



PROGRAM OF STUDY

HIGH-PRESSURE WELDING (AVS 5883)

Training Sector

METALLURGICAL TECHNOLOGY

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Introduction to the Program

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

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

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

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

Program Components

Program Goals

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

Educational Aims

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

Competency

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

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

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

1. Behavioural Competency

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

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

2. Situational Competency

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

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

Competency-Related Knowledge and Know-How

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

Duration

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

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

Credit

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

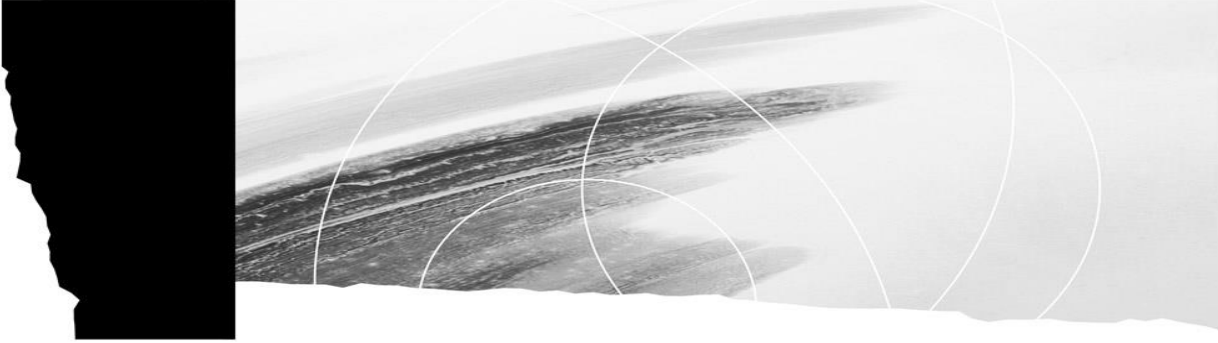
Aspects of Program Implementation

Program-Based Approach

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



5883

High-Pressure Welding

Year of approval: 2022

Certification:	Attestation of Vocational Specialization
Number of credits:	43
Number of competencies:	11
Total duration:	645 hours

To be eligible for admission to the *High-Pressure Welding* program, candidates must meet one of the following requirements:

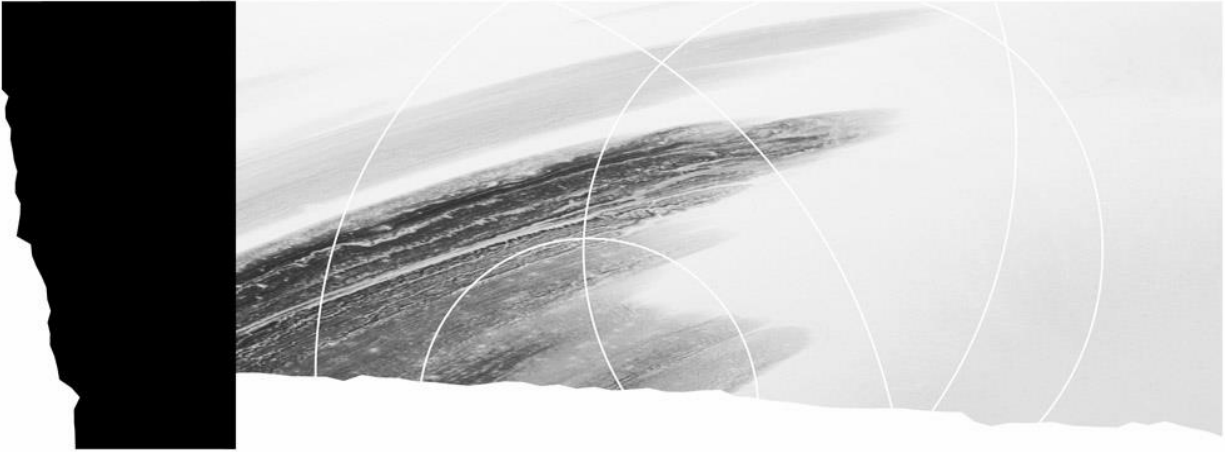
- Hold one of the following Diplomas of Vocational Studies (DVSs) or have been granted recognition of equivalent learning:
 - 5382 *Soudage-assemblage*
 - 5195 *Soudage-montage*
 - 1049 *Soudage général*
 - 5882 *Welding and Assembly*
 - 5695 *Welding and Fitting*
 - 1549 *General Welding*
- OR
- Practise a trade or occupation related to this program of study

The duration of the program is 645 hours, which includes 600 hours spent on the specific competencies required to practise the trade or occupation and 45 hours on general, work-related competencies. The program of study is divided into 11 competencies which vary in length from 15 to 105 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 the student, at their request, to certifications issued by recognized authorities.

Competency	Code	Number	Hours	Credits
The Trade and the Training Process	802321	1	15	1
Interpretation of Information on High-Pressure Welding	802332	2	30	2
SMAW – 1G for Mild Steel Pipes	802345	3	75	5
SMAW – 2G for Mild Steel Pipes	802354	4	60	4
SMAW – 5G and 6G for Mild Steel Pipes	802367	5	105	7
GTAW and SMAW – 2G and 5G for Mild Steel Pipes	802374	6	60	4
GTAW – 2G for Purging and Welding Stainless Steel Pipes	802384	7	60	4
GTAW and SMAW Welding Mild Steel and Stainless Steel Pipes with a Purging System in the 5G and 6G Positions	802394	8	60	4
GMAW and FCAW – 1G, 5G and 6G for Mild Steel Pipes	802403	9	45	3
GMAW – 1G, 5G and 6G for Stainless Steel Pipes	802414	10	60	4
Assembly, Welding and Connection of a Pipe System	802425	11	75	5



Part I

Program Goals

Educational Aims

Statements of the Competencies

Grid of Competencies

Harmonization

Program Goals

The *High-Pressure Welding* program prepares students to practise the trade of high-pressure welder.

High-pressure welders work in sectors of activity such as the manufacture of metal products, machines and paper, civil engineering and building construction. They work in a range of production or metal shops and on construction sites.

High-pressure welders are capable of performing specialized welding operations on pipes designed to hold pressurized fluids and gases. More specifically, they prepare, assemble, weld and repair pipes and pipe components such as supports and anchors. They also connect pipe systems to pressure vessels.

High-pressure welders are proficient in the main welding processes used in the trade and work on different metals (in particular mild and stainless steel) and in all welding positions used in piping. They require the utmost dexterity to be able to produce welds in compliance with the different laws and standards governing the welding of pipes and pressure vessels. They must regularly pass practical exams to obtain certificates of competency, including those issued by Emploi-Québec. Stress management is also an asset.

To ensure the conformity of their work, high-pressure welders must be able to correctly interpret various types of documents, in particular piping diagrams and welding procedures.

High-pressure welders regularly use lifting equipment and accessories to move heavy workpieces. They must also use access equipment to get to certain work sites. They work indoors or outdoors, often in hot or cold environments, and must deal with dust, gases and high noise levels, and work at heights or work in confined spaces. They must pay special attention to mandatory health and safety rules in all their activities.

Although they mainly work alone and independently, they occasionally work with other high-pressure welders, labourers, pipe fitters and boilermakers. Forepersons and site managers oversee their activities.

The program goals of the *High-Pressure Welding* 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 work force, 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 *High-Pressure Welding* program is to help students develop attitudes and behaviours that representatives from education and the field deem essential to the practice of the trade:

- Develop a high level of manual dexterity allowing them to do work that complies with the industry's strict standards
- Develop the ability to adapt (to situations, welding processes, materials, etc.) and persevere when faced with difficulties
- Foster effective stress management techniques, in particular during exams to qualify for welding procedures or obtain certificates of competency
- Develop autonomy and a sense of responsibility
- Develop the ability to collaborate and communicate in a professional manner

Statements of the Competencies

List of Competencies

- Determine their suitability for the trade and the training process.
- Interpret information on high-pressure welding.
- Weld mild steel pipes using the SMAW process in the 1G position.
- Weld mild steel pipes using the SMAW process in the 2G position.
- Weld mild steel pipes using the SMAW process in the 5G and 6G positions.
- Weld mild steel pipes using the GTAW and SMAW processes in the 2G and 5G positions.
- Purge and weld stainless steel pipes using the GTAW process in the 2G position.
- Weld mild steel and stainless steel pipes using the GTAW and SMAW processes with a purging system in the 5G and 6G positions.
- Weld mild steel pipes using the GMAW and FCAW processes in the 1G, 5G and 6G positions.
- Weld stainless steel pipes using the GMAW process in the 1G, 5G and 6G positions.
- Assemble and weld a pipe system and connect it to a pressure vessel.

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.

HIGH-PRESSURE WELDING																		
SPECIFIC COMPETENCIES		Competency number	Type of competency	Duration (in hours)	Determine their suitability for the trade and the training process	Interpret information on high-pressure welding	Learn about the job to be done	Plan the work	Prepare the work area, equipment and consumables	Prepare the pipes	Assemble the pipes	Weld the pipes	Comply with test requirements	Finish the work				
Competency number	Type of competency	Duration (in hours)	1	2														
Competency number	Type of competency	Duration (in hours)	S	B														
Competency number	Type of competency	Duration (in hours)	15	30													45	
Weld mild steel pipes using the SMAW process in the 1G position	3	B	75	○	●	▲	△	▲	▲	▲	▲	▲	▲	▲				
Weld mild steel pipes using the SMAW process in the 2G position	4	B	60	○	●	▲	△	▲	▲	▲	▲	▲	▲	▲				
Weld mild steel pipes using the SMAW process in the 5G and 6G positions	5	B	105	○	●	▲	△	▲	▲	▲	▲	▲	▲	▲				
Weld mild steel pipes using the GTAW and SMAW processes in the 2G and 5G positions	6	B	60	○	●	▲	△	▲	▲	▲	▲	▲	▲	▲				
Purge and weld stainless steel pipes using the GTAW process in the 2G position	7	B	60	○	●	▲	△	▲	▲	▲	▲	▲	▲	▲				
Weld mild steel and stainless steel pipes using the GTAW and SMAW processes with a purging system in the 5G and 6G positions	8	B	60	○	●	▲	△	▲	▲	▲	▲	▲	▲	▲				
Weld mild steel pipes using the GMAW and FCAW processes in the 1G, 5G and 6G positions	9	B	45	○	●	▲	△	▲	▲	▲	▲	▲	▲	▲				
Weld stainless steel pipes using the GMAW process in the 1G, 5G and 6G positions	10	B	60	○	●	▲	△	▲	▲	▲	▲	▲	▲	▲				
Assemble and weld a pipe system and connect it to a pressure vessel	11	B	75	○	●	▲	▲	▲	▲	▲	▲	▲	△	▲				
Duration of training			600														645	

Links between the general competencies and the 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

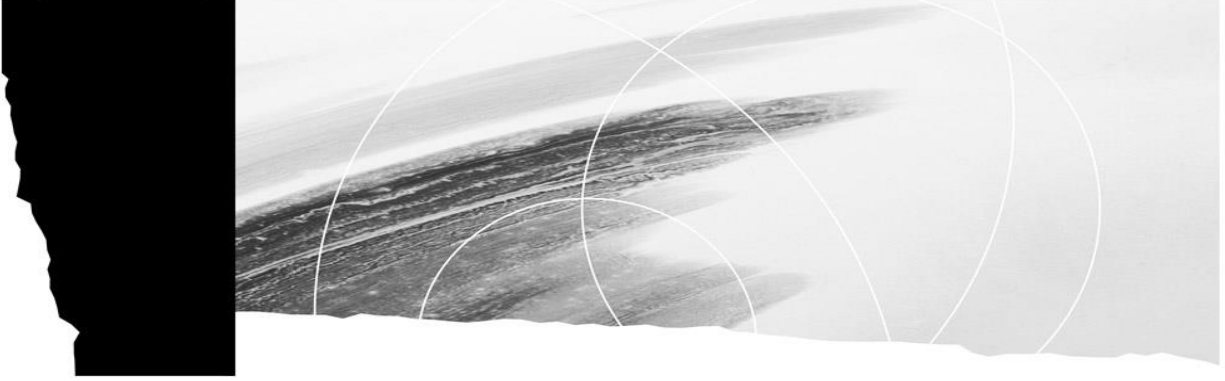
The Ministère de l'Éducation harmonizes its vocational and technical programs by establishing similarities and continuity between secondary- and college-level programs within a particular sector or between sectors in order to avoid overlap in program offerings, to recognize prior learning and to optimize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

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

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

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

Harmonization of the *High-Pressure Welding* 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 Soudage haute pression*.



Part II

Program Competencies

Glossary

Competency 1 Duration 15 hours Credit 1

Situational Competency

Statement of the Competency

Determine their suitability for the trade and the training process.

Elements of the Competency

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

Learning Context

Information Phase

- Learning about the characteristics of the job market in the various settings where high-pressure welders work
- Learning about the nature and requirements of the trade
- Learning about the skills, attitudes and expected professional conduct
- Learning about the health and safety risks in high-pressure welding
- Learning about the program and the evaluation methods
- Becoming familiar with the training process at the educational institution
- Learning how to develop their competencies during their training and throughout their career

Participation Phase

- Talking to high-pressure welders during visits to companies, presentations, etc.
- Discussing the data collected and their views on the trade
- Discussing the links between the training requirements and the actual work situation
- Finding ways of fostering their academic success and integration into the job market

Synthesis Phase

- Identifying their preferences, skills and attitudes
- Comparing the requirements of the trade with their profile
- Assessing their interest in various trade-related tasks and the types of companies in which they are performed

Instructional Guidelines

- Make a variety of suitable reference materials available to the students.
- Help students become familiar with the trade by visiting companies, attending presentations by specialists, etc.
- Organize discussions where:
 - students are encouraged to communicate with each other
 - students can express themselves freely
 - everyone's input is welcome
- Foster the development of a realistic view of the trade and an honest and objective career choice.

Participation Criteria

Information Phase

- Gather information about the topics to be addressed.

Participation Phase

- Take part in the activities organized.

Synthesis Phase

- Produce a report in which they:
 - list their preferences, skills and attitudes
 - make a comparison between the requirements of the trade and their profile
 - assess their interest in the various trade-related tasks

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

- Sources of information: high-pressure welder job analysis report, program of study, employer websites, videos showing pipe welding processes, Emploi-Québec, employment agencies, career and job fairs, etc.
- Definition of the trade, duties, tasks and operations
- Skills (cognitive, perceptive and motor), attitudes and professional behaviours
- Knowledge used in the trade: metallurgy, electricity, mathematics, measurement, etc.
- Sectors of activity and types of companies
- Differences between work in an industrial setting and work on a construction site
- Differences between work subject to a decree and work not subject to a decree
- Certificates of competency (Emploi-Québec, Red Seal, etc.)
- Working conditions: status and work schedule, work environment, physical requirements, occupational health and safety, stress factors, remuneration and benefits, etc.
- Job prospects, hiring criteria and possibilities for advancement
- Entrepreneurial opportunities
- Trades related to high-pressure welding: boilermaker, pipe fitter, etc.
- Main legal and ethical aspects of the trade: confidentiality of company information, use of smartphones during working hours, etc.
- Trade-related developments, trends and prospects
- Competencies to be developed in the training program and specific characteristics of the certification of studies in vocational training
- Organization of the training at the educational institution: schedule, remedial work, retakes, etc.
- Possibility of continuing training and self-training: documentation and procedures, colleagues, training organized by the employer or welding equipment suppliers, etc.
- Information search and synthesis strategies

Participation Phase

- Health and safety directives when visiting companies: use of personal protective gear, circulation in designated corridors, authorization to take pictures, etc.
- Elements to observe: work environment, health and safety, welding processes and level of automation, equipment and tools, production phases, etc.

- Rules governing discussion: participation, respect for others, etc.
- Advantages of sharing their point of view and taking those of others into account
- Links between tasks, requirements of the trade and program competencies
- Factors of educational success: learning strategies, participation in class, frequency of study periods, school-work-family balance, etc.

Synthesis Phase

- Report formats: written documents and oral, audio or video presentations
- Importance of objectivity

Competency 2 Duration 30 hours Credits 2

Behavioural Competency

Statement of the Competency

Interpret information on high-pressure welding.

Achievement Context

- When preparing and conducting high-pressure pipe-fitting and welding operations
- Given sources of information (drawings, welding procedures, etc.):
 - in paper or digital format
 - in English or French
- Using reference documents on the standards governing:
 - pressurized pipes
 - technical drawings, etc.

Elements of the Competency

Performance Criteria

1. Interpret drawings of pressurized pipes.

- Accurate interpretation of:
 - orthogonal projection (top, front and side view, transversal and longitudinal views)
 - isometric drawings
 - 3D modelling
- Accurate interpretation of notes
- Appropriate verification of coherence between the list of materials, the drawing and the materials available
- Accurate determination of missing measurements
- Accurate calculations
- Appropriate links between development patterns and the pipe joints to be prepared

2. Interpret welding procedures.

- Accurate interpretation of information on:
 - pipe preparation
 - pipe assembly
 - welding processes
 - filler metals
 - polarity
 - shielding gas
 - preheating

3. Interpret the results of destructive and non-destructive tests.

- Accurate interpretation of information on location and types of welding defects
- Appropriate determination of the causes of defects and the corrective measures to be taken

4. Interpret health and safety documents.
- Accurate interpretation of lockout placards
 - Appropriate processing of risk analysis forms
 - Accurate interpretation of hot-work permits
 - Accurate interpretation of confined space entry permits

For the competency as a whole:

- Accurate interpretation of the main welding symbols used in pipework
- Methodical analysis of information

Suggestions for Competency-Related Knowledge and Know-How²

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

For the competency as a whole:

- Responsibility of high-pressure welders with respect to standards: refer to information provided by the people responsible for welding drawings and welding procedures and for interpreting standards (technicians, engineers, drafters, etc.)
- Standards governing the welding of high-pressure pipes, for example:
 - ASME Boiler-Pressure Vessel Code, Section IX: welding and brazing qualifications
 - ASME standards B31.1 Power Piping and B31.3 Process Piping
- Use of pipe class charts
- Recognition of the specific characteristics of various piping components: flanges, valves, reducers, elbows, tees, fittings, supports, etc.
- Main welding symbols used in high-pressure welding
- Predominance of the imperial system of measurement in high-pressure welding: use of materials in imperial sizes, reference to U.S. standards in most industries, etc.

1. Interpret drawings of pressurized pipes.

- Importance of spatial perception in the interpretation of piping drawings
- The most used isometric projection: 30 degrees
- Drawings, in particular 3D drawings, viewed on a computer screen or tablet, etc.
- Strategies to verify their understanding of the drawings: front, top and left-side views, sketches, etc.
- Main mathematical concepts used: calculation of circumference, rule of three, basic operations (addition, subtraction, multiplication and division), etc.
- Importance of calculations to determine the missing measurements in drawings with a view to marking out or preparing workpieces and converting the units of measurement, etc.
- Use of calculators, in particular for converting units of measurement
- Analysis of drawing to determine whether it is possible to make subassemblies to facilitate the welding, transportation and installation of the pipe systems
- Usefulness of a development pattern and variety of shapes depending on the joints to be welded
- Method of applying a development pattern to a pipe and marking it out

² Some of this knowledge was learned in the DVS program (*General Welding, Welding and Fitting or Welding and Assembling*). However, it was deemed appropriate that it be reviewed to help students consolidate their learning.

2. Interpret welding procedures.
 - Differences between welding procedures in different companies, for different jobs, etc.
3. Interpret the results of destructive and non-destructive tests.
 - Main welding defects found in tests: excessive or insufficient penetration, lack of fusion, porosity, undercut, slag inclusion, blowouts, etc.
 - Tolerances for welding defects based on the prescribed standards
 - Specific characteristics of different types of non-destructive tests: radiography, magnetic particle tests, hydrostatic tests, etc.
 - Specific characteristics of destructive bend tests
 - Ubiquity of non-destructive tests in high-pressure welding and limited use of destructive tests (procedure qualification, hiring tests, training)
4. Interpret health and safety documents.
 - Documents related to occupational health and safety; variety of formats and titles
 - Procedure for applying for hot-work, confined space entry and lockout permits, etc.
 - Importance of occupational health and safety in companies and examples of documents used in employee training: videos, online training, paper documents, etc.

Competency 3 Duration 75 hours Credits 5

Behavioural Competency

Statement of the Competency

Weld mild steel pipes using the SMAW process in the 1G position.

Achievement Context

- Working on pipes: 8 inch diameter SCH 80, 6 inch diameter, SCH 80, 6 inch diameter SCH 40, etc.
- Given:
 - oral or written instructions
 - welding procedures
 - simple drawings
- Using:
 - welding machine and the accessories needed for the SMAW process
 - the prescribed electrodes for the different welding passes
 - automatic oxyacetylene and /or plasma arc pipe-cutting and bevelling equipment
 - hand-operated and motorized welding positioners and rollers
 - lifting and handling equipment (travelling cranes, hoists, trolleys, etc.) and accessories (slings, hooks, etc.)
 - personal and collective protective gear (screens, extraction system for gases and fumes, etc.)

Elements of the Competency

Performance Criteria

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Learn about the job to be done. | <ul style="list-style-type: none"> • Accurate identification of the information needed for the job • Accurate interpretation of oral or written instructions • Accurate interpretation of welding procedure and drawing |
| <ol style="list-style-type: none"> 2. Prepare the equipment and consumables. | <ul style="list-style-type: none"> • Appropriate inspection of equipment • Proper choice and installation of positioner or roller • Proper assembly of welding set-up • Appropriate selection of electrodes • Proper installation of protective gear |

3. Prepare the pipes.
 - Proper use of automatic oxy-acetylene and /or plasma arc pipe-cutting and bevelling equipment
 - Bevel angles and landing sizes in conformity with welding procedure
 - Proper length of pipes
 - Clean, uniform cuts
4. Tack weld pipes.
 - Proper alignment of pipes
 - Positioning of tack welds and tacking sequence appropriate to the situation
 - Appropriate size and penetration of tack welds
5. Add the weld beads.
 - Precise adjustment of settings of the welding machine
 - Effective use of positioner or roller
 - Effective use of welding methods appropriate to penetration, filler and capping passes
 - Absence of obvious defects that exceed tolerances at the root pass
 - Proper identification and correction of defects as they occur
 - Proper cleaning of joint between passes
 - Absence of obvious defects that exceed tolerances in the filler and capping passes
 - Careful finishing of joint
6. Comply with test requirements.
 - Proper preparation for tests
 - Absence of defects that exceed tolerances in the tested welds
 - Appropriate determination of the causes of defects
7. Finish the job.
 - Appropriate storage of equipment, tools and materials
 - Cleanliness of work area

For the competency as a whole:

- Compliance with occupational health and safety rules
- Compliance with welding procedure
- Choice and use of equipment, tools and consumables based on the job
- Appropriate work posture
- Respectful behaviour toward other workers

Suggestions for Competency-Related Knowledge and Know-How

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

For the competency as a whole:

- Difficulties inherent in pipe welding: roundness of workpiece, positioning of body, different heights, quality requirements (qualification tests, high percentage of joints tested) etc.
 - Main occupational health and safety risks: air quality (fumes, dust), mechanical cutting equipment (grinders, saws, etc.), oxyacetylene and /or plasma arc cutting equipment, movement of workpieces (manually or using lifting and handling equipment and accessories), electricity, workstation ergonomics, stress, etc.
 - Importance of wearing approved personal protective gear adapted to the job: safety glasses, hearing protection, safety boots, gloves, fire-retardant clothing and leather clothing as needed, grinding full face shield, welding mask, etc.
 - Importance of adopting work postures that allow for the freedom of movement needed to do quality work (welding, cutting, grinding, etc.)
 - Stress management strategies
1. Learn about the job to be done.
 - Review of Competency 2 – *Interpret information on high-pressure welding*
 2. Prepare the equipment and consumables
 - Installation and use of protective gear: protective screens, extraction system for gases and fumes, fire extinguishers, asbestos blankets, etc.
 - Installation of welding set-up: vise ground clamp, SMAW electrode holder, connection to electrical system, etc.
 - Installation of tools and accessories: grinders, extension cords, lights, etc.
 - Use of different types of positioners and rollers with different drive systems (manual, motorized, etc.), roller alignment methods
 3. Prepare the pipes.
 - Use of measuring instruments such as tape measures, vernier calipers and wrap-around rulers
 - Main adjustments to automatic oxyacetylene and /or plasma arc pipe-cutting and bevelling equipment: alignment, rotation speed, choice of nozzle, neutral flame adjustment, etc.
 - Cleaning of bevel using hammers, chisels and grinders to remove slag and scale
 - Importance of having a uniform root face while maintaining the squareness of the pipe
 - Finishing of cut using a file or a fine-grained wheel
 - Consideration of the specific characteristics and uses of adjustable pipe fitter's benches for the preparation of pipes

4. Tack weld pipes.

- Consideration of the specific characteristics and uses of different assembly tools: guide rail system with chain-clamp locking pliers, pipe alignment clamps (chain clamps, quick-acting screw clamps, manual double clamps, etc.), levels, rulers (to check the alignment), etc.
- Amount and purpose of spacing between pipes.
- Settings of CC welding machine for tack welding: polarity, amperage, etc.
- Importance of doing tests on scrap pieces to verify the settings of the welding set-up
- Use of same type of electrode for tack welding as for the root pass
- Number, size and positioning of tack welds and tack welding sequence, usually specified in the welding procedure or established by the welder based on the diameter and thickness of the pipe, etc.
- Importance of verifying and correcting the alignment of the pipes before tack welding and welding

5. Add the weld beads.

- Importance of readjusting the settings of the welding machine as needed
- Characteristics of electrodes used for the root pass: F-3 (AWS E6010 or E6011) (CSA/CWB E4310 or E4311)
- Characteristics of electrodes used for the filler and capping passes: F-4 (AWS E7018) (CSA/CWB E4918)
- Importance of mastering penetration methods on plates in the 1G (flat) position
- Welding methods used for the root pass: oscillating movement, back-and-forth movement, circular movement, etc.
- Welding methods used for the filler and capping passes: dragging and multipass movements
- Importance of controlling the thickness and regularity of the root, penetration in the root pass, filler and capping beads
- Importance of changing the direction of rotation of the positioner or roller between the penetration, filler and capping passes and of adjusting the speed as needed
- Importance of staggering the starting points of the filler and capping passes to avoid blowouts, excessive buildup, etc.
- Grinding methods and choice of wheels for preparing a starting point, repairing or feathering off a joint, etc.
- Cleaning using chipping (flux) hammers and manual wire brushes, and finishing using wire brushes on a grinder and files
- Main welding defects to look for during a visual inspection: lack of penetration, undercut, slag inclusion, wrong width or thickness of the weld bead, irregularity, incorrect overlapping, lack of penetration, etc.
- Tolerances for welding defects based on the prescribed standards

6. Comply with test requirements.

- Review of element 3, Interpret the results of destructive and non-destructive tests, of Competency 2 – *Interpret information on high-pressure welding*

7. Finish the job.

- Impact of maintaining equipment and keeping a tidy workstation on efficient production and occupational health and safety
- Best practices for storing equipment: close cylinders, power off welding machine, wind cables, etc.
- Materials stored in the appropriate places
- Cleaning of work area: electrode butts, slag, dust, etc.

Competency 4 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Weld mild steel pipes using the SMAW process in the 2G position.

Achievement Context

- Working on pipes: 6 in. diameter SCH 80, 6 in. diameter SCH 40, 4 in. diameter SCH 80, etc.
- Given:
 - oral or written instructions
 - welding procedures
 - simple drawings
- Using:
 - a CC welding machine and the accessories needed for the SMAW process
 - the prescribed electrodes for the different welding passes
 - manual and automatic oxyacetylene and/or plasma-arc pipe-cutting and bevelling equipment
 - lifting and handling equipment (travelling cranes, hoists, trolleys, etc.) and accessories (slings, hooks, etc.)
- With personal and collective protective gear (screens, extraction system for gases and fumes, etc.)

Elements of the Competency

Performance Criteria

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Learn about the job to be done. | <ul style="list-style-type: none"> • Accurate interpretation of oral or written instructions • Accurate interpretation of welding procedure and drawing |
| <ol style="list-style-type: none"> 2. Prepare the equipment and consumables. | <ul style="list-style-type: none"> • Appropriate inspection of equipment • Proper assembly of welding set-up • Appropriate selection of electrodes • Proper installation of protective gear |
| <ol style="list-style-type: none"> 3. Prepare the pipes. | <ul style="list-style-type: none"> • Proper use of manual and automatic oxyacetylene and/or plasma-arc pipe-cutting and bevelling equipment • Bevel angles and root landing sizes in conformity with welding procedure • Proper length of pipes • Clean, uniform cuts |

4. Tack weld pipes.
 - Proper alignment of pipes
 - Positioning of tack welds and tacking sequence appropriate to the situation
 - Appropriate size and penetration of tack welds

5. Add the weld beads.
 - Precise adjustment of settings of the welding machine
 - Effective use of welding methods appropriate to root, filler and capping passes
 - Absence of obvious defects that exceed tolerances at the penetration of the root pass
 - Proper identification and correction of defects as they occur
 - Proper cleaning of joint between passes
 - Absence of obvious defects that exceed tolerances at the filler and capping passes
 - Careful finishing of joint

6. Comply with test requirements.
 - Proper preparation for tests of the cross-section samples or coupons
 - Absence of defects that exceed tolerances in the tested welds
 - Accurate determination of the causes of the defects

7. Finish the job.
 - Appropriate storage of equipment, tools and materials
 - Cleanliness of work area

For the competency as a whole:

- Compliance with occupational health and safety rules
- Compliance with welding procedure
- Choice and use of equipment, tools and consumables based on the job
- Appropriate work posture
- Respectful behaviour toward other workers

Suggestions for Competency-Related Knowledge and Know-How

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

For the competency as a whole:

- Difficulties inherent in pipe welding: roundness of workpiece, positioning of body, different heights, quality requirements (qualification tests, high percentage of joints tested) etc.
- Main occupational health and safety risks: air quality (fumes, dust), mechanical cutting equipment (grinders, saws, etc.), oxygen cutting equipment, movement of workpieces (manually or using lifting and handling equipment and accessories), electricity, workstation ergonomics, stress, etc.

- Importance of wearing approved personal protective gear adapted to the job: safety glasses, hearing protection, safety boots, gloves, fire-retardant clothing and leather clothing as needed, grinding visor, welding mask, etc.
 - Work (welding, grinding, etc.) at a variety of heights, and importance of adopting work postures that allow for freedom of movement and quality work
 - Stress management strategies
1. Learn about the job to be done.
 - Review of Competency 2 – *Interpret information on high-pressure welding*
 2. Prepare the equipment and consumables.
 - Installation and use of protective gear: protective screens, extraction system for gases and fumes, fire extinguishers, asbestos blankets, etc.
 - Installation of welding machine: vise ground clamp, SMAW electrode holder, connection to electrical system, etc.
 - Installation of tools and accessories: grinders, extension cords, lights, etc.
 3. Prepare the pipes.
 - Use of measuring instruments such as tape measures, vernier calipers and wrap-around rulers
 - Importance of mastering manual oxyacetylene and /or plasma arc cutting techniques
 - Main adjustments to automatic oxyacetylene and /or plasma arc bevelling equipment: alignment, rotation speed, choice of nozzle, flame adjustment, etc.
 - Cleaning of bevel using hammers, chisels and grinders to remove slag and scale
 - Importance of having a uniform root landing while maintaining the squareness of the pipe
 - Finishing of cut using a file or a fine-grained wheel
 - Consideration of the specific characteristics and use of adjustable pipe fitter's benches for the preparation of pipes
 4. Tack weld pipes.
 - Consideration of the specific characteristics and uses of different assembly tools: guide rail system with chain-clamp locking pliers, pipe alignment clamps (chain clamps, quick-acting screw clamps, manual double clamps, etc.), levels, rulers (to check the alignment), etc.
 - Amount and purpose of spacing between pipes
 - Settings of welding machine for tack welding: polarity, amperage, etc.
 - Importance of doing tests on scrap pieces to verify the settings of the welding machine
 - Use of same type of electrode for tack welding as for the root pass
 - Number, size and positioning of tack welds and tack welding sequence, usually specified in the welding procedure or established by the welder based on the diameter and thickness of the pipe, etc.
 - Importance of verifying and correcting the alignment of the pipes before tack welding and welding
 5. Add the weld beads.
 - Importance of readjusting the settings of the welding machine as needed
 - Characteristics of electrodes used for the penetration pass: F-3 (AWS E6010 or E6011) (CSA/CWB E4310 or E4311)
 - Characteristics of electrodes used for the filler and capping passes: F-4 (AWS E7018) (CSA/CWB E4918)
 - Importance of mastering penetration methods on plates in the 2G (horizontal) position
 - Welding methods used for the root pass: oscillating movement, back-and-forth movement, circular movement, etc.

- Use of movements and multipasses for filler and capping passes in the 2G position
 - Importance of controlling the thickness and regularity of the root, filler and capping beads
 - Importance of staggering the starting points of the filler and capping passes to avoid blowouts, excessive buildup, etc.
 - Grinding methods and choice of wheels for preparing a starting point, repairing or feathering off a joint, etc.
 - Cleaning using chipping (flux) hammers and manual wire brushes, and finishing using wire brushes on a grinder and files
 - Main welding defects to look for during a visual inspection: lack of penetration, undercut, slag inclusion, wrong width or thickness of the weld bead, irregularity, incorrect overlap, lack of penetration, etc.
 - Tolerances for welding defects based on the prescribed standards
6. Comply with test requirements.
- Review of element 3, Interpret the results of destructive and non-destructive tests, of Competency 2 – *Interpret information on high-pressure welding*
7. Finish the job.
- Impact of maintaining equipment and keeping a tidy workstation on efficient production and occupational health and safety
 - Best practices for storing equipment: close cylinders, power off welding machine, wind cables, etc.
 - Materials stored in the appropriate places
 - Cleaning of work area: electrode butts, slag, dust, etc.

Competency 5 Duration 105 hours Credits 7

Behavioural Competency

Statement of the Competency

Weld mild steel pipes using the SMAW process in the 5G and 6G positions.

Achievement Context

- Working on pipes: 6 in. diameter SCH 80, 6 in. diameter SCH 40, 4 in. SCH 80, 2 in. diameter SCH 160, etc.
- Given:
 - oral or written instructions
 - welding procedures
 - simple drawings
- Using:
 - a CC welding machine and the accessories needed for the SMAW process
 - the prescribed electrodes for the different welding passes
 - portable oxyacetylene and/or plasma-arc pipe-cutting and bevelling equipment
 - lifting and handling equipment (travelling cranes, hoists, trolleys, etc.) and accessories (slings, hooks, etc.)
 - personal and collective protective gear (screens, extraction system for gases and fumes, etc.)

Elements of the Competency

Performance Criteria

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Learn about the job to be done. | <ul style="list-style-type: none"> • Accurate interpretation of oral or written instructions • Accurate interpretation of welding procedure and drawing |
| <ol style="list-style-type: none"> 2. Prepare the equipment and consumables. | <ul style="list-style-type: none"> • Appropriate inspection of equipment • Proper assembly of welding set-up • Appropriate selection of electrodes • Proper installation of protective gear |
| <ol style="list-style-type: none"> 3. Prepare the pipes. | <ul style="list-style-type: none"> • Proper use of portable oxyacetylene and/or plasma-arc pipe-cutting and bevelling equipment • Bevel angles and root landing sizes in conformity with welding procedure • Proper length of pipes • Clean, uniform cuts |

4. Tack weld pipes.
 - Proper alignment of pipes
 - Positioning of tack welds and tacking sequence appropriate to the situation
 - Appropriate size and penetration of tack welds

5. Add the weld beads.
 - Precise adjustment of settings of the welding machine
 - Effective use of welding methods appropriate to root, filler and capping passes
 - Absence of obvious defects that exceed tolerances at the root pass
 - Proper identification and correction of defects as they occur
 - Proper cleaning of joint between passes
 - Absence of obvious defects that exceed tolerances at the filler and capping passes
 - Careful finishing of joint

6. Comply with test requirements.
 - Proper preparation for tests of the cross-section samples or coupons
 - Absence of defects that exceed tolerances in the tested welds
 - Accurate determination of the causes of the defects

7. Finish the job.
 - Appropriate storage of equipment, tools and materials
 - Cleanliness of work area

For the competency as a whole:

- Compliance with occupational health and safety rules
- Compliance with welding procedure
- Choice and use of equipment, tools and consumables based on the job
- Appropriate work posture
- Respectful behaviour toward other workers

Suggestions for Competency-Related Knowledge and Know-How

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

For the competency as a whole:

- Difficulties inherent in pipe welding: roundness of workpiece, positioning of body, different heights, quality requirements (qualification tests, high percentage of joints tested) etc.
- Main occupational health and safety risks: air quality (fumes, dust), mechanical cutting equipment (grinders, saws, etc.), oxyacetylene cutting equipment, movement of workpieces (manually or using lifting and handling equipment and accessories), electricity, workstation ergonomics, stress, etc.

- Importance of wearing approved personal protective gear adapted to the job: safety glasses, hearing protection, safety boots, gloves, fire-retardant clothing and leather clothing as needed, grinding visor, welding mask, etc.
 - Work (welding, grinding, etc.) at a variety of heights, and importance of adopting work postures that allow for freedom of movement and quality work
 - Stress management strategies
1. Learn about the job to be done.
 - Review of Competency 2 – *Interpret information on high-pressure welding*
 2. Prepare the equipment and consumables.
 - Installation and use of protective gear: protective screens, extraction system for gases and fumes, fire extinguishers, asbestos blankets, etc.
 - Installation of welding set-up: vise ground clamp, SMAW electrode holder, connection to electrical system, etc.
 - Installation of tools and accessories: grinders, extension cords, lights, etc.
 3. Prepare the pipes.
 - Use of measuring instruments such as tape measures, vernier calipers and wrap-around rulers
 - Characteristics and use of portable oxyacetylene and/or plasma-arc pipe-cutting and bevelling equipment: components, adjustments, alignment, rotation speed, etc.
 - Main adjustments to portable oxyacetylene and/or plasma-arc pipe-cutting and bevelling machines: choice of adapters depending on the diameter of the pipe, alignment, rotation speed, choice of nozzle, flame adjustment, etc.
 - Cleaning of bevel using hammers, chisels and grinders to remove slag, and chisels
 - Importance of having a uniform root face while maintaining the squareness of the pipe
 - Finishing of cut using a file or a fine-grained wheel
 - Consideration of the specific characteristics and use of adjustable pipe fitter's benches for the preparation of pipes
 4. Tack weld pipes.
 - Consideration of the specific characteristics and uses of different assembly tools: guide rail system with chain-clamp locking pliers, pipe alignment clamps (chain clamps, quick-acting screw clamps, manual double clamps, etc.), levels, rulers (to check the alignment), etc.
 - Amount and purpose of spacing between pipes
 - Settings of CC welding machine for tack welding: polarity, amperage, etc.
 - Importance of doing tests on scrap pieces to verify the settings of the welding machine
 - Use of same type of electrode for tack welding as for the root pass
 - Number, size and positioning of tack welds and tack welding sequence, usually specified in the welding procedure or established by the welder based on the diameter and thickness of the pipe, etc.
 - Importance of verifying and correcting the alignment of the pipes before tack welding and welding
 5. Add the weld beads.
 - Importance of readjusting the settings of the welding machine as needed
 - Characteristics of electrodes used for the root pass: F-3 (AWS E6010 or E6011) (CSA/CWB E4310 or E4311)
 - Characteristics of electrodes used for the filler and capping passes: F-4 (AWS E7018) (CSA/CWB E4918)

- Importance of mastering penetration methods on plates in the 3G (vertical up) and 4G (overhead) positions
 - Welding methods used for the root pass: oscillating movement, back-and-forth movement, circular movement, etc.
 - Welding methods used for the filler and capping passes: dragging (5G position only) and multipass (5G and 6G positions) movements
 - Importance of controlling the thickness and regularity of the root, hot, filler and capping beads
 - Importance of staggering the starting points of the filler and capping passes to avoid blowouts, excessive buildup, etc.
 - Grinding methods and choice of wheels for preparing a starting point, repairing or feathering off a joint, etc.
 - Cleaning using chipping (flux) hammers and manual wire brushes, and finishing using wire brushes on a grinder and files
 - Main welding defects to look for during a visual inspection: lack of penetration, undercut, slag inclusion, wrong width or thickness of the weld bead, irregularity, incorrect overlap, lack of penetration, etc.
 - Tolerances for welding defects based on the prescribed standards
6. Comply with test requirements.
- Review of element 3, Interpret the results of destructive and non-destructive tests, of Competency 2 – *Interpret information on high-pressure welding*
7. Finish the job.
- Impact of maintaining equipment and keeping a tidy workstation on efficient production and occupational health and safety
 - Best practices for storing equipment: close cylinders, disconnect welding set-up, wind cables, etc.
 - Materials stored in the appropriate places
 - Cleaning of work area: electrode butts, slag, dust, etc.

Competency 6 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Weld mild steel pipes using the GTAW and SMAW processes in the 2G and 5G positions.

Achievement Context

- Working on pipes: 6 in. diameter SCH 40, 4 in. diameter SCH 40, 2 in. diameter SCH 40, etc.
- Given:
 - oral or written instructions
 - welding procedures
 - simple drawings
- Using:
 - a CC welding machine and the accessories needed for the GTAW process (for root pass) and SMAW process (for root, hot, fillers and capping passes)
 - the prescribed filler metals, tungsten electrodes and shielding gases
 - automatic oxyacetylene and/or plasma-arc pipe-cutting and bevelling equipment
 - lifting and handling equipment (travelling cranes, hoists, trolleys, etc.) and accessories (slings, hooks, etc.)
 - personal and collective protective gear (screens, extraction system for gases and fumes, etc.)

Elements of the Competency**Performance Criteria**

- | | |
|---|--|
| 1. Learn about the job to be done. | <ul style="list-style-type: none"> • Accurate interpretation of oral or written instructions • Accurate interpretation of welding procedure and drawing |
| 2. Prepare the equipment and consumables. | <ul style="list-style-type: none"> • Appropriate inspection of equipment • Proper assembly of welding set-up • Appropriate selection of filler metals • Proper installation of protective and safety equipment |
| 3. Prepare the pipes. | <ul style="list-style-type: none"> • Proper use of automatic oxyacetylene and/or plasma-arc pipe-cutting and bevelling equipment • Bevel angles and root landing sizes in conformity with welding procedure • Proper length of pipes • Clean, uniform cuts |

4. Tack weld pipes.
 - Proper alignment of pipes
 - Positioning of tack welds and tacking sequence appropriate to the situation
 - Appropriate size and penetration of tack welds

5. Add the weld beads.
 - Precise adjustment of settings of the welding machine
 - Effective use of welding methods appropriate to root, hot, filler and capping passes
 - Absence of obvious defects that exceed tolerances at the penetration pass
 - Proper identification and correction of defects as they occur
 - Proper cleaning of joint between passes
 - Absence of obvious defects that exceed tolerances at the hot, filler and capping passes
 - Careful finishing of joint

6. Comply with test requirements.
 - Proper preparation for tests of the cross-section samples or coupons
 - Absence of defects that exceed tolerances in the tested welds
 - Accurate determination of the causes of the defects

7. Finish the job.
 - Appropriate storage of equipment, tools and materials
 - Cleanliness of work area

For the competency as a whole:

- Compliance with occupational health and safety rules
- Compliance with welding procedure
- Choice and use of equipment, tools and consumables based on the job
- Appropriate work posture
- Respectful behaviour toward other workers

Suggestions for Competency-Related Knowledge and Know-How

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

For the competency as a whole:

- Difficulties inherent in pipe welding: roundness of workpiece, positioning of body, different heights, quality requirements (qualification tests, high percentage of joints tested) etc.
- Main occupational health and safety risks: air quality (fumes, dust), mechanical cutting equipment (grinders, saws, etc.), oxyacetylene cutting equipment, movement of workpieces (manually or using lifting and handling equipment and accessories), electricity, workstation ergonomics, stress, etc.

- Importance of wearing approved personal protective gear adapted to the job: safety glasses, hearing protection, safety boots, gloves, fire-retardant clothing and leather clothing as needed, grinding visor, welding mask, etc.
 - Work (welding, grinding, etc.) at a variety of heights, and importance of adopting work postures that allow for freedom of movement and quality work
 - Stress management strategies
1. Learn about the job to be done.
 - Review of Competency 2 – *Interpret information on high-pressure welding*
 2. Prepare the equipment and consumables.
 - Installation and use of protective gear: protective screens, extraction system for gases and fumes, fire extinguishers, asbestos blankets, etc.
 - Positioning of extraction system for gases and fumes based on the welding process used
 - Installation of welding set-up: vise ground clamp, polarity, connection to electrical system, GTAW torch or SMAW electrode holder, shielding gases, pressure regulator with flowmeter, etc.
 - Preparation of tungsten electrode: choice of diameter, selection based on the metal to be welded, sharpening, installation of extensions, etc.
 - Installation of tools and accessories: grinders, extension cords, lights, etc.
 3. Prepare the pipes.
 - Use of measuring instruments such as tape measures, vernier calipers and wrap-around rulers
 - Characteristics and use of automatic oxyacetylene and/or plasma-arc-pipe-cutting and bevelling equipment: components, adjustments, alignment, rotation speed, etc.
 - Main adjustments to automatic oxyacetylene and/or plasma-arc-pipe-cutting and bevelling equipment: alignment, rotation speed, choice of nozzle, flame adjustment, etc.
 - Cleaning of bevel using hammers, chisels and grinders to remove slag and scale
 - Importance of having a uniform root landing while maintaining the squareness of the pipe
 - Finishing of cut using a file or a fine-grained wheel
 - Consideration of the specific characteristics and use of adjustable pipe fitter's benches for the preparation of pipes
 4. Tack weld pipes.
 - Consideration of the specific characteristics and uses of different assembly tools: guide rail system with chain-clamp locking pliers, pipe alignment clamps (chain clamps, quick-acting screw clamps, manual double clamps, etc.), levels, rulers (to check the alignment), etc.
 - Amount and purpose of spacing between pipes
 - Settings of welding set-up for tack welding: polarity, amperage, shielding gas flow rate, etc.
 - Importance of doing tests on scrap pieces to verify the settings of the welding set-up
 - Use of same welding process and filler metal for tack welding and the root pass
 - Characteristics of the tungsten electrodes used to weld mild steel
 - Shielding gases used in GTAW, and importance of adjusting the flow rate
 - Number, size and positioning of tack welds and tack welding sequence, usually specified in the welding procedure or established by the welder based on the diameter and thickness of the pipe, etc.
 - Importance of verifying and correcting the alignment of the pipes before tack welding and welding

5. Add the weld beads.

- Importance of readjusting the settings of the welding machine as needed
- Characteristics of welding rods used for the root pass in GTAW process: (AWS ER70S-3), (CSA/CWB ER49S-3)
- Characteristics of electrodes used for the hot, filler and capping passes in SMAW: F-4 (AWS E7018) (CSA/CWB E4918)
- Importance of mastering penetration methods on plates in the 1G (flat), 2G (horizontal) and 4G (overhead) positions
- GTAW start methods: scratch TIG, lift arc, high frequency
- Welding methods used for the root pass in GTAW: freehand welding, walking the cup, positioning of rod in joint, etc.
- Welding methods used for the hot, filler and capping passes in SMAW: dragging (5G position only) and multipass (2G and 5G positions) movements
- Importance of controlling the thickness and regularity of the root, hot, filler and capping beads
- Importance of staggering the starting points of the filler and capping passes to avoid blowouts, excessive buildup, etc.
- Grinding methods and choice of wheels for preparing a starting point, repairing a joint, etc.
- Cleaning using chipping (flux) hammers and manual wire brushes, and finishing using wire brushes on a grinder and files
- Main welding defects to look for during a visual inspection: lack of penetration, undercut, slag inclusion, wrong width or thickness of the weld bead, irregularity, incorrect overlap, lack of penetration, etc.
- Tolerances for welding defects based on the prescribed standards

6. Comply with test requirements.

- Review of element 3, Interpret the results of destructive and non-destructive tests, of Competency 2 – *Interpret information on high-pressure welding*

7. Finish the job.

- Impact of maintaining equipment and keeping a tidy workstation on efficient production and occupational health and safety
- Best practices for storing equipment: close cylinders, power off welding machine, wind cables, etc.
- Materials stored in the appropriate places
- Cleaning of work area: electrode butts, slag, dust, etc.

Competency 7 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Purge and weld stainless steel pipes using the GTAW process in the 2G position.

Achievement Context

- Working on pipes: stainless steel 6 in. diameter SCH 10 and 4 in. diameter SCH 10, etc.
- Given:
 - oral or written instructions
 - welding procedures
 - simple drawings
- Using:
 - a CC welding machine and the accessories needed for the GTAW process
 - the prescribed welding rods, tungsten electrodes and shielding gases
 - automatic hydraulic or pneumatic bevelling equipment and grinders
 - purge accessories and consumables
 - lifting and handling equipment (travelling cranes, hoists, trolleys, etc.) and accessories (slings, hooks, etc.)
 - personal and collective protective gear (screens, extraction system for gases and fumes, etc.)

Elements of the Competency

Performance Criteria

- | | |
|---|--|
| 1. Learn about the job to be done. | <ul style="list-style-type: none"> • Accurate interpretation of oral or written instructions • Accurate interpretation of welding procedure and drawing |
| 2. Prepare the equipment and consumables. | <ul style="list-style-type: none"> • Appropriate inspection of equipment • Proper assembly of welding set-up • Appropriate selection of welding rods • Proper installation of protective and safety equipment |
| 3. Prepare the pipes. | <ul style="list-style-type: none"> • Proper use of automatic hydraulic or pneumatic bevelling equipment and grinders • Bevel angles and root landing sizes in conformity with welding procedure • Proper length of pipes • Clean, uniform cuts |

4. Tack weld pipes.
 - Proper alignment of pipes
 - Building of bridges as needed
 - Positioning of tack welds and tacking sequence appropriate to the situation
 - Appropriate size and penetration of tack welds
5. Purge the pipes.
 - Proper choice and installation of purge accessories
 - Precise adjustment of shielding gas flow rate
6. Add the weld beads.
 - Precise adjustment of settings of the welding machine
 - Effective use of welding methods appropriate to root, filler and capping passes
 - Absence of obvious defects that exceed tolerances at the root pass
 - Proper identification and correction of defects as they occur
 - Proper cleaning of joint between passes
 - Absence of obvious defects that exceed tolerances at the filler and capping passes
 - Careful finishing of joint
7. Comply with test requirements.
 - Proper preparation for tests of the cross-section samples or coupons
 - Absence of defects that exceed tolerances in the tested welds
 - Accurate determination of the causes of the defects
8. Finish the job.
 - Appropriate storage of equipment, tools and materials
 - Cleanliness of work area

For the competency as a whole:

- Compliance with occupational health and safety rules
- Compliance with welding procedure
- Choice and use of equipment, tools and consumables based on the job
- Appropriate measures taken to prevent metal contamination
- Appropriate work posture
- Respectful behaviour toward other workers

Suggestions for Competency-Related Knowledge and Know-How

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

For the competency as a whole:

- Difficulties inherent in pipe welding: roundness of workpiece, positioning of body, different heights, quality requirements (qualification tests, high percentage of joints tested) etc.
 - Importance of avoiding stainless steel contamination by using best practices, for example, by using the appropriate accessories and consumables for stainless steel
 - Main occupational health and safety risks: air quality (fumes, gases, dust), mechanical cutting equipment (grinders, saws, etc.), plasma arc cutting equipment, movement of workpieces (manually or using lifting and handling equipment and accessories), electricity, workstation ergonomics, stress, etc.
 - Importance of wearing approved personal protective gear adapted to the job: safety glasses, hearing protection, safety boots, gloves, fire-retardant clothing and leather clothing as needed, grinding full face shield, welding mask, etc.
 - Work (welding, grinding, etc.) at a variety of heights, and importance of adopting work postures that allow for freedom of movement and quality work
 - Stress management strategies
1. Learn about the job to be done.
 - Review of Competency 2 – *Interpret information on high-pressure welding*
 2. Prepare the equipment and consumables.
 - Installation and use of protective gear: protective screens, extraction system for gases and fumes, fire extinguishers, asbestos blankets, etc.
 - Positioning of extraction system for gases and fumes based on the welding process used
 - Installation of welding set-up: vise ground clamp, polarity, connection to electrical system, GTAW torch, shielding gas, pressure regulator with flowmeter, etc.
 - Preparation of tungsten electrode: choice of diameter, selection based on the metal to be welded, sharpening, installation of extensions, etc.
 - Installation of tools and accessories: grinders, extension cords, lights, etc.
 3. Prepare the pipes.
 - Use of measuring instruments such as tape measures, vernier calipers and wrap-around rulers
 - Main adjustments to automatic hydraulic or pneumatic bevelling equipment: alignment, rotation speed, blade changes, etc.
 - Specific characteristics of root landing in the GTAW process, sometimes specified in the welding procedure or left to the welder's discretion
 - Finishing of cut using a file or a fine-grained wheel
 - Consideration of the specific characteristics and use of adjustable pipe fitter's benches for the preparation of pipes
 4. Tack weld pipes.
 - Consideration of the specific characteristics and uses of different assembly tools: guide rail system with chain-clamp locking pliers, pipe alignment clamps (chain clamps, quick-acting screw clamps, manual double clamps, etc.), levels, rulers (to check the alignment), etc.
 - Amount and purpose of spacing between pipes
 - Building of bridges to avoid contamination inside the pipes in certain situations
 - Settings of welding machine for tack welding: polarity, amperage, shielding gas flow rate, etc.

- Importance of doing tests on scrap pieces to verify the settings of the welding machine
 - Use of same type of welding rod for tack welding and the root pass
 - Shielding gases used in GTAW, and importance of adjusting the flow rate
 - Number, size and positioning of tack welds and tack welding sequence, usually specified in the welding procedure or established by the welder based on the diameter and thickness of the pipe, etc.
 - Importance of verifying and correcting the alignment of the pipes before tack welding and welding
5. Purge the pipes.
- Principles for installing and using a purge system: type of gas; gas flow rate; positioning of gas entry and exit points; rubber, foam, emery paper and adhesive tape dams, etc.
6. Add the weld beads.
- Importance of readjusting the settings of the welding machine as needed
 - Characteristics of welding rods (AWS and CSA/CWB) for root, filler and capping passes in GTAW on stainless steel (e.g. ER316-L)
 - Importance of mastering penetration methods on plates in the 1G (flat) and 2G (horizontal) positions
 - GTAW start methods: scratch TIG, lift arc, high frequency
 - Welding methods used for the root, filler and capping passes in GTAW: freehand welding, walking the cup, positioning of filler rod in joint, dragging and multipass movements in the 1G and 2G positions
 - Importance of controlling the thickness and regularity of the root, filler and capping beads
 - Importance of staggering the starting points of the filler and capping passes to avoid blowouts, excessive buildup, etc.
 - Grinding methods and choice of wheels for preparing a starting point, repairing a joint, etc.
 - Finishing using wire brushes (manual or on a grinder) and files
 - Main welding defects to look for during a visual inspection: lack of penetration, undercut, wrong width or thickness of the weld bead, irregularity, incorrect overlap, lack of penetration, etc.
 - Tolerances for welding defects based on the prescribed standards
7. Comply with test requirements.
- Review of element 3, Interpret the results of destructive and non-destructive tests, of Competency 2 – *Interpret information on high-pressure welding*
8. Finish the job.
- Impact of maintaining equipment and keeping a tidy workstation on efficient production and occupational health and safety
 - Best practices for storing equipment: close cylinders, power off welding machine, wind cables, etc.
 - Materials stored in the appropriate places
 - Cleaning of work area: rods, adhesive tape, dust, etc.

Competency 8 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Weld mild steel and stainless steel pipes using the GTAW and SMAW processes with a purging system in the 5G and 6G positions.

Achievement Context

- Working on pipes: stainless steel 4 in. diameter SCH 10 and 4 in. diameter SCH 40 and mild steel 2 in. diameter SCH 40 and 2 in. diameter SCH 160, etc.
- Given:
 - oral or written instructions
 - welding procedures
 - simple drawings
- Using:
 - a CC welding machine and the accessories needed for the GTAW (root pass) and SMAW (hot, filler and capping) processes
 - the prescribed filler metals, tungsten electrodes and shielding gases
 - automatic hydraulic or pneumatic bevelling equipment and grinders
 - purge accessories and consumables
 - lifting and handling equipment (travelling cranes, hoists, trolleys, etc.) and accessories (slings, hooks, etc.)
 - personal and collective protective equipment (screens, extraction system for gases and fumes, etc.)

Elements of the Competency

Performance Criteria

- | | |
|--|--|
| <p>1. Learn about the job to be done.</p> | <ul style="list-style-type: none"> • Accurate interpretation of oral or written instructions • Accurate interpretation of welding procedure and drawing |
| <p>2. Prepare the equipment and consumables.</p> | <ul style="list-style-type: none"> • Appropriate inspection of equipment • Proper assembly of welding set-up • Appropriate selection of filler metals • Proper installation of protective and safety equipment |
| <p>3. Prepare the pipes.</p> | <ul style="list-style-type: none"> • Proper use of automatic hydraulic or pneumatic bevelling equipment and grinders • Bevel angles and root landing sizes in conformity with welding procedure • Proper length of pipes • Clean, uniform cuts |

4. Tack weld pipes.
 - Proper alignment of pipes
 - Building of bridges as needed
 - Positioning of tack welds and tacking sequence appropriate to the situation
 - Appropriate size and penetration of tack welds
5. Purge the pipes.
 - Proper choice and installation of purge accessories
 - Precise adjustment of argon gas flow rate
6. Add the weld beads.
 - Precise adjustment of settings of the welding machine
 - Effective use of welding methods appropriate to root, hot, filler and capping passes
 - Absence of obvious defects that exceed tolerances at the root pass
 - Proper identification and correction of defects as they occur
 - Proper cleaning of joint between passes
 - Absence of obvious defects that exceed tolerances at the filler and capping passes
 - Careful finishing of joint
7. Comply with test requirements.
 - Proper preparation for tests of the cross-section samples or coupons
 - Absence of defects that exceed tolerances in the tested welds
 - Accurate determination of the causes of the defects
8. Finish the job.
 - Appropriate storage of equipment, tools and materials
 - Cleanliness of work area

For the competency as a whole:

- Compliance with occupational health and safety rules
- Compliance with welding procedure
- Choice and use of equipment, tools and controls based on the job
- Appropriate measures taken to prevent metal contamination
- Appropriate work posture
- Respectful behaviour toward other workers

Suggestions for Competency-Related Knowledge and Know-How

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

For the competency as a whole:

- Difficulties inherent in pipe welding: roundness of workpiece, positioning of body, different heights, quality requirements (qualification tests, high percentage of joints tested) etc.
 - Importance of avoiding stainless steel contamination by using best practices, for example, by using the appropriate accessories and consumables for stainless steel
 - Main occupational health and safety risks: air quality (fumes, gases, dust), mechanical cutting equipment (grinders, saws, etc.), thermal (oxyacetylene and/or plasma-arc) cutting equipment, movement of workpieces (manually or using lifting and handling equipment and accessories), electricity, workstation ergonomics, stress, etc.
 - Importance of wearing approved personal protective gear adapted to the job: safety glasses, hearing protection, safety boots, gloves, fire-retardant clothing and leather clothing as needed, grinding full face shield, welding mask, etc.
 - Work (welding, grinding, etc.) at a variety of heights, and importance of adopting work postures that allow for freedom of movement and quality work
 - Stress management strategies
1. Learn about the job to be done.
 - Review of Competency 2 – *Interpret information on high-pressure welding*
 2. Prepare the equipment and consumables.
 - Installation and use of protective gear: protective screens, extraction system for gases and fumes, fire extinguishers, asbestos blankets, etc.
 - Positioning of extraction system for gases and fumes based on the welding process used
 - Installation of welding set-up: vise ground clamp, polarity, connection to electrical system, SMAW electrode holder or GTAW torch, shielding gases, pressure regulator with flowmeter, etc.
 - Preparation of tungsten electrode: choice of diameter, selection based on the metal to be welded, sharpening, installation of extensions, etc.
 - Installation of tools and accessories: grinders, extension cords, lights, etc.
 3. Prepare the pipes.
 - Use of measuring instruments such as tape measures, vernier calipers and wrap-around rulers
 - Main adjustments to automatic hydraulic or pneumatic bevelling equipment: alignment, rotation speed, blade changes, etc.
 - Specific characteristics of root landing in the GTAW process, sometimes specified in the welding procedure or left to the welder's discretion
 - Finishing of cut using a file or a fine-grained wheel
 - Consideration of the specific characteristics and use of adjustable pipe fitter's benches for the preparation of pipes
 4. Tack weld pipes.
 - Consideration of the specific characteristics and uses of different assembly tools: guide rail system with chain-clamp locking pliers, pipe alignment clamps (chain clamps, quick-acting screw clamps, manual double clamps, etc.), levels, rulers (to check the alignment), etc.
 - Amount and purpose of spacing between pipes
 - Building of bridges to avoid contamination inside the pipes in certain situations

- Settings of welding machine for tack welding: polarity, amperage, shielding gas flow rate, etc.
 - Importance of doing tests on scrap pieces to verify the settings of the welding machine
 - Use of same welding process and filler metal for tack welding and the root pass
 - Characteristics of the tungsten electrodes used to weld mild and stainless steel
 - Shielding gases used in GTAW, and importance of adjusting the flow rate
 - Number, size and positioning of tack welds and tack welding sequence, usually specified in the welding procedure or established by the welder based on the diameter and thickness of the pipe, etc.
 - Importance of verifying and correcting the alignment of the pipes before tack welding and welding
5. Purge the pipes.
- Principles for installing and using a purge system: type of gas; gas flow rate; positioning of gas entry and exit points; rubber, foam, emery paper and adhesive tape dams, etc.
6. Add the weld beads.
- Importance of readjusting the settings of the welding machine as needed
 - Characteristics of welding rods (AWS and CSA/CWB) for root passes in GTAW on stainless steel (e.g. ER316-L) or mild steel (e.g. ER309-L) or E7018 for SMAW process on mild steel pipes
 - Characteristics of welding electrodes (AWS and CSA/CWB) for filler and capping passes in SMAW for stainless steel (e.g. E316-L) or mild steel (e.g. E309-L) or E7018 for SMAW process on mild steel pipes
 - Importance of mastering penetration methods on plates in the 3G (vertical up) and 4G (overhead) positions
 - GTAW start methods: scratch TIG, lift arc, high frequency
 - Welding methods used for the root pass in GTAW: freehand welding, walking the cup, positioning of filler rod in joint, etc.
 - Welding methods used for the filler and capping passes in SMAW: dragging (5G position only) and multipass (5G and 6G positions) movements
 - Importance of controlling the thickness and regularity of the root, filler and capping beads
 - Importance of staggering the starting points of the filler and capping passes to avoid blowouts, excessive buildup, etc.
 - Grinding methods and choice of wheels for preparing a starting point, repairing a joint, etc.
 - Cleaning using chipping (flux) hammers and manual wire brushes, and finishing using wire brushes on a grinder and files
 - Main welding defects to look for during a visual inspection: lack of penetration, undercut, slag inclusion, wrong width or thickness of the weld bead, irregularity, incorrect overlap, lack of penetration, etc.
 - Tolerances for welding defects based on the prescribed standards
7. Comply with test requirements.
- Review of element 3, Interpret the results of destructive and non-destructive tests, of Competency 2 – *Interpret information on high-pressure welding*
8. Finish the job.
- Impact of maintaining equipment and keeping a tidy workstation on efficient production and occupational health and safety
 - Best practices for storing equipment: close cylinders, powering off the welding machine, wind cables, etc.
 - Materials stored in the appropriate places
 - Cleaning of work area: electrode butts, slag, dust, etc.

Competency 9 Duration 45 hours Credits 3

Behavioural Competency

Statement of the Competency

Weld mild steel pipes using the GMAW and FCAW processes in the 1G, 5G and 6G positions.

Achievement Context

- Working on pipes: 8 in. diameter SCH 80, 6 in. diameter SCH 80, etc.
- Given:
 - oral or written instructions
 - welding procedures
 - simple drawings
- Using:
 - a CC/CV welding machine and the accessories needed for conventional GMAW or GMAW with current-voltage waveforms specific to pipe welding (root pass) and FCAW (filler and capping passes)
 - the necessary pipe-cutting and bevelling equipment
 - the prescribed welding wire and shielding gases
 - motorized positioners and rollers
 - lifting and handling equipment (travelling cranes, hoists, trolleys, etc.) and accessories (slings, hooks, etc.)
 - personal and collective protective gear (screens, extraction system for gases and fumes, etc.)

Elements of the Competency**Performance Criteria**

- | | |
|---|---|
| 1. Learn about the job to be done. | <ul style="list-style-type: none"> • Accurate interpretation of oral or written instructions • Accurate interpretation of welding procedure and drawing |
| 2. Prepare the equipment and consumables. | <ul style="list-style-type: none"> • Appropriate inspection of equipment • Proper choice and installation of positioner or roller • Proper assembly of welding set-up • Appropriate selection of welding wire • Proper installation of protective and safety equipment |
| 3. Prepare the pipes. | <ul style="list-style-type: none"> • Proper choice and use of pipe-cutting and bevelling equipment |

- Bevel angles and root landing sizes in conformity with welding procedure
 - Proper length of pipes
 - Clean, uniform cuts
4. Tack weld pipes.
- Proper alignment of pipes
 - Positioning of tack welds and tacking sequence appropriate to the situation
 - Appropriate size and penetration of tack welds
5. Add the weld beads.
- Precise adjustment of settings of the welding machine
 - Effective use of positioner or roller in the 1G position
 - Proper downhill welding of the root pass in the 5G and 6G positions
 - Proper uphill welding of the filler and capping passes in the 5G and 6G positions
 - Absence of obvious defects that exceed tolerances at the root pass
 - Proper identification and correction of defects as they occur
 - Proper cleaning of joint between passes
 - Absence of obvious defects that exceed tolerances at the filler and capping passes
 - Careful finishing of joint
6. Comply with test requirements.
- Proper preparation for tests of the cross-section samples or coupons
 - Absence of defects that exceed tolerances in the tested welds
 - Accurate determination of the causes of the defects
7. Finish the job.
- Appropriate storage of equipment, tools and materials
 - Cleanliness of work area

For the competency as a whole:

- Compliance with occupational health and safety rules
- Compliance with welding procedure
- Choice and use of equipment, tools and consumables based on the job
- Appropriate work posture
- Respectful behaviour toward other workers

Suggestions for Competency-Related Knowledge and Know-How

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

For the competency as a whole:

- Difficulties inherent in pipe welding: roundness of workpiece, positioning of body, different heights, quality requirements (qualification tests, high percentage of joints tested) etc.
 - Main occupational health and safety risks: air quality (fumes, gases, dust), mechanical cutting equipment (grinders, saws, etc.), thermal (oxyacetylene and/or plasma-arc) cutting equipment, movement of workpieces (manually or using lifting and handling equipment and accessories), electricity, workstation ergonomics, stress, etc.
 - Importance of wearing approved personal protective gear adapted to the job: safety glasses, hearing protection, safety boots, gloves, fire-retardant clothing and leather clothing as needed, grinding full face shield, welding mask, etc.
 - Importance of adopting work postures that allow for the freedom of movement needed to do quality work (welding, cutting, grinding, etc.)
 - Stress management strategies
1. Learn about the job to be done.
 - Review of Competency 2 – *Interpret information on high-pressure welding*
 2. Prepare the equipment and consumables.
 - Installation and use of protective gear: protective screens, extraction system for gases and fumes, fire extinguishers, asbestos blankets, etc.
 - Installation of welding set-up: vise ground clamp, polarity, connection to electrical system, GMAW and FCAW welding gun, wire feeder, drive rollers, shielding gases, pressure regulator with flowmeter, etc.
 - Installation of tools and accessories: grinders, extension cords, lights, etc.
 - Different types of motorized positioners and rollers, methods of aligning rollers
 3. Prepare the pipes.
 - Use of measuring instruments such as tape measures, vernier calipers and wrap-around rulers
 - Specific characteristics of root landing in GMAW, sometimes specified in the welding procedure or left to the welder's discretion
 - Finishing of cut using a file or a fine-grained wheel
 - Consideration of the specific characteristics and use of adjustable pipe fitter's benches for the preparation of pipes
 4. Tack weld pipes.
 - Consideration of the specific characteristics and uses of different assembly tools: guide rail system with chain-clamp locking pliers, pipe alignment clamps (chain clamps, quick-acting screw clamps, manual double clamps, etc.), levels, rulers (to check the alignment), etc.
 - Amount and purpose of spacing between pipes
 - Settings of welding machine for tack welding: adjustment of voltage, wire speed, etc.
 - Importance of doing tests on scrap pieces to verify the settings of the welding machine
 - Use of same welding process and filler metal for tack welding and the root pass
 - Number, size and positioning of tack welds and tack welding sequence, usually specified in the welding procedure or established by the welder based on the diameter and thickness of the pipe, etc.

- Importance of verifying and correcting the alignment of the pipes before tack welding and welding
5. Add the weld beads.
 - Limitations of conventional GMAW and advantages of GMAW with current-voltage waveforms specific to pipe welding: better arc transfer, higher tolerance for the preparation and alignment of pipes, excellent wetting, speedier execution, etc.
 - Importance of readjusting the settings of the welding machine as needed
 - Characteristics of welding wires for the root pass in GMAW, for example: (AWS ER70S-3) (CSA/CWB ER49S-3)
 - Characteristics of welding wires for the filler and capping passes in FCAW, for example: (AWS E71-T-1) (CSA/CWB E491T-1) and several other possibilities depending on the welding procedure
 - Importance of mastering penetration methods on plates in the 3G (vertical down) position in GMAW
 - Welding methods used for the filler and capping passes in FCAW: dragging (1G and 5G positions) and multipass (1G, 5G and 6G positions) movements
 - Importance of controlling the thickness and regularity of the weld beads
 - Importance of staggering the starting points of the filler and capping passes to avoid blowouts, excessive buildup, etc.
 - Methods for using air arc cutting (AAC) to remove a defective weld
 - Grinding methods and choice of wheels for preparing a starting point, repairing a joint, etc.
 - Finishing using wire brushes (manual or on a grinder) and files
 - Main welding defects to look for during a visual inspection: lack of penetration, undercut, slag inclusion, wrong width or thickness of the weld bead, irregularity, incorrect overlap, lack of penetration, etc.
 - Tolerances for welding defects based on the prescribed standards
 6. Comply with test requirements.
 - Review of element 3, Interpret the results of destructive and non-destructive tests, of Competency 2 – *Interpret information on high-pressure welding*
 7. Finish the job.
 - Impact of maintaining equipment and keeping a tidy workstation on efficient production and occupational health and safety
 - Best practices for storing equipment: close cylinders, power off welding machine, wind cables, etc.
 - Materials stored in the appropriate places
 - Cleaning of work area: bits of welding wire, dust, etc.

Competency 10 Duration 60 hours Credits 4

Behavioural Competency

Statement of the Competency

Weld stainless steel pipes using the GMAW process in the 1G, 5G and 6G positions.

Achievement Context

- Working on pipes: 8 in. diameter SCH 10, 6 in. diameter SCH 10, 6 in. diameter SCH 40, etc.
- Given:
 - oral or written instructions
 - welding procedures
 - simple drawings
- Using:
 - a CV welding machine and the accessories needed for GMAW with current-voltage waveforms specific to pipe welding
 - the prescribed welding wire and shielding gases
 - cutting wheels and band saws
 - motorized positioners and rollers
 - lifting and handling equipment (travelling cranes, hoists, trolleys, etc.) and accessories (slings, hooks, etc.)
 - personal and collective protective gear (screens, extraction system for gases and fumes, etc.)

Elements of the Competency

Performance Criteria

- | | |
|---|---|
| 1. Learn about the job to be done. | <ul style="list-style-type: none"> • Accurate interpretation of oral or written instructions • Accurate interpretation of welding procedure and drawing |
| 2. Prepare the equipment and consumables. | <ul style="list-style-type: none"> • Appropriate inspection of equipment • Proper choice and installation of positioner or roller • Proper assembly of welding set-up • Appropriate selection of welding wire • Proper installation of protective and safety equipment |
| 3. Prepare the pipes. | <ul style="list-style-type: none"> • Proper use of cutting wheels and band saws • Bevel angles and root landing sizes in conformity with welding procedure • Proper length of pipes • Clean, uniform cuts |

4. Tack weld pipes.
 - Proper alignment of pipes
 - Positioning of tack welds and tacking sequence appropriate to the situation
 - Appropriate size and penetration of tack welds

5. Add the weld beads.
 - Precise adjustment of settings of the welding machine
 - Effective use of positioner or roller in the 1G position
 - Effective use of single-pass (SCH 10 pipes) and double-pass (SCH 40 pipes) welding
 - Proper downhill welding of joint in the 5G and 6G positions
 - Proper identification and correction of welding defects as they occur
 - Absence of obvious welding defects that exceed tolerances on the inside of the pipe
 - Absence of obvious welding defects that exceed tolerances on the outside of the pipe
 - Careful finishing of joint

6. Comply with test requirements.
 - Proper preparation for tests of the cross-section samples or coupons
 - Absence of defects that exceed tolerances in the tested welds
 - Accurate determination of the causes of the defects

7. Finish the job.
 - Appropriate storage of equipment, tools and materials
 - Cleanliness of work area

For the competency as a whole:

- Compliance with occupational health and safety rules
- Compliance with welding procedure
- Choice and use of equipment, tools and consumables based on the job
- Appropriate measures taken to prevent metal contamination
- Appropriate work posture
- Respectful behaviour toward other workers

Suggestions for Competency-Related Knowledge and Know-How

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

For the competency as a whole:

- Difficulties inherent in pipe welding: roundness of workpiece, positioning of body, different heights, quality requirements (qualification tests, high percentage of joints tested) etc.
- Main occupational health and safety risks: air quality (fumes, gases, dust), mechanical cutting equipment (grinders, saws, etc.), plasma cutting equipment, movement of workpieces (manually or using lifting and handling equipment and accessories), electricity, workstation ergonomics, stress, etc.
- Importance of wearing approved personal protective gear adapted to the job: safety glasses, hearing protection, safety boots, gloves, fire-retardant clothing and leather clothing as needed, grinding full face shield, welding mask, etc.
- Importance of adopting work postures that allow for the freedom of movement needed to do quality work (welding, cutting, grinding, etc.)
- Stress management strategies

1. Learn about the job to be done.

- Review of Competency 2 – *Interpret information on high-pressure welding*

2. Prepare the equipment and consumables.

- Installation and use of protective gear: protective screens, extraction system for gases and fumes, fire extinguishers, asbestos blankets, etc.
- Installation of welding set-up: vise ground clamp, polarity, connection to electrical system, GMAW welding gun, wire feeder, drive rollers, shielding gases, pressure regulator with flowmeter, etc.
- Installation of tools and accessories: grinders, extension cords, lights, etc.
- Different types of motorized positioners and rollers, and methods of aligning rollers

3. Prepare the pipes.

- Use of measuring instruments such as tape measures, vernier calipers and wrap-around rulers
- Use of cutting wheels and band saws to cut pipes
- Specific preparation of pipes for GMAW with current-voltage waveforms specific to pipe welding: straight end-to-end (SCH 10 pipes), bevel and root landing (SCH 40 pipes)
- Finishing of cut using a file or a fine-grained wheel
- Consideration of the specific characteristics and use of adjustable pipe fitter's benches for the preparation of pipes

4. Tack weld pipes.

- Consideration of the specific characteristics and uses of different assembly tools: guide rail system with chain-clamp locking pliers, pipe alignment clamps (chain clamps, quick-acting screw clamps, manual double clamps, etc.), levels, rulers (to check the alignment), etc.
- Amount and purpose of spacing between pipes
- Settings of welding machine for tack welding: pre-set programs, manual adjustment of voltage, wire speed, etc.
- Importance of doing tests on scrap pieces to verify the settings of the welding machine
- Use of same welding process and filler metal for tack welding and the root pass
- Number, size and positioning of tack welds and tack welding sequence, usually specified in the welding procedure or established by the welder based on the diameter and thickness of the pipe, etc.

- Importance of verifying and correcting the alignment of the pipes before tack welding and welding
5. Add the weld beads.
 - Limitations of conventional GMAW and advantages of GMAW with current-voltage waveforms specific to pipe welding: no need for purging, better arc transfer, higher tolerance for the preparation and alignment of pipes, excellent wetting, single-pass welding for SCH 10 pipes, speedier execution
 - Importance of readjusting the settings of the welding machine as needed
 - Characteristics of welding wires such as ER316-L (AWS, CSA/CWB) for the welding passes
 - Importance of mastering penetration methods on plates for straight end-to-end welding in the vertical down position
 - Use of positioner: counter-clockwise rotation, positioning of gun at 2 o'clock (30 degrees)
 - Vertical downhill welding for all passes in the 5G and 6G positions
 - Importance of controlling the thickness and regularity of the weld beads
 - Grinding methods and choice of wheels for preparing a starting point, repairing a joint, etc.
 - Finishing using wire brushes (manual or on a grinder) and files
 - Main welding defects to look for during a visual inspection: lack of penetration, undercut, wrong width or thickness of the weld bead, irregularity, incorrect overlap, lack of penetration, etc.
 - Tolerances for welding defects based on the prescribed standards
 6. Comply with test requirements.
 - Review of element 3, Interpret the results of destructive and non-destructive tests, of Competency 2 – *Interpret information on high-pressure welding*
 7. Finish the job.
 - Impact of maintaining equipment and keeping a tidy workstation on efficient production and occupational health and safety
 - Best practices for storing equipment: close cylinders, power off welding machine, wind cables, etc.
 - Materials stored in the appropriate places
 - Cleaning of work area: bits of welding wire, dust, etc.

Competency 11 Duration 75 hours Credits 5

Behavioural Competency

Statement of the Competency

Assemble and weld a pipe system and connect it to a pressure vessel.

Achievement Context

- Working on a pipe system that includes:
 - a variety of parts: elbows, tees, flanges, fittings, pipes (e.g. 6 in. diameter SCH 80, 6 in. diameter SCH 40, 4 in. diameter SCH 80), etc.
 - joints to be welded in a variety of positions
- Given:
 - oral or written instructions
 - welding procedures
 - simple drawings
- Working with a colleague where necessary
- Using:
 - a CC/CV welding machine and the accessories needed for the SMAW, GTAW, GMAW or FCAW processes
 - pipe-cutting and bevelling equipment
 - lifting and handling equipment (travelling cranes, hoists, trolleys, winches, etc.) and accessories (slings, hooks, etc.)
 - scaffolding (steel frame, rosette, tubular with couplers), ladders and stepladders
 - the personal and collective protective gear used on construction sites: hard hat, harness, lifeline, portable extraction system for gases and fumes, etc.

Elements of the Competency

Performance Criteria

1. Learn about the job to be done.

- Accurate interpretation of oral or written instructions
- Accurate interpretation of welding procedure and drawing

2. Plan the work.

- Detailed verification of the availability of the required materials
- Appropriate determination of the necessary equipment and tools
- Accurate determination of:
 - cutting sequence
 - assembly or subassembly sequence
 - welding sequence
- Accurate determination of safety measures required

3. Prepare the work area, equipment and consumables.
 - Appropriate inspection of equipment
 - Proper assembly of welding set-up
 - Appropriate selection of filler metals
 - Proper participation in the installation of access equipment
 - Proper implementation of the safety measures required on a construction site:
 - safety perimeter
 - portable extraction system for gases and fumes
 - protective screens
 - lifelines
4. Prepare the pipes.
 - Proper use of pipe-cutting and bevelling equipment
 - Bevel angles and root landing sizes in conformity with welding procedure
 - Proper length of pipes
 - Clean, uniform cuts
5. Assemble the pipe system.
 - Effective use of assembly equipment and tools
 - Proper alignment of pipes
 - Positioning of tack welds and tacking sequence appropriate to the situation
 - Appropriate size and penetration of tack welds
 - Assembly in conformity with drawing
6. Add the weld beads.
 - Precise adjustment of settings of the welding machine
 - Effective use of strategies to avoid warping
 - Effective use of welding methods appropriate to root, filler and capping passes
 - Absence of obvious defects that exceed tolerances at the root pass
 - Proper identification and correction of defects as they occur
 - Proper cleaning of joint between passes
 - Absence of obvious defects that exceed tolerances at the filler and capping passes
 - Careful finishing of joint
7. Connect the pipe system to a pressure vessel.
 - Adjustment of the assembly and components as needed
 - Appropriate installation of supports
 - Proper alignment of flanges
 - Proper bolting
8. Finish the job.
 - Appropriate storage of equipment, tools and materials
 - Cleanliness of work area

For the competency as a whole:

- Compliance with occupational health and safety rules
- Compliance with welding procedure
- Health and safety documents correctly filled out
- Choice and use of equipment, tools and consumables based on the job
- Effective use of lifting and handling equipment and accessories
- Appropriate work posture
- Effective communication and collaboration

Suggestions for Competency-Related Knowledge and Know-How

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

For the competency as a whole:

- Characteristics and use of the personal protective gear used on construction sites: hard hat with welding mask adapter, harness, lifeline, etc.
 - Main occupational health and safety risks: air quality (fumes, gases, dust), mechanical cutting equipment (grinders, saws, etc.), oxygen cutting equipment, movement of workpieces (manually or using lifting and handling equipment and accessories), use of access equipment, electricity, work postures, stress, etc.
 - Work (assembly, welding, grinding, etc.) at a variety of heights, and importance of adopting work postures that allow for freedom of movement and quality work
 - Movement of workpieces using lifting and handling equipment and accessories on a construction site: occasional outdoor work, equipment different from that used in industrial settings (e.g. telescoping lift trucks), need to use visual signals given the greater distance between workers, etc.
 - Importance of adopting an attitude and behaviours conducive to communication and teamwork when working on a construction site
1. Learn about the job to be done.
 - Review of Competency 2 – *Interpret information on high-pressure welding*
 2. Plan the work.
 - Importance of planning to save time and materials, foster more comfortable working positions, avoid accidents, etc.
 - Authorizations to obtain before doing the work, for example: hot-work permit, confined space entry permit, lockout permit, safety perimeter, compliance of scaffolding, etc.
 - Importance of filling out the necessary risk analysis forms when working on a construction site
 3. Prepare the work area, equipment and consumables.
 - Installation and use of protective and safety gear on construction sites: protective screens, portable extraction system for gases and fumes, fire extinguishers, asbestos blankets, red and yellow tape to mark safety perimeters, etc.
 - Installation and use of a mobile oxyacetylene and/or plasma-arc machine
 - Specific characteristics of the connection of a welding machine to the electrical system on a construction site

- Installation of an extension cord with breaker to supply power to tools on a construction site
 - Specific characteristics of different types of access equipment: scaffolding, scissor lifts, lifts with articulated booms, etc.
 - Different types of scaffolding (steel frame, rosette, tubular with couplers) and level of high-pressure welder's participation in their installation depending on the work setting
4. Prepare the pipes.
 - Choice of pipe-cutting and bevelling equipment depending on the job
 - Preheating methods and importance of respecting the temperatures specified in the welding procedure
 - Specific characteristics of various piping components: flanges, valves, reducers, elbows, tees, fittings, supports, etc.
 5. Assemble the pipe system.
 - Consideration of the specific characteristics and uses of different assembly tools: centring squares, flexible tape measures, guide rail system with chain-clamp locking pliers, pipe alignment clamps (chain clamps, quick-acting screw clamps, manual double clamps, etc.), levels, rulers (to check the alignment), etc.
 - Consideration of the specific characteristics and use of adjustable pipe fitter's benches for levelling pipes
 - Importance of respecting the drawings: dimensions, angles and levels, etc.
 - Physical constraints at the location where the pipe system is to be assembled and need to adapt the assembly
 - Strategies for reducing warping: flanges, preshaping, welding sequence, etc.
 - Importance of verifying and correcting the alignment of the pipes before tack welding and welding
 6. Add the weld beads.
 - Review of competencies 3 to 10 respecting welding processes and positions
 7. Connect the pipe system to a pressure vessel.
 - Importance of precisely establishing the assembly or subassembly sequence to facilitate connection
 - Importance of respecting the bolting sequence
 8. Finish the job.
 - Impact of maintaining equipment and keeping a tidy workstation on efficient production and occupational health and safety
 - Best practices for storing equipment: close cylinders, power off welding machine, wind cables, etc.
 - Materials stored in the appropriate places
 - Cleaning of work area: electrode butts, slag, dust, etc.

Glossary

The glossary below provides definitions of certain terms used in the following pages.

Pipe welding positions

- 1G: Flat welding position, working on bevelled pipes on a welding positioner or roller
- 2G: Horizontal welding position, working on bevelled pipes fixed in a vertical position
- 5G: Welding position, working on bevelled pipes fixed in a horizontal position
- 6G: Welding position, working on bevelled pipes fixed at a 45-degree angle

Welding processes

- FCAW: English: flux-cored arc welding³
French: *soudage à l'arc avec fil tubulaire (fourré) sous protection gazeuse*
- GMAW: English: gas metal arc welding
French: *soudage à l'arc avec fil solide sous protection gazeuse*
- GTAW: English: gas tungsten arc welding
French: *soudage à l'arc avec électrode de tungstène (réfractaire) sous protection gazeuse*
- SMAW: English: shielded metal arc welding
French: *soudage à l'arc avec électrode enrobée*

Miscellaneous

- SCH: Schedule. Abbreviation used in the classification of pipes to specify the wall thickness and outside diameter: SCH 40, SCH 80, etc.
- Piping: Components ensuring the circulation of a fluid or gas: pipes, fittings, supports, anchors, etc.

³ Arc welding always involves an electric arc.

