Accurate distinction between the different types of lines.
- Accurate interpretation of technical data.
- Identification of all units, piping and accessories in the drawing and specifications.
- Identification of all units, piping and accessories on site.
- Precise transfer of data from the drawing to the site.
- Appropriate use of measuring and scribing instruments.

For the competency as a whole:

- Careful handling of drawings and specifications.
- Accurate conversion of imperial and metric units of measurement.
- Use of appropriate terminology.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions, and guidelines related to each element of the competency.

1. Identify the information in drawings.
 - Dimensions and units of measurement: metric and imperial systems, angles, etc.
 - Scales: 1/20, 1/4 inch = 1 foot, etc.

- Symbols: elevation, orientation, hatching, etc.
 - Top, elevation, sectional and detail views.
 - Types of lines: dotted and solid, bold, phantom, etc.
2. Identify, in a drawing and specifications, the components of an air conditioning, refrigeration, heating and ventilation system.
- Main characteristics of drawings and specifications for the installation of air conditioning and refrigeration systems.
 - Main characteristics of drawings and specifications for the installation of heating and ventilation systems.
3. Locate, on site, the components of an air conditioning, refrigeration, heating and ventilation system.
- Units, piping, and accessories.
 - Use of levels, tape measures, chalk lines, etc.
 - Marking out of leader lines and elevations.

Competency 9 Duration 45 hours Credits 3

Behavioural Competency

Statement of the Competency

Use access and handling equipment.

Achievement Context

- Given instructions.
- Using access equipment: ladder, aerial bucket, lift platform.
- Using handling equipment: shear legs, winch, chain hoists.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

- | | |
|---|--|
| 1. Plan the work. | <ul style="list-style-type: none"> • Accurate interpretation of instructions. • Careful choice of type of equipment. |
| 2. Establish a safety perimeter. | <ul style="list-style-type: none"> • Identification of all potential obstacles and hazards in the work area. • Proper use of personal and collective protective equipment. |
| 3. Use a ladder. | <ul style="list-style-type: none"> • Appropriate choice of type of ladder. • Compliant positioning of ladder. • Methodical technique for climbing up and down. |
| 4. Use an aerial bucket and a lift platform. | <ul style="list-style-type: none"> • Appropriate inspection of aerial bucket or lift platform. • Appropriate use of controls. • Proper positioning of aerial bucket or lift platform. • Precise, steady manoeuvres. • Compliance with start-up and shutdown procedures. |
| 5. Move loads on a vertical, horizontal, or inclined plane alone, or with help. | <ul style="list-style-type: none"> • Appropriate use of shear legs, winches and chain hoists. • Appropriate use of lifting signals. • Compliance with techniques for moving loads. |
| 6. Finish the job. | <ul style="list-style-type: none"> • Proper cleaning of equipment. • Proper storage of equipment. • Neatness and cleanliness of work area. |

For the competency as a whole:

- Adoption of cautious attitudes and behaviours.
- Compliance with instructions.
- Compliance with load capacities.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the work.
 - Choice of type of access and handling equipment based on height, span, space, load, etc.
2. Establish a safety perimeter.
 - Sources of risk (fall, power lines, wind, etc.), potential obstacles and hazards in the work area: confined space, enclosed space, site dimensions, etc.
 - Individual and collective safety equipment: hard hat, boots, glasses, mask, visor, gloves, safety guards, guide rails, screens, cones, flagging tape, warning signs, etc.
3. Use a ladder.
 - Types of ladders: single ladder, extension ladder, step ladder, etc.
 - Features and uses: height, materials, accessories.
 - Inspection of ladder.
 - Positioning, techniques and manufacturer's standards.
4. Use an aerial bucket and a lift platform.
 - Characteristics and uses of an aerial bucket and a lift platform.
 - Visual inspection and verification of hydraulic components, cables, etc.
 - Range, positioning, techniques and manufacturer's standards.
5. Move loads on a vertical, horizontal or inclined plane alone or with help.
 - Lifting capacity of shear legs, winches and chain hoists.
 - Use of slings.
 - Standardized and non-standardized lifting signals.
 - Determination of techniques for moving loads based on centre of gravity, area layout, pathways, availability of tools and equipment, etc.
 - Lever effect, safety factors, etc.
6. Finish the job.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 10 Duration 120 hours Credits 8

Behavioural Competency

Statement of the Competency

Install and commission electric motors and control circuits.

Achievement Context

- Working on single- and three-phase motors and control circuits of refrigeration systems.
- Given instructions.
- Given technical information: rating plates, technical specifications, circuit diagrams.
- Using control circuit components: thermostat, pressure switch, relay, condenser, etc.
- Using hand tools.
- Using electrical measuring instruments: multimeter, ammeter, ohmmeter, megohmmeter, etc.
- Using the necessary protective equipment.

Elements of the Competency

1. Plan the work.
2. Install the motor and control circuit components.
3. Connect the motor and control circuit components.
4. Prepare to commission the motor and control circuit.

Performance Criteria

- Accurate interpretation of instructions and technical information.
- Appropriate selection of components.
- Appropriate choice of tools and measuring instruments.
- Proper positioning of motor and circuit components.
- Proper anchoring of motor and circuit components.
- Proper installation of conductors.
- Precise determination of connection points.
- Appropriate connection of conductors.
- Proper performance of continuity and insulation tests.
- Correct energization of circuit.
- Appropriate preliminary adjustment of initial control circuit parameters.

5. Commission the motor and control circuit.
 - Observance of start-up procedure.
 - Accurate measurement of voltage, amperage and resistance.
 - Appropriate verification of the motor's direction of rotation.
 - Appropriate verification of the operating sequence of the motor and control circuit.
 - Careful determination of malfunctions and their causes.
 - Relevant corrective measures taken.

6. Adjust the control circuit.
 - Appropriate adjustment of the final control circuit parameters.
 - Proper operation of motor and control circuit.

7. Finish the job.
 - Proper storage of tools and measuring instruments.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools and measuring instruments.
- Compliance with instructions.
- Compliance with electrical codes.
- Observance of lockout procedures.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions, and guidelines related to each element of the competency.

1. Plan the work.
 - Technical information: rating plates, technical specifications, circuit diagrams.
 - Electrical code requirements.
 - Lockout procedures depending on the type of equipment.
 - Occupational health and safety rules for live-line work: electric shock, arc flash.
 - Types of electric motors used in refrigeration systems: compressor motor, condenser motor, evaporator motor, etc.
 - Components: motor, control circuit, conductor.
 - Tools: electrician's pliers, adjustable pliers, crimper, screwdriver, electrician's knife, etc.
 - Electrical measuring instruments: multimeter, ammeter, ohmmeter, megohmmeter, etc.

2. Install the motor and control circuit components.
 - Single- and three-phase motors.
 - Control circuit: start relay, run capacitors, start capacitors, high pressure control, low pressure control, overload relay, defrost termination thermostat (DTT), high limit thermostat (HLT), etc.
 - Positioning of motor compliant with manufacturer's requirements (clearance, dimensions, air circulation, ambient temperature, etc.)
 - Anchoring: screws, anchors, DIN rail, etc.
3. Connect the motor and control circuit components.
 - Conductors: gauge, amperage, number of strands, sheath, shield, etc.
 - Connection points: power source, return (neutral), ground.
 - Connection of a single-phase motor: without a start capacitor (RSIR), with a start capacitor (CSIR), with a run capacitor (PSC) and with a capacitor start capacitor run (CSCR) motor.
 - Connection of a three-phase motor: star and delta.
 - Method of removing conductor sheaths and insulation.
 - Methods of screwing, splicing and crimping conductors, and use of insulated and non-insulated connectors (wire nuts, terminals, etc.)
 - Methods of identifying conductors: colour, number, etc.
4. Prepare to commission the motor and control circuit.
 - Conductor and control circuit continuity tests, motor insulation test.
 - Preliminary adjustment of initial parameters of the control circuit: temperature, pressure, duration, amperage, etc.
5. Commission the motor and control circuit.
 - Use of measuring instruments.
 - Single-phase motor: reading of 120- or 240-volt voltage, amperage and resistance.
 - Three-phase motor: reading of 208- or 600-volt voltage, amperage and resistance.
 - Use of Ohm's law and calculation of wattage.
 - Motor's direction of rotation and manufacturer's requirements.
 - Operating sequence of motor and control circuit with regard to control points, cycles (refrigeration, defrost, pump down), etc.
 - Electrical malfunctions: open circuit, short circuit, defective electrical or electronic components, etc.
6. Adjust the control circuit.
 - Preliminary adjustment of final control circuit parameters: temperature, pressure, duration, amperage, etc.
7. Finish the job.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 11 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency

Install a large-capacity refrigeration system.

Achievement Context

- Given drawings, specifications and instructions.
- Using technical information: rating plates, technical specifications, earthquake standards.
- Using large-capacity refrigeration system units: electric motor, compressor, condenser, evaporator, expansion valve.
- Using pipes, regulators, accessories, components and assembly products.
- Using control circuit components.
- Using hand tools
- Using the necessary equipment for brazing, welding, access, handling, etc.
- Using measuring and scribing instruments, instruments for measuring liquids and electrical measuring instruments.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

1. Plan the installation.

- Accurate interpretation of drawings, specifications and instructions.
- Accurate interpretation of technical information
- Appropriate selection of system components.
- Appropriate choice of tools, equipment and measuring and scribing instruments.

2. Install the refrigeration system units.

- Precise determination of positioning of units.
- Precise installation and alignment of units.
- Precise levelling of units.
- Proper, solid anchoring of units.
- Appropriate connection of units.
- Observance of the required distance between units.

3. Install the piping.

- Precise determination of the positioning of the pipes, regulators and accessories.
- Precise installation and alignment of pipes, regulators and accessories.
- Proper, solid anchoring of pipes, regulators and accessories.
- Appropriate verification of leaktightness of valves.

- Compliant positioning of evacuated circuit.
 - Appropriate precharging of refrigerant.
4. Install the control circuit.
- Precise determination of the positioning of control circuit components.
 - Proper installation and anchoring of control circuit components.
 - Appropriate connection of control circuit components.
5. Finish the job.
- Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Proper preparation of job sheet.
 - Proper storage of tools, equipment, measuring and scribing instruments and products.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools, equipment and measuring and scribing instruments.
- Relevant corrective measures taken.
- Compliance with earthquake standards.
- Observance of lockout procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions, and guidelines related to each element of the competency.

1. Plan the installation.
- Characteristics of a large-capacity refrigeration system:
 - types of cold rooms: positive cold room, negative cold room, humidity, controlled atmosphere
 - types of refrigerated cases and cabinets: single installation, multiple installations, installation with air distribution, etc.
 - types of ice machines: capacity, manufacturers
 - types of heat reclaimers: desuperheater (tube in tube, plate, shell and tube) and air heater, plain and finned tubes
 - cooling processes: types of evaporators, speed, glycol plate exchanger, etc.
 - defrosting methods: natural, electric, hot gas

- Drawings and specifications (see Competency 8).
 - Technical information: rating plates, technical specifications, earthquake standards (see Competency 3).
 - System components: units, piping, control circuit.
 - Tools, equipment and measuring and scribing instruments to use based on the installation requirements (see competencies 3, 5, 6, 9 and 10).
2. Install the refrigeration system units.
- Units: electric motor, compressor, condenser, evaporator, expansion valve.
 - Positioning of units compliant with manufacturer's requirements (clearance, dimensions, air circulation, ambient temperature, etc.)
 - Installation, alignment and levelling of units: manufacturer's requirements and use of measuring and scribing instruments.
 - Anchoring of units: screws, anchors, etc..
 - Connection of units (see competencies 5 and 10)
3. Install the piping.
- Rigid and flexible pipes.
 - Condensing pressure regulators, evaporating pressure regulators, etc.
 - Accessories: solenoid valve, oil separator, suction accumulator, drier with interchangeable solid core, sight glass, etc.
 - Positioning of pipes and accessories based on the position of the units.
 - Installation, alignment and anchoring of pipes and accessories (see Competency 3).
 - Verification of the leaktightness of the installation and evacuation (see Competency 6).
 - Vacuum breaking with refrigerant precharge.
4. Install the control circuit.
- Control circuit: thermostat, low pressure control, high pressure control, defrost timer, overload relay, oil level regulator, etc.
 - Positioning of thermostat sensor near the air return.
 - Positioning of pressure test points on the compressor and refrigerant lines.
 - Connection of control circuit components (see competencies 5 and 10).
5. Finish the job.
- Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
 - Recording of information in the halocarbon log (see Competency 6).
 - Preparation of job sheet: information about the system, components used, work done, labour, etc.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 12 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Commission a large-capacity refrigeration system.

Achievement Context

- Given instructions.
- Using technical information: rating plates, technical specifications.
- Using hand tools.
- Using instruments for measuring liquids and electrical measuring instruments.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Prepare to commission the refrigeration system. 2. Perform a pre-operational inspection of the system. 3. Make the preliminary adjustments to the refrigeration system. 4. Start up the refrigeration system. 5. Adjust the refrigeration system. | <ul style="list-style-type: none"> • Accurate interpretation of instructions and technical information. • Appropriate choice of tools and measuring instruments. • Appropriate check for ground faults and short circuits. • Appropriate verification of voltage at the isolating switch inlet. • Appropriate verification of oil level. • Correct energization of circuit. • Proper start-up of crankcase heater. • Appropriate preliminary adjustment of initial control point parameters. • Appropriate preliminary adjustment of initial parameters of the motor control circuit. • Appropriate preliminary adjustment of initial regulator parameters. • Proper adjustment of defrost sequences. • Accurate measurement of voltage, amperage and resistance. • Appropriate charging of refrigerant. • Appropriate verification of the refrigeration system's operation. • Proper adjustment of final control point parameters. • Proper adjustment of final parameters of the motor control circuit. |
|--|---|

- Proper adjustment of regulators.
 - Proper operation of system.
6. Finish the job.
- Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Accurate recording of information in the commissioning report.
 - Proper storage of tools and measuring instruments.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of hand tools and measuring instruments.
- Relevant corrective measures taken.
- Compliance with instructions.
- Observance of lockout procedures.
- Observance of shutdown and restart procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Prepare to commission the refrigeration system.
 - Technical information: rating plates, technical specifications.
 - Tools and measuring instruments to use (see competencies 4, 5, 6 and 10).
2. Perform a pre-operational inspection of the system.
 - Check for ground faults and short circuits and verification of voltage at the isolating switch inlet (see competencies 5 and 10).
 - Verification of compressor oil level.
3. Make the preliminary adjustments to the refrigeration system.
 - Energization (see Competency 5).
 - Preliminary adjustment of initial control point parameters: temperature, pressure.
 - Preliminary adjustment of initial parameters of the motor control circuit (see Competency 10).
 - Preliminary adjustment of initial regulator parameters: pressure, flow, level, etc.
 - Adjustment of defrost sequences: frequency, duration, start.

4. Start up the refrigeration system.
 - Measurement of voltage, amperage and resistance (see competencies 5 and 10).
 - Charging of refrigerant (see Competency 6).
 - Verification of the refrigeration system's operation (see Competency 4).
5. Adjust the refrigeration system.
 - Adjustment of final control point parameters: temperature, pressure.
 - Adjustment of final parameters of the motor control circuit (see Competency 10).
 - Adjustment of final regulator parameters: pressure, flow, level, etc.
6. Finish the job.
 - Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
 - Recording of information in the halocarbon log (see Competency 6).
 - Recording of information in the commissioning report: information about the system, operational data, materials used, work done, labour, etc.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 13 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Install and commission electronic motor control devices.

Achievement Context

- Given instructions.
- Given technical information: rating plates, technical specifications, block diagrams of the electronic devices.
- Using components of the electronic control device: variable-speed drives, controls.
- Using hand tools.
- Using electrical measuring instruments: multimeter, ammeter, ohmmeter, megohmmeter, etc.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

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| <ol style="list-style-type: none"> 1. Plan the work.
 2. Install the electronic control device.
 3. Connect the electronic control device.
 4. Prepare to commission the motor and the electronic control device.
 5. Commission the motor and the electronic control device. | <ul style="list-style-type: none"> • Accurate interpretation of instructions and technical information. • Appropriate selection of components. • Appropriate choice of tools and measuring instruments.
 • Proper positioning of electronic control device. • Proper anchoring of electronic control device.
 • Proper installation of conductors. • Precise determination of connection points. • Appropriate connection of conductors.
 • Correct performance of continuity and insulation tests. • Correct energization of circuit. • Appropriate preliminary adjustment of initial parameters of the electronic control device.
 • Observance of start-up procedure • Accurate measurement of voltage, amperage and resistance. • Appropriate verification of the motor's direction of rotation. • Appropriate verification of the operating sequence of the motor and electronic control device. |
|--|--|

- Careful determination of malfunctions and their causes.
 - Relevant corrective measures taken.
6. Adjust the electronic control device.
- Appropriate adjustment of final parameters of the electronic control device.
 - Proper operation of motor and control circuit.
7. Finish the job.
- Proper storage of tools and measuring instruments.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools and measuring instruments.
- Compliance with instructions.
- Compliance with electrical codes.
- Observance of lockout procedures.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the work.
 - Technical information: rating plates, technical specifications, block diagrams of the electronic devices.
 - Electrical code requirements.
 - Lockout procedures depending on the type of equipment.
 - Occupational health and safety rules for live-line work: electric shock, arc flash.
 - Components: motor, electric device, conductor.
 - Tools: electrician's pliers, adjustable pliers, crimper, screwdriver, electrician's knife, etc.
 - Electrical measuring instruments: multimeter, ammeter, ohmmeter, megohmmeter, etc.
2. Install the electronic control device.
 - Electronic motor control devices: AC variable-speed drives, DC variable-speed drives, etc.
 - Positioning of electronic motor control devices compliant with manufacturer's requirements (clearance, air circulation, ambient temperature, etc.).
 - Anchoring: screws, anchors, DIN rail, etc.
3. Connect the electronic control device.
 - Conductors: gauge, amperage, number of strands, sheath, shield, etc.
 - Connection points: power source, return (neutral), ground, signal.
 - Method of removing conductor sheaths and insulation.
 - Methods of screwing, splicing and crimping conductors, and use of insulated and non-insulated connectors (wire nuts, terminals, communications connectors, etc.)
 - Methods of identifying conductors: colour, number, etc.

4. Prepare to commission the motor and the electronic control device.
 - Conductor and control circuit continuity tests, motor insulation test.
 - Preliminary adjustment of initial parameters of the electronic control device: voltage, amperage, RPM, frequencies, etc.
5. Commission the motor and the electronic control device.
 - Use of measuring instruments.
 - Power section: reading of voltages and amperages at the inlets and outlets.
 - Control section: reading of voltages (AC, 0-10 volts [DC], 2-10 volts [DC], etc.), amperages (4-20 milliamperes) and resistances (0-135 ohms) at the inlets and outlets.
 - Use of Ohm's law and calculation of wattage.
 - Motor's direction of rotation and manufacturer's requirements.
 - Operating sequence of motor and electronic control device with regard to control points, starting torque, speed, acceleration, deceleration, etc.
 - Electrical malfunctions: open circuit, short circuit, defective electrical or electronic components, etc.
6. Adjust the electronic control device.
 - Adjustment of final parameters of the electronic control device: control points, starting torque, speed, acceleration, deceleration, etc.
7. Finish the job.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 14 Duration 75 hours Credits 5

Behavioural Competency

Statement of the Competency

Maintain a compressor.

Achievement Context

- Working on reciprocating, scroll, rotary, screw or centrifugal compressors.
- Given instructions.
- Using the service contract.
- Using technical information: rating plates, technical specifications.
- Using maintenance and repair procedures.
- Using maintenance products and replacement components.
- Using hand tools.
- Using instruments for measuring liquids and electrical measuring instruments.
- Using the necessary equipment for brazing, access, handling, etc.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

1. Plan the work.

2. Diagnose a compressor malfunction.

3. Use a maintenance procedure on a compressor.

Performance Criteria

- Accurate interpretation of dispatcher's instructions.
- Accurate interpretation of service contract.
- Accurate interpretation of technical information.
- Appropriate choice of tools, equipment and measuring instruments.

- Appropriate verification of condition of compressor.
- Appropriate verification of the refrigeration system's operation.
- Accurate measurement of voltage, amperage and resistance.
- Accurate diagnosis.

- Accurate interpretation of maintenance procedure.
- Proper cleaning of components.
- Oil change in compliance with requirements.
- Proper tightening of loose electrical connections.
- Proper replacement of components as a preventive measure.

4. Use a repair procedure on a compressor.
 - Accurate interpretation of repair procedure.
 - Observance of sequence of operations for removing and reinstalling parts.
 - Proper replacement or repair of defective components.
5. Install and connect a replacement compressor.
 - Careful choice of replacement components.
 - Precise positioning of compressor.
 - Proper, solid anchoring of compressor.
 - Appropriate connection of compressor.
6. Commission a compressor and adjust its operation.
 - Appropriate verification of operation of compressor.
 - Accurate measurement of voltage, amperage and resistance.
 - Proper adjustment of capacity modulation controls.
 - Proper operation of compressor.
7. Finish the job.
 - Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Proper preparation of job sheet.
 - Proper storage of tools, equipment, measuring instruments and products.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools, equipment and measuring instruments.
- Compliance with instructions.
- Observance of lockout procedures.
- Observance of shutdown and restart procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the work.
 - Dispatcher's instructions: priority, urgency, work schedule, etc.
 - Types of service contracts: preventive maintenance, repair, etc.
 - Technical information: rating plates, technical specifications.
 - Tools, equipment and measuring instruments to use based on job requirements (see competencies 3, 4, 5, 6, 9, 10 and 13).
2. Diagnose a compressor malfunction.
 - Characteristics of reciprocating, scroll, rotary, screw or centrifugal compressors:
 - type of housing: sealed, hermetic, open
 - cycles: decompression, vacuum, compression, discharge
 - clearance pocket (reciprocating compressor)
 - operational data: pressure, temperature, rotation speed, refrigerant volume displacement (cubic feet per hour [CFPH]), compression rate, percentage efficiency, etc.
 - types of drives: direct, indirect
 - lubrication methods: splash, force-feed
 - cooling systems: air, water, suction vapour, liquid refrigerant injection
 - capacity reduction devices: load shedding at the cylinder, suction gas admission control, hot gas bypass, rotation speed control
 - Signs of malfunctions: superheat, noise, vibration, wear, deterioration (oil, seal, winding), etc.
 - Verification of the refrigeration system's operation (see Competency 4).
 - Measurement of the voltage, amperage and resistance of electrical or electronic components (see competencies 5, 10 and 13).
 - Diagnoses: electrical malfunction, mechanical malfunction, defective component, insufficient pumping capacity.
3. Use a maintenance procedure on a compressor.
 - Frequency of maintenance: monthly, quarterly, yearly, etc.
 - Lockout, shutdown and restart procedures depending on the type of compressor.
 - Cleaning of components: use of degreasers, pressure washer, etc.
 - Mineral and synthetic oils: characteristics, function, effects on system units, handling, precautions to take.
 - Oil changing procedures depending on the type of compressor and housing.
 - Tightening of electrical connections: wire nuts, thimbles, connectors, screws.
 - Replacement of components as a preventive measure: belts, filters, etc.
4. Use a repair procedure on a compressor.
 - Repair procedures for the different components.
 - Lockout, shutdown and restart procedures depending on the type of compressor.
 - Sequence of operations for removing and reinstalling parts: identification of parts, positioning of parts, work methods, etc.
 - Replacement of a valve plate, unloader, start device, overload protector, variable-speed drive, etc.
 - Repair of a valve, leak, electrical connections, etc.

5. Install and connect a replacement compressor.
 - Choice of replacement compressor: types of installations and applications, operating pressures, location (indoors or outdoors), power supply, etc.
 - Positioning of compressor: installation and alignment.
 - Anchoring of units: screws, anchors, etc.
 - Connection of units (see competencies 5, 10 and 13).
6. Commission a compressor and adjust its operation.
 - Compressor's operational data (see above).
 - Measurement of voltage, amperage and resistance (see competencies 5, 10 and 13).
 - Adjustment of capacity modulation controls: pressure, temperature, rotation speeds.
7. Finish the job.
 - Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
 - Recording of information in the halocarbon log (see Competency 6).
 - Preparation of job sheet: information about the compressor, operational data, components used, work done, labour, etc.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 15 Duration 120 hours Credits 8

Behavioural Competency

Statement of the Competency

Install and commission digital control systems.

Achievement Context

- Working on wired and wireless digital control systems.
- Given instructions.
- Given technical information: rating plates, technical specifications, diagrams of the digital control system.
- Using controllers, sensors and actuators.
- Using hand tools.
- Using electrical measuring instruments: multimeter, ammeter, ohmmeter, etc.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

- | | |
|--|---|
| 1. Plan the work. | <ul style="list-style-type: none"> • Accurate interpretation of instructions and technical information. • Appropriate selection of components. • Appropriate choice of tools and measuring instruments. |
| 2. Install the components of the digital control system. | <ul style="list-style-type: none"> • Proper positioning of controller, sensor and actuator. • Proper anchoring of controller, sensor and actuator. |
| 3. Connect the digital control system. | <ul style="list-style-type: none"> • Proper installation of conductors. • Precise determination of connection points. • Compliance with requirements respecting the connection of a wired or wireless digital control system. |
| 4. Prepare to commission the digital control system. | <ul style="list-style-type: none"> • Correct energization of circuit. • Appropriate preliminary adjustment of initial parameters of the digital control system. |
| 5. Commission the digital control system. | <ul style="list-style-type: none"> • Observance of start-up procedure. • Accurate measurement of voltage, amperage and resistance. • Accurate measurement of input and output signals of the digital control system. • Appropriate verification of the digital control system's operating sequence. |

- Careful determination of malfunctions and their causes.
 - Relevant corrective measures taken.
6. Adjust the digital control system.
- Appropriate adjustment of final parameters of the digital control system.
 - Proper operation of digital control system.
7. Finish the job.
- Proper storage of tools and measuring instruments.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools and measuring instruments.
- Compliance with instructions.
- Compliance with electrical codes.
- Observance of lockout procedures.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the work.
 - Technical information: rating plates, technical specifications, diagrams of the digital control system.
 - Electrical code requirements.
 - Lockout procedures depending on the type of equipment.
 - Occupational health and safety rules for live-line work: electric shock, arc flash.
 - Components: controller, sensor, actuator, conductor.
 - Tools: electrician's pliers, crimper, screwdriver, electrician's knife, etc.
 - Electrical measuring instruments: multimeter, ammeter, ohmmeter, etc.
2. Install the components of the digital control system.
 - Controllers: proportional, proportional-plus-integral, proportional-plus-integral-plus-derivative, digital and analog outputs, control strategy and options.
 - Sensors: temperature, pressure, humidity, enthalpy, speed, flow, etc.
 - Actuators: electric and pneumatic servo-actuators, stepper motor, etc.
 - Positioning of components of the digital control system based on the manufacturer's requirements (clearance, air circulation, ambient temperature, length of conductors between components, etc.).
 - Anchoring: screws, anchors, DIN rail, etc.

3. Connect the digital control system.
 - Conductors: gauge, amperage, number of strands, sheath, shield, etc.
 - Connection points: power source, return (neutral), ground, signal.
 - Method of removing conductor sheaths and insulation.
 - Methods of screwing, splicing and crimping conductors, and use of insulated and non-insulated connectors (wire nuts, terminals, communications connectors, etc.).
 - Methods of identifying conductors: colour, number, etc.
 - Connection to a wireless network: software, gateway, addressing, pairing, etc.
4. Prepare to commission the digital control system.
 - Adjustment of initial controller parameters: control points, schedule, start-up, shutdown, etc.
 - Adjustment of initial sensor parameters: temperature, pressure, flow, level, etc.
 - Adjustment of initial actuator parameters: direction of rotation, stroke, etc.
5. Commission the digital control system.
 - Use of measuring instruments.
 - Reading of voltages (AC, 0-10 volts [DC], 2-10 volts [DC], etc.), amperages (4-20 milliamperes) and resistances (0-135 ohms) at the controller, sensor and actuator inputs and outputs.
 - Malfunctions: open circuit, short circuit, defective electrical or electronic components, parasitic resistance, defective network, etc.
6. Adjust the digital control system.
 - Adjustment of final controller parameters: control points, schedule, start-up, shutdown, etc.
 - Adjustment of final sensor parameters: temperature, pressure, flow, level, etc.
 - Adjustment of final actuator parameters: direction of rotation, stroke, etc.
7. Finish the job.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 16 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency

Establish the optimal operating conditions for an HVAC/R system.

Achievement Context

- Using technical information about the different HVAC/R systems.
- Using a psychrometric chart.
- Using enthalpy diagrams.
- Using measuring instruments: thermometer, manometer, multimeter, hygrometer, velocimeter, flowmeter, anemometer, refractometer, etc.
- Using the necessary protective equipment.

Elements of the Competency

1. Gather technical information about an HVAC/R system.
2. Prepare to take measurements.
3. Measure the ambient conditions and the properties of a heat transfer medium.
4. Analyze the system's performance.

Performance Criteria

- Accurate interpretation of technical information
- Identification of all system units, refrigerant lines, accessories and ducts.
- Careful determination of measurements to be taken.
- Careful choice of measuring points.
- Careful choice of measuring instruments.
- Accurate measurement of temperatures.
- Accurate measurement of pressures.
- Accurate measurement of humidity.
- Accurate measurement of amperage and current.
- Accurate measurement of air speed and flow.
- Accurate measurement of the concentration of the heat transfer medium.
- Appropriate use of measuring instruments.
- Appropriate use of a psychrometric chart.
- Accurate determination of the amount of heat to extract.
- Accurate determination of the system's capacity.
- Accurate determination of the absorption capacity of the heat transfer medium.
- Accurate calculation of the difference between the amount of heat to extract and the system's capacity.
- Appropriate use of enthalpy diagrams.

5. Propose solutions for optimizing the system.
- Careful determination of units, components or accessories to optimize.
 - Careful determination of the optimal operating variables.

For the competency as a whole:

- Appropriate choice and use of mathematical formulas.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Gather technical information about an HVAC/R system.
 - Types of applications: refrigeration, air conditioning.
 - Technical information about HVAC/R systems.
 - Refrigeration system units: compressor, condenser, expansion valve, evaporator.
 - Heating and ventilation system units: furnace, air make up unit, ventilator, etc.
 - Refrigerant lines: discharge, condensate, fluid, suction.
 - Direction of flow of refrigerant.
 - Refrigeration system accessories: receiver, drier, sight glass, expansion valve, etc.
 - Heating and ventilation system accessories: heating elements, dampers, baffles, canvas ducts, louvers, grilles, mufflers, diffusers, etc.
 - Ventilation ducts: dimensions, speed, volumetric flow (cubic feet per minute [CFM], etc.).

2. Prepare to take measurements.
 - Conditions for comfort: ambient temperature, air quality, sunlight, etc.
 - Types of measurements: temperature, pressure, humidity, voltage, amperage, air speed, air flow
 - Units of measurement for temperature: Celsius, Fahrenheit, Kelvin and Rankine.
 - Units of measurement for pressure: gauge pressure in pounds per square inch gauge (PSIG), absolute pressure in pounds per square inch absolute (PSIA), inch of mercury (mmHg and inHg), bar, kilopascal, etc.
 - Units of measurement for humidity: percentage of relative humidity.
 - Units of measurement for voltage (volts) and amperage (amperes).
 - Units of measurement for air speed: feet per minute (FPM).
 - Units of measurement for air flow: cubic feet per minute (CFM).
 - Units of measurement for the concentration of a heat transfer medium: percentage of glycol.
 - Pressure measurement points: at the compressor's inlet and outlet.
 - Temperature measurement points: at the inlets and outlets of the compressor, condenser, expansion valve and evaporator.
 - Humidity measurement points: at the air inlets and outlets of the condenser and evaporator.

- Voltage and amperage measurement points: at the inlets of the various units.
 - Air speed and air flow measurement points: at the inlets and outlets of the heating and ventilation units, ducts, etc.
 - Measurement points for the concentration of the heat transfer medium: at the pipes' entry points.
3. Measure the ambient conditions and the properties of a heat transfer medium.
- Use of infrared and electronic thermometers: positioning, insulation, duration and precautions to take.
 - Use of analog or digital manometer, multimeter, hygrometer, velocimeter, flowmeter, anemometer and refractometer: positioning, duration, precautions to take.
 - Use of air psychrometric chart: data collected, plotting.
4. Analyze the system's performance.
- Formulas for calculating the latent, sensible and total heat of the air.
 - Use of enthalpy diagrams to calculate the system's capacity: heat of compression (HoC), net refrigeration effect (NRE), heat of rejection (HoR), etc.
5. Propose solutions for optimizing the system.
- Examples of units, components or accessories to be optimized: changes to or replacement of a compressor, expansion valve, fan, damper, regulator, controller, actuator, etc.
 - Optimal operation variables: temperatures, pressures, humidity, refrigerant charge, air speed or flow, superheating, subcooling.

Competency 17 Duration 105 hours Credits 7

Behavioural Competency

Statement of the Competency

Service a refrigeration system.

Achievement Context

- Given instructions.
- Using the service contract.
- Using technical information: rating plates, technical specifications.
- Using maintenance and repair procedures.
- Using maintenance products and replacement components.
- Using hand tools.
- Using instruments for measuring liquids and electrical measuring instruments.
- Using the necessary equipment for brazing, access, handling, etc.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

- | | |
|---|--|
| 1. Plan the work. | <ul style="list-style-type: none"> • Accurate interpretation of dispatcher's instructions. • Accurate interpretation of service contract. • Accurate interpretation of technical information. • Appropriate choice of tools, equipment and measuring instruments. |
| 2. Diagnose a refrigeration system malfunction. | <ul style="list-style-type: none"> • Appropriate verification of the condition of the units and piping. • Appropriate verification of the refrigeration system's operation. • Accurate measurement of voltage, amperage and resistance. • Accurate diagnosis. |
| 3. Use a maintenance procedure on a refrigeration system. | <ul style="list-style-type: none"> • Accurate interpretation of maintenance procedure. • Proper cleaning of units and components • Appropriate lubrication of mechanical components. • Proper tightening of loose electrical connections. • Proper replacement of components as a preventive measure. |

4. Use a repair procedure on a refrigeration system.
 - Accurate interpretation of repair procedure.
 - Observance of sequence of operations for removing and reinstalling parts.
 - Proper replacement or repair of units, piping or defective components.

5. Ensure the efficiency of a refrigeration system.
 - Accurate measurement of ambient conditions.
 - Precise analysis of system performance.
 - Precise adjustment of operating parameters.
 - Precise adjustment of regulators.
 - Optimal operation of system.

6. Inform the customer of the work done.
 - Observance of customer-based approach and the rules of courtesy.
 - Accurate and relevant information conveyed.

7. Finish the job.
 - Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Proper preparation of job sheet.
 - Proper storage of tools, equipment, measuring instruments and products.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools, equipment and measuring instruments.
- Optimization of refrigerant charge.
- Compliance with instructions.
- Observance of lockout procedures.
- Observance of shutdown and restart procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the work.
 - Dispatcher's instructions: priority, urgency, work schedule, etc.
 - Types of service contracts: preventive maintenance, repair, etc.
 - Technical information: rating plates, technical specifications.
 - Tools, equipment and measuring instruments to use based on job requirements (see competencies 3, 4, 5, 6, 9, 10, 13, 15 and 16).
2. Diagnose a refrigeration system malfunction.
 - Signs of malfunctions: frozen evaporator, obstructed condenser, compressor start-up failure, hissing in the expansion valve, traces of oil, etc.
 - Verification of the refrigeration system's operation (see Competency 4).
 - Measurement of the voltage, amperage and resistance of electrical or electronic components (see competencies 5, 10, 13 and 15).
 - Diagnoses: faulty defrosting, dirt, electrical malfunction, lack of refrigerant, etc.
3. Use a maintenance procedure on a refrigeration system.
 - Frequency of maintenance: monthly, quarterly, yearly, etc.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Cleaning of units and components: use of degreasers, pressure washer, etc.
 - Lubrication of mechanical components: bearings, motors, etc.
 - Tightening of electrical connections: wire nuts, thimbles, connectors, screws.
 - Replacement of components as a preventive measure: worn electrical components, filters and belts.
4. Use a repair procedure on a refrigeration system.
 - Procedures for repairing the different units, piping or components.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Sequence of operations for removing and reinstalling parts: identification of parts, positioning of parts, work methods, etc.
 - Replacement of expansion valve, drier, sight glass, regulator, worn electrical component, defrost timer, solenoid, etc.
 - Repair of the fins in a condenser or evaporator, repair of a leak, repair of electrical connections, etc.
5. Ensure the efficiency of a refrigeration system.
 - Measurement of ambient conditions and analysis of system performance (see Competency 16)
 - Factors that affect efficiency: condensation medium, produce, rate of use, air stream, lighting, temperature, humidity, etc.
 - Adjustment of operating parameters: pressure, temperature, etc.
 - Adjustment of regulators: condensing pressure, evaporating pressure, etc.
 - Optimization of refrigeration system (see competencies 4 and 16).

6. Inform the customer of the work done.
 - Customer-based approach and rules of courtesy: attire, smile, respect, appropriate language etc.
 - Importance of the information conveyed.
7. Finish the job.
 - Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
 - Recording of information in the halocarbon log (see Competency 6).
 - Preparation of job sheet: information about the system, operational data, components used, work done, labour, etc.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 18 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Install a split air conditioning system.

Achievement Context

- Given drawings, specifications and instructions.
- Using technical information: rating plates, technical specifications, earthquake standards.
- Using split air conditioning system units: heat pump, air conditioner.
- Using pipes, accessories, components and assembly products.
- Using the components of the control device.
- Using hand tools.
- Using the necessary equipment for brazing, welding, access, handling, etc.
- Using measuring and scribing instruments, instruments for measuring liquids and electrical measuring instruments.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

1. Plan the installation.

- Accurate interpretation of drawings, specifications and instructions.
- Accurate interpretation of technical information.
- Appropriate selection of system components.
- Appropriate choice of tools, equipment and measuring and scribing instruments.

2. Install the units of the split air conditioning system.

- Precise determination of positioning of units.
- Precise installation and alignment of units.
- Precise levelling of units.
- Proper, solid anchoring of units.
- Appropriate connection of units.
- Observance of the required distance between units.

3. Install the piping.

- Precise determination of the positioning of the pipes and accessories.
- Precise installation and alignment of pipes and accessories.
- Proper, solid anchoring of pipes and accessories.
- Appropriate verification of leaktightness of valves.

- Compliant evacuation of circuit.
 - Appropriate precharging of refrigerant.
4. Install the control devices.
- Precise determination of positioning of the control circuit, digital control system and zone panel.
 - Proper installation and anchoring of the control circuit, digital control system and zone panel.
 - Appropriate connection of the control circuit, digital control system and zone panel.
5. Finish the job.
- Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Proper preparation of job sheet.
 - Proper storage of tools, equipment, measuring and scribing instruments and products.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools, equipment and measuring and scribing instruments.
- Relevant corrective measures taken.
- Compliance with instructions.
- Compliance with earthquake standards.
- Observance of lockout procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the installation.
- Characteristics of a split air conditioning system:
 - split air conditioners and heat pumps
 - types of heat transfer: air-air, air-water, water-water
 - air conditioning processes: types of evaporators, speed, humidity, etc.
 - hot gas defrosting: time/temperature, on demand

- Drawings and specifications (see Competency 8).
 - Technical information: rating plates, technical specifications, earthquake standards (see Competency 3).
 - Components: units, piping, control device.
 - Tools, equipment and measuring and scribing instruments to use based on job requirements (see competencies 3, 5, 6, 9, 10, 13 and 15).
2. Install the units of the split air conditioning system.
- Types of split air conditioners and heat pumps: self-contained or other air conditioner, single-zone or multizone split system.
 - Positioning of units based on manufacturer's requirements (clearance, air circulation, etc.).
 - Installation, alignment and levelling of units: manufacturer's requirements and use of measuring and scribing instruments.
 - Anchoring of units: screws, anchors, etc.
 - Connection of units (see Competency 5).
3. Install the piping..
- Flexible and rigid pipes
 - Accessories: dampers, damper motors, bidirectional drier, load compensator, etc.
 - Positioning of pipes and accessories based on the position of the units.
 - Installation, alignment and anchoring of pipes and accessories (see Competency 3).
 - Verification of the installation's leaktightness and evacuation (see Competency 6).
 - Vacuum breaking with refrigerant precharge.
4. Install the control devices.
- Control circuit devices: thermostat, frost controller, fan controller, etc. (see Competency 10).
 - Digital control system: controller, sensor, actuator (see Competency 15).
 - Zone panel: number of zones, variable volume, constant volume at the unit, variable volume in the room.
 - Positioning of thermostat near the air return, away from heat sources, etc.
 - Connection of control circuit, digital control system and zone panel (see competencies 5, 10 and 15).
5. Finish the job.
- Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
 - Recording of information in the halocarbon log (see Competency 6).
 - Preparation of job sheet: information about the system, components used, work done, labour, etc.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 19 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Commission an air conditioning system or liquid chiller.

Achievement Context

- Given instructions.
- Using technical information: rating plates, technical specifications.
- Using hand tools.
- Using instruments for measuring liquids and electrical measuring instruments.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

1. Prepare to commission the air conditioning system or liquid chiller.
2. Perform a pre-operational inspection of the system.
3. Make the preliminary adjustments to the air conditioning system or liquid chiller.
4. Start up the air conditioning system or liquid chiller.
5. Adjust the air conditioning system or liquid chiller.

Performance Criteria

- Accurate interpretation of instructions and technical information.
- Appropriate choice of tools and measuring instruments.
- Appropriate check for ground faults and short circuits.
- Appropriate verification of voltage at the isolating switch inlet.
- Appropriate verification of oil level.
- Correct energization of circuit.
- Appropriate preliminary adjustment of flows.
- Appropriate preliminary adjustment of initial control point parameters.
- Appropriate preliminary adjustment of initial parameters of the motor control circuit, electronic motor control device or digital control system.
- Appropriate preliminary adjustment of regulators.
- Accurate measurement of voltage, amperage and resistance.
- Appropriate charging of refrigerant.
- Appropriate verification of the operation of the system or chiller.
- Proper adjustment of final flow parameters.
- Proper adjustment of final control point parameters.

- Proper adjustment of final parameters of the motor control circuit, electronic motor control device or digital control system.
 - Proper adjustment of regulators.
 - Proper operation of system or chiller.
6. Finish the job.
- Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Accurate recording of information in the commissioning report.
 - Proper storage of tools and measuring instruments.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of hand tools and measuring instruments.
- Relevant corrective measures taken.
- Compliance with instructions.
- Observance of lockout procedures.
- Observance of shutdown and restart procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Prepare to commission the air conditioning system or liquid chiller.
 - Technical information: rating plates, technical specifications.
 - Tools and measuring instruments to use based on job requirements (see competencies 4, 5, 6, 10, 13 and 15).
2. Perform a pre-operational inspection of the system.
 - Check for ground faults and short circuits and verification of voltage at the isolating switch inlet (see competencies 5, 10, 13 and 15).
 - Verification of compressor oil level.

3. Make the preliminary adjustments to the air conditioning system or liquid chiller.
 - Energization (see Competency 5).
 - Appropriate preliminary adjustment of flows: air, water, glycol, etc.
 - Preliminary adjustment of initial control point parameters: temperature, pressure.
 - Preliminary adjustment of initial parameters of the motor control circuit, electronic motor control device or digital control system (see competencies 10, 13 and 15).
 - Preliminary adjustment of initial regulator parameters: pressure, flow, level, etc.
4. Start up the air conditioning system or liquid chiller.
 - Measurement of voltage, amperage and resistance (see competencies 5, 10, 13 and 15).
 - Charging of refrigerant (see Competency 6).
 - Verification of the refrigeration system's operation (see Competency 4).
5. Adjust the air conditioning system or liquid chiller.
 - Adjustment of final flow parameters: air, water, glycol, etc.
 - Adjustment of final control point parameters: temperature, pressure
 - Adjustment of final parameters of the motor control circuit, electronic motor control device or digital control system (see competencies 10, 13 and 15).
 - Adjustment of final regulator parameters: pressure, flow, level, etc.
6. Finish the job.
 - Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
 - Recording of information in the halocarbon log (see Competency 6).
 - Recording of information in the commissioning report: information about the system, operational data, work done, labour, etc.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 20 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency

Service a packaged air conditioning system.

Achievement Context

- Given instructions.
- Using the service contract.
- Using technical information: rating plates, technical specifications.
- Using maintenance and repair procedures.
- Using maintenance products and replacement components.
- Using hand tools.
- Using instruments for measuring liquids and electrical measuring instruments.
- Using the necessary equipment for brazing, access, handling, etc.
- Using the halocarbon log.
- Using the necessary protective equipment

Elements of the Competency

Performance Criteria

- | | |
|--|--|
| <p>1. Plan the work.</p> | <ul style="list-style-type: none"> • Accurate interpretation of dispatcher's instructions. • Accurate interpretation of service contract. • Accurate interpretation of technical information. • Appropriate choice of tools, equipment and measuring instruments. |
| <p>2. Diagnose a packaged air conditioning system malfunction.</p> | <ul style="list-style-type: none"> • Appropriate verification of the condition of the units and piping. • Appropriate verification of the operation of the supplementary heating. • Appropriate verification of the refrigeration system's operation. • Accurate measurement of voltage, amperage and resistance. • Accurate diagnosis. |
| <p>3. Use a maintenance procedure on a packaged air conditioning system.</p> | <ul style="list-style-type: none"> • Accurate interpretation of maintenance procedure. • Proper cleaning of units and components • Appropriate lubrication of mechanical components. • Proper tightening of loose electrical connections. • Proper replacement of components as a preventive measure. |

4. Use a repair procedure on a packaged air conditioning system.
 - Accurate interpretation of repair procedure.
 - Observance of sequence of operations for removing and reinstalling parts.
 - Proper replacement or repair of units, piping or defective components.

5. Ensure the efficiency of a packaged air conditioning system.
 - Accurate measurement of ambient conditions.
 - Accurate analysis of system performance.
 - Precise adjustment of operating parameters.
 - Optimal operation of system.

6. Inform the customer of the work done.
 - Observance of customer-based approach and the rules of courtesy.
 - Accurate and relevant information conveyed.

7. Finish the job.
 - Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Proper preparation of job sheet.
 - Proper storage of tools, equipment, measuring instruments and products.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools, equipment and measuring instruments.
- Optimization of refrigerant charge.
- Compliance with instructions.
- Observance of lockout procedures.
- Observance of shutdown and restart procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations
- Compliance with environmental protection rules
- Compliance with occupational health and safety rules

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the work.
 - Dispatcher's instructions: priority, urgency, work schedule, etc.
 - Types of service contracts: preventive maintenance, repair, etc.
 - Technical information: rating plates, technical specifications.
 - Tools, equipment and measuring instruments to use based on job requirements (see competencies 3, 4, 5, 6, 9, 10, 13, 15 and 16).
2. Diagnose a packaged air conditioning system malfunction.
 - Signs of malfunctions: frozen evaporator, obstructed condenser, compressor start-up failure, hissing in the expansion valve, traces of oil, etc.
 - Verification of operation of the supplementary heating (propane, natural gas, electricity).
 - Verification of the refrigeration system's operation (see Competency 4).
 - Measurement of the voltage, amperage and resistance of electrical or electronic components (see competencies 5, 10, 13 and 15).
 - Diagnoses: economizer malfunction, dirt, electrical malfunction, lack of refrigerant, etc.
3. Use a maintenance procedure on a packaged air conditioning system.
 - Frequency of maintenance: monthly, quarterly, yearly, etc.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Cleaning of units and components: use of degreasers, pressure washer, etc.
 - Cleaning of drain and condensation pan.
 - Lubrication of mechanical components: bearings, motors, etc.
 - Tightening of electrical connections: wire nuts, thimbles, connectors, screws.
 - Replacement of components as a preventive measure: worn electrical components, filters and belts.
4. Use a repair procedure on a packaged air conditioning system.
 - Procedures for repairing the different units, piping or components.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Sequence of operations for removing and reinstalling parts: identification of parts, positioning of parts, work methods, etc.
 - Replacement of economizer motor or control, room thermostat, contactor, etc.
 - Repair of the fins in a condenser or evaporator, repair of a leak, repair of electrical connections, etc.
5. Ensure the efficiency of a packaged air conditioning system.
 - Measurement of ambient conditions and analysis of system performance (see Competency 16).
 - Factors that affect efficiency: condensation medium, season, outdoor temperature, number of people and their activities, sunlight, lighting, ambient temperature and humidity, etc.
 - Adjustment of operating parameters: condensing pressure, evaporating pressure, air flow (cubic feet per minute [CFM]), percentage of fresh air, carbon dioxide level, etc.
 - Optimization of refrigeration system (see competencies 4 and 16).

6. Inform the customer of the work done.
 - Customer-based approach and rules of courtesy: attire, smile, respect, appropriate language, etc.
 - Importance of the information conveyed.
7. Finish the job.
 - Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
 - Recording of information in the halocarbon log (see Competency 6).
 - Preparation of job sheet: information about the system, operational data, components used, work done, labour, etc.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 21 Duration 105 hours Credits 7

Behavioural Competency

Statement of the Competency

Service a split air conditioning system.

Achievement Context

- Given instructions.
- Using the service contract.
- Using technical information: rating plates, technical specifications.
- Using maintenance and repair procedures.
- Using maintenance products and replacement components.
- Using hand tools.
- Using instruments for measuring liquids and electrical measuring instruments.
- Using the necessary equipment for brazing, access, handling, etc.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

- | | |
|---|--|
| <p>1. Plan the work.</p> | <ul style="list-style-type: none"> • Accurate interpretation of dispatcher's instructions. • Accurate interpretation of service contract. • Accurate interpretation of technical information. • Appropriate choice of tools, equipment and measuring instruments. |
| <p>2. Diagnose a split air conditioning system malfunction.</p> | <ul style="list-style-type: none"> • Appropriate verification of the condition of the units and piping. • Appropriate verification of the operation of the supplementary heating. • Appropriate verification of the refrigeration system's operation. • Accurate measurement of voltage, amperage and resistance. • Accurate diagnosis. |
| <p>3. Use a maintenance procedure on a split air conditioning system.</p> | <ul style="list-style-type: none"> • Accurate interpretation of maintenance procedure. • Proper cleaning of units and components. • Appropriate lubrication of mechanical components. • Proper tightening of loose electrical connections • Proper replacement of components as a preventive measure. |

4. Use a repair procedure on a split air conditioning system.
 - Accurate interpretation of repair procedure.
 - Observance of sequence of operations for removing and reinstalling parts.
 - Proper replacement or repair of units, piping or defective components.
5. Ensure the efficiency of a split air conditioning system.
 - Accurate measurement of ambient conditions.
 - Accurate analysis of system performance.
 - Precise adjustment of operating parameters.
 - Optimal operation of system.
6. Inform the customer of the work done.
 - Observance of customer-based approach and the rules of courtesy.
 - Accurate and relevant information conveyed.
7. Finish the job.
 - Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Proper preparation of job sheet.
 - Proper storage of tools, equipment, measuring instruments and products.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools, equipment and measuring instruments.
- Optimization of refrigerant charge.
- Compliance with instructions.
- Observance of lockout procedures.
- Observance of shutdown and restart procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the work.
 - Dispatcher's instructions: priority, urgency, work schedule, etc.
 - Types of service contracts: preventive maintenance, repair, etc.
 - Technical information: rating plates, technical specifications.
 - Tools, equipment and measuring instruments to use based on job requirements (see competencies 3, 4, 5, 6, 9, 10, 13, 15 and 16).
2. Diagnose a split air conditioning system malfunction.
 - Signs of malfunctions: frozen evaporator, obstructed condenser, compressor start-up failure, hissing in the expansion valve, traces of oil, etc.
 - Verification of operation of the supplementary heating and the forced-air furnace (oil, propane, natural gas, wood, electricity).
 - Verification of the refrigeration system's operation (see Competency 4).
 - Measurement of the voltage, amperage and resistance of electrical or electronic components (see competencies 5, 10, 13 and 15).
 - Diagnoses: faulty defrosting, dirt, electrical malfunction, lack of refrigerant, etc.
3. Use a maintenance procedure on a split air conditioning system.
 - Frequency of maintenance: monthly, quarterly, yearly, etc.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Cleaning of units and components: use of degreasers.
 - Cleaning of drain and condensation pan.
 - Lubrication of mechanical components: bearings, motors, etc.
 - Tightening of electrical connections: wire nuts, thimbles, connectors, screws.
 - Replacement of components as a preventive measure: worn electrical components, filters, belts.
4. Use a repair procedure on a split air conditioning system.
 - Procedures for repairing the different units, piping or components.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Sequence of operations for removing and reinstalling parts: identification of parts, positioning of parts, work methods, etc.
 - Replacement of drier, contactor, defrost control board, switchover valve, room thermostat, zone panel, electric heating element, etc.
 - Repair of the fins in a condenser or evaporator, repair of a leak, repair of electrical connections, etc.
5. Ensure the efficiency of a split air conditioning system.
 - Measurement of ambient conditions and analysis of system performance (see Competency 16).
 - Factors that affect efficiency: condensation medium, season, outdoor temperature, sunlight, ambient temperature and humidity, etc.
 - Adjustment of operating parameters: condensing pressure, evaporating pressure, air flow (cubic feet per minute [CFM]), etc.
 - Optimization of refrigeration system (see competencies 4 and 16).

6. Inform the customer of the work done.
 - Customer-based approach and rules of courtesy: attire, smile, respect, appropriate language, etc.
 - Importance of the information conveyed.
7. Finish the job.
 - Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
 - Recording of information in the halocarbon log (see Competency 6).
 - Preparation of job sheet: information about the system, operational data, components used, work done, labour, etc.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 22 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency

Service a liquid chiller.

Achievement Context

- Given instructions.
- Using the service contract.
- Using technical information: rating plates, technical specifications.
- Using maintenance and repair procedures.
- Using maintenance products and replacement components.
- Using hand tools.
- Using measuring instruments to measure liquids and/or electrical circuits.
- Using the necessary equipment for brazing, access, handling, etc.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

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|--|---|
| <p>1. Plan the work.</p> | <ul style="list-style-type: none"> • Accurate interpretation of dispatcher's instructions. • Accurate interpretation of service contract. • Accurate interpretation of technical information. • Appropriate choice of tools, equipment and measuring instruments. |
| <p>2. Diagnose a liquid chiller malfunction.</p> | <ul style="list-style-type: none"> • Appropriate verification of the condition of the units and piping. • Appropriate verification of the refrigeration system's operation. • Accurate measurement of voltage, amperage and resistance. • Accurate diagnosis. |
| <p>3. Use a maintenance procedure on a liquid chiller.</p> | <ul style="list-style-type: none"> • Accurate interpretation of maintenance procedure. • Proper cleaning of units and components. • Appropriate lubrication of mechanical components. • Proper tightening of loose electrical connections. • Proper replacement of components as a preventive measure. |

4. Use a repair procedure on a liquid chiller.
 - Accurate interpretation of repair procedure.
 - Observance of sequence of operations for removing and reinstalling parts.
 - Proper replacement or repair of units, piping or defective components.

5. Ensure the efficiency of a liquid chiller.
 - Accurate measurement of ambient conditions and the properties of the heat transfer medium
 - Accurate analysis of system performance.
 - Precise adjustment of operating parameters.
 - Precise adjustment of regulators or fluidic networks.
 - Optimal operation of liquid chiller.

6. Inform the customer of the work done.
 - Observance of customer-based approach and the rules of courtesy.
 - Accurate and relevant information conveyed.

7. Finish the job.
 - Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Proper preparation of job sheet.
 - Proper storage of tools, equipment, measuring instruments and products.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools, equipment and measuring instruments.
- Optimization of refrigerant charge.
- Compliance with instructions.
- Observance of lockout procedures.
- Observance of shutdown and restart procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the work.
 - Dispatcher's instructions: priority, urgency, work schedule, etc.
 - Types of service contracts: preventive maintenance, repair, etc.
 - Technical information: rating plates, technical specifications
 - Tools, equipment and measuring instruments to use based on job requirements (see competencies 3, 4, 5, 6, 9, 10, 13, 15 and 16).
2. Diagnose a liquid chiller malfunction.
 - Signs of malfunctions: inoperative refrigeration subsystem, insufficient temperature or flow in the cooled water subsystem or condensed water subsystem, poor quality water in the networks, etc.
 - Verification of the refrigeration system's operation (see Competency 4).
 - Measurement of the voltage, amperage and resistance of electrical or electronic components (see competencies 5, 10, 13 and 15).
 - Diagnoses: water tower or dry cooler malfunction, dirt, contamination, lack of refrigerant, etc.
3. Use a maintenance procedure on a liquid chiller.
 - Frequency of maintenance: monthly, quarterly, yearly, etc.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Cleaning of units and components: use of degreasers, disinfectants, pressure washer, etc.
 - Lubrication of mechanical components: bearings, motors, etc.
 - Tightening of electrical connections: wire nuts, thimbles, connectors, screws.
 - Replacement of components as a preventive measure: worn electrical components, air filters, water network filters, etc.
4. Use a repair procedure on a liquid chiller.
 - Procedures for repairing the different units, piping or components.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Sequence of operations for removing and reinstalling parts: identification of parts, positioning of parts, work methods, etc.
 - Replacement of pump, unloader, regulator, contactor, variable-speed drive, controller, etc.
 - Repair of the fins in a condenser or evaporator, repair of a leak, repair of electrical connections, etc.
5. Ensure the efficiency of a liquid chiller.
 - Measurement of ambient conditions and the properties of the heat transfer medium, and analysis of system performance (see Competency 16).
 - Factors that affect efficiency: condensation medium, produce, rate of use, air stream, lighting, temperature, humidity, etc.
 - Adjustment of operating parameters: pressure, temperature, etc.
 - Adjustment of regulators or fluidic networks: condensing pressure, evaporating pressure, heat transfer medium flow, etc.
 - Optimization of refrigeration system (see competencies 4 and 16).

6. Inform the customer of the work done.
 - Customer-based approach and rules of courtesy: attire, smile, respect, appropriate language, etc.
 - Importance of the information conveyed.
7. Finish the job.
 - Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
 - Recording of information in the halocarbon log (see Competency 6).
 - Preparation of job sheet: information about the system, operational data, components used, work done, labour, etc.
 - Importance of proper storage of equipment and cleanliness of work area.

Competency 23 Duration 120 hours Credits 8

Behavioural Competency

Statement of the Competency

Service a central air conditioning system.

Achievement Context

- Given instructions.
- Using the service contract.
- Using technical information: rating plates, technical specifications.
- Using maintenance and repair procedures.
- Using maintenance products and replacement components.
- Using hand tools.
- Using instruments for measuring liquids and electrical measuring instruments.
- Using the necessary equipment for brazing, access, handling, etc.
- Using the halocarbon log.
- Using the necessary protective equipment.

Elements of the Competency

Performance Criteria

- | | |
|--|---|
| 1. Plan the work. | <ul style="list-style-type: none"> • Accurate interpretation of dispatcher's instructions. • Accurate interpretation of service contract. • Accurate interpretation of technical information. • Appropriate choice of tools, equipment and measuring instruments. |
| 2. Diagnose a central air conditioning system malfunction. | <ul style="list-style-type: none"> • Appropriate verification of the condition of the units and piping. • Appropriate verification of the refrigeration system's operation. • Accurate measurement of voltage, amperage and resistance. • Accurate diagnosis. |
| 3. Use a maintenance procedure on a central air conditioning system. | <ul style="list-style-type: none"> • Accurate interpretation of maintenance procedure. • Proper cleaning of units and components. • Appropriate lubrication of mechanical components. • Proper tightening of loose electrical connections. • Proper replacement of components as a preventive measure. |

4. Use a repair procedure on a central air conditioning system.
 - Accurate interpretation of repair procedure.
 - Observance of sequence of operations for removing and reinstalling parts.
 - Proper replacement or repair of units, piping or defective components.

5. Ensure the efficiency of a central air conditioning system.
 - Accurate measurement of ambient conditions and the properties of the heat transfer medium.
 - Accurate analysis of system performance.
 - Precise adjustment of operating parameters.
 - Precise adjustment of regulators or fluidic networks.
 - Optimal operation of system.

6. Inform the customer of the work done.
 - Observance of customer-based approach and the rules of courtesy.
 - Accurate and relevant information conveyed.

7. Finish the job.
 - Observance of procedures for making the system secure.
 - Accurate recording of information in the halocarbon log.
 - Proper preparation of job sheet.
 - Proper storage of tools, equipment, measuring instruments and products.
 - Neatness and cleanliness of work area.

For the competency as a whole:

- Appropriate use of tools, equipment and measuring instruments.
- Optimization of refrigerant charge.
- Compliance with instructions.
- Observance of lockout procedures.
- Observance of shutdown and restart procedures.
- Observance of deadlines.
- Compliance with halocarbon regulations.
- Compliance with environmental protection rules.
- Compliance with occupational health and safety rules.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Plan the work.
 - Dispatcher's instructions: priority, urgency, work schedule, etc.
 - Types of service contracts: preventive maintenance, repair, etc.
 - Technical information: rating plates, technical specifications.
 - Tools, equipment and measuring instruments to use based on job requirements (see competencies 3, 4, 5, 6, 9, 10, 13, 15 and 16).
2. Diagnose a central air conditioning system malfunction.
 - Signs of malfunctions: obstructed ventilation subsystem, inoperative refrigeration and heating subsystems, limestone in the humidification subsystem, etc.
 - Verification of the refrigeration system's operation (see Competency 4).
 - Measurement of the voltage, amperage and resistance of electrical or electronic components (see competencies 5, 10, 13 and 15).
 - Diagnoses: insufficient temperature of air supply, insufficient humidity of air supply, dirt, electrical malfunction, insufficient pneumatic pressure, etc.
3. Use a maintenance procedure on a central air conditioning system.
 - Frequency of maintenance: monthly, quarterly, yearly, etc.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Cleaning of units and components: use of degreasers, descalers, pressure washer, etc.
 - Cleaning of drain and condensation pan.
 - Lubrication of mechanical components: bearings, motors, etc.
 - Tightening of electrical connections: wire nuts, thimbles, connectors, screws.
 - Replacement of components as a preventive measure: worn electrical components, air filters, water network filters, etc.
4. Use a repair procedure on a central air conditioning system.
 - Procedures for repairing the different units, piping or components.
 - Lockout, shutdown and restart procedures depending on the type of system.
 - Sequence of operations for removing and reinstalling parts: identification of parts, positioning of parts, work methods, etc.
 - Replacement of contactor, overload relay, pneumatic regulator, electropneumatic relay, electric pneumatic relay, three-way valve, variable-speed drive, etc.
 - Repair of a leak in the fluidic network (air, water, glycol), repair of electrical connections, etc.
5. Ensure the efficiency of a central air conditioning system.
 - Measurement of ambient conditions and the properties of the heat transfer medium, and analysis of system performance (see Competency 16).
 - Factors that affect efficiency: season, outdoor temperature, fresh air supply, number of people and their activities, sunlight, lighting, ambient temperature and humidity, etc.
 - Adjustment of operating parameters: condensing pressure, evaporating pressure, percentage of fresh air, carbon dioxide level, etc.
 - Adjustment of regulators or fluidic networks: condensing pressure, evaporating pressure, heat transfer medium flow, etc.
 - Optimization of refrigeration system (see competencies 4 and 16).

6. Inform the customer of the work done.

- Customer-based approach and rules of courtesy: attire, smile, respect, appropriate language, etc.
- Importance of the information conveyed.

7. Finish the job.

- Procedures for making the system secure: closing of service valves, insertion of plugs, installation of electrical cover plates, etc.
- Recording of information in the halocarbon log (see Competency 6).
- Preparation of job sheet: information about the system, operational data, components used, work done, labour, etc.
- Importance of proper storage of equipment and cleanliness of work area.

Competency 24 Duration 15 hours Credit 1

Situational Competency

Statement of the Competency

Be familiar with construction industry organizations.

Elements of the Competency

- Become familiar with the construction industry.
- Learn about the role and importance of industry organizations.
- Understand labour relations in the industry.

Learning Context

Information Phase

- Learning about the construction industry.
- Learning about the roles and responsibilities of construction industry organizations (employer associations, unions, CCQ, Commission des normes, de l'équité, de la santé et de la sécurité du travail [CNESST], etc.).
- Learning about labour relations in the construction industry.

Participation Phase

- Participating in activities enabling them to understand:
 - the past and future of the construction industry
 - the relationships between different trades and occupations
 - the effects of regulations on construction work.
- Exploring development possibilities for industry workers.

Synthesis Phase

- Presenting a report summarizing their learning and evaluating its impact on their career path.

Instructional Guidelines

- Provide the necessary sources of information.
- Rely heavily on learning contexts based on real-life situations in the industry.
- Encourage students to engage in discussions and express themselves.
- Guide the students' synthesis process by providing the necessary tools (e.g. a questionnaire)

Participation Criteria

Information Phase

- Consult the sources of information made available.

Participation Phase

- Participate seriously and consistently in the suggested activities.

Synthesis Phase

- Present a report summarizing their learning and evaluating its impact on their career path.

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to the learning context.

Information Phase

- Characteristics and economic importance of the construction industry.
- Roles and responsibilities of employer associations: Association de la construction du Québec, Association des constructeurs de routes et grands travaux du Québec, Association des entrepreneurs en construction du Québec, Association des professionnels de la construction et de l'habitation du Québec, Corporation des maîtres électriciens du Québec, Corporation des maîtres mécaniciens en tuyauterie du Québec.
- Roles and responsibilities of unions: Fédération des travailleurs et travailleuses du Québec, Conseil provincial du Québec des métiers de la construction, Centrale des syndicats démocratiques, Confédération des syndicats nationaux, Syndicat québécois de la construction.
- Roles and responsibilities of the Commission des relations de travail: structure, sections, fonctions and powers with respect to the construction industry.
- Roles and responsibilities of the Régie du bâtiment du Québec: structure, sections, fonctions and powers.
- Roles and responsibilities of the Commission de la construction du Québec (CCQ): structure, sections, fonctions and powers.
- Roles and responsibilities of occupational health and safety organizations (CNESST and Association sectorielle paritaire): structure, sections, fonctions and powers.

Participation Phase

- Importance of sharing their point of view with classmates: attitude with respect to differing points of view and usefulness in the practice of the trade.
- Characteristics of trades and occupations and differences between them.
- Characteristics of sectoral collective agreements and differences between them: residential, institutional and commercial, industrial, civil engineering, roadworks.
- Legislation and regulations governing labour relations in the construction industry: *Act respecting labour relations, vocational training and workforce management in the construction industry* (CQLR, c. R-20), *Regulation respecting the vocational training of the workforce in the construction industry*, *Règlement sur les régimes complémentaires d'avantages sociaux dans l'industrie de la construction* (regulation respecting complementary social benefit plans in the construction industry) (CQLR, c. R-20, r. 10); reasons for these laws and regulations and their impact on working conditions.
- Advantages of training funds: training fund for construction industry workers, training plan for residential sector workers.

Competency 25 Duration 15 hours Credit 1

Behavioural Competency

Statement of the Competency

Use job search techniques.

Achievement Context

- Using computer hardware and software.

Elements of the Competency

1. Write a résumé.
2. Write a letter of application.

Performance Criteria

- Inclusion of relevant information.
- Comprehensive, accurate information.
- Determination of a sufficient number of potential employers.
- Text relevant to the job sought.
- Careful highlighting of qualifications and interest.

For the competency as a whole:

- Quality of written communication.
- Demonstration of honesty and objectivity .

Suggestions for Competency-Related Knowledge and Know-How

The following is a list of knowledge, skills, attitudes, perceptions and guidelines related to each element of the competency.

1. Write a résumé.
 - Content of a résumé: personal information, education, work experience, achievements, competencies, etc.
 - Importance of the quality of language and the use of a spell checker.
2. Write a letter of application.
 - Search for potential employers by sector of activity and according to personal interest.
 - Content of a letter of application: additional information, highlighting of job-related competencies, explanation of job-related qualifications, request for an interview, thanks, signature.
 - General rules of presentation: lively style, short sentences and paragraphs, etc.
 - Importance of the quality of language and the use of a spell checker.

