PROGRAM OF STUDY

Industrial Construction and Maintenance Mechanics (DVS 5899)

TRAINING SECTOR: MAINTENANCE MECHANICS

Votre gouvernement

Québec

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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 consists of 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.

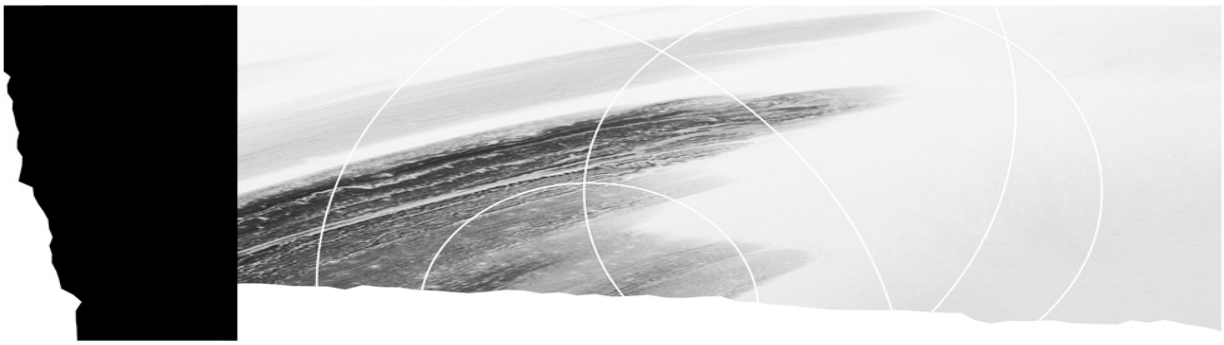
Aspects of Program Implementation

Program-Based Approach

The program-based approach is founded on a comprehensive view of a program of study and its components (e.g. objectives, 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.



5899	**Industrial Construction and Maintenance Mechanics**

Year of approval: 2024

Certification:	Diploma of Vocational Studies
Number of credits:	120
Number of competencies:	26
Total duration:	1800 hours

To be eligible for admission to the *Industrial Construction and Maintenance Mechanics* program, candidates must meet one of the following requirements:

- Persons holding a Secondary School Diploma or its recognized equivalent (e.g. Attestation of Equivalence of Secondary Studies) or a diploma of higher studies, such as a Diploma of College Studies or a bachelor's degree.

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

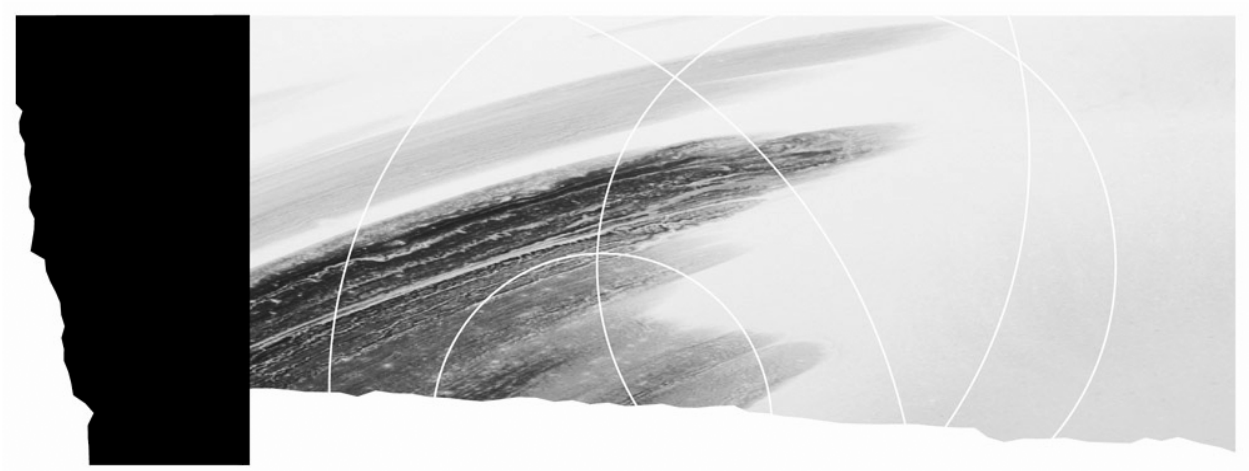
- Persons who have obtained Secondary III credits in language of instruction, second language and mathematics in programs established by the Minister are required to pursue general education courses, concurrently with their vocational training, in Secondary Cycle Two school programs established by the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

The duration of the program is 1800 hours, which includes 915 hours spent on the specific competencies required to practise the trade or occupation and 885 hours on general, work-related competencies. The program of study is divided into 26 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

Successful completion of some or all of the program competencies may entitle students, at their request, to certifications issued by recognized authorities.

Competency	Code	Number	Hours	Credits
The Trade and the Training Process	898501	1	15	1
Sketches	782933	2	45	3
Drawings and Technical Documentation	898513	3	45	3
Health and Safety on Construction Sites	754992	4	30	2
Access and Handling	782962	5	30	2
Shopwork	782947	6	105	7
Forming	898523	7	45	3
Shafts, Bearings and Bushings	898535	8	75	5
Alignment	898544	9	60	4
Mechanical Motion Transmission Devices	898557	10	105	7
Preparation and Installation of Watertight Ducts	782974	11	60	4
Machine Tool Operations	782986	12	90	6
Cutting, Assembly and Welding	898568	13	120	8
Compressors, Vacuum Pumps and Pneumatic Motors	898575	14	75	5
Pumps and Hydraulic Motors	898585	15	75	5
Diagnosis of Electrical Problems	898596	16	90	6
Pneumatic and Electropneumatic Circuits	783027	17	105	7
Hydraulic and Electrohydraulic Circuits	783047	18	105	7
Proportional Hydraulics	898604	19	60	4
Automated System Repair	898614	20	60	4
Vibration Analysis and Balancing	898624	21	60	4
Planned Preventive Maintenance	898634	22	60	4
Installation of Industrial Equipment	898646	23	90	6
Troubleshooting of Industrial Equipment	898656	24	90	6
Career Development	783111	25	15	1
Entering the Workforce	898666	26	90	6



Part I

Program Goals

Educational Aims

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Grid of Competencies

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Program Goals

The *Industrial Construction and Maintenance Mechanics* program prepares students to practise the trade of millwright.

Millwrights install, maintain, troubleshoot, refurbish, repair and modify production equipment, machine tools, handling equipment and all other types of industrial equipment, and help find solutions to optimize them.

They work in manufacturing companies, processing plants, public utility companies and a variety of other industrial establishments. They also work in mining and on construction sites and major civil engineering projects, such as hydro-electric stations, where, among other things, they install machinery and equipment.

The program goals of the *Industrial Construction and Maintenance Mechanics* 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 *Industrial Construction and Maintenance Mechanics* program is to help students develop attitudes and behaviours that representatives from education and the field deem essential to the practice of the trade or occupation:

- self-reliance, for example, to manage their time or learn on their own
- stress tolerance, for example, during a production shutdown, or when faced with a costly or hazardous repair or tight deadlines
- the ability to work in a team

Statements of the Competencies

List of Competencies

- Determine their suitability for the trade and the training process.
- Draw sketches.
- Interpret drawings and technical documentation.
- Prevent risks to health, safety and physical well-being on construction sites.
- Use access and handling equipment.
- Do shopwork.
- Perform forming operations.
- Remove, assemble and adjust shafts, bearings and bushings.
- Perform alignment tasks.
- Maintain and repair mechanical motion transmission devices.
- Prepare and install watertight ducts.
- Perform machining operations using machine tools.
- Cut, assemble and weld metals.
- Maintain and troubleshoot compressors, vacuum pumps and pneumatic motors.
- Maintain and troubleshoot pumps and hydraulic motors.
- Diagnose electrical problems in industrial equipment.
- Install, maintain and troubleshoot pneumatic and electropneumatic circuits.
- Install, maintain and troubleshoot hydraulic and electrohydraulic circuits.
- Install, maintain and troubleshoot proportional control hydraulic circuits.
- Repair automated systems.
- Use a vibration analyzer and perform dynamic balancing.
- Apply the preventive maintenance program for industrial equipment.
- Install industrial equipment.
- Troubleshoot industrial equipment.
- Manage their career.
- Enter the workforce.

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, as well as the major steps in the work process.

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. The symbol (△) indicates a correlation between a specific competency and a step in the work process. 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.

GRID OF COMPETENCIES

INDUSTRIAL CONSTRUCTION AND MAINTENANCE MECHANICS				GENERAL COMPETENCIES																PROCESS						TOTAL
SPECIFIC COMPETENCIES	**Competency number**	**Type of competency**	**Duration (in hours)**	Determine their suitability for the trade and the training process	Draw sketches	Interpret drawings and technical documentation	Prevent risks to health, safety and physical well-being on construction sites	Use access and handling equipment	Do shopwork	Perform forming operations	Remove, assemble and adjust shafts, bearings and bushings	Perform alignment tasks	Prepare and install watertight ducts	Perform machining operations using machine tools	Cut, assemble and weld metals	Diagnose electrical problems in industrial equipment	Use a vibration analyzer and perform dynamic balancing	Manage their career	Learn about the job to be done	Prepare the work	Do the work	Verify the work	Record information about the work	Clean and tidy up	
Competency number				1	2	3	4	5	6	7	8	9	11	12	13	16	21	25							
Type of competency				S	B	B	S	B	B	B	B	B	B	B	B	B	B	S							
Duration (in hours)				15	45	45	30	30	105	45	75	60	60	90	120	90	60	15							885
Maintain and repair mechanical motion transmission devices	10	B	105	○	●	●	●	●	●	○	○	●	○	○	○	○	○	○	▲	▲	▲	▲	▲	▲	
Maintain and troubleshoot compressors, vacuum pumps and pneumatic motors	14	B	75	○	●	●	●	●	●	○	●	●	●	○	○	○	○	○	▲	▲	▲	▲	▲	▲	
Maintain and troubleshoot pumps and hydraulic motors	15	B	75	○	●	●	●	●	●	○	●	●	●	○	○	○	○	○	▲	▲	▲	▲	▲	▲	
Install, maintain and troubleshoot pneumatic and electropneumatic circuits	17	B	105	○	●	●	●	●	●				●	○	○	●		○	▲	▲	▲	▲	▲	▲	
Install, maintain and troubleshoot hydraulic and electrohydraulic circuits	18	B	105	○	●	●	●	●	●			○	●	○	○	○		○	▲	▲	▲	▲	▲	▲	
Install, maintain and troubleshoot proportional control hydraulic circuits	19	B	60	○	●	●	●	●	●				●	○	○	●		○	▲	▲	▲	▲	▲	▲	
Repair automated systems	20	B	60	○	●	●	●	●	●	○	●	●	●	○	○	●	○	○	▲	▲	▲	▲	▲	▲	
Apply the preventive maintenance program for industrial equipment	22	B	60	○	●	●	●	●	●	●	●	●	●	●	●	●	●	○	▲	▲	▲	▲	▲	▲	
Install industrial equipment	23	B	90	○	●	●	●	●	●	●	●	●	●	●	●	●	●	○	▲	▲	▲	▲	▲	▲	
Troubleshoot industrial equipment	24	B	90	○	●	●	●	●	●	●	●	●	●	●	●	●	●	○	▲	▲	▲	▲	▲	▲	
Enter the work force	26	S	90	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	△	△	△	△	△	△	
Total duration			915																						1800

Links between the general and specific competencies:
○: Existence of a link
●: Application of a link

Links between the work process and the specific competencies
△: Existence of a link
▲: Application of a link

Harmonization

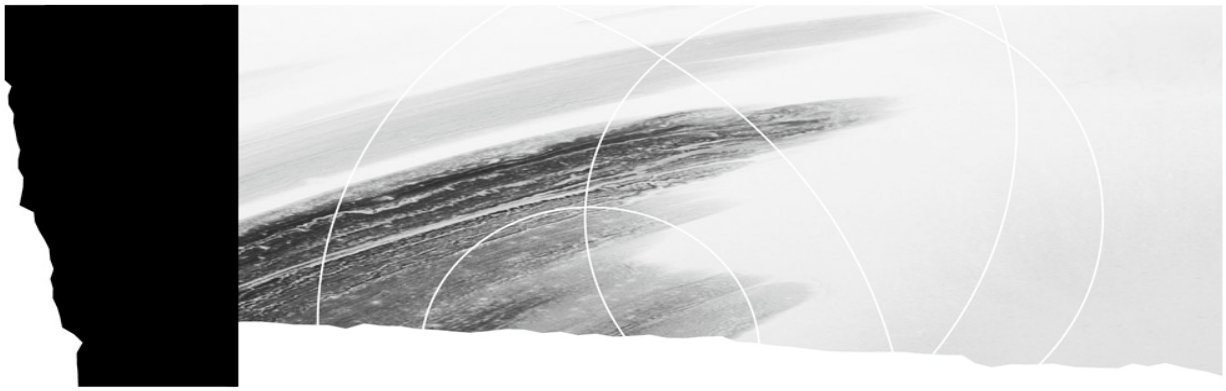
Harmonization of vocational and technical programs is a Ministerial orientation. It involves establishing similarities and continuity between secondary- and college-level programs within a particular sector or between sectors in order to avoid overlap in program offerings, to recognize prior learning 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 *Industrial Construction and Maintenance Mechanics* 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, Mécanique industrielle de construction et d'entretien*.



Part II

Program Competencies

The Trade and the Training Process	Code: 898501

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

- Become familiar with the nature of the trade and potential career opportunities.
- Understand the training process.
- Confirm their career choice.

Learning Context

Information Phase

- Learning about the nature of the trade (legal and regulatory framework, etc.)
- Learning about the characteristics of the job market in industrial construction and maintenance mechanics (workplaces, job prospects, remuneration, opportunities for advancement and transfer, etc.)
- Learning about the nature and requirements of the job (tasks, working conditions, etc.)
- Learning about the training program (program of study, training process, evaluation methods and certification of studies) and opportunities for continuing training.

Participation Phase

- Discussing the skills, attitudes and knowledge required to practise the trade.
- Discussing the relevance of the training program with respect to the trade of millwright.
- Participating in a group visit to a workplace.
- Presenting the information gathered and discussing their perception of the trade.

Synthesis Phase

- Assessing their aptitudes, preferences, skills, attitudes and aspects to be improved with regard to practising the trade.
- Assessing their career choice by comparing the requirements of the trade with their profile.

Instructional Guidelines

- Foster discussion and allow all students to express themselves.
- Help students develop a realistic perception of the trade.
- Make available all relevant documents.
- Organize an activity allowing students to become familiar with the workplace and talk to people who practise the trade.
- Provide students with the means to assess their career choice honestly and objectively.

Participation Criteria

Information Phase

- Gather information on the topics covered.

Participation Phase

- During a group meeting or a meeting with the teacher, and making connections with the information gathered, present their perception of:
  - the training program
  - the trade.

Synthesis Phase

- Present an oral or written report containing:
  - a summary of their preferences, interests and aptitudes
  - explanations of their career choice, comparing the requirements of the trade with their preferences, interests and aptitudes.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to each phase of the learning context, along with their attendant guidelines.

Information Phase

- Locating of information in technical documents, during visits, at meetings or on the Internet; importance of the source of the information.
- Note-taking method.
- Definition of the trade: tasks, functions, etc.
- Types of companies in which the trade is practised: industrial manufacturing and processing companies, the construction sector, public utilities, mining, civil engineering, etc.
- Laws, regulations, codes and standards governing millwrights' work.
- Fields of activity, hiring statistics, salaries, etc.
- Skills sought by employers.
- Conditions required for learning: favourable climate, interest, concentration, physical and mental well-being, etc.
- Code of conduct and requirements of the educational institution.
- Training process, scope of the trade and versatility.
- Contents of the program of study and information about evaluation for certification purposes.

Participation Phase

- Method of organizing and presenting information.
- Information to be recorded during the visit to the workplace or a meeting with a millwright.
- Benefits of stating their point of view and listening to others.
- Rules governing group discussion: listening, each person's right to speak, staying on topic, attentiveness to others and openness to different points of view, etc.
- Development of open-mindedness to constructive criticism.

Synthesis Phase

- Definition of expectations.
- Preferences with respect to the field of application and tasks performed.
- Reasons justifying their career choice, their view of the trade and the means available to practise it.
- Principal elements of an oral or written report confirming their career choice: summary of their preferences, interests and aptitudes, and the requirements someone must satisfy in order to practise the trade; comparison of their preferences, aptitudes and interests with the requirements of the trade.
- Explanation of their career choice.

Sketches	Code: 782933

Competency 2 Duration 45 hours Credits 3

Behavioural Competency

Statement of the Competency	**Achievement Context**
Draw sketches.	• Given a simple mechanical component requiring three orthographic projections. • Using: – the equipment needed to draw freehand and perform computer-aided drawing (CAD) – measuring instruments: graduated ruler, tape measure, vernier calliper, etc. – an email application.

Elements of the Competency	**Performance Criteria**
1. Take measurements of a component.	• Accurate determination of measurements to take. • Accurate determination of the measuring system used. • Appropriate use of measuring instruments. • Accurate measurements.
2. Draw freehand an orthographic projection of a component.	• Proper selection of views. • Appropriate arrangement of views. • Observance of proportions. • Observance of shapes. • Use of the appropriate types of lines. • Presence of all lines.
3. Handwrite the dimensions and additional data on a sketch.	• Accuracy and arrangement of dimensions on a sketch. • Presence of all the data needed to manufacture a component. • Absence of redundancy.
4. Reproduce a component in a technical drawing application.	• Effective use of the basic functions of an application. • Faithful reproduction of a component. • Correct indication of dimensions and additional data. • Proper backing up of file.

5. Transmit a file.	• Proper printing of file, if applicable. • Appropriate transfer of file in a different format • Proper transmission of file using an email application.
	For the competency as a whole: • Clarity and legibility of the sketches. • Proper choice and appropriate use of measuring instruments and drawing equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Imperial and metric units for measuring length, and conversion from one system to the other.
- Distinction between orthographic and isometric projections.
- Steps in the production of a sketch.
- Importance of neatness, and accurate and clear indications.
- English and French terminology related to technical drawing.

1. Take measurements of a component.
   - Use of imperial and international units of measurement.
   - Measurement and reading methods used with graduated rulers, tape measures, vernier callipers, etc., in millimetres and fractions of an inch.
   - Method of determining the measuring system used.
   - Determination of the diameter of a hole and the thread pitch.

2. Draw freehand an orthographic projection of a component.
   - Distinction among the different views in technical drawing.
   - Criteria for choosing which views to draw.
   - Convention concerning the arrangement of views.
   - Method of transferring a sketch from one view to another.
   - Methods of drawing horizontal, vertical, oblique, perpendicular and curved lines.
   - Methods of drawing geometric shapes: squares, rectangles, circles, etc.
   - Characteristics of the different types of lines: contour, hidden, centre, etc.
   - Elements to verify to ensure the compliance of a sketch.

3. Handwrite the dimensions and additional data on a sketch.
    - Convention concerning the arrangement of dimensions.
    - Convention concerning extension lines and dimensions.
    - Dimensioning of sizes and positions.
    - Dimensioning of diameters, radii and angles.
    - Dimensioning of threads and bevels.
    - Arrangement of dimensions.
    - Indication of threaded holes.
    - Method of verifying the presence of all the necessary dimensions, without redundancies.
    - Additional data: nature of the material to use, measurement system used, number of components to draw, name of drafter, tolerances, annotations, data needed to manufacture the component, etc.
    - Importance of indicating additional data.

4. Reproduce a component in a technical drawing application.
    - Terminology related to the functions of a drawing application.
    - Basic functions: locating and reading of a file, creation of a file and choice of file name (importance of choosing a coherent and logical name), use of application commands, method of backing up a file (on a removable medium, to the cloud, etc.), etc.
    - Distinction among the different axes: *x*, *y* and *z.*

5. Transmit a file.
    - Selection (or addition) of a printer and adjustment of printer settings.
    - Distinction among the different paper formats.
    - Most common file format types.
    - Method of transferring files in a different format.
    - Advantages and disadvantages of the different email applications.
    - Functions of email applications: transfer a file, send to several recipients, etc.

Drawings and Technical Documentation	Code: 898513

Competency 3 Duration 45 hours Credits 3

Behavioural Competency

Statement of the Competency

Interpret drawings and technical documentation.

Achievement Context

- Given:
  - mechanical drawings in the metric and imperial systems of measurement, in English and French, in paper and digital formats
  - technical documentation in English and French provided by manufacturers, suppliers, organizations, etc.
- Using:
  - templates
  - rulers
  - a calculator
  - digital tools
  - etc.

Elements of the Competency	Performance Criteria
1. Interpret the projections and views used in a mechanical drawing.	• Accurate determination of type of projection used. • Proper distinction among the different views used. • Accurate association of data between the different views represented. • Correct interpretation of projections and views.
2. Interpret the dimensioning used in a mechanical drawing.	• Comprehensive identification of information useful for the job. • Accurate determination of the values of the dimensions and tolerances. • Accurate calculations. • Relevant connections between the dimensions and the surfaces of the different views. • Correct interpretation of dimensioning.
3. Locate the additional information in a mechanical drawing.	• Appropriate locating of the desired information in: – the title block – the nomenclature – the annotations. • Comprehensive collection of the necessary information.

4. Match items on a drawing to the actual components of a piece of industrial equipment.	• Accurate matching of the items with: – threaded and unthreaded fasteners – mechanical components – industrial materials – metal shapes – etc.
5. Gather information in technical documentation.	• Appropriate choice of reference source. • Effective research method. • Relevant information gathered. • Correct recording of data. *For the competency as a whole:* • Compliance with technical drawing standards. • Accurate reading of all dimensions. • Observance of the rules of ergonomics. • Appropriate choice and use of templates, rulers, calculator, etc. • Appropriate use of digital tools.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Types and formats of paper used in technical drawing: A4, A3, A2, A1, A0, A, B, C, D, E.
- Units of measurement used in drawings, and conversion between imperial and metric units of measurement.
- Arrangement of information on a drawing.
- Standard method of folding a drawing.
- Basic functions of a software program for viewing drawings in digital format.
- English and French terminology used in drawings and technical documentation.
- Importance of keeping the work area organized at all times.
- Importance of taking note of the information gathered.
- Industrial drawing standards and conventions: conventional rules of presentation subject to standards.
- Basic functions of digital tools, such as applications for reading drawings and documentation.

1. Interpret the projections and views used in a mechanical drawing.
   - Types of projections: isometric, third angle orthographic and first angle orthographic.
   - Distinction among the six basic views in industrial drawing: front, left side, right side, bottom, top and rear.
   - Auxiliary views: depth, height and elevation.
   - Sections (full, partial, half, revolved, etc.), etc.
   - Arrangement of views on a drawing.
   - Accurate association of data between the different views represented.

- Meaning of the different types of lines: contour, hidden, centre, phantom, extension, dimension, section, short break, long break.
- Visible and hidden edges.
- Meanings of the different types of standardized hatching patterns.
- Determination of the operation of a piece of equipment based on a drawing.

2. Interpret the dimensioning used in a mechanical drawing.
   - Information useful for the job: dimensions; dimensions with tolerances; geometric shape, position and run-out tolerances; thread nomenclature; fit tolerances.
   - Determination of the values of dimensions, dimensions with tolerances, shape tolerances, position tolerances, etc.
   - Determination of dimensions on drawings.
   - Distinction among the different dimension lines: lines or arrows used, position of dimensions, origins, etc.
   - Distinction among the shape and position values: location, superimposition of several values.
   - Choice and use of mathematical formulas to calculate lengths, volumes, surface areas, allowances, tolerances, etc.
   - Identification of data concerning allowances.
   - General and local tolerances for lengths and angles.
   - Bidirectional and unidirectional tolerances.
   - General notes: manufacturing details, specific characteristics of a part or assembly, etc.
   - Local notes: hole details, finishing details, etc.

3. Locate the additional information in a mechanical drawing.
   - Scale, codification of materials, symbols, abbreviations, etc.
   - Tolerances, surface finishes, roughness index symbols, etc.
   - Association of components represented on a drawing with their names in the table of nomenclature.
   - Interpretation of title block (date, materials, scale, etc.)
   - Distinction among the different parts of a list of simple materials: identification of parts, shapes, dimensions, materials, quantities, etc.

4. Match items on a drawing to the actual components of a piece of industrial equipment.
   - Locating on a drawing of the different pieces of equipment, mechanical components, materials, mechanical fasteners, etc.
   - Reference points between the drawing and the actual component.
   - Association of items on a drawing with:
     - threaded and unthreaded fasteners
     - mechanical components (motor, pump, transmission, etc.)
     - electrical components (motors, electrical panels, etc.)
     - metal structural components
     - plumbing components
     - etc.

5. Gather information from technical documentation.
    - Strategies for finding information in technical documentation in paper and digital formats.
    - Method of using a software program to consult technical documentation in digital format.
    - Examination of the table of contents and the different sections (by system, component, etc.).
    - Locating and interpretation of data concerning:
        - bolt grades
        - torques
        - types of materials (steel, aluminum, etc.)
        - types of lubricants and frequency of lubrication
        - equipment installation and start-up
        - the required adjustments and maintenance
        - the required replacement components
        - part numbers
        - equipment handling and rigging
        - etc.

Health and Safety on Construction Sites	Code: 754992

Competency 4 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

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

Learning Context

Information Phase

- Learning about the risks inherent in construction sites.
- Learning about the laws, regulations and standards respecting health and safety on construction sites.
- Learning the measures to take in the event of an emergency.
- Reflecting on the importance of acquiring proficiency in occupational health and safety.

Participation Phase

- Experiencing situations in which risks must be prevented and dangers eliminated with respect to the environment, facilities, machinery, equipment, materials, tools, energy sources, etc.
- Participating in activities allowing them to recognize the risks associated with moving loads and awkward work postures.
- Participating in activities allowing them to recognize symbols and signals associated with risk prevention (hazardous products, road work, transportation of hazardous materials, etc.)
- Comparing risky behaviours observed on a construction site and identifying the basic principles of safe behaviour.

Synthesis Phase

- Presenting a report containing:
  - a summary of their newly acquired knowledge and skills
  - an assessment of their attitude with respect to occupational health and safety
  - their goals and means of improvement.

Instructional Guidelines

- Provide the necessary information sources.
- If applicable, invite occupational health and safety specialists to meet with students.
- Make the best use of audiovisual materials.
- Make extensive use of learning situations that reflect the reality of construction sites.
- Prevent students from performing unsafe acts during simulations.
- Foster the participation of all students in discussions.
- Guide the students in their self-assessment by providing them with tools (e.g. questionnaire) to help them analyze their experience and set their goals.

Participation Criteria

Information Phase

- Consult the information sources made available to them.
- Describe the advantages of complying with occupational health and safety laws, regulations and standards on construction sites.

Participation Phase

- Participate in the suggested activities and take them seriously.
- State the principles of safe behaviour.
- Make a list of the risks associated with construction sites and the applicable preventive measures.

Synthesis Phase

- Present a report containing:
  - a summary of their newly acquired knowledge and skills
  - an assessment of their attitude with respect to occupational health and safety
  - their goals and means of preserving their own health, safety and physical well-being and those of others on a construction site.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to each phase of the learning context, along with their attendant guidelines.

Information Phase

- Importance of information about health and safety on construction sites.
- The most common risks to health, safety and physical well-being on construction sites.
- Sources of information about health and safety on construction sites and locating of the relevant information.
- Roles and responsibilities with respect to health and safety on construction sites.
- Legal framework for occupational health and safety.
- Advantages of complying with occupational health and safety rules on construction sites.
- 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.
- Systems for identifying hazardous material.

Access and Handling	Code: 782962

Competency 5 Duration 30 hours Credits 2

Behavioural Competency

Statement of the Competency	**Achievement Context**
Use access and handling equipment.	• Given verbal or written orders. • Using: – personal and collective protective equipment – access and handling tools and equipment – technical documentation.

Elements of the Competency	**Performance Criteria**
1. Install and use ladders and stepladders.	• Appropriate choice of ladders or stepladders for the job. • Careful inspection of ladders or stepladders. • Proper installation of ladders or stepladders. • Safe use of ladders or stepladders.
2. Install and use metal frame scaffolding.	• Proper installation of scaffolding. • Thorough inspection of scaffolding and accessories. • Appropriate use of scaffolding. • Appropriate disassembly sequence.
3. Lift and move loads using chain hoists, shop hoists, pallet trucks, skids, etc.	• Correct estimate of the weight of the loads. • Appropriate use of load capacity charts for lifting accessories. • Accurate determination of centre of gravity. • Appropriate choice of lifting devices and accessories. • Thorough inspection of the compliance of lifting equipment and accessories. • Planning of movements based on the characteristics of the environment. • Appropriate positioning of lifting accessories based on the centre of gravity. • Appropriate lifting and moving of loads. • Absence of damage to the object being moved, surrounding objects and work area.
4. Lift and move loads by hand.	• Correct estimate of the weight of the loads. • Planning of movements based on the characteristics of the environment. • Appropriate vertical and horizontal movements of loads. • Absence of damage to the object being moved, surrounding objects and the work area.

For the competency as a whole:

- Compliance with occupational health and safety rules.
- Appropriate sectioning off of work area.
- Effective communication and cooperation with the appropriate people.
- Compliance with verbal or written orders.
- Compliance with current laws, regulations and standards.
- Accurate determination of sequence of operations.
- Appropriate storage of all equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Safety rules associated with access and handling (review of Competency 4).
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Methods and equipment for marking off the work area (review of Competency 4).
- Aspects to verify when planning lifting and moving operations.
- English and French terminology related to access and handling equipment.
- Importance of keeping the work area organized at all times.

1. Install and use ladders and stepladders.
   - Criteria for ensuring the conformity of the equipment.
   - Materials from which ladders and step ladders are made, and their characteristics.
   - Ladder and stepladder grades (review of Competency 4).
   - Factors for the safe use of ladders and stepladders (review of Competency 4).
   - Standards and risks associated with working at a height (review of Competency 4).

2. Install and use metal frame scaffolding.
   - Components and functions of scaffolding, limitations, etc. (review of Competency 4).
   - Assembly and installation of metal frame scaffolding up to two sections high.
   - Inspection, use and adjustment of a safety harness (review of Competency 4).
   - Inspection, use, maintenance and storage of personal and collective protective equipment: safety harness, guardrails, etc.
   - Standards and risks associated with working at a height.

3. Lift and move loads using chain hoists, shop hoists, pallet trucks, skids, etc.
    - Reading of name plates on equipment.
    - Locating of weight information on a piece of equipment.
    - Locating of information about the maximum capacity of a piece of equipment or a lifting or moving accessory.
    - Locating of weight information and lifting methods in a manual.
    - Use of formulas to calculate volumes and determine the mass of a piece of equipment.
    - Conversion between imperial and metric units of measurement (review of Competency 2).
    - Ways of using slings: basket, eye and vertical.
    - Materials used to make slings and their characteristics.
    - Appropriate use of lifting signals.

4. Lift and move loads by hand.
    - Methods of handling loads by hand alone and with help (review of Competency 4).
    - Importance of positioning and ergonomics when handling loads by hand.
    - Risk factors associated with handling loads by hand.

Shopwork	Code: 782947

Competency 6 Duration 105 hours Credits 7

Behavioural Competency

Statement of the Competency

Do shopwork.

Achievement Context

- Given verbal or written orders.
- Using:
  - personal and collective protective equipment
  - technical drawings or sketches
  - ferrous and non-ferrous materials
  - tools and equipment
  - technical documentation.

Elements of the Competency	Performance Criteria
1. Cut workpieces using a hand saw and a power saw.	• Determination of the exact dimensions of the workpieces to cut. • Economical use of materials. • Proper marking out of workpieces. • Regular cutting of workpieces. • Appropriate shape and dimensions of workpieces. • Proper deburring of workpieces.
2. Drill holes using a portable drill and a drill press.	• Accurate determination of: – the position of the holes to be drilled – the dimensions of the holes to be drilled, including those that are to be tapped. • Proper marking out of workpieces. • Precise punching of hole centres. • Correct calculation and adjustment of the rotation speed of the drill bit. • Appropriate dimensions of pilot holes, if applicable. • Appropriate dimensions of holes. • Correct positioning and squareness of holes.
3. Grind workpieces using a sander, a file and a portable grinder.	• Absence of burrs or striations. • Appropriate dimensions of workpieces.
4. Tap holes and thread rods.	• Accurate determination of the diameter of rods for threading. • Uniform and continuous threads. • Alignment of threads to the axis.

5. Extract bolts.	• Drilling to the appropriate diameter. • Precise drilling at the centre of the bolts. • Proper insertion of bolt extractor. • Appropriate extraction of bolts. • Intact threads in holes.
6. Bolt components together.	• Proper assembly of fasteners. • Accurate determination of bolt torque. • Compliance with bolt torque.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Compliance with orders, drawings and sketches. • Compliance with current laws, regulations and standards. • Strict observance of manufacturers' recommendations. • Accurate determination of sequence of operations. • Appropriate choice and use of equipment, tools, accessories and measuring instruments.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Risks associated with shopwork (review of Competency 4).
- Importance of wearing personal protective equipment (PPE): safety glasses, safety shoes, etc. (review of Competency 4).
- Importance of recycling waste oil and absorbent materials.
- Properties (e.g. hardness) of the most commonly used materials.
- Technical drawing concepts: tolerance, scale, views, etc. (review of Competency 2).
- Interpretation of mechanical drawings and sketches (review of Competency 2).
- Importance of following manufacturers' recommendations concerning the use of measuring instruments, tools and equipment.
- Characteristics and use of measuring instruments, and selection criteria: graduated ruler, tape measure, vernier calliper, square, etc. (review of Competency 2)
- Conversion between values in different units of measurement and between imperial and metric units of measurement (review of Competency 2).
- Search method in technical documentation.
- English and French terminology related to shopwork.
- Importance of keeping the work area organized at all times.

Shopwork	Code: 782947

1. Cut workpieces using a hand saw and a power saw.
    - Importance of optimizing the use of materials.
    - Criteria for choosing blades: teeth, thickness, etc.
    - Installation of cutting accessories: blade, cutting disk, etc.
    - Determination of cutting speed based on the material to be cut.
    - Characteristics and use of jigsaws, grinders with cutting disks, horizontal and vertical band saws, etc., and selection criteria.
    - Characteristics of choosing marking out instruments, and selection criteria: marking gauge, compass, dividers, etc.

2. Drill holes using a portable drill and a drill press.
    - Characteristics of a well-sharpened drill bit.
    - Methods of sharpening a drill bit.
    - Manual reaming technique.
    - Formulas for calculating the rotation speed of the drill bit.
    - Use of accessories for holding workpieces.
    - Connection between the pressure exerted on the drill and the feed rate.

3. Grind workpieces using a sander, a file and a portable grinder.
    - Method of marking out workpieces.
    - Characteristics and use of grinding tools, and selection criteria: sander, file, grinder, grinding wheel, etc.

4. Tap holes and thread rods.
    - Method of installing the different types of threaded inserts.
    - Tapping method.
    - Threading method.
    - Importance of lubrication during tapping and threading operations.
    - Use of templates (e.g. thread chaser and screw gage) to determine the thread pitch.

5. Extract bolts.
    - Types of extractors.
    - Determination of drilling diameter required.
    - Use of tap wrench.
    - Methods for extracting bolts, and troubleshooting methods.

6. Bolt components together.
    - Distinction among the different sizes of wrenches and sockets in the imperial and metric systems.
    - Use of clamping tools: wrench, pan sockets, torque wrench, impact wrench, ratcheting wrench, etc.
    - Units of measurement of torque: newton metre (N m), pound-force per foot (lbf-ft) and pound-force per inch (lbf-in).
    - Locating of nuts and bolts in the technical documentation to determine their thread pitch, length, diameter and grade.
    - Usefulness of the different types of washers, nuts and bolts: flat washer, lock washer, locknut, etc.

Forming	Code: 898523

Competency 7 Duration 45 hours Credits 3

Behavioural Competency

Statement of the Competency	Achievement Context
Perform forming operations.	• Given: – detail drawings – ferrous and non-ferrous sheet metal – verbal or written orders. • Using: – technical documentation – the necessary measuring instruments, tools and equipment – lifting and handling equipment – personal and collective protective equipment.

Elements of the Competency	Performance Criteria
1. Prepare the forming operations.	• Accurate interpretation of orders, drawings and technical documentation. • Accurate determination of: – the type of forming required – the sequence of operations – the quantity of materials required – etc. • Accurate determination of the actual dimensions of the sheet metal.
2. Perform marking out and development operations.	• Correct application of workpiece development methods: – parallel line development – radial line development – triangulation. • Accurate measurements and calculations. • Compliance with marking out and development methods.
3. Cut sheet metal.	• Observance of cutting sequence. • Proper adjustment of tools and accessories. • Proper positioning of material. • Quality of deburring.

Forming	Code: 898523
4. Bend sheet metal.	• Observance of bending sequence. • Appropriate adjustment of flanges. • Accurate adjustment of bending angles. • Compliance with required dimensions.
5. Roll sheet metal.	• Appropriate adjustment of rollers. • Observance of rolling sequence. • Appropriate cleaning of area to be flared. • Accurate measurement of interior dimensions of the tube after rolling. • Observance of rolling tolerances.
6. Assemble sheet metal using: – wire stapling – riveting – resistance welding	• Observance of assembly sequence. • Solid and precise assembly of sheet metal.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Compliance with current laws, regulations and standards. • Compliance with orders and diagrams. • Strict observance of manufacturers' recommendations. • Appropriate choice and use of measuring instruments, tools and forming equipment. • Compliance with the capacity of the forming equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- English and French terminology related to forming.
- Risks associated with forming and means of preventing them.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of keeping the work area organized at all times.
- Importance of taking note of useful information.
- Precautions to take when handling materials.

1. Prepare the forming operations.
   - Interpretation of orders, drawings and technical documentation.
   - Determination of sequence of operations.
   - Choice and preparation of tools for marking out (ruler, compass, square, bluing, etc.), cutting, bending, etc.
   - Choice of materials based on the capacity of the equipment and the type of part to be formed.

2. Perform marking out and development operations.
   - Criteria for choosing the development method: parallel line development, radial line development or triangulation.
   - Calculation of dimensions (length, surface area, etc.)
   - Use of development methods: parallel line development, radial line development or triangulation.
   - Preparation of a cardboard pattern before cutting the workpieces.
   - Verification of conformity of pattern.
   - Arrangement of pattern and marking out of part on the sheet metal.
   - Importance of observing marking out tolerances.

3. Cut sheet metal.
   - Distinction among the different types of shears, angle grinders, etc., and selection criteria based on the work to be done.
   - Adjustment of blade distance based on the thickness and type of material.
   - Adjustment of back stopper.
   - Adjustment of cutting stroke based on the length of the material.
   - Verification of squareness of material.
   - Positioning of material.
   - Use of cutting oils or lubricants.
   - Importance of observing cutting tolerances.
   - Deburring method.

4. Bend sheet metal.
   - Use of bending chart or mathematical formulas.
   - Criteria for choosing bending tools and equipment.
   - Method of installing flanges.
   - Determination of steps in the bending process based on the number of bends, the dimensions of the part and tolerances.
   - Use of sketches to represent the steps in the bending process.
   - Precautions to take when handling materials.
   - Positioning of parts to be bent.
   - Use of bending method for different bending angles.
   - Installation of locking or braking device.
   - Importance of observing tolerances.

5. Roll sheet metal.
   - Adjustment of front roller based on the thickness of the material and the diameter of the part to be produced.
   - Importance of making sure the rollers are parallel.
   - Precautions to take when handling materials.
   - Use of rolling method.
   - Importance of observing tolerances.

6. Assemble sheet metal using wire stapling, riveting and resistance welding.
   - Types and uses of jigs: shapes, materials, braking and locking devices, positioning holes, etc.
   - Positioning and fastening sequence of parts and fasteners on jigs, torquing devices and sequence, etc.

Forming	Code: 898523

Wire stapling

- Distinction among the different types of wire staples.
- Criteria for choosing and using staplers.
- Use of stapling method.
- Installation of locking or braking device.
- Importance of observing assembly tolerances.

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Riveting

- Characteristics of rivets: type of head, material code, diameter and length.
- Position of rivets defined by edge distance (distance between the rivets and the edge of the sheet) using a jig, and by pitch (centre-to-centre distance between the rivets).
- Criteria for choosing rivets.
- Criteria for choosing and using tools.
- Riveting methods: percussion, compression and pull.
- Riveting tools and accessories: air gun, rivet sets, riveting rams, manual and pneumatic rollers, drift punch, riveters, shaving tools, etc.
- Work methods: position of workpieces, tools, accessories and millwright.
- Use of riveting method.
- Method of installing blind rivets.
- Importance of observing assembly tolerances.
- Verification of riveting using measuring instruments: depth gauges, shims, etc.
- Main riveting defects: rivet head defects, seam defects, loose rivets, etc.

Spot welding

- Welding jigs and temporary fastening accessories.
- Cleaning products.
- Criteria for choosing, inspecting and sharpening electrodes.
- Installation and alignment of electrodes.
- Importance of solidly fastening electrodes and electrode holders.
- Adjustment of welding setup, amperage, pressure on the electrodes and welding sequence.
- Performance of shearing and separation tests.
- Precautions to take when handling materials.
- Positioning of parts.
- Application of tacking sequence.
- Tack welds at the appropriate locations.
- Alignment of tack welds.

Shafts, Bearings and Bushings	Code: 898535

Competency 8 Duration 75 hours Credits 5

Behavioural Competency

Statement of the Competency	**Achievement Context**
Remove, assemble and adjust shafts, bearings and bushings.	• Given: – drawings – verbal or written orders. • Using: – technical documentation – measuring instruments, tools and equipment – lifting and handling equipment – personal and collective protective equipment.

Elements of the Competency	**Performance Criteria**
1. Prepare the work.	• Accurate interpretation of orders, drawings and technical documentation. • Accurate determination of: – the type of shafts, bearings and bushings to use – the sequence of operations – the quantity of materials needed – etc.
2. Determine the adjustments to be made when assembling shafts, bearings and bushings.	• Determination of recommended adjustments and allowances. • Compliance with tolerances.
3. Remove shafts, bearings and bushings.	• Accurate recording of initial position of components. • Methodical removal of shafts, bearings and bushings. • Thorough inspection of shafts, bearings and bushings.
4. Assemble and adjust shafts, bearings and bushings.	• Proper choice of replacement components. • Methodical assembly of shafts, bearings and bushings. • Adjustments in compliance with established tolerances and allowances. • Proper lubrication of components.

For the competency as a whole:

- Compliance with occupational health and safety rules.
- Compliance with current laws, regulations and standards.
- Compliance with orders and diagrams.
- Strict observance of manufacturers' recommendations.
- Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Risks associated with the removal, installation and adjustment of shafts, bearings and bushings, and means of preventing them.
- Importance of recycling waste oil and absorbent materials.
- Importance of keeping the work area organized at all times.
- Importance of taking note of useful information.
- English and French terminology related to shafts, bearings and bushings.
- Distinction among the different types of shafts, bearings and bushings: purpose, characteristics, mode of operation and replacement products.
- Designation system for bearings and bushings.
- Measurement of bearings and bushings in the absence of designations.

1. Prepare the work.
   - Interpretation of orders, drawings and technical documentation.
   - Determination of sequence of operations.
   - Choice and preparation of tools for the job: extractor, mounting tools sets, bearing hook wrenches, etc.

2. Determine the adjustments to be made when assembling shafts, bearings and bushings.
   - Characteristics of allowances, adjustments and tolerances.
   - Method of using measuring and control instruments: feeler gauges, tapered ring gauges, micrometers, etc.
   - Formulas for calculating allowances and adjustments.
   - Use of tolerance classes.

3. Remove shafts, bearings and bushings.
   - Method of using the tools, accessories and devices needed to remove shafts, bearings and bushings.
   - Methods of removing shafts, bearings and bushings.
   - Importance of methodical removal and the recording of the initial position of the components.
   - Seal removal method.
   - Methods of inspecting shafts, bearings and bushings: visual examination and use of measuring and control instruments.

4. Assemble and adjust shafts, bearings and bushings.
    - Types, sizes, models and methods of assembling replacement shafts, bearings and bushings.
    - Choice of adapted mechanical, hydraulic and heat tools.
    - Methods of assembling shafts, bearings and bushings (cold, hot).
    - Methods of straightening shafts.
    - Methods of using lubrication tools, accessories and devices.
    - Types of adapted lubricants and quantity required.
    - Methods of assembling static and dynamic seals.
    - Methods of handling shafts, bearings and bushings.
    - Effect of expansion on locking clamps.
    - Importance of verifying locking clamps after assembly (using calibrated feeler gauges, thickness gauges, etc.)

Alignment	Code: 898544

Competency 9 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency	**Achievement Context**
Perform alignment tasks.	• Working on pump motors, speed reducer motors, etc. • Given: – drawings – verbal or written orders. • Using: – technical documentation – measuring instruments, tools and equipment – lifting and handling equipment – personal and collective protective equipment.

Elements of the Competency	**Performance Criteria**
1. Prepare the work.	• Accurate interpretation of orders, drawings and technical documentation. • Accurate determination of: – sequence of operations – recommended tolerances – etc.
2. Perform the preliminary alignment.	• Proper and thorough inspection of components. • Appropriate inspection and correction of lame foot adjustment. • Correct preliminary alignment.
3. Take measurements and do calculations related to the alignment.	• Precise measurements. • Appropriate choice of mathematical formulas for alignment, if applicable. • Accurate calculations.
4. Perform the alignment using: – a dial gauge – laser alignment equipment	• Accurate entry of data in the laser device. • Observance of alignment sequence. • Proper use of alignment methods. • Correct installation of shims at the appropriate points. • Compliance with tolerances. • Use of appropriate torque.

For the competency as a whole:

- Compliance with occupational health and safety rules.
- Compliance with current laws, regulations and standards.
- Compliance with orders and diagrams.
- Strict observance of manufacturers' recommendations.
- Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Risks associated with alignment and means of preventing them.
- Importance of keeping the work area organized at all times.
- Importance of taking note of useful information.
- English and French terminology related to alignment.
- Distinction between the different types of misalignment (horizontal and vertical).
- Distinction between the different misalignment defects (parallel and angular).

1. Prepare the work.
   - Interpretation of orders, drawings and technical documentation.
   - Determination of sequence of operations.
   - Locating of alignment tolerances in the documentation.
   - Choice and preparation of tools for the job.

2. Perform the preliminary alignment.
   - Method of inspecting the coupling and shafts.
   - Method of inspecting the bearing sets.
   - Distinction between short foot and angular foot.
   - Methods of inspecting and correcting foot adjustments.
   - Distinction between stationary equipment (which does not require alignment) and mobile equipment (which does).
   - Characteristics of the components to be aligned.
   - Desired degree of precision.

3. Take measurements and do calculations related to the alignment.
   - Use of measuring instruments: rulers, tape measure, thickness gauges, etc. (review of Competency 2).
   - Choice of mathematical formulas for calculating the thickness of shims depending on the dial gauge alignment method used (rim and face, cross-dial, etc.)
   - Importance of precise measurements and calculations.
   - Calculation of thermal expansion.

4. Perform the alignment using a dial gauge and laser alignment equipment.
    - Installation and removal of sensors.
    - Distinction between negative and positive readings on a dial gauge.
    - Use of alignment methods employing a dial gauge and laser equipment.
    - Method of installing shims to correct a misalignment.
    - Use of a torque wrench to obtain the recommended torque.

Mechanical Motion Transmission Devices	Code: 898557

Competency 10 Duration 105 hours Credits 7

Behavioural Competency

Statement of the Competency

Maintain and repair mechanical motion transmission devices.

Achievement Context

- Given:
  - mechanical motion transmission devices:
    - chain drives
    - belt drives
    - speed reducers
    - etc.
  - verbal or written orders
- Using:
  - drawings
  - technical documentation
  - measuring instruments, tools and equipment
  - lifting and handling equipment
  - personal and collective protective equipment
  - replacement devices and components and consumables.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders, drawings and technical documentation. • Determination of logical sequence of operations. • Accurate determination of lubricants to use, if applicable.
2. Maintain mechanical motion transmission devices.	• Detection of abnormal odours, temperatures, vibrations, noises and leaks. • Careful cleaning of devices. • Comprehensive recording of operating parameters and comparison with expected parameters. • Appropriate lubrication of the devices that require it. • Meticulous recording of the dimensions of the components and comparison with expected dimensions. • Accurate verification of component alignment.

Mechanical Motion Transmission Devices	Code: 898557
3. Replace mechanical motion transmission devices.	• Appropriate choice of replacement device or component. • Observance of disassembly procedure. • Absence of damage to adjacent components. • Careful production of gaskets, if applicable. • Appropriate positioning of devices or components. • Observance of reassembly procedure. • Accurate adjustment and alignment of components.
4. Ensure the proper operation of components and devices.	• Appropriate verifications before powering up. • Proper testing. • Careful verification of the effectiveness of the work and appropriate corrections, if necessary.
5. Finish the work.	• Comprehensive and accurate record of the work done. • Appropriate suggestions regarding maintenance or repair work, if applicable. • Appropriate cleaning of work area. • Storage of all measuring instruments, tools and equipment.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Compliance with current laws, regulations and standards. • Compliance with orders and diagrams. • Strict observance of manufacturers' recommendations. • Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Risks associated with working on motion transmission devices and their components, and means of preventing them.
- Importance of recycling waste oil and absorbent materials.
- Lockout and powering down procedure.
- Hot work procedure.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of keeping the work area organized at all times.
- Importance of taking note of useful information.
- English and French terminology related to motion transmission devices and their components.
- Components and operation of mechanical motion transmission devices: types of belts, types of chains, etc.
- Mathematical formulas for calculating ratios, lengths, power, adjustments, and angular and linear speed.

1. Prepare the work.
    - Locating in the manufacturer's manual of part numbers, type of oil, adjustment parameters, torque, etc.
    - Consultation of charts, tables, formulas and so on in the technical documentation.
    - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
    - Questions to ask to gather information about the job to be done.
    - Interpretation of mechanical drawings.
    - Content of a work order: job to be done, estimated time, etc.
    - Grades and types of oils.
    - Tools and equipment needed to maintain and repair mechanical motion transmission devices.
    - Job planning method ensuring a logical sequence of operations.
    - Methods of lifting and handling mechanical motion transmission devices.
    - Estimation of the centre of gravity and weight of loads.
    - Lifting signals.

2. Maintain mechanical motion transmission devices.
    - Methods of detecting abnormalities: by sight, smell, touch, etc.
    - Cleaning methods for different devices and their components.
    - Locating of mechanical maintenance instructions in the technical documentation.
    - Methods of verifying oil levels and topping them off.
    - Method of changing oil, filters and gaskets.
    - Criteria for choosing the type of oil.
    - Use of a grease gun and replacement of cartridge.
    - Handling of components that must always be immersed in oil.
    - Methods of verifying the alignment of pulleys, chain wheels and sprockets (e.g. using a true bar, plumb line and laser tool).
    - Verification and adjustment of the allowance of a chain.
    - Methods of verifying the wear on a chain.
    - Types of chain assembly: horizontal, vertical and oblique.

- Verification using a tension meter and adjustment of the tension of a belt.
- Detection of signs of wear on mechanical parts such as belts, pulleys, chains and couplings.
- Verification of the speed of rotation or translation using a contact or infrared tachometer.
- Method of reading a thermometer to check oil temperature.
- Method of reading a pressure gauge to check oil pressure.
- Use of chemicals such as thread-locking compound, penetrating oil and anti-seize compound.

3. Replace mechanical motion transmission devices.
   - Criteria for choosing a replacement device and component.
   - Procedures for removing and replacing a device or component: methods involving memorization of the original position of the components removed (coding, reference points made with a chisel or punch, placement and orientation of components).
   - Method of producing gaskets, types of seals, materials, etc.
   - Methods of adjusting mechanical allowances.
   - Phenomenon of thermal expansion and consideration of this phenomenon when making adjustments.
   - Use of tools such as an extractor, torch, press, stamping tools.
   - Methods of aligning pulleys, chain wheels and gears (e.g. using a ruler or a line).
   - Use of chemicals such as thread-locking compound, penetrating oil and anti-seize compound.

4. Ensure the proper operation of components and devices.
   - Operation of basic safety devices.
   - Importance of installing mechanical safety devices before testing.
   - Important points to verify before powering up.
   - Procedure for powering up a mechanical motion transmission device.
   - Reading of measuring instruments.
   - Comparison of measured values with expected values.
   - Signs of failure.
   - Possible solutions to the problem.
   - Criteria for choosing the best solution.

5. Finish the work.
   - Data to be recorded (e.g. on a work order).
   - Precautions to be taken when storing certain tools and measuring instruments.

Preparation and Installation of Watertight Ducts	Code: 782974

Competency 11 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency	**Achievement Context**
Prepare and install watertight ducts.	• Working on watertight ducts used in industrial circuits. • Given verbal or written orders. • Using: – personal and collective protective equipment – drawings and sketches – tools, equipment and consumables.

Elements of the Competency	**Performance Criteria**
1. Prepare copper pipes.	• Appropriate cutting of pipes. • Proper deburring and reaming of pipes. • Careful cleaning of pipes. • Proper application of sealants, if applicable. • Proper installation of fittings. • Appropriate assembly of pipes.
2. Prepare steel pipes.	• Appropriate cutting of pipes. • Proper deburring and reaming of pipes. • Appropriate threading of pipes. • Proper application of sealants. • Proper installation of fittings. • Appropriate assembly and clamping of pipes.
3. Prepare plastic pipes.	• Appropriate cutting of pipes. • Proper application of adhesive, if applicable. • Proper installation of fittings. • Appropriate assembly of pipes.
4. Prepare steel tubes.	• Appropriate cutting of tubes. • Proper deburring and reaming of tubes. • Precise bending of tubes. • Proper installation of fittings. • Proper flaring of tubes. • Appropriate assembly of tubes.
5. Prepare pneumatic and hydraulic hoses.	• Appropriate cutting of hoses. • Proper use of sealants, if applicable. • Proper installation of fittings. • Appropriate assembly of hoses.

6. Install ducts.	• Proper removal of ducts to be replaced, if applicable. • Proper use of sealants, if applicable. • Proper installation of fittings. • Appropriate installation of ducts. • Aesthetic appearance of installation. • Careful verification of watertightness of the circuit and appropriate corrections, if applicable. *For the competency as a whole:* • Compliance with occupational health and safety rules. • Compliance with orders, drawings and sketches. • Respect for the areas of practice of the different trades. • Compliance with current laws, regulations and standards. • Strict observance of manufacturers' recommendations. • Accurate determination of sequence of operations. • Appropriate choice and use of tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Health and safety rules when preparing, assembling and installing watertight ducts: lockout, live work permit, work at a height, cleanliness and tidiness of work area, etc.
- Symbols used in plumbing.
- Scope of practice and qualifications required for working with gas, stationary engines, pressure vessels and plumbing.
- Steps in the effective preparation and installation of ducts.
- Application of the different types of sealants.
- English and French terminology related to watertight ducts.
- Importance of keeping the work area always organized.

1. Prepare copper pipes.
    - Types of copper pipes used in fluid circuits.
    - Important characteristics of the different types of copper pipes.
    - Brazing method and filler metals.
    - Use of a brazing torch.
    - Measurement of pipes and use of cutting tools.
    - Method of reaming copper pipes.
    - Cleaning and preparation of surfaces to be brazed.
    - Brazing techniques: combustion gas, melting point, etc.

- Installation of the different union fittings.
- Application of the different types of sealants.
- Installation of the different copper fittings.

2. Prepare steel pipes.
   - Use of different types of threaders: manual threader, portable power threader, vertical power threader, etc.
   - Important characteristics of the different types of steel pipes.
   - Measurement of pipes and use of cutting tools.
   - Method of reaming steel pipes.
   - Application of the different types of sealants.
   - Installation of the different union fittings.
   - Distinction among the different types of threads.

3. Prepare plastic pipes.
   - Important characteristics of plastic pipes.
   - Measurement of pipes and use of cutting tools.
   - Application of adhesives.
   - Installation of the different union fittings.

4. Prepare steel tubes.
   - Important characteristics of the different types of steel tubes.
   - Measurement of tubes and use of cutting tools.
   - Use of bender.
   - Use of flaring tool.
   - Installation of the different union fittings.

5. Prepare pneumatic and hydraulic hoses.
   - Important characteristics of the different types of hydraulic hoses.
   - Measurement of hoses and use of cutting tools.
   - Installation of the different union fittings.

6. Install ducts.
   - Characteristics of the different types of commonly used ducts.
   - Characteristics and use of the different tools used in plumbing.
   - Method of removing the different types of ducts.
   - Safe commissioning of ducts.
   - Maximum pressure of ducts, if applicable.
   - Installation of the different union fittings.
   - Means of fastening ducts and fasteners used.

Machine Tool Operations	Code: 782986

Competency 12 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency	**Achievement Context**
Perform machining operations using machine tools.	• Given verbal or written orders. • Using: – personal and collective protective equipment – technical drawings or sketches – ferrous and non-ferrous metals – a milling machine and a lathe – tools and equipment – technical documentation – consumables.

Elements of the Competency	**Performance Criteria**
1. Perform daily maintenance on machine tools.	• Careful verification of oil levels. • Proper lubrication of the components that require it. • Thorough inspection of safety devices. • Thorough detection and correction of any abnormalities.
2. Turn outside diameters over predetermined lengths.	• Appropriate mounting of workpieces to a four-jaw chuck. • Correct diameter of workpieces. • Uniform finish of turned surfaces.
3. Drill workpieces using a milling machine and a lathe.	• Conformity of hole diameters. • Squareness and concentricity of holes. • Proper positioning of holes. • Uniform finish of hole walls.
4. Turn inside diameters.	• Appropriate mounting of workpieces to a four-jaw chuck. • Correct reaming diameter. • Uniform finish of groove.
5. Face mill workpieces using a milling machine.	• Accurate determination of the origin points of the workpieces, if applicable. • Appropriate dimensions of workpieces. • Uniform surface finish.
6. Cut grooves on workpieces using a milling machine.	• Accurate determination of the origin points of the workpieces, if applicable. • Appropriate dimensions and correct positioning of grooves. • Uniform finish of grooves.

For the competency as a whole:

- Compliance with occupational health and safety rules.
- Compliance with orders, drawings and sketches.
- Compliance with current laws, regulations and standards.
- Strict observance of manufacturers' recommendations.
- Determination of relevant sequences of machining operations.
- Accurate determination of rotation speed.
- Correct adjustment of rotation speed and feed rate.
- Appropriate choice and use of equipment, tools, accessories and measuring instruments.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Safety rules for using machine tools.
- Use of measuring instruments: telescope gauge, micrometer, vernier calliper, etc.
- Interpretation of mechanical drawings (review of Competency 3).
- Purpose of cutting oil.
- Importance of recycling waste oil and absorbent materials.
- Properties of different materials and distinction among them (review of Competency 6).
- Conversion between values in different units of measurement and between imperial and metric units of measurement.
- English and French terminology related to machining.
- Importance of planning the machining process.
- Importance of keeping the work area always organized.

1. Perform daily maintenance on machine tools.
   - Interpretation of oil levels.
   - Operation of safety devices.
   - Methods of lubricating machine tools.
   - Signs and detection of abnormalities: noise, vibration, etc.

2. Turn outside diameters over predetermined lengths.
    - Turning of outside diameters within a tolerance of ± 0.127 mm or ± 0.005 in.
    - Short assembly and long assembly.
    - Distinction between the characteristics of a three-jaw chuck and a four-jaw chuck.
    - Method of centring a workpiece in a four-jaw chuck.
    - Use and reading of a dial gauge.
    - Calculation of lathe feed rate and rotation speed.
    - Adjustment of lathe rotation speed and feed rate, and interpretation of tables on the lathe.
    - Adjustment of cutting tool on the lathe.
    - Locating and use of indicators on the lathe handles.
    - Use of facing, roughing and finishing techniques.

3. Drill workpieces using a milling machine and a lathe.
    - Use of countersinking and counterboring techniques.
    - Use of parallel bars.
    - Calculation of rotation speed for drilling.
    - Factors ensuring squareness and a uniform finish.

4. Turn inside diameters.
    - Turning of inside diameters within a tolerance of ± 0.127 mm or ± 0.005 in.
    - Use and reading of a dial gauge.
    - Approximate calculation of rotation speed for turning.
    - Adjustment of lathe rotation speed and feed rate.
    - Adjustment of cutting tool on the lathe.
    - Reading and use of indicators on the lathe handles.

5. Face mill workpieces using a milling machine.
    - Use of parallel bars.
    - Types of milling cutters or cutting tools and their characteristics.
    - Calculation of rotation speed.
    - Method of measuring the zero point on workpieces on the milling machine.
    - Adjustment of the milling machine’s rotation speeds and, if applicable, its feed rates.

6. Cut grooves on workpieces using a milling machine.
    - Use of parallel bars.
    - Types and characteristics of cutting tools.
    - Calculation of rotation speed.
    - Method of measuring the zero point on workpieces on the milling machine.
    - Adjustment of the milling machine’s rotation speeds and, if applicable, its feed rates.

Cutting, Assembly and Welding	Code: 898568

Competency 13 Duration 120 hours Credits 8

Behavioural Competency

Statement of the Competency

Cut, assemble and weld metals.

Achievement Context

- Given:
  - drawings and technical documentation
  - verbal or written orders
  - mild steel and stainless steel plates, bars and tubes measuring no more than ¼ in. thick.
- Using:
  - lifting and handling equipment
  - personal and collective protective equipment
  - cutting and welding setups
  - tools, equipment, products, etc.
  - shielding gases
  - different types and diameters of electrode wires and welding rods
  - etc.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders, drawings and technical documentation. • Accurate determination of: – the accessories needed for the job – the sequence of operations – the quantity of materials, accessories and gas needed – etc. • Proper preparation of cutting or welding setup. • Correct placement of plates, bars and tubes. • Appropriate adjustment of equipment depending on the job. • Appropriate preparation of surfaces.
2. Cut plates, bars and tubes using oxyacetylene and plasma arc cutting techniques.	• Proper use of cutting methods. • Observance of prescribed dimensions and angles. • Clean cuts.
3. Assemble plates, bars and tubes.	• Precise positioning of each part. • Observance of assembly angles and dimensions. • Proper squaring of parts.

	• Appropriate orientation of parts. • Assembly method minimizing the risk of distortion during welding. • Appropriate tack welding of assembly.
4. Perform arc welding using the MIG (metal inert gas) process.	• Proper application of welding process in the following positions: - flat - horizontal - vertical. • Uniformity of weld bead. • Adequate penetration of filler metal. • Appropriate resistance of weld bead. • Correct cleaning of welds.
5. Perform electric arc welding using coated electrodes.	• Appropriate choice of electrodes. • Proper application of welding process in the following positions: – flat – horizontal – vertical. • Uniformity of weld bead. • Adequate penetration of filler metal. • Appropriate resistance of weld bead. • Correct cleaning of welds.
6. Perform electric arc welding using the TIG (tungsten inert gas) process.	• Proper application of welding process in the following positions: – flat – horizontal – vertical. • Uniformity of weld bead. • Adequate penetration of filler metal. • Appropriate resistance of weld bead. • Correct cleaning of welds.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Compliance with current laws, regulations and standards. • Compliance with orders and diagrams. • Strict observance of manufacturers' recommendations. • Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Risks associated with cutting, tacking, assembling and welding, and means of preventing them.
- Importance of keeping the work area organized at all times.
- Importance of taking note of useful information.
- English and French terminology related to cutting, tacking, assembly and welding.
- Tools, accessories and devices needed for cutting, tacking, assembly and welding.

1. Prepare the work.
    - Interpretation of orders, drawings and technical documentation.
    - Interpretation of welding symbols.
    - Determination of sequence of operations.
    - Adjustment of setups depending on the job and the process.
    - Choice of materials based on the specifications: carbon steel, stainless steel.
    - Locating in the drawings and technical documentation of the thickness of the metal and the quantity required.
    - Determination of position to adopt depending on the type of work.
    - Criteria for choosing the shielding gas, electrode, electrode wire or filler metal.

2. Cut plates, bars and tubes using oxyacetylene and plasma arc cutting techniques.
    - Set-up of an oxyfuel cutting setup and a plasma cutting setup.
    - Distinction between the components of an oxyfuel cutting setup and a plasma cutting setup.
    - Choice of cutting head based on the thickness of the metal to be oxy-cut.
    - Choice of cutting head angle for oxy-cutting.
    - Inspection of the cutting head for oxy-cutting, and replacement if applicable.
    - Inspection of the nozzle for plasma cutting.
    - Methods of adjusting the flame for oxy-cutting.
    - Adjustment of gas pressure for oxy-cutting and plasma cutting.
    - Operating instructions for using an oxy-cutting torch for heating or cutting.
    - Methods of preheating before oxy-cutting.
    - Methods of starting the cut in oxy-cutting and plasma cutting.
    - Use of guides for rectilinear and circular cuts.
    - Cutting process while maintaining feed rate, angle and arc length Preparation of edges depending on the thickness of the metal, the assembly and the weld bead required: square, single bevel, V, J, U, etc.
    - Troubleshooting of oxy-cutting and plasma cutting defects.
    - Cleaning of workpieces after cutting.

3. Assemble plates, bars and tubes.
    - Assembly sequence.
    - Tacking methods.
    - Use of holding tools: restraints, C-clamps, magnetic square, etc.
    - Choice of joints depending on the assembly required.
    - Observance of dimensions, angles and shapes.

4. Perform arc welding using the MIG (metal inert gas) process.
    - Installation of a MIG welding setup.
    - Choice of wire and shielding gas depending on the metal to be MIG welded.
    - Characteristics of MIG welders.
    - General characteristics of the different types of electrodes.
    - Role and characteristics of shielding gases.
    - Production of weld beads on different types of joints and in different positions: flat, horizontal and vertical.
    - Troubleshooting of MIG welding defects.

5. Perform electric arc welding using coated electrodes.
    - Installation of an electric arc welding setup with coated electrodes.
    - Characteristics of arc welders (constant current or constant voltage).
    - General characteristics of the different types of electrodes.
    - Production of weld beads on different types of joints, on different metals and in different positions: flat, horizontal and vertical.
    - Troubleshooting of defects in arc welding with coated electrodes.
    - Methods of cleaning weld beads.

6. Perform electric arc welding using the TIG (tungsten inert gas) process.
    - Installation of a TIG welding setup.
    - Choice of nozzle size.
    - Use of TIG welding mostly on stainless steel.
    - Characteristics of TIG welders.
    - General characteristics and choice of tungsten electrodes and shielding gases for welding different metals.
    - Role and characteristics of shielding gases.
    - Production of weld beads on different types of joints and in different positions: flat, horizontal and vertical.
    - Troubleshooting of TIG welding defects.
    - Methods of cleaning TIG weld beads.

Compressors, Vacuum Pumps and Pneumatic Motors	Code: 898575

Competency 14 Duration 75 hours Credits 5

Behavioural Competency

Statement of the Competency

Maintain and troubleshoot compressors, vacuum pumps and pneumatic motors.

Achievement Context

- Given verbal or written orders.
- Using:
  - drawings
  - technical documentation
  - measuring instruments, tools and equipment
  - lifting and handling equipment
  - personal and collective protective equipment
  - replacement devices and components and consumables.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders, drawings and technical documentation. • Determination of logical sequence of operations. • Accurate determination of lubricants to use, if applicable.
2. Maintain all types of compressors, vacuum pumps and pneumatic motors.	• Appropriate visual inspection of the components of the pneumatic system: ducts, fittings, oil level, etc. • Careful cleaning of devices to prevent clogging and contamination. • Comprehensive recording of operating parameters and comparison with expected parameters. • Appropriate lubrication of the devices that require it. • Accurate verification of alignment of components.
3. Troubleshoot reciprocating compressors, vacuum pumps and pneumatic motors.	• Correct analysis of failure. • Correct locating of sector or identification of stage of the failure. • Plausible hypotheses as to the cause of the failure. • Logical diagnostic method. • Accurate determination of the cause of the problem. • Appropriate choice of corrective measure and, if applicable, replacement component. • Proper removal of defective component, if applicable.

	• Proper installation and adjustment of replacement component, if applicable. • Full correction of problem. • Appropriate optimization of operating parameters.
4. Ensure the proper operation of all types of compressors, as well as vacuum pumps and pneumatic motors.	• Thorough inspection of safety devices. • Appropriate verifications before powering up. • Proper testing of compressors, vacuum pumps and pneumatic motors. • Careful verification of the effectiveness of the work and appropriate corrections if necessary.
5. Finish the work.	• Comprehensive and accurate record of the work done. • Appropriate suggestions regarding maintenance or repair work, if applicable. • Appropriate cleaning of work area. • Storage of all measuring instruments, tools and equipment.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Compliance with current laws, regulations and standards. • Compliance with orders and diagrams. • Strict observance of manufacturers' recommendations. • Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Risks associated with working on compressors, vacuum pumps and pneumatic motors and their components, and means of preventing them.
- Lockout and powering down procedure.
- Hot work procedure.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of keeping the work area organized at all times.
- Importance of taking note of useful information.
- English and French terminology related to compressors, vacuum pumps and pneumatic motors and their components.
- Components and operation of compressors (e.g. piston, screw, rotary blade), vacuum pumps and pneumatic motors.

1. Prepare the work.
   - Locating in the manufacturer's manual of part numbers, type of oil, torque adjustment parameters, etc.
   - Formulas for calculating adjustment parameters.
   - Locating in the technical documentation of instructions for the job.
   - Consultation of charts, tables, formulas, etc. in the technical documentation.
   - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
   - Questions to ask to gather information about the job to be done.
   - Interpretation of mechanical drawings.
   - Content of a work order: job to be done, schedule, etc.
   - Grades and types of oils.
   - Tools and equipment needed to maintain and repair compressors, vacuum pumps and pneumatic motors.
   - Job planning method ensuring a logical sequence of operations.
   - Methods of lifting and handling compressors, vacuum pumps and pneumatic motors.
   - Estimation of the centre of gravity and weight of loads.
   - Lifting signals.

2. Maintain all types of compressors, vacuum pumps and pneumatic motors.
   - Methods of detecting abnormalities: by sight, smell, touch, etc.
   - Cleaning methods for different devices and their components.
   - Methods of verifying oil levels and topping them off.
   - Method of changing oil, filters and gaskets.
   - Criteria for choosing the type of oil.
   - Use of a grease gun and replacement of cartridge.
   - Handling of components that must always be immersed in oil.
   - Method of verifying pulley alignment (review of Competency 9).
   - Method of using a true bar, plumb line and laser tool to verify pulley alignment (review of Competency 9).
   - Verification of the performance of the compressor, vacuum pumps and pneumatic motors.

- Methods of verifying the safety valves.
- Methods of verifying the pressure switch.
- Verification using a tension meter and adjustment of the tension of a belt (review of Competency 9).
- Detection of the most obvious signs of wear on mechanical parts: segments, piston, valves, etc.
- Method of reading a thermometer to check oil temperature.
- Method of reading a pressure gauge to check oil pressure.

3. Troubleshoot piston compressors, vacuum pumps and pneumatic motors.
   - Logical troubleshooting methods to quickly identify the sector where the failure occurred.
   - Determination of verification priorities and causes of failures.
   - Most common causes of failures.
   - Use of measuring instruments.
   - Important aspects of replacing a device and a component.
   - Criteria for choosing a replacement device and component.
   - Procedures for removing and replacing a device or component: methods involving memorization of the original position of the components removed: coding, reference points made with a chisel or punch, placement and orientation of components.
   - Method of producing gaskets, types of seals, materials, etc.
   - Methods of adjusting mechanical allowances.
   - Phenomenon of thermal expansion and consideration of this phenomenon when making adjustments.
   - Use of tools such as ring tools.
   - Methods of aligning pulleys (review of Competency 9).
   - Adjustment of pressure switch.
   - Importance of optimizing operating parameters to extend the useful life of components.

4. Ensure the proper operation of all types of compressors, as well as vacuum pumps and pneumatic motors.
   - Operation of basic safety devices.
   - Importance of installing mechanical safety devices before testing.
   - Important points to verify before powering up.
   - Start-up procedure for compressors, vacuum pumps and pneumatic motors.
   - Reading of measuring instruments.
   - Comparison of measured values with expected values.
   - Signs of failure.
   - Possible solutions to the problem.
   - Criteria for choosing the best solution.

5. Finish the work.
   - Data to be recorded (e.g. on a work order).
   - Precautions to be taken when storing certain tools and measuring instruments.

Pumps and Hydraulic Motors	Code: 898585

Competency 15 Duration 75 hours Credits 5

Behavioural Competency

Statement of the Competency

Maintain and troubleshoot pumps and hydraulic motors.

Achievement Context

- Given:
  - positive-displacement pumps
  - nonpositive-displacement pumps
  - hydraulic motors
  - verbal or written orders.
- Using:
  - drawings
  - technical documentation
  - measuring instruments, tools and equipment
  - lifting and handling equipment
  - personal and collective protective equipment
  - replacement devices and components and consumables.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders, drawings and technical documentation. • Determination of logical sequence of operations. • Accurate determination of lubricants to use, if applicable.
2. Maintain pumps and hydraulic motors.	• Appropriate visual inspection of indicators and the components of the hydraulic system (ducts, fittings, oil level, etc.) • Careful cleaning of devices to prevent clogged filters and oil contamination. • Comprehensive recording of operating parameters and comparison with expected parameters. • Appropriate lubrication of the devices that require it. • Accurate verification of alignment of components.

Pumps and Hydraulic Motors	Code: 898585
3. Troubleshoot pumps and hydraulic motors.	• Correct analysis of failure. • Correct locating of sector or identification of stage of the failure. • Plausible hypotheses as to the cause of the failure. • Logical diagnostic method. • Accurate determination of the cause of the problem. • Appropriate choice of corrective measure and, if applicable, replacement component. • Proper removal of defective component, if applicable. • Proper installation and adjustment of replacement component, if applicable. • Full correction of problem. • Appropriate optimization of operating parameters.
4. Ensure the proper operation of pumps and hydraulic motors.	• Thorough inspection of safety devices. • Appropriate verifications before powering up. • Proper testing of pumps and hydraulic motors. • Careful verification of the effectiveness of the work and appropriate corrections if necessary.
5. Finish the work.	• Comprehensive and accurate record of the work done. • Appropriate suggestions regarding maintenance or repair work, if applicable. • Appropriate cleaning of work area. • Storage of all measuring instruments, tools and equipment.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Compliance with current laws, regulations and standards. • Compliance with orders and diagrams. • Strict observance of manufacturers' recommendations. • Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Risks associated with working on hydraulic systems, and means of preventing them.
- Importance of recycling waste oil and absorbent materials.
- Lockout and powering down procedure.
- Hot work procedure.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of keeping the work area organized at all times.
- Importance of taking note of useful information.
- English and French terminology related to pumps and hydraulic motors and their components.
- Components and operation of the components of a hydraulic system: types of hydraulic pumps, hydraulic motors, etc.
- Mathematical formulas for calculating pressure, flow, force, and tank power and volume.

1. Prepare the work.
    - Locating in the manufacturer's manual of part numbers, type of oil, adjustment parameters, torque, etc.
    - Consultation of tables, formulas, etc. in the technical documentation.
    - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
    - Questions to ask to gather information about the job to be done.
    - Interpretation of mechanical drawings.
    - Content of a work order: job to be done, schedule, etc.
    - Grades and types of oils.
    - Tools and equipment needed to maintain and troubleshoot pumps and hydraulic motors.
    - Job planning method ensuring a logical sequence of operations.
    - Methods of lifting and handling components of pumps and hydraulic motors.
    - Estimation of the centre of gravity and weight of loads.
    - Lifting signals.

2. Maintain pumps and hydraulic motors.
    - Methods of detecting abnormalities: by sight, smell, touch, etc.
    - Methods of verifying breather caps and air filters.
    - Locating in the technical documentation of instructions for maintaining pumps and hydraulic motors (schedules, actions to take, procedures, etc.)
    - Methods of verifying oil levels and topping them off.
    - Method of changing oil, filters and gaskets.
    - Criteria for choosing the type of oil.
    - Handling of components that must always be immersed in oil.
    - Verification, using measuring instruments, of oil pressure (pressure gauge), temperature (thermometer), flow (flowmeter), etc.
    - Detection of symptoms in hydraulic systems: cavitation, pressure loss, flow loss, etc.
    - Verification of the rotation speed of pumps and hydraulic motors using a tachometer.

3. Troubleshoot pumps and hydraulic motors.
    - Logical troubleshooting methods to quickly identify the sector where the failure occurred.
    - Determination of verification priorities and causes of failures.
    - Most common causes of failures.
    - Use of measuring instruments.
    - Important aspects of replacing a hydraulic component (pump or hydraulic motor) or device (impeller, mechanical seal, packing, gears, etc.)
    - Criteria for choosing a replacement device and component.
    - Procedures for removing and replacing a device or component: methods involving memorization of the original position of the components removed: coding, reference points made with a chisel or punch, placement and orientation of components.
    - Verification of performance of pumps and hydraulic motors before and after the repair
    - Method of producing gaskets, types of seals, materials, etc.
    - Methods of adjusting impeller and turbine allowances.
    - Phenomenon of thermal expansion and consideration of this phenomenon when making adjustments.
    - Use of the appropriate tools: extractor, press, stamping tools, torque wrench, etc.
    - Importance of optimizing operating parameters to extend the useful life of components (e.g. adjustment of pressure relief devices).

4. Ensure the proper operation of pumps and hydraulic motors.
    - Operation of basic safety devices.
    - Importance of installing safety devices before testing.
    - Important points to verify before powering up.
    - Procedure for powering up a hydraulic system.
    - Reading of measuring instruments.
    - Comparison of measured values with expected values.
    - Signs of other failures.
    - Possible solutions to other problems.
    - Criteria for choosing the best solution.

5. Finish the work.
    - Data to be recorded (e.g. on a work order).
    - Precautions to be taken when storing certain tools and measuring instruments.

Diagnosis of Electrical Problems	Code: 898596

Competency 16 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency

Diagnose electrical problems in industrial equipment.

Achievement Context

- Given:
  - electrical circuits in industrial equipment
  - verbal or written orders.
- Using:
  - electrical circuit diagrams
  - technical documentation
  - tools and measuring instruments
  - personal and collective protective equipment.

Elements of the Competency	Performance Criteria
1. Analyze the problem.	• Accurate interpretation of orders and technical documentation. • Correct identification of the sector affected. • Plausible hypotheses as to the cause of the problem. • Appropriate determination of tests to be done.
2. Verify the electrical circuit.	• Meticulous detection of signs of problems. • Accurate determination of appropriate values. • Relevant measurements taken. • Connection of measurement instruments at the appropriate points. • Accurate reading of values measured. • Correct recording of values measured.

3. Make a diagnosis.	• Accurate interpretation of values measured.
	• Proper comparison of values measured with expected values.
	• Accurate determination of:
	  – differences between the values measured and the expected values
	  – the nature of the problem
	  – the cause of the problem.

For the competency as a whole:

- Compliance with occupational health and safety rules.
- Compliance with current with laws, regulations and standards.
- Strict observance of manufacturers' recommendations.
- Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Health and safety rules for working with electricity.
- Safe procedure for powering up or powering down an electrical circuit (lockout).
- Methods of producing and transporting energy.
- Distinction between conductors and insulators.
- Distinction among the different types of electric motors.
- Nature of electricity (movement of electrons between atoms).
- Characteristics of electrical phenomena: magnetism and electromagnetism, induction, etc.
- Structure of a building's electrical network (power source, electrical installation, apparatus) and the related equipment (e.g. main electrical panel, secondary electrical panel, disconnector) .
- Types of voltage: direct current, alternating current, single phase and three phase, etc.
- Role of safety devices such as fuses, breakers, thermal overload relays, etc.
- Role and operation of transformers, relays, switches, etc.
- Distinction between the control and power parts of an electrical circuit.
- States of a circuit: open, closed, short circuit, etc.
- Conventional direction of positive or negative current, power supply and grounding.
- Structure of matter (atoms, electrons, protons, neutrons, ions, etc.)
- Series, parallel and series-parallel circuits.
- Transformation of electrical energy into thermal energy.
- English and French terminology related to electrical circuits.
- Importance of taking note of useful information for the diagnosis.
- Importance of keeping the work area organized at all times.

Diagnosis of Electrical Problems	Code: 898596

1. Analyze the problem.
   - Questions to ask to gather information about the job to be done.
   - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
   - Interpretation of electrical circuit diagrams.
   - Determination of expected values in different electrical circuits: parallel, series, etc.
   - Locating and interpretation in an electrical circuit diagram of the symbols representing electrical components and sources, such as relays, transformers, power supplies, pushbutton contacts, thermal overload relays, motors, fuses, sensors, etc.
   - Visual verification and interpretation of results.
   - Possible causes of problems on an electrical circuit.
   - Determination of verifications and measurements to take based on the characteristics of the circuit and the problem detected.

2. Verify the electrical circuit.
   - Locating of components in the circuit: relay, transformer, power supply, pushbutton contacts, thermal overload relay, motor, fuse, etc.
   - Locating of terminals on the components.
   - Measuring instrument safety ratings (e.g. CAT II 1000V).
   - Use of a multimeter and clamp-on ammeter: choice of operating mode, methods of connecting them, and reading of the values of the different parameters.
   - Methods of taking relevant electrical measurements.
   - Measurement of different direct current and alternating current parameters (e.g. voltage, current, resistance) and comparison with expected values.
   - Methods of verifying control and power electrical components.
   - Powered-up and powered-down test methods.
   - Deductive method of identifying abnormalities: plausible hypotheses, investigation, relationships of cause and effect, etc.
   - Important visual verification points.
   - Detection of abnormal odours, temperatures, vibrations and noises.
   - Measurements, choice of units of measurement, etc.
   - Method of recording data.

3. Make a diagnosis.
   - Use of logical diagnostic methods.
   - Connections between the parameters and the electrical components, for example, same voltage before and after a closed switch.
   - Identification of differences between the values measured and the expected values.
   - Acceptable tolerances between the values measured and the expected values.
   - Possible causes of defects and their impact: short circuit, open circuit, loose contact, etc.

Pneumatic and Electropneumatic Circuits	Code: 783027

Competency 17 Duration 105 hours Credits 7

Behavioural Competency

Statement of the Competency

Install, maintain and troubleshoot pneumatic and electropneumatic circuits.

Achievement Context

- Given:
  - pneumatic circuits
  - electropneumatic circuits controlled by relay logic or a programmable device
  - verbal or written orders.
- Using:
  - personal and collective protective equipment
  - electrical circuit diagrams
  - pneumatic circuit diagrams
  - information explaining how the program works, if applicable
  - technical documentation
  - measuring instruments, tools and equipment
  - components and consumables.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders and diagrams. • Correct choice of components. • Appropriate choice of consumables.
2. Assemble and connect pneumatic components.	• Proper positioning and installation of pneumatic components. • Aesthetic appearance of the pneumatic circuit. • Solidity of connections. • Absence of leaks. • Assembly compliant with pneumatic circuit diagram. • Marking of components compliant with pneumatic circuit diagram.
3. Assemble and connect electrical components.	• Proper positioning of electrical components. • Aesthetic appearance of electrical circuit. • Correct identification of wires and components, if applicable. • Proper preparation and installation of wires. • Connections compliant with electrical circuit diagram. • Proper adjustment of sensors.

4. Perform preventive maintenance on pneumatic and electropneumatic circuits.	• Appropriate verification of the parameters of the systems and the sensors, and corrective measures, if applicable. • Meticulous detection of leaks. • Proper verification, adjustment and cleaning of conditioning unit.
5. Troubleshoot pneumatic and electropneumatic circuits.	• Correct analysis of failure. • Correct locating of sector or identification of stage of the failure. • Plausible hypotheses as to the cause of the failure. • Logical diagnostic method. • Accurate determination of appropriate corrective measure. • Appropriate choice of replacement components, if applicable. • Proper removal of defective components, if applicable. • Proper installation and adjustment of replacement components, if applicable. • Full correction of problem.
6. Ensure the proper operation of pneumatic and electropneumatic circuits.	• Thorough inspection of safety devices. • Appropriate verifications before powering up. • Proper testing of equipment. • Careful verification of the effectiveness of the work and application of the appropriate corrective measures, if necessary.
7. Finish the work.	• Comprehensive and accurate record of the work done. • Appropriate cleaning of work area. • Appropriate storage of all measuring instruments and tools.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Compliance with orders and diagrams. • Compliance with current laws, regulations and standards. • Strict observance of manufacturers' recommendations. • Effective communication and cooperation with the appropriate people. • Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Lockout and, if applicable, other method of controlling energy (review of Competency 4).
- Risks associated with compressed air (review of Competency 4).
- Standards for working on live electrical circuits (review of Competency 4).
- Connection between air pressure, contact surface and force.
- Connection between air flow, actuator volume and speed.
- Connection between air pressure, volume and temperature.
- Search method in technical documentation.
- English and French terminology related to pneumatic and electropneumatic circuits.
- Importance of keeping the work area always organized.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of taking note of useful information.

1. Prepare the work.
   - Questions to ask to gather information about the job to be done.
   - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
   - Locating of expected parameters in the technical documentation.
   - Interpretation of electrical circuit diagrams (review of Competency 3) and pneumatic circuit diagrams: symbols and standards for identifying components.
   - Verification of the operation of the system using technical documentation.
   - Important aspects for selecting an electrical component (review of Competency 3) and a pneumatic component.
   - Types of threads on pneumatic components.
   - Types of pneumatic fittings.
   - Colours and gauges of electrical conductors (review of Competency 3).

2. Assemble and connect pneumatic components.
   - Cutting of ducts.
   - Arrangement of pneumatic components.
   - Types of sealants (review of Competency 8).
   - Locating of orifices in pneumatic components.
   - Methods of connecting ducts.
   - Logical sequence of operations for assembling components and connecting ducts.

3. Assemble and connect electrical components.
    - Cutting and stripping of conductors (review of Competency 3).
    - Interpretation of electrical circuit diagrams: wiring diagram and ladder diagram (review of Competency 3).
    - Installation of grommets for conductor.
    - Common tools and their uses: pliers, wire stripper, crimper, screwdriver (review of Competency 3).
    - Methods used to mark wires.
    - Types of proximity sensors: magnetic, inductive, capacitive, etc.
    - Locating of terminals on the electrical components.
    - Connection of limit and proximity switches (NPN and PNP).

4. Perform preventive maintenance on pneumatic and electropneumatic circuits.
    - Methods of adjusting servo speed or the rotation of a pneumatic motor.
    - Operation and, if applicable, adjustment of the different pneumatic components: regulator, filter regulator lubricator (FRL), sequence valve, flow regulator, quick-release valve, etc.
    - Criteria for choosing the oil.
    - Means of checking for internal and external air leaks.
    - Use of measuring instruments.

5. Troubleshoot pneumatic and electropneumatic circuits.
    - Interpretation of electrical and pneumatic circuit diagrams.
    - Reading of simple programs in ladder diagrams or GRAFCET diagrams.
    - Determination of the sequence and operation of a circuit based on the diagrams.
    - Logical troubleshooting method to quickly identify the sector where the failure occurred.
    - Use of measuring instruments.
    - Important aspects of replacing a component.
    - Replacement of joints on servos or regulators.
    - Method of inspecting electrical and pneumatic components: solenoid, relay, sensor, servo, regulator, etc.

6. Ensure the proper operation of pneumatic and electropneumatic circuits.
    - Operation of basic safety devices.
    - Importance of installing mechanical safety devices before testing.
    - Important points to verify before powering up.
    - Powering up of pneumatic and electropneumatic circuits.
    - Reading of measuring instruments.
    - Comparison of the parameters measured with the expected parameters.
    - Signs of failure.
    - Possible solutions to problems.
    - Criteria for choosing the best solution.

7. Finish the work.
    - Data to be recorded (e.g. on a work order).
    - Terminology used to describe defects.
    - Precautions to be taken when storing certain tools.

Hydraulic and Electrohydraulic Circuits	Code: 783047

Competency 18 Duration 105 hours Credits 7

Behavioural Competency

Statement of the Competency

Install, maintain and troubleshoot hydraulic and electrohydraulic circuits.

Achievement Context

- Given:
  - hydraulic circuits
  - electrohydraulic circuits controlled by relay logic, a programmable relay or a programmable controller
  - verbal or written orders.
- Using:
  - personal and collective protective equipment
  - electrical circuit diagrams
  - hydraulic circuit diagrams
  - information explaining how the program works, if applicable
  - the equipment's operating parameters
  - technical documentation
  - measuring instruments, tools and equipment
  - components and consumables.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders and diagrams. • Correct choice of components. • Appropriate choice of consumables.
2. Assemble and connect hydraulic components.	• Proper positioning and installation of hydraulic components. • Aesthetic appearance of hydraulic circuit. • Solidity of connections. • Absence of leaks. • Assembly compliant with hydraulic circuit diagram. • Marking of components compliant with hydraulic circuit diagram.
3. Assemble and connect electrical components.	• Proper positioning of electrical components. • Aesthetic appearance of electrical circuit. • Correct identification of wires and components, if applicable. • Proper preparation and installation of wires. • Connections compliant with electrical circuit diagram. • Proper adjustment of sensors.

4. Perform preventive maintenance on hydraulic and electrohydraulic circuits.	• Accurate adjustment of system parameters: speed and pressure. • Precise adjustment of sensors. • Appropriate verification of absence of leaks.
5. Troubleshoot hydraulic and electrohydraulic circuits.	• Correct analysis of failure. • Correct locating of sector or identification of stage of the failure. • Plausible hypotheses as to the cause of the failure. • Logical diagnostic method. • Accurate determination of the cause of the problem. • Accurate determination of appropriate corrective measure. • Appropriate choice of replacement components, if applicable. • Proper removal of defective components, if applicable. • Proper installation and adjustment of replacement components, if applicable. • Full correction of problem.
6. Ensure the proper operation of hydraulic and electrohydraulic circuits.	• Thorough inspection of safety devices. • Appropriate verifications before powering up. • Proper testing of equipment. • Careful verification of the effectiveness of the work and appropriate corrections, if necessary.
7. Finish the work.	• Comprehensive and accurate record of the work done. • Appropriate cleaning of work area. • Appropriate storage of all measuring instruments and tools.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Compliance with orders and diagrams. • Compliance with current laws, regulations and standards. • Strict observance of manufacturers' recommendations. • Effective communication and cooperation with the appropriate people. • Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Lockout and, if applicable, other methods of controlling energy (review of Competency 4).
- Risks associated with hydraulics.
- Importance of recycling waste oil and absorbent materials.
- Standards for working on live electrical circuits (review of Competency 4).
- Connection between pressure, contact surface and force.
- Connection between oil flow, volume and speed.
- Search method in technical documentation.
- English and French terminology related to hydraulic and electrohydraulic circuits.
- Importance of keeping the work area always organized.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of taking note of useful information.

1. Prepare the work.
   - Questions to ask to gather information about the job to be done.
   - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
   - Locating of expected parameters in the technical documentation.
   - Interpretation of electrical circuit diagrams (review of Competency 3) and hydraulic circuit diagrams: symbols and standards for identifying components.
   - Determination of the operation of the system using technical documentation.
   - Important aspects for selecting an electrical component (review of Competency 3) and a hydraulic component.
   - Types of threads on hydraulic components.
   - Types of hydraulic fittings.
   - Colours and gauges of electrical conductors (review of Competency 3).

2. Assemble and connect hydraulic components.
   - Arrangement of hydraulic components.
   - Locating of orifices in hydraulic components.
   - Methods of connecting ducts.
   - Logical sequence of operations for assembling components and connecting ducts.

3. Assemble and connect electrical components.
   - Cutting and stripping of conductors (review of Competency 3).
   - Interpretation of electrical circuit diagrams: wiring diagram and ladder diagram (review of Competency 3).
   - Installation of grommets for conductor.
   - Tools and how to use them: screwdriver, pliers, wire stripper and crimper.
   - Methods used to mark wires.
   - Types of proximity sensors: magnetic, inductive, capacitive, etc.
   - Connection of limit and proximity switches (NPN and PNP).
   - Locating of terminals on the electrical components.

4. Perform preventive maintenance on hydraulic and electrohydraulic circuits.
    - Methods of adjusting servo speed or the rotation of a hydraulic motor.
    - Operation and, if applicable, adjustment of different hydraulic components: pressure-limiting device, flow regulator, etc.
    - Criteria for choosing the oil.
    - Means of checking for internal and external oil leaks.
    - Use of measuring instruments.

5. Troubleshoot hydraulic and electrohydraulic circuits.
    - Interpretation of electrical and hydraulic circuit diagrams.
    - Interpretation of simple programs in ladder diagrams or GRAFCET diagrams.
    - Determination of the sequence and operation of a circuit based on the diagrams.
    - Method to quickly identify the sector where the failure occurred.
    - Use of measuring instruments.
    - Important aspects of replacing a component.
    - Replacement of joints on servos or regulators.
    - Method of inspecting electrical and hydraulic components: solenoid, relay, sensor, servo, regulator, etc.

6. Ensure the proper operation of hydraulic and electrohydraulic circuits.
    - Operation of basic safety devices.
    - Importance of installing mechanical safety devices before testing.
    - Important points to verify before powering up.
    - Powering up of hydraulic and electrohydraulic circuits.
    - Reading of measuring instruments.
    - Comparison of the parameters measured with the expected parameters.
    - Signs of failure.
    - Possible solutions to problems.
    - Criteria for choosing the best solution.

7. Finish the work.
    - Data to be recorded (e.g. on a work order).
    - Terminology used in electricity and hydraulics.
    - Terminology used to describe defects.
    - Importance of a clean and tidy work area.
    - Precautions to be taken when storing certain tools.

Proportional Hydraulics	Code: 898604

Competency 19 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Install, maintain and troubleshoot proportional control hydraulic circuits.

Achievement Context

- Given:
  - proportional control hydraulic circuits made up of different components: flow control valves, pressure valves, directional valves, set point table, etc.
  - verbal or written orders.
- Using:
  - personal and collective protective equipment
  - electrical circuit diagrams
  - hydraulic circuit diagrams
  - information explaining how the program works, if applicable
  - the equipment's operating parameters
  - technical documentation
  - measuring instruments, tools and equipment
  - components and consumables.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders and diagrams. • Correct choice of components. • Appropriate choice of consumables.
2. Assemble and connect proportional control hydraulic circuits.	• Appropriate marking of components. • Proper positioning and installation of components. • Correct identification of wires and components, if applicable. • Aesthetic appearance of circuit. • Solidity of connections. • Absence of leaks. • Proper adjustment of sensors.
3. Perform preventive maintenance on proportional control hydraulic circuits.	• Accurate adjustment of system parameters: speed and pressure. • Precise adjustment of sensors. • Appropriate verification of absence of leaks.

4. Troubleshoot proportional control hydraulic circuits.	• Correct analysis of failure. • Correct locating of sector or identification of stage of the failure. • Plausible hypotheses as to the cause of the failure. • Logical diagnostic method. • Accurate determination of the cause of the problem. • Appropriate choice of corrective measure. • Appropriate choice of replacement component, if applicable. • Proper removal of defective component, if applicable. • Proper installation and adjustment of replacement component, if applicable. • Full correction of problem.
5. Ensure the proper operation of proportional control hydraulic circuits.	• Thorough inspection of safety devices. • Appropriate verifications before powering up. • Proper testing of equipment. • Careful verification of the effectiveness of the work and appropriate corrections if necessary.
6. Finish the work.	• Comprehensive and accurate record of the work done. • Appropriate cleaning of work area. • Appropriate storage of all measuring instruments and tools.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Compliance with orders and diagrams. • Compliance with current laws, regulations and standards. • Strict observance of manufacturers' recommendations. • Effective communication and cooperation with the appropriate people. • Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Lockout and other energy control methods (review of Competency 4).
- Risks associated with hydraulics.
- Importance of recycling waste oil and absorbent materials.
- Standards for working on live electrical circuits (review of Competency 4).
- Characteristics of proportional controls.
- Search method in technical documentation.
- English and French terminology related to proportional control hydraulic circuits.
- Importance of keeping the work area organized at all times.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of taking note of useful information.

1. Prepare the work.
   - Questions to ask to gather information about the job to be done.
   - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
   - Locating of expected parameters in the technical documentation.
   - Interpretation of diagrams: symbols and standards for identifying components (review of Competency 3).
   - Determination of the operation of the system using technical documentation.
   - Important aspects for selecting a proportional control hydraulic component.
   - Types of hydraulic fittings.
   - Colours and gauges of electrical conductors (review of Competency 3).

2. Assemble and connect proportional control hydraulic circuits.
   - Arrangement of proportional control hydraulic components: proportional regulator, proportional pressure-limiting device, proportional flow limiter, proportional hydraulic amplifier, set point table, coil, sensor, etc.
   - Locating of orifices and terminals on the components.
   - Methods of connecting components.
   - Logical sequence of operations for assembling components and connecting ducts.
   - Assembly of interfaces for open and closed loop control.
   - Accurate adjustment of circuit parameters: pressure, speed, time, set point, tension, etc.
   - Harmonization of electrical and hydraulic components.

3. Perform preventive maintenance on proportional control hydraulic circuits.
   - Means of readjusting hydraulic and electrical parameters.
   - Operation and adjustment, if applicable, of different components: proportional pressure-limiting device, proportional regulator, etc.
   - Means of checking for internal and external oil leaks.
   - Use of measuring instruments.

4. Troubleshoot proportional control hydraulic circuits.
    - Interpretation of diagrams.
    - Determination of the sequence and operation of a circuit based on the diagrams.
    - Use of measuring instruments.
    - Measurement of pressure, flow, tension, time, etc.
    - Logical troubleshooting methods to quickly identify the sector where the failure occurred.
    - Methods of verifying components and operating parameters: characteristic curves of components, pressure stages, etc.
    - Comparison of values measured with expected values.
    - Important aspects of replacing a component.
    - Initialization of set point, amplifier, ramps, etc.

5. Ensure the proper operation of proportional control hydraulic circuits.
    - Operation of basic safety devices.
    - Importance of installing safety devices before testing.
    - Important points to verify before powering up.
    - Procedure for powering up a proportional control hydraulic circuit.
    - Use of measuring instruments.
    - Comparison of the parameters measured with the expected parameters.
    - Signs of failure.
    - Possible solutions to the problem.
    - Criteria for choosing the best solution.

6. Finish the work.
    - Data to be recorded (e.g. on a work order).
    - Terms used in electricity and hydraulics.
    - Terms used to describe defects.
    - Importance of a clean and tidy work area.
    - Precautions to be taken when storing certain tools.

Automated System Repair	Code: 898614

Competency 20 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency	**Achievement Context**
Repair automated systems.	• Given: – defective automated systems – verbal or written orders. • Using: – personal and collective protective equipment – electrical circuit and wiring diagrams – electropneumatic and electrohydraulic circuit diagrams, etc. – technical documentation – measuring instruments, tools and equipment – replacement components and consumables.
Elements of the Competency	**Performance Criteria**
1. Prepare the work.	• Accurate interpretation of orders, drawings and technical documentation. • Confirmation of the nature of the problem. • Determination of logical sequence of operations.
2. Analyze the problem.	• Accurate locating of the elements of the automated control system. • Accurate distinction among components based on their: – characteristics – distinctive features – use. • Plausible hypotheses as to the cause of the problem. • Proper determination of verifications required, if applicable.
3. Remove the defective component.	• Positioning of system to facilitate the work, if possible. • Proper removal of defective component and, if applicable, the peripheral components. • Thorough inspection of the defective component. • Appropriate choice of replacement component.

4. Install the replacement component.	• Proper fastening of replacement component and peripheral components, if applicable. • Careful connection of replacement component, if applicable. • Appropriate adjustment of replacement component, if applicable. • Reinstallation of protective devices.
5. Ensure the proper operation of the automated system.	• Thorough inspection of safety devices. • Appropriate verifications before powering up. • Proper testing of equipment. • Careful verification of the effectiveness of the work and appropriate corrections, if necessary.
6. Finish the work.	• Comprehensive and accurate record of the work done. • Appropriate suggestions regarding maintenance or repair work, if applicable. • Appropriate cleaning of work area. • Storage of all measuring instruments, tools and equipment.
	For the competency as a whole: • Compliance with occupational health and safety rules. • Observance of the scope of a millwright's work. • Compliance with orders and diagrams. • Compliance with current laws, regulations and standards. • Strict observance of manufacturers' recommendations. • Effective communication and cooperation with the appropriate people. • Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Risks associated with working on automated systems and their components, and means of preventing them.
- Safety rules for working with electricity (review of Competency 4).
- Lockout and powering down procedure (review of Competency 4): specific technical procedure for locking out an automated system, procedure for powering up equipment for the start-up test following locking out, etc.
- Hot work procedure (review of Competency 4).

- Search method in technical documentation.
- English and French terminology related to the troubleshooting of automated systems, defects and the tasks required.
- Importance of keeping the work area organized at all times.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of taking note of useful information.

1. Prepare the work.
    - Questions to ask to gather information about the job to be done.
    - Importance of attitude toward the person asking for service.
    - Method of interpreting verbal and written orders (e.g. work orders).
    - Locating of expected parameters in the technical documentation.
    - Interpretation of an electrical circuit diagram (review of Competency 16).
    - Interpretation of an electropneumatic circuit diagram (review of Competency 17).
    - Interpretation of an electrohydraulic circuit diagram (review of Competency 18).
    - Locating of the industrial programmable controller (IPC) and the other components of the automated system.
    - Locating of input/output elements.
    - Interpretation of diagrams of the automated system: symbols and standards for identifying components and wiring logic.

2. Analyze the problem.
    - Characteristics and operation of physical control devices: start buttons, stop buttons, switches, potentiometers, pedals, etc. (review of Competency 16).
    - Characteristics and operation of the various sensors: cells or probes, photocells, limit sensors, inductive and capacitive proximity sensors, absolute and incremental encoders, temperature probes, pressure sensors, flowmeters, weight cells, etc.
    - Characteristics and operation of safety devices: emergency shutdown, safety relay, safety programmable controller, safety light curtain, safety laser, etc.
    - Characteristics and operation of direct and alternating current motors, stepper motors and servomotors.
    - Use of start-up functions of a variable speed drive in local mode only.
    - Characteristics, technical specifications and operation of a programmable controller: input module, functioning of program, output module, etc.
    - Information found on a control screen: real-time process, choice of programs or recipes, modification of settings, control keys, alarm management, management of equipment input and output, production statistics, etc.
    - Manual, step-by-step and automatic operation modes.
    - Interpretation of data provided by the programmable controller: indicator, messages and error codes, etc.
    - Conditions for starting an automatic cycle.
    - Main parameters to control on the automated system (travel and rotation speeds, pressure, flow, press times, etc.)

3. Remove the defective component.
    - Characteristics and use of pliers, wrenches, screwdrivers, etc., and selection criteria.
    - Important characteristics to verify when replacing a component of an automated system.
    - Method of finding replacement components (manual, Internet).
    - Application of removal procedure, methods of identifying components and recording data: position, connections, etc.
    - Replacement of defective components with the same types of components or their equivalent.
    - Characteristics and technical specifications of components, conductors, cables, connectors, etc.

4. Install the replacement component.
    - Identification of connection terminals, type of connection and colour code.
    - Specific criteria to observe when installing the component and list of parameters to adjust, if applicable.
    - Observance of reassembly procedure.

5. Ensure the proper operation of the automated system.
    - Verification of the operation of safety devices.
    - Importance of installing safety devices before testing.
    - Important points to verify before powering up.
    - Procedure for powering up an automated system.
    - Reading of measuring instruments.
    - Comparison of measured values with expected values.
    - Signs of other defects.
    - Possible solutions to the problem, if applicable.
    - Criteria for choosing the best solution.

6. Finish the work.
    - Data to be recorded (e.g. on a work order).
    - Terminology used to describe defects.
    - Precautions to be taken when storing certain tools and instruments.
    - Importance of properly storing tools and instruments.
    - Hazards related to poor organization of the work area.

Vibration Analysis and Balancing	Code: 898624

Competency 21 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Use a vibration analyzer and perform dynamic balancing.

Achievement Context

- Given:
  - unbalanced industrial equipment
  - verbal or written orders.
- Using:
  - mechanical drawings
  - technical documentation
  - measuring instruments, tools and equipment
  - lifting and handling equipment
  - personal and collective protective equipment.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders, drawings and technical documentation. • Determination of logical sequence of operations. • Accurate determination, if applicable of: – alarms indicating that thresholds have been exceeded – the system of measurement used. • Appropriate choice and use of mathematical formulas, if applicable. • Accurate calculations, if applicable.
2. Collect data using a vibration analyzer.	• Proper use of computer and analyzer. • Observance of technique for taking readings and transferring data. • Appropriate transfer of vibration route from the computer to the analyzer. • Accurate reading of vibration data on the equipment. • Appropriate selection of reports to be printed.
3. Interpret the data collected using a vibration analyzer.	• Proper use of vibration analysis software. • Observance of analysis process. • Proper use of tables and charts. • Accurate identification of equipment malfunctions.

4. Perform dynamic balancing on industrial equipment on one and two planes.	• Observance of process for balancing industrial equipment. • Correct application of balancing methods. • Accurate balancing.
5. Finish the work.	• Comprehensive and accurate record of the work done. • Appropriate suggestions regarding maintenance or repair work, if applicable. • Appropriate cleaning of work area. • Storage of all measuring instruments, tools and equipment.
	For the competency as a whole:
	• Compliance with occupational health and safety rules. • Compliance with current laws, regulations and standards. • Observance of orders. • Strict observance of manufacturers' recommendations. • Appropriate choice and use of measuring instruments, tools and equipment.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Risks associated with using a vibration analyzer and balancing industrial equipment, and means of preventing them.
- Lockout and powering down procedure
- Hot work procedure..
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of keeping the work area organized at all times.
- Importance of taking note of useful information.
- English and French terminology related to vibration analysis and the balancing of industrial equipment.
- Importance of carefully handling vibration analysis and balancing equipment.
- Characteristics of industrial equipment and its mechanical components (couplings, transmission, bearing, etc.)
- Most common defects associated with industrial equipment.

Vibration Analysis and Balancing — Code: 898624

1. Prepare the work.
    - Consultation of manufacturer's manual to learn how to use the vibration analyzer and balancing equipment.
    - Consultation of charts, tables, formulas and so on in the technical documentation.
    - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
    - Questions to ask to gather information about the job to be done.
    - Interpretation of mechanical drawings.
    - Content of a work order: job to be done, schedule, etc.
    - Job planning method ensuring a logical sequence of operations.

Use of vibration analyzer

- Parameters of vibration analysis: frequencies, phases, amplitudes, etc.
- Choice of amplitudes: peak to peak or root mean square (RMS).
- Choice of frequencies: hertz or cycles per minute (CPM).
- Distinction among the different vibrational spectra: temporal, fast Fourier transform (FFT), etc.
- Instruments needed to take measurements (tape measure, tachometer, balance, etc.)
- Choice of sensors (incremental position, velocity or acceleration).
- Safe position of sensors that ensures the most direct and shortest route to the source of vibrations.
- Sensor direction: radial or axial.
- Types of mounting for sensors: studs, magnets, epoxy, etc.
- Method of verifying sensors before use.
- Cleaning of vibration analyzer.
- Choice of units of measurement (metric or imperial).
- Verification of the machine's vibrational state (overall value).

Balancing

- Methods of detecting abnormalities: by sight, smell, touch, etc.
- Distinction among the different types of unbalance: static, couple and dynamic.
- Confirmation of unbalance before balancing: readings, spectra, etc.
- Determination of degree of balancing.
- Choice and use of mathematical formulas to calculate balancing parameters: rotation speed, rotor mass, test mass, etc.
- Verification of rotation speeds.
- Verification of sensors before use.
- Connection of sensors and accessories.
- Choice and operation of the tools and equipment needed to balance a piece of equipment.
- Positioning of sensors.
- Method of cleaning balancing equipment.
- Choice of units of measurement: mm/s^2, in/s^2, etc.

2. Collect data using a vibration analyzer.
   - Connection of sensors and accessories needed to collect data through vibration analysis.
   - Verification of user speeds and frequencies.
   - Creation of a route for the vibration analyzer.
   - Use of the basic functions of the vibration analysis software.
   - Methods of transferring the route from the computer to the analyzer.
   - Method of taking readings: order, position, direction, etc.
   - Reading of vibration data: overall value, vibration spectra, etc.
   - Methods of transferring data from the analyzer to the computer.
   - Criteria for choosing the reports to print.

3. Interpret the data collected using a vibration analyzer.
   - Use of vibration analysis software to interpret the data collected.
   - Comparison of data collected with prior data, if applicable.
   - Identification of equipment malfunctions and suggestion of corrective measures.

4. Perform dynamic balancing on industrial equipment on one or two planes.
   - Distinction between static and dynamic balancing.
   - Dynamic balancing methods: adding, removing, splitting and combining weights, changing the correction radius, without phase measurement.
   - Configurations of the equipment to be balanced: between bearings and overhung.
   - Distinction between balancing on one plane and balancing on two planes.
   - Method of verifying the precision of the balancing using mathematical formulas.

5. Finish the work.
   - Data to be recorded (e.g. on a work order).
   - Printing of reports.
   - Recording of data.
   - Precautions to be taken when storing certain tools and measuring instruments.

Code: 898634

Competency 22 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Apply the preventive maintenance program for industrial equipment.

Achievement Context

- Given:
  - functioning industrial equipment
  - a work order generated by a maintenance software program
  - drawings and diagrams
  - technical documentation.
- Using:
  - personal and collective protective equipment
  - maintenance software
  - digital tools
  - measuring instruments, tools and equipment
  - replacement components and consumables.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders and diagrams. • Locating in the work order of the precise work to be done. • Accurate locating of checkpoints and maintenance periods in the manufacturer's manual. • Consultation of inventory of replacement parts. • Relevant verification of the equipment's maintenance history. • Planning of logical sequence of tasks.
2. Perform preventive maintenance operations on industrial equipment and components.	• Thorough inspection of components. • Appropriate cleaning of equipment. • Appropriate lubrication of components, if applicable. • Meticulous detection and correction of abnormalities. • Thorough data collection. • Comparison of recent data with prior data. • Appropriate adjustment of parameters, if applicable. • Proper performance of preventive maintenance tasks.
3. Ensure the proper operation of industrial equipment and components.	• Thorough inspection of safety devices. • Appropriate verifications before powering up. • Proper testing of components and equipment. • Careful verification of the effectiveness of the work and appropriate corrections if necessary.

4. Finish the work.	• Comprehensive and accurate record in the maintenance software of the work done. • Number of parts in inventory kept to the recommended minimum. • Appropriate suggestions regarding maintenance or repair work, if applicable. • Appropriate cleaning of work area. • Storage of all measuring instruments, tools and equipment.
	For the competency as a whole:
	• Compliance with occupational health and safety rules. • Observance of the scope of a millwright's work. • Compliance with orders and diagrams. • Compliance with current laws, regulations and standards. • Strict observance of manufacturers' recommendations. • Effective communication and cooperation with the appropriate people. • Appropriate choice and use of measuring instruments, tools and equipment. • Appropriate use of maintenance software.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Lockout and powering down procedure (review of Competency 4).
- Safety rules for working with electricity (review of competencies 4 and 16).
- Hot work procedure (review of Competency 16).
- Risks related to planned maintenance tasks.
- Use of equipment and accessories, and lifting and handling methods (review of Competency 5).
- Use of the appropriate measuring instruments (review of competencies 8, 10 and 16).
- Characteristics and use of pliers, wrenches, screwdrivers, etc., and selection criteria (review of competencies 8, 10, 11 and 14).
- Readings on a pressure gauge (review of Competency 14).
- Characteristics of lubricants (review of competencies 8 and 10).
- Search method in technical documentation.
- Most common preventive maintenance tasks.
- Detection of signs of an imminent failure and system weaknesses, and suggested maintenance and repair tasks.
- English and French terminology related to the planned maintenance of industrial equipment.
- Use of maintenance software.
- Importance of keeping the work area organized at all times.

- Categories of machine safety: characteristics and operation of components.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- Importance of taking note of useful information.

1. Prepare the work.
   - Questions to ask to gather information about the job to be done.
   - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
   - Browsing a maintenance software program or application.
   - Preparation of replacement parts.
   - Preparation of the tools required for the job.
   - Consultation of maintenance history.

2. Perform preventive maintenance operations on industrial equipment and components.
   - Determination of the condition of the part to be changed or adjusted by reading a measurement or making a visual assessment.
   - Planning of equipment shutdown and duration of work.
   - Performance of preventive maintenance tasks recommended by the manufacturer of the hydraulic systems: oil change, replacement of filters and gaskets, etc.
   - Performance of preventive maintenance tasks recommended by the manufacturer of the pneumatic systems: replacement of air filter, adjustment of lubricating oil flow, replacement of gaskets, etc.
   - Performance of preventive maintenance tasks recommended by the manufacturer of the electrical systems: cleaning of filters and fans in the electrical cabinets, replacement of electrical components (relays, sensor, etc.) nearing the end of their useful life, etc.
   - Performance of preventive maintenance tasks recommended by the manufacturer of the mechanical systems: greasing and lubrication of bearings, replacement and adjustment of belts, replacement and adjustment of chains, replacement of piston compressor segments, etc.

3. Ensure the proper operation of industrial equipment and components.
   - Detection and correction of any abnormalities found during data collection.
   - Comparison of the data collected with prior data.
   - Interpretation of data collected.
   - Operation of the different electrical and mechanical safety control devices.
   - Procedure for starting up industrial equipment.
   - Signs of failure.

4. Finish the work.
   - Suggestion of maintenance or repair work: determination of the nature of the maintenance or repairs and the time frame of required shutdowns, etc.
   - Data to be recorded (e.g. on a work order).
   - Importance of properly storing tools and measuring instruments.
   - Importance of keeping replacement parts in inventory.

Installation of Industrial Equipment	Code: 898646

Competency 23 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency

Install industrial equipment.

Achievement Context

- Given:
  - industrial equipment broken down into parts including:
    - an electrical circuit
    - a proportional control hydraulic circuit
    - a pneumatic circuit
    - a mechanical circuit
    - safety guards
    - etc.
  - verbal or written orders
- Using:
  - personal and collective protective equipment
  - diagrams
  - installation drawings
  - technical documentation
  - measuring instruments, tools and equipment
  - replacement components and consumables.

Elements of the Competency	Performance Criteria
1. Prepare the work.	• Accurate interpretation of orders, diagrams and drawings. • Careful study of the characteristics of the industrial equipment to be installed. • Accurate locating of installation site. • Logical planning of work. • Appropriate verification of availability and compliance of components.
2. Install the industrial equipment rack.	• Transfer of rack to the designated location. • Proper levelling of rack. • Proper fastening or anchoring of rack.
3. Install the mechanical components.	• Installation of components in a logical order. • Installation at the precise location. • Proper mechanical adjustment or alignment of components. • Solid assembly of components.

Installation of Industrial Equipment	Code: 898646
4. Install and connect the pneumatic components.	• Installation of components in a logical order. • Aesthetic appearance of installation and connections. • Proper connection of: – components to each other – equipment to the pneumatic power source, if applicable.
5. Install and connect the proportional control hydraulic components.	• Installation of components in a logical order. • Aesthetic appearance of installation and connections. • Proper connection of: – components to each other – equipment to the hydraulic power source, if applicable.
6. Install and connect the electrical components.	• Installation of components in a logical order. • Appropriate running of wires in the conduits, if applicable. • Aesthetic appearance of installation and connections. • Proper connection of: – components to each other – equipment to the pneumatic power source, if applicable.
7. Install the safety guards.	• Proper drilling and tapping. • Appropriate installation of guards.
8. Ensure the proper operation of the industrial equipment.	• Appropriate inspection of the systems before powering up. • Sequential start-up of equipment. • Proper adjustments to the parameters of the controller, variable speed drive, etc. • Careful verification of the effectiveness of the work and appropriate corrections, if necessary.
9. Finish the work.	• Comprehensive and accurate record of the work done. • Appropriate suggestions regarding maintenance or repair work, if applicable. • Appropriate cleaning of work area. • Storage of all measuring instruments, tools and equipment.

For the competency as a whole:

- Compliance with occupational health and safety rules.
- Compliance with orders, diagrams and drawings.
- Compliance with current laws, regulations and standards.
- Strict observance of manufacturers' recommendations.
- Proper production of missing parts, if applicable.
- Effective communication and cooperation with the appropriate people.
- Appropriate selection and use of equipment and tools and their accessories, and measuring instruments.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Safety rules for working on live equipment, locking out, handling equipment, using machine tools, doing hot work, working at a height, etc. (review of Competency 4).
- Importance of recycling waste oil and absorbent materials.
- Use of lifting and handling equipment and accessories (review of Competency 5).
- Methods of lifting and handling loads.
- Method of using hand tools and machine tools (review of competencies 6 and 12).
- Characteristics and operation of hand tools, and selection criteria.
- Interpretation of electrical, pneumatic and mechanical circuit diagrams, etc.
- Importance of complying with drawings, diagrams and manufacturers' recommendations.
- Importance of keeping the work area organized at all times.
- Categories of machine safety: characteristics and operation of components.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc.
- English and French terminology related to the installation of industrial equipment.
- Importance of taking note of useful information.
- Methods of producing missing parts (e.g. safety guards) with or without drawings.

Installation of Industrial Equipment	Code: 898646

1. Prepare the work.
    - Questions to ask to gather information about the job to be done.
    - Methods of analyzing and interpreting verbal and written orders (e.g. work orders).
    - Locating of important information concerning an installation (name plates, technical documentation).
    - Tasks important to a complete installation and a logical sequence of operations.
    - Standards related to the job.
    - Regulations respecting electrical work.
    - Regulations respecting gas work.
    - Importance of planning the work and the installation sequence, and of meeting deadlines.
    - Distinction among electrical, mechanical, pneumatic and hydraulic components, etc.
    - Important characteristics of electrical, pneumatic, hydraulic and mechanical components, etc., and selection criteria.
    - Important units of measurement for power sources.
    - Method of determining the flow rate and supply pressure of fluids.
    - Method of preparing grout.

2. Install the industrial equipment rack.
    - Use of measuring tools: automatic level, laser level, square, tape measure, etc.
    - Characteristics of the different types of anchors.
    - Criteria for choosing bolts.
    - Types of rack anchors: chemical or mechanical.
    - Verification and correction of foot adjustment.
    - Methods of levelling the rack.

3. Install the mechanical components.
    - Positioning and fastening of components: belt, chain, speed reducer, etc.
    - Use of mechanical alignment methods for pulleys, couplings, conveyor belts, etc.
    - Use of methods of adjusting tension and mechanical allowance (belt, chain, gear wheel).
    - Differentiation between bolts, nuts and other fasteners.

4. Install and connect the pneumatic components.
    - Distinction among the different pneumatic components.
    - Positioning and fastening of components (regulator, servo, vacuum pump, pneumatic motor, etc.)
    - Criteria for choosing pneumatic hoses and types of fittings.
    - Connection of pneumatic components.
    - Quality criteria for a professional installation.
    - Methods of fastening ducts.

5. Install and connect the proportional control hydraulic components.
    - Distinction among the different hydraulic parts.
    - Positioning and fastening of components (hydraulic pump, hydraulic motor, control card, regulators, etc.)
    - Criteria for choosing hydraulic hoses.
    - Production of hydraulic hoses and tubes: bending, crimping and installation of fittings.
    - Types of hydraulic fittings.
    - Criteria for a professional installation.
    - Methods of fastening hoses and tubes.

6. Install and connect the electrical components.
    - Distinction between the control and power parts of an electrical circuit.
    - Colour code and types and sizes of electric wires.
    - Purpose of shielded cables.
    - Methods of pulling conductors.
    - Methods of drilling electrical panels using die punches, step drills, etc.
    - Positioning and fastening of components: relays, sensors, motors, etc.
    - Preparation and installation of conductors: cutting, stripping, installation of ferrules, tinning, installation of connectors, fastening method, etc.

7. Install the safety guards.
    - Use of measuring instruments (vernier calliper, micrometer, etc.)
    - Use of tools and machining, welding and forming equipment.
    - Positioning and fastening of safety guards.

8. Ensure the proper operation of the automated system.
    - Methods of verifying oil levels.
    - Use of measuring instruments: multimeter, thermometer, clamp-on ammeter, etc.
    - Method of checking for fluid leaks.
    - Criteria for selecting oils.
    - Adjustment of hydraulic components: hydraulic pressure-limiting device, hydraulic flow regulator, etc.
    - Adjustment of pneumatic components: air pressure regulator, air flow regulator, etc.
    - Importance of installing mechanical safety devices before testing.
    - Important points to verify before powering up.
    - Insulation categories of measuring instruments.
    - Important measures to take when verifying the operation of the circuit.
    - Signs of failure.
    - Possible solutions to the problem.
    - Criteria for choosing the best solution.

9. Finish the work.
    - Data to be recorded (e.g. on a work order).
    - Precautions to be taken when storing certain tools and measuring instruments.

Troubleshooting of Industrial Equipment	Code: 898656

Competency 24 Duration 90 hours Credits 6

Behavioural Competency

Statement of the Competency	**Achievement Context**
Troubleshoot industrial equipment.	• Given: – malfunctioning industrial equipment – verbal or written orders, etc. • Using: – personal and collective protective equipment – electrical, pneumatic and hydraulic circuit diagrams, etc. – technical documentation – measuring instruments, tools and equipment – replacement components and consumables.
Elements of the Competency	**Performance Criteria**
1. Analyze an equipment failure.	• Accurate interpretation of the order. • Appropriate verification of the equipment's maintenance and repair history. • Use of different methods of analyzing equipment failures. • Correct identification of the sector in question. • Plausible hypotheses as to the cause of the failure. • Accurate determination of required verifications and expected results. • Identification of relevant data.
2. Make a diagnosis.	• Proper comparison of data collected with expected data. • Accurate determination of the component that caused the failure. • Appropriate choice of intervention to solve the problem. • Determination of logical sequence of operations.
3. Repair a pneumatic circuit.	• Appropriate choice of replacement component, if applicable. • Proper removal of defective component, if applicable. • Proper installation and adjustment of replacement component, if applicable. • Full correction of problem.

4. Repair a hydraulic circuit.	• Appropriate choice of replacement component, if applicable. • Proper removal of defective component, if applicable. • Proper installation and adjustment of replacement component, if applicable. • Full correction of problem.
5. Repair an electrical circuit.	• Appropriate choice of replacement component, if applicable. • Proper removal of defective component, if applicable. • Proper installation and adjustment of replacement component, if applicable. • Full correction of problem.
6. Repair a mechanical system.	• Appropriate choice of replacement component, if applicable. • Proper removal of defective component, if applicable. • Proper installation and adjustment of replacement component, if applicable. • Full correction of problem.
7. Ensure the proper operation of the industrial equipment.	• Thorough inspection of safety devices. • Appropriate verifications before powering up. • Proper testing of equipment. • Careful verification of the effectiveness of the work done. • Appropriate corrections, if applicable.
8. Finish the work.	• Appropriate cleaning of work area. • Absence of materials or debris in the control panel. • Appropriate storage of all measuring instruments and tools. *For the competency as a whole*: • Compliance with occupational health and safety rules. • Compliance with orders, diagrams and drawings. • Compliance with current laws, regulations and standards. • Strict observance of manufacturers' recommendations. • Proper production of missing parts, if applicable. • Effective communication and cooperation with the appropriate people. • Appropriate selection and use of equipment and tools and their accessories, and measuring instruments.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to the competency as a whole and to each element of the competency, along with their attendant guidelines.

For the competency as a whole:

- Lockout and powering down procedure (review of Competency 4).
- Safety rules for working with electricity (review of Competency 4).
- Importance of recycling waste oil and absorbent materials.
- Hot work procedure (review of Competency 4).
- Search method in technical documentation.
- English and French terminology related to the troubleshooting of industrial equipment, defects and the tasks required.
- Importance of keeping the work area organized at all times.
- Categories of machine safety: characteristics and operation of components.
- Importance of effective communication and cooperation with the appropriate people: operators, co-workers, other tradespersons, superiors, etc..
- Importance of taking note of useful information.

1. Analyze an equipment failure.
    - Questions to ask to gather information about the job to be done.
    - Methods of analyzing and interpreting orders.
    - Importance of attitude toward the person asking for service.
    - Interpretation of electrical, pneumatic, electropneumatic, hydraulic and electrohydraulic circuit diagrams, etc.
    - Factors to check to quickly rule out possible causes.
    - Interpretation of indicators, messages and error codes.
    - Interpretation of input and output signals.
    - Operation of components and interactions between them.
    - Determination of normal measurements or data at different points based on diagrams.
    - Choice of effective verification sequence, considering the possible results.
    - Insulation categories of measuring instruments.
    - Physical aspect of industrial equipment components: control, power and safety components, power supplies, variable speed drives, pneumatic and hydraulic regulators, terminal boards, fuses, breakers, etc.

2. Make a diagnosis.
    - Types of defects and their observable characteristics.
    - Use of logical diagnostic methods.
    - Troubleshooting methods: cleaning, repairing a part, changing a part, etc.
    - Evaluation of the durability of the different types of repairs and the time frame in order to make the right choice.

3. Repair a pneumatic circuit.
    - Characteristics and use of the equipment and tools needed for the repair, and selection criteria.
    - Important characteristics to verify when replacing a pneumatic component.
    - Method of finding replacement components (manual, Internet).
    - Application of removal procedure, methods of identifying components and recording data: position, connections, etc.
    - Observance of reassembly procedure.

4. Repair a hydraulic circuit.
    - Characteristics and use of the equipment and tools needed for the repair, and selection criteria.
    - Important characteristics to verify when replacing a hydraulic component.
    - Method of finding replacement components (manual, Internet).
    - Application of removal procedure, methods of identifying components and recording data: position, connections, etc.
    - Observance of reassembly procedure.

5. Repair an electrical circuit.
    - Characteristics and use of the equipment and tools needed for the repair, and selection criteria.
    - Important characteristics to verify when replacing an electrical component.
    - Method of finding replacement components (manual, Internet).
    - Application of removal procedure, methods of identifying components and recording data: position, connections, etc.
    - Observance of reassembly procedure.

6. Repair a mechanical system.
    - Characteristics and use of the equipment and tools needed for the repair, and selection criteria.
    - Important characteristics to verify when replacing a mechanical component.
    - Method of finding replacement components (manual, Internet).
    - Application of removal procedure, methods of identifying components and recording data: position, connections, etc.
    - Observance of reassembly procedure.

7. Ensure the proper operation of the industrial equipment.
    - Operation of different safety systems and their components: safety curtain, emergency shutdown, safety line, safety relay, etc.
    - Importance of installing mechanical safety devices before testing.
    - Important points to verify before powering up.
    - Method of verifying possible short circuits.
    - Powering up procedure.
    - Procedure for starting up industrial equipment.
    - Industrial equipment operating modes: automatic, manual, etc.
    - Signs of failure.
    - Possible solutions to the problem.
    - Criteria for choosing the best solution.

8. Finish the work.
    - Data to be recorded (e.g. on a work order).
    - Importance of carefully storing tools and measuring instruments.

Code: 783111

Competency 25 Duration 15 hours Credit 1

Situational Competency

Statement of the Competency

Manage their career.

Elements of the Competency

- Gather information from organizations in the targeted field.
- Determine their career goals.
- Be familiar with the job search process.

Learning Context

Information Phase

- Learning about job opportunities in the field.
- Listing the work experience, aptitudes and skills required for the job they are interested in.
- Learning about the steps in a job search process.
- Learning about the tools used to apply for jobs.

Participation Phase

- Reflecting on their preferences and interest in various career paths.
- Evaluating their strengths and areas requiring improvement in real or simulated interviews with potential employers.
- Determining the aptitudes and skills likely to influence their career choice, based on prior experience, including during the training program.
- Producing tools to apply for a job or request a meeting with a potential employer.

Synthesis Phase

- Determining the measures to take to improve their performance when requesting an interview by phone and going for a job interview.

Instructional Guidelines

- Create an environment conducive to reflection.
- Facilitate exchanges of opinions.
- Encourage students to identify their preferences and interest in various career paths.
- Organize realistic learning situations.

Participation Criteria

Information Phase

- Learn about the topics covered.
- Make a list of the work experience, aptitudes and skills required for the job they are interested in.

Participation Phase

- Participate in the suggested activities.
- Make a list of potentially interesting jobs.
- Produce tools.

Synthesis Phase

- Make a list of their strengths and areas requiring improvement, as well as means of improvement.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to each phase of the learning context, along with their attendant guidelines.

Information Phase

- Potential jobs in the field, types of companies likely to hire millwrights: industrial manufacturing and processing companies, companies in the construction sector, public utilities, mines, civil engineering firms, etc.
- Consultation of employment centres, employment agencies, local newspapers, the Internet, etc.
- Steps in the job search process: identification of fields of interest, applying for a job, formal or informal interviews, follow-up, etc.
- Tools used to apply for a job: cover letter, business card, resumé, etc.

Participation Phase

- Reflection on their preferences and interest in certain career paths in the field: employee, self-employed worker, etc.
- Assessment of their strengths and weaknesses in meetings with potential employers.
- Attitudes to adopt in an interview: dress, language, etc.
- Telephone communication: introduction, protocol, tone of voice, level of language and politeness.
- Production of job search tools: cover letter, business card, resumé.
- Rules of writing.

Synthesis Phase

- Determination of their strengths and areas requiring improvement in terms of job search, as well as means of improvement.
- Self-assessment, comments gathered during the scenarios or practicums, etc.

Code: 898666

Competency 26 Duration 90 hours Credit 6

Situational Competency

Statement of the Competency

Enter the workforce.

Elements of the Competency

- Apply competencies acquired during the training process.
- Comply with the company's standards and practices.
- Consolidate attitudes compatible with the practice of the trade.
- Take stock of their learning.

Learning Context

Information Phase

- Learning about the terms and conditions for the practicum.
- Learning about the contents of a log.
- Learning about the rules and practices in the company offering the practicum.

Participation Phase

- Observing trade-related practices.
- Integrating into the work team.
- Performing a variety of trade-related tasks.
- Keeping their log up to date.

Synthesis Phase

- Producing a report on their practicum experience.
- Presenting a summary of their practicum experience.

Instructional Guidelines

- Encourage students to share their points of view.
- Inform students in advance of the practicum's objectives.
- Agree with the practicum supervisors on ways of fostering the performance of trade-related tasks and the development of students' autonomy.
- Maintain close collaboration with the practicum supervisors.
- Make sure trainees are effectively supervised.
- Regularly visit trainees in the workplace.
- Solve problems that arise during the practicum.
- Foster critical evaluation of the practicum.

Code: 898666

Participation Criteria

Information Phase

- Learn about the topics covered.
- Participate in activities.

Participation Phase

- Perform or participate in the performance of the tasks assigned under the agreement.
- Keep a log.

Synthesis Phase

- Present a practicum report.
- Participate in the evaluation of their practicum.

Suggestions for Competency-Related Knowledge and Know-How

The following is a summary of the knowledge, skills, strategies, attitudes and perceptions related to each phase of the learning context, along with their attendant guidelines.

Information Phase

- Terms and conditions, objectives and duration of the practicum, supervision, requirements, participation criteria, company rules.
- Log: headers, purpose, importance of recording the facts as they occur and connection to the practicum report.
- Identification of companies that meet their expectations and needs, as well as companies that have taken in student trainees in the past, and examination of those practicum experiences.
- Consultation of various sources.
- Procedure for obtaining a practicum position: communication with the employer, agreement on the terms and conditions of the practicum, presentation to the employer of a list of tasks students must perform in order to meet practicum requirements, confirmation of practicum, receipt of the necessary documents.

Participation Phase

- Integration into the work team: observation of and compliance with work methods, team meetings and informal meetings, teamwork, reception and transmission of information, acceptance of advice and comments, feedback, verification of the satisfaction of the practicum supervisors.
- Adoption of attitudes and behaviours conducive to a successful practicum.
- Qualities appreciated by employers.
- Attitudes conducive to making the most of the experience.
- Production of a log.
- Useful and meaningful elements for the practicum report.
- Observations in the workplace: work context, tasks performed, application of work methods, etc.
- Introduction to new work methods or procedures.
- Recording of observations in the log.
- Performance of tasks: active participation in the practicum.
- Occupational health and safety rules.
- Instructions and company rules.
- Recording of tasks in the log.

Synthesis Phase

- Report on activities carried out during the practicum.
- Typical content of a practicum report:
  - Report on activities performed or observed on a daily basis
  - Procedures used or new technologies, new learning, new problems and solutions found, etc.
- Comments received about their performance of tasks.
- Use of the log.
- Evaluation of the practicum: criteria to consider
  - Self-evaluation
  - Report on their experience
  - Mention of positive elements and level of satisfaction
  - Mention of problems encountered and solutions found
  - Perception of the trade before and after the practicum
  - Use of the log.
- Comparison of the learning acquired during the program with the activities observed or performed in the workplace.
- Aspects of the trade that are consistent or inconsistent with their training with respect to the workplace, trade practices, job requirements, etc.

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