

16

METALLURGICAL TECHNOLOGY

HIGH-PRESSURE WELDING

PROGRAM OF STUDY
5734

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5734**

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METALLURGICAL TECHNOLOGY

HIGH-PRESSURE WELDING

PROGRAM OF STUDY 5734

The *High-Pressure Welding* program leads to the Attestation of Vocational Specialization (AVS) and prepares the student to practise the specialized trade of

HIGH-PRESSURE WELDER

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François Legault
Minister of Education

TABLE OF CONTENTS

| | Page |
|---|------|
| INTRODUCTION | 1 |
| GLOSSARY | 3 |
| PART I | |
| 1. SYNOPTIC TABLE | 7 |
| 2. PROGRAM TRAINING GOALS | 9 |
| 3. COMPETENCIES | 11 |
| Grid of Learning Focuses | 12 |
| 4. GENERAL OBJECTIVES | 13 |
| 5. FIRST- AND SECOND-LEVEL OPERATIONAL OBJECTIVES | 15 |
| 5.1 Definition | 15 |
| 5.2 How to Read First-Level Operational Objectives | 16 |
| PART II | |
| MODULE 1 : THE TRADE AND THE TRAINING PROCESS | 21 |
| MODULE 2 : CONCEPTS RELATED TO STANDARDS AND TO THE CLASSIFICATION OF PIPES | 25 |
| MODULE 3 : INTERPRETING DRAWINGS OF PRESSURE VESSELS | 27 |
| MODULE 4 : PREPARING PIPES | 29 |
| MODULE 5 : WELDING PIPES USING THE SMAW PROCESS IN THE 2G POSITION .. | 33 |
| MODULE 6 : WELDING PIPES USING THE SMAW PROCESS | 39 |
| MODULE 7 : WELDING PIPES USING THE GTAW AND SMAW PROCESSES | 45 |
| MODULE 8 : WELDING MILD STEEL AND STAINLESS STEEL PIPES USING THE GTAW PROCESS | 51 |
| MODULE 9 : WELDING ALUMINUM PIPES USING THE GTAW PROCESS | 57 |
| MODULE 10 : WELDING PIPES USING THE GMAW AND FCAW PROCESSES | 61 |
| MODULE 11 : TORCH BRAZING PIPES | 67 |
| MODULE 12 : WELDING AND REPAIRING PRESSURE VESSEL COMPONENTS | 71 |

INTRODUCTION

The *High-Pressure Welding* program is based on the orientations for secondary school vocational education, which call for the participation of experts from the workplace and the field of education.

The program of study is developed in terms of competencies, expressed as objectives. These objectives are divided into modules. Various factors were kept in mind in developing the program: training needs, the job situation, purposes, goals, and strategies and means used to attain objectives.

The program of study lists the competencies that are the minimum requirements for an Attestation of Vocational Specialization (AVS) for students in both the youth and adult sectors. It also provides the basis for organizing courses, planning teaching strategies, and designing instructional and evaluation materials.

The duration of the program is 600 hours, which includes 540 hours spent on the specific competencies required to practise the trade and 60 hours on general competencies. The program of study is divided into 12 modules, which vary in length from 15 to 105 hours (multiples of 15). The time allocated to the program is to be used not only for teaching but also for evaluation and remedial work.

This document contains two parts. Part I is of general interest and provides an overview of the training plan. It includes a synoptic table of basic information about the modules, a description of the program training goals, the competencies to be developed and the general objectives, and an explanation of operational objectives. Part II is designed primarily for those directly involved in implementing the program. It contains a description of the operational objectives of each module.

In keeping with this broad approach, three accompanying documents will be provided: a teaching guide, an evaluation guide, and a planning guide.

GLOSSARY

Program Training Goals

Statements that describe the educational aims of a program. These goals are the general goals of vocational education adapted to a specific trade or occupation.

Competency

A set of socio-affective behaviours, cognitive skills or psycho-sensori-motor skills that enable a person to correctly perform a role, function, activity or task.

General Objectives

Instructional objectives that provide an orientation for leading the students to attain one or more related objectives.

Operational Objectives

Statements of the educational aims of a program in practical terms. They serve as the basis for teaching, learning and evaluation.

Module of a Program

A component part of a program of study comprising a first-level operational objective and the related second-level operational objectives.

Credit

A unit used for expressing quantitatively the value of the modules in a program of study. One credit corresponds to 15 hours of training. Students must accumulate a set number of credits to graduate from a program.

PART I

1 SYNOPTIC TABLE

Number of modules: 12 High-Pressure Welding
 Duration in hours: 600 Code: 5734
 Credits: 40

| CODE | TITLE OF THE MODULE | HOURS | CREDITS* |
|---------|--|-------|----------|
| 802 511 | 1. The Trade and the Training Process | 15 | 1 |
| 802 522 | 2. Concepts Related to Standards and to the Classification of Pipes | 30 | 2 |
| 802 532 | 3. Interpreting Drawings of Pressure Vessels | 30 | 2 |
| 802 542 | 4. Preparing Pipes | 30 | 2 |
| 802 558 | 5. Welding Pipes Using the SMAW Process in the 2G Position | 120 | 8 |
| 802 568 | 6. Welding Pipes Using the SMAW Process | 120 | 8 |
| 802 585 | 7. Welding Pipes Using the GTAW and SMAW Processes | 75 | 5 |
| 802 575 | 8. Welding Mild Steel and Stainless Steel Pipes Using the GTAW Process | 75 | 5 |
| 802 592 | 9. Welding Aluminum Pipes Using the GTAW Process | 30 | 2 |
| 802 602 | 10. Welding Pipes Using the GMAW and FCAW Processes | 30 | 2 |
| 802 621 | 11. Torch Brazing Pipes | 15 | 1 |
| 802 632 | 12. Welding and Repairing Pressure Vessel Components | 30 | 2 |

* 15 hours = 1 credit

This program leads to an Attestation of Vocational Specialization (AVS) in High-Pressure Welding.

2 PROGRAM TRAINING GOALS

The training goals of the *High-Pressure Welding* program are based on the general goals of vocational education and take into account the specific nature of the occupation. These goals are:

To develop effectiveness in the practice of the trade.

- To teach students to perform high-pressure welding tasks and activities (i.e. manufacture, repair and installation of pressure vessels) correctly, at an acceptable level of competence for entry into the job market.
- To prepare students to progress satisfactorily on the job by fostering:
 - the skills required to interpret standards related to high-pressure welding, the classification of pipes and the interpretation of drawings of pipes.

To ensure integration into the job market.

- To help students learn about:
 - the job market in general;
 - the metallurgical technology sector;
 - the trade of high-pressure welder;
 - the nature of the training program and its requirements and procedure.

To foster personal development and the acquisition of trade-related knowledge.

- To help students:
 - develop autonomy and a sense of initiative and responsibility in the performance of their tasks;
 - develop a desire for success;
 - develop a concern for excellence and the quality of the finished product;
 - understand the principles underlying the different techniques used;
 - develop work methods and a sense of discipline.

To ensure job mobility.

- To help students:
 - acquire a solid basic education and develop versatility in the performance of tasks;
 - improve their ability to learn and find information;
 - acquire a positive attitude toward technological change and new situations;
 - prepare for a creative job search;
 - acquire an accurate perception of career possibilities in the field of high-pressure welding.

3 COMPETENCIES

The competencies to be developed in the *High-Pressure Welding* program are shown in the grid of learning focuses on the following page. The grid lists general and specific competencies as well as the major steps in the work process.

General competencies involve activities common to several tasks or situations. They cover, for example, the technological or scientific principles that the students must understand to practise the trade or occupation. Specific competencies focus on tasks and activities that are of direct use in the trade or occupation. The work process includes the most important steps in carrying out the tasks and activities of the trade or occupation.

The grid of learning focuses shows the relationship between the general competencies on the horizontal axis and the specific competencies on the vertical axis. The symbol (Δ) indicates a correlation between a specific competency and a step in the work process. The symbol (\circ) indicates a correlation between a general and a specific competency.

The symbols (\blacktriangle) and (\bullet) indicate that these relationships have been taken into account in the formulation of objectives intended to develop specific competencies related to the trade or occupation.

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 of the grid shows the competencies directly related to the practice of a specific trade or occupation. These competencies are arranged in a relatively fixed order; therefore, the modules should be taught, insofar as possible, in the order represented on the grid. The modules including the general competencies on the horizontal axis should be taught in relation to those on the vertical axis. This means that some modules are prerequisite to others, while other modules are taught concurrently.

| GRID OF LEARNING FOCUSES HIGH-PRESSURE WELDING | | FIRST-LEVEL OPERATIONAL OBJECTIVES | DURATION (IN HOURS) | PROCESSUS (grandes étapes) | | | | | | GENERAL COMPETENCIES (related to technology, subjects personal development, | | | | | | | |
|--|--|------------------------------------|---------------------|-------------------------------|----------------------|-------------------------------------|-----------|---------------------------------|--|--|--|----|--|--|--|--|--|
| | | | | Read the instructions | Take safety measures | Prepare the materials and equipment | Do a weld | Inspect the quality of the work | Prepare the welded assembly for inspection | Apply concepts related to standards and to the classification of pipes | Interpret drawings of pressure vessels | | | | | | |
| SPECIFIC COMPETENCIES (directly related to the practice of the specific occupation) | | | | | | | | | | | | | | | | | |
| MODULES | MODULES | | | | | | | | | | 2 | 3 | | | | | |
| | FIRST-LEVEL OCCUPATIONAL OBJECTIVES | | | | | | | | | | B | B | | | | | |
| | DURATION (IN HOURS) | | | | | | | | | | 15 | 30 | | | | | |
| 1 | Determine their suitability for the trade and the training process | S | 15 | △ | △ | △ | △ | △ | △ | △ | ○ | ○ | | | | | |
| 4 | Prepare pipes | B | 30 | ▲ | ▲ | ▲ | △ | ▲ | △ | ● | ○ | | | | | | |
| 5 | Weld pipes using the SMAW process in the 2G position | B | 120 | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ● | ○ | | | | | | |
| 6 | Weld pipes using the SMAW process | B | 120 | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ● | ● | | | | | | |
| 7 | Weld pipes using the SMAW and GTAW processes | B | 75 | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ● | ● | | | | | | |
| 8 | Weld mild steel and stainless steel pipes using the GTAW process | B | 75 | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ● | ● | | | | | | |
| 9 | Weld aluminum pipes using the GTAW process | B | 30 | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ● | ● | | | | | | |
| 10 | Weld pipes using the GMAW and FCAW processes | B | 30 | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ● | ● | | | | | | |
| 11 | Torch braze pipes | B | 15 | ▲ | ▲ | ▲ | ▲ | ▲ | △ | ● | ● | | | | | | |
| 12 | Weld and repair pressure vessel components | B | 30 | ▲ | ▲ | ▲ | ▲ | ▲ | △ | ● | ● | | | | | | |
| NUMBER OF OBJECTIVES | | 11 | | | | | | | | | | | | | | | |
| DURATION (IN HOURS) | | | 540 | | | | | | | | | | | | | | |

S : Situational objective
B: Behavioural objective

- △ Correlation between a step and a specific competency
- ▲ Correlation to be taught and evaluated
- Correlation between a general and a specific competency
- Correlation to be taught and evaluated

4 GENERAL OBJECTIVES

The general objectives of the *High-Pressure Welding* program are presented below, along with the major statement of each corresponding first-level operational objective.

To develop in the students the competencies required to integrate harmoniously into the school and work environments.

- Determine their suitability for the trade and the training process.

To develop in the students the competencies required to perform tasks prerequisite to high-pressure welding.

- Prepare pipes.

To develop in the students the competencies required to understand the concepts and principles essential to the trade.

- Apply concepts related to standards and to the classification of pipes.

To develop in the students the competencies required to make use of information contained in drawings of pressure vessels.

- Interpret drawings of pressure vessels.

To develop in the students the competencies required to apply the different processes used to weld pressure pipes.

- Weld pipes using the SMAW process in the 2G position.
- Weld pipes using the SMAW process.
- Weld mild steel and stainless steel pipes using the GTAW process.
- Weld pipes using the GTAW and SMAW processes.
- Weld aluminum pipes using the GTAW process.
- Weld pipes using the GMAW and FCAW processes.

To develop in the students the competencies required to apply the torch brazing process used on pressure pipes.

- Torch braze pipes.

To develop in the students the competencies required to weld and repair pressure vessels.

- Weld and repair pressure vessel components.

5 FIRST- AND SECOND-LEVEL OPERATIONAL OBJECTIVES

5.1 DEFINITION

A first-level objective is defined for each competency to be developed. Competencies are organized into an integrated training program designed to prepare students to practise the trade or occupation. This systematic organization of competencies produces better overall results than training by isolated objectives. More specifically, it fosters a smooth progression from one objective to the next, saves teaching time by eliminating needless repetition, and integrates and reinforces learning material.

First-level operational objectives are the main, compulsory teaching/learning targets and they are specifically evaluated for certification. There are two kinds of operational objectives: behavioural and situational.

- **A behavioural objective** is a relatively closed objective that describes the actions and results expected of the student by the end of a learning step. Evaluation is based on expected results.
- **A situational objective** is a relatively open-ended objective that outlines the major phases of a learning situation. It allows for output and results to vary from one student to another. Evaluation is based on the student's participation in the activities of the learning context.

Second-level operational objectives are intermediate teaching/learning targets deemed prerequisite for attaining first-level objectives. They are grouped according to the specifications (see 5.2 A) or the phases (see 5.2 B) of the first-level objective.

The division of operational objectives into first- and second-level objectives is based on a clear distinction between the levels of learning:

- learning involving prerequisite knowledge
- learning involving competencies

Second-level operational objectives indicate prerequisite knowledge. They prepare the students to learn what is necessary to attain the first-level operational objectives, which collectively lead to the development of a competency. The objectives should always be adapted to meet the particular needs of the individual students or groups of students.

First-level operational objectives cover the learning that the students need to develop a competency:

- The specifications or the phases of the objective determine or guide specific learning, thereby allowing the competency to be developed step by step.

- The objective as a whole (i.e. the six components and in particular the last phase of a situational objective) determines or guides the overall learning and the integration and synthesis of this learning, allowing the competency to be developed fully.

To attain the objectives, the following learning activities may be prepared:

- specific learning activities for second-level objectives
- specific learning activities for the specifications or phases of first-level objectives
- general learning activities for first-level objectives

5.2 HOW TO READ FIRST-LEVEL OPERATIONAL OBJECTIVES

A. How to Read a Behavioural Objective

Behavioural objectives consist of six components. The first three provide an overview of the objective:

1. The **expected behaviour** states a competency in terms of the general behaviour that the students are expected to have acquired by the end of the module.
2. The **conditions for performance evaluation** define what is necessary or permissible to the students during evaluation designed to verify whether or not the students have attained the objective. This means that the conditions for evaluation are the same wherever and whenever the program is taught.
3. The **general performance criteria** define the requirements by which to judge whether or not the results obtained are generally satisfactory.

The last three components ensure that the objective is understood clearly and unequivocally:

4. The **specifications of the expected behaviour** describe the essential elements of the competency in terms of specific behaviours.
5. The **specific performance criteria** define the requirements for each of the specifications of behaviour. They ensure a more enlightened decision on the attainment of the objective.
6. The **field of application** defines the limits of the objective, where necessary. It indicates cases where the objective applies to more than one task, occupation or field.

B. How to Read a Situational Objective

Situational objectives consist of six components:

1. The **expected outcome** states a competency as an aim to be pursued throughout the course.
2. The **specifications** outline the essential aspects of the competency and ensure a better understanding of the expected outcome.
3. The **learning context** provides an outline of the learning situation designed to help the students develop the required competencies. It is normally divided into three phases of learning:
 - information
 - performance, practice or involvement
 - synthesis, integration and self-evaluation
4. The **instructional guidelines** provide suggested ways and means of teaching the course to ensure that learning takes place and that the same conditions apply wherever and whenever the course is taught. These guidelines may include general principles or specific procedures.
5. The **participation criteria** describe the requirements the students must fulfil, which are usually related to each phase of the learning context. 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 context.
6. **The field of application** defines the limits of the objective, where necessary. It indicates cases where the objective applies to more than one task, occupation or field.

PART II

MODULE 1 : THE TRADE AND THE TRAINING PROCESS

CODE: 802 511

Duration: 15 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE SITUATIONAL OBJECTIVE

EXPECTED OUTCOME

By participating in the required activities of the learning context according to the indicated criteria, the students will be able to

determine their suitability for the trade and the training process.

SPECIFICATIONS

During this module, the students will:

- Become familiar with the nature of the trade.
- Understand the training program.
- Confirm their career choice.

LEARNING CONTEXT

PHASE 1: Information on the Trade

- Learning about the job market in high-pressure welding, i.e. types of companies that manufacture, install or repair pressure vessels, types of products manufactured and welding processes used, job prospects, wages, advancement opportunities.
- Learning about the nature and requirements of the trade, i.e. tasks, working conditions, qualification, regulations and standards.
- Presenting the information gathered at a group meeting and discussing their perception of the trade, i.e. advantages, disadvantages and requirements.

FIRST-LEVEL OPERATIONAL OBJECTIVE SITUATIONAL OBJECTIVE

LEARNING CONTEXT

PHASE 2: Information on and Participation in the Program

- Discussing the skills, attitudes, aptitudes and knowledge required to practise the trade.
- Discussing the relevance of the program of study with respect to the working conditions of high-pressure welders.
- Expressing their opinion on the training process.

PHASE 4: Evaluation and Confirmation of Career Choice

- Producing a report in which they:
 - specify their preferences, aptitudes and interests with regard to high-pressure welding;
 - assess their career choice by comparing the aspects and requirements of the trade with their own preferences, aptitudes and interests.

INSTRUCTIONAL GUIDELINES

The teacher should:

- Promote an atmosphere favouring personal development and integration into the workforce.
- Encourage the students to engage in discussions and to express themselves.
- Motivate the students to take part in the suggested activities.
- Help the students acquire an accurate perception of the trade.
- Help the students assess their career choice honestly and objectively.
- Organize a visit to a company representative from the field of high-pressure welding.
- Make suitable reference material available to the students (e.g. information on the trade, training program, monographs).
- Arrange for the students to meet with trade specialists.

**FIRST-LEVEL OPERATIONAL OBJECTIVE
SITUATIONAL OBJECTIVE**

PARTICIPATION CRITERIA

PHASE 1:

- Gather information on most of the topics to be addressed.
- Express their perception of the trade at a group meeting, referring to the information gathered.

PHASE 2:

- Express their opinion of some of the requirements of the training program.
- Consult the documents provided.
- Listen attentively to explanations.
- Express their opinion of the training program at a group meeting.

PHASE 3:

- Produce a report containing:
 - a brief description of their preferences, interests and aptitudes;
 - an explanation of their career choice;
 - justification for their decision to continue in the program or to drop out.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before undertaking the activities of Phase 1:

1. Determine their suitability for the targeted competency and the suggested learning process.
2. Find information.
3. Differentiate among a task, an operation and a job.
4. Identify the various regulations and standards governing high-pressure welding.

Before undertaking the activities of Phase 2:

5. Identify the skills, aptitudes and knowledge required to practise the trade.
6. Describe the nature, functions and content of a program of study.

Before undertaking the activities of Phase 3:

7. Describe the main components of a report confirming their career choice.

MODULE 2 : CONCEPTS RELATED TO STANDARDS AND TO THE CLASSIFICATION OF PIPES

CODE: 802 522

Duration: 30 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **apply concepts related to standards and to the classification of pipes** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given learning situations involving prescribed tolerances for high-pressure welding
- Referring to documentation

GENERAL PERFORMANCE CRITERIA

- Accurate identification of elements
- Accurate interpretation of information
- Proper use of terminology

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR

- Identify ferrous and non-ferrous pipes and connections.
- Interpret the prescribed welding tolerances in ASME standards, Section IX, and ANSI standards, Article 31.3.

SPECIFIC PERFORMANCE CRITERIA

- Accurate identification of the different types of pipes
- Accurate interpretation of tolerances prescribed in the standards

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to identify ferrous and non-ferrous pipes and connections (A):

1. Identify the composition of alloys used in ferrous and non-ferrous pipes.
2. Recognize the different methods of manufacturing ferrous and non-ferrous pipes (e.g. casting, moulding, forging).
3. Identify the different classifications of pipes and connections.
4. Associate grades of pipes with ferrous and non-ferrous metals.

Before learning how to interpret the prescribed welding tolerances in ASME standards, Section IX, and ANSI standards, Article 31.3 (B):

5. Find information on welding tolerances in Section IX of the ASME code and Article 31.3 of the ANSI code.
6. Understand the requirements of Articles B.31.1 and B.31.3 of the ASME code, Section IX.

MODULE 3 : INTERPRETING DRAWINGS OF PRESSURE VESSELS

CODE: 802 532

Duration: 30 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **interpret drawings of pressure vessels** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given drawings of pressure vessels (pipes and tanks)
- Without referring to documentation

GENERAL PERFORMANCE CRITERIA

- Accurate interpretation of information
- Proper use of terminology
- Accurate, comprehensive reading
- Proper use of development techniques

SPECIFICATIONS OF THE EXPECTED BEHAVIOUR

- Interpret information contained in a drawing of pipes.
- Interpret information contained in a drawing of pressure vessels.
- Draw patterns for basic pipe assemblies.

SPECIFIC PERFORMANCE CRITERIA

- Accurate interpretation of information
- Accurate interpretation of information
- Accurate and clear development of drawings

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret information contained in a drawing of pipes (A):

1. Identify the characteristics specific to drawings of pipes.
2. Interpret orthographic sketches of piping.
3. Interpret isometric sketches of piping.

Before learning how to interpret information contained in a drawing of pressure vessels (B):

4. Identify the characteristics specific to drawings of pressure vessels.

Before learning how to draw patterns for basic pipe assemblies (C):

5. Acquire the technique of development using parallel lines.
6. Acquire the technique of development using radial lines.

MODULE 4 : PREPARING PIPES

CODE: 802 542

Duration: 30 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **prepare pipes** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given a drawing indicating the dimensions of the pipes and the bevel angles
- Using manual oxyacetylene cutting equipment
- Working with schedule 80 mild steel pipes measuring 152 mm in diameter

GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of tools and equipment
- Proper use of technique for preparing pipes
- Conformity with applicable standards

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

A. Mark out the pipes.

- Proper choice of pipes
- Proper marking out of pipes

B. Prepare pipes:

- using manual oxyacetylene cutting equipment, for butt and T joints:
 - schedule 160 mild steel pipes measuring 51 mm in diameter
 - schedule 40 and schedule 80 mild steel pipes measuring 152 mm in diameter
- using semi-automatic or automatic oxyacetylene cutting equipment, for butt joints:
 - schedule 40 and schedule 80 mild steel pipes measuring 152 mm in diameter
 - schedule 160 mild steel pipes measuring 51 mm in diameter
- using an automatic snap type cutter, for butt joints:
 - stainless steel pipes measuring 76 mm in diameter x 5.5 mm x 100 mm
 - aluminum pipes measuring 152 mm in diameter by 10.97 mm x 100 mm

- Proper choice and preparation of cutting tools and equipment
- Observance of prescribed dimensions
- Observance of prescribed bevel angle

C. Clean the cuts.

- Clean cuts
- Proper finishing of cuts

D. Assess the quality of the cuts.

- Accurate assessment of quality of cuts
- Detection of any defects

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

E. Tidy up the work area.

**SPECIFIC PERFORMANCE
CRITERIA**

- Proper storage of equipment
- Clean work area

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to mark out the pipes (A):

1. List the different types of pipe assemblies.
2. Identify the tools for marking out pipes.
3. Explain the methods of marking out for the different types of pipe assemblies.

Before learning how to prepare pipes:

- using manual oxyacetylene cutting equipment, for butt and T joints:
 - schedule 160 mild steel pipes measuring 51 mm in diameter
 - schedule 40 and schedule 80 mild steel pipes measuring 152 mm in diameter
- using semi-automatic or automatic oxyacetylene cutting equipment, for butt joints:
 - schedule 40 and schedule 80 mild steel pipes measuring 152 mm in diameter
 - schedule 160 mild steel pipes measuring 51 mm in diameter
- using an automatic snap type cutter, for butt joints:
 - stainless steel pipes measuring 76 mm in diameter x 5.5 mm x 100 mm
 - aluminum pipes measuring 152 mm in diameter by 10.97 mm x 100 mm (B):

4. Explain the health and safety measures to be taken.
5. Explain the methods of using manual, semi-automatic and automatic pipe cutting equipment.
6. Explain the characteristics of the different types of pipe cuts.

Before learning how to clean the cuts (C):

7. Identify the tools used to clean cuts.
8. Explain the safe method of cleaning cuts with various tools.
9. Explain the technique for finishing cuts.

Before learning how to assess the quality of the cuts (D):

10. Be familiar with the qualities and defects of a cut and the appropriate corrective measures.

MODULE 5 : WELDING PIPES USING THE SMAW PROCESS IN THE 2G POSITION

CODE: 802 558

Duration: 120 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **weld pipes using the SMAW process in the 2G position** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given a welding procedure
- Using manual oxyacetylene cutting equipment
- Working on mild steel pipes measuring 152 mm in diameter x 10.97 mm x 100 mm in the 2G position
- Using cellulosic (E-41011 or E-41010) and low hydrogen (E-48018) electrodes

GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of welding technique
- Conformity with applicable standards
- Observance of prescribed time limit

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

- | | |
|--|--|
| A. Interpret the welding procedure. | - Accurate interpretation |
| B. Prepare plates and pipes. | <ul style="list-style-type: none"> - Proper choice of plates and pipes - Observance of prescribed dimensions and bevel angles - Proper cleaning and finishing of cuts |
| C. Do assemblies: <ul style="list-style-type: none"> • mild steel plates measuring 9.6 mm x 200 mm, of the same thickness, using V-groove welds, in the flat position • mild steel pipes, using V-groove welds and butt joints, in the flat position: <ul style="list-style-type: none"> - pipes measuring 152 mm in diameter x 7.11 mm x 100 mm - pipes measuring 152 mm in diameter x 10.97 mm x 100 mm | <ul style="list-style-type: none"> - Proper choice and use of tools and equipment - Proper alignment of plates and pipes - Accurate positioning and sequence of tacking |
| D. Weld plate and pipe assemblies in the 1G and 2G positions. | <ul style="list-style-type: none"> - Proper adjustment of parameters - Proper application of process - Observance of prescribed welding position - Quality welds |
| E. Visually assess the quality of the welds. | <ul style="list-style-type: none"> - Detection of any welding defects - Determination of causes of welding defects - Determination of corrective measures |

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

- F. Prepare the welded assemblies for destructive testing.

- G. Verify the quality of the welds using bend tests.

- H. Tidy up the work area.

**SPECIFIC PERFORMANCE
CRITERIA**

- Proper choice and use of tools and equipment
- Proper preparation of test coupons

- Detection of any welding defects
- Determination of causes of welding defects
- Determination of corrective measures

- Proper storage of equipment
- Clean work area

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the welding procedure (A):

1. List the specifications contained in a SMAW welding procedure.

Before learning how to prepare plates and pipes (B):

2. Explain the health and safety measures to be taken.
3. Explain the steps involved in the preparation of pipes and plates for assembly.

Before learning how to do assemblies:

- mild steel plates measuring 9.6 mm x 200 mm, of the same thickness, using V-groove welds, in the flat position
- mild steel pipes, using V-groove welds and butt joints, in the flat position:
 - pipes measuring 152 mm in diameter x 7.11 mm x 100 mm
 - pipes measuring 152 mm in diameter x 10.97 mm x 100 mm (C):

4. Explain the health and safety measures to be taken.
5. Describe the steps involved in the assembly of plates and pipes.
6. Explain the methods of assembling plates and pipes.
7. Explain the tacking sequences for plates and pipes.

Before learning how to weld plate and pipe assemblies in the 1G and 2G positions (D):

8. Explain the techniques for doing penetration beads and filler and cover passes using the SMAW process in the 1G and 2G positions.
9. Explain the characteristics of penetration beads and filler and cover passes using the SMAW process.
10. Describe the causes of welding defects using the SMAW process and the appropriate corrective measures.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to visually assess the quality of the welds (E):

11. Be familiar with the specifications in the standards related to high-pressure welding.
12. Be familiar with the tolerances applicable to the assessment of welds.
13. Detect welding defects.

Before learning how to prepare the welded assemblies for destructive testing (F):

14. Explain the methods of using the tools and equipment required to prepare test coupons.
15. Explain the methods of preparing test coupons for destructive tests.

Before learning how to verify the quality of the welds using bend tests (G):

16. Explain the criteria for assessing a weld after a bend test.

MODULE 6 : WELDING PIPES USING THE SMAW PROCESS

CODE: 802 568

Duration: 120 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **weld pipes using the SMAW process** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given a pipe assembly drawing and a welding procedure
- Using manual oxyacetylene cutting equipment
- Working on mild steel pipes measuring 51 mm in diameter x 8.14 mm x 100 mm in the 6G position
- Using cellulosic (E-41011 or E-41010) and low hydrogen (E-48018) electrodes

GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of welding technique
- Conformity with applicable standards
- Observance of prescribed time limit

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

- | | |
|---|--|
| A. Interpret the instructions. | - Accurate interpretation of drawing and welding procedure |
| B. Prepare plates and pipes. | <ul style="list-style-type: none"> - Proper choice of plates and pipes - Observance of prescribed dimensions and bevel angles - Proper cleaning and finishing of cuts |
| C. Do assemblies: <ul style="list-style-type: none"> • mild steel plates measuring 9.6 mm x 200 mm, of the same thickness, using V-groove welds, in the flat position • mild steel pipes, using V-groove welds and butt joints, in the flat position: <ul style="list-style-type: none"> - pipes measuring 152 mm in diameter x 10.97 mm x 100 mm - pipes measuring 51 mm in diameter x 8.74 mm x 100 mm | <ul style="list-style-type: none"> - Proper choice and use of tools and equipment - Proper alignment of plates and pipes - Accurate positioning and sequence of tacking |
| D. Weld: <ul style="list-style-type: none"> • plates in the 3G and 4G positions • pipes in the 5G and 6G positions | <ul style="list-style-type: none"> - Proper adjustment of welding parameters - Proper application of process - Observance of prescribed welding position - Quality welds |
| E. Visually assess the quality of the welds. | <ul style="list-style-type: none"> - Detection of any welding defects - Determination of causes of welding defects - Determination of corrective measures |

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

F. Prepare the welded assemblies for destructive testing.

- Proper choice and use of tools and equipment
- Proper preparation of test coupons

G. Verify the quality of the welds using bend tests.

- Detection of any welding defects
- Determination of causes of welding defects
- Determination of corrective measures

H. Tidy up the work area.

- Proper storage of equipment
- Clean work area

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the instructions (A):

1. List the tolerances prescribed in the standards for the type of assembly.
2. List the characteristics of an assembly drawing of plates and pipes.
3. List the specifications contained in a SMAW welding procedure.

Before learning how to prepare plates and pipes (B):

4. Explain the health and safety measures to be taken.
5. Explain the steps involved in the preparation of pipes and plates for assembly.

Before learning how to do assemblies:

- mild steel plates measuring 9.6 mm x 200 mm, of the same thickness, using V-groove welds, in the flat position
- mild steel pipes, using V-groove welds and butt joints, in the flat position:
 - pipes measuring 152 mm in diameter x 10.97 mm x 100 mm
 - pipes measuring 51 mm in diameter x 8.74 mm x 100 mm (C):

6. Explain the health and safety measures to be taken.
7. Describe the steps involved in the assembly of plates and pipes.
8. Explain the methods of assembling plates and pipes.
9. Explain the tacking sequences for plates and pipes.

Before learning how to weld:

- plates in the 3G and 4G positions
- pipes in the 5G and 6G positions (D):

10. Explain the techniques for doing root passes, hot passes and cover passes using the SMAW process in the 3G, 4G, 5G and 6G positions.
11. Explain the characteristics of root passes, hot passes and cover passes using the SMAW process.
12. Describe the causes of welding defects using the SMAW process and the appropriate corrective measures.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to visually assess the quality of the welds (E):

13. Be familiar with the specifications in the standards related to high-pressure welding.
14. Be familiar with the tolerances applicable to the assessment of welds.
15. Detect welding defects.

Before learning how to prepare the welded assemblies for destructive testing (F):

16. Explain the methods of using the tools and equipment required to prepare test coupons.
17. Explain the methods of preparing test coupons for destructive tests.

Before learning how to verify the quality of the welds using bend tests (G):

18. Explain the criteria for assessing a weld after a bend test.

MODULE 7 : WELDING PIPES USING THE GTAW AND SMAW PROCESSES

CODE: 802 585

Duration: 75 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **weld pipes using the GTAW and SMAW processes** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given a pipe assembly drawing and a welding procedure
- Working on stainless steel pipes measuring 51 mm in diameter x 5.54 mm x 75 mm in the 6G position

GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of welding technique
- Conformity with applicable standards
- Observance of prescribed time limit

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

- | | |
|--|--|
| <p>A. Interpret the instructions.</p> | <ul style="list-style-type: none"> - Accurate interpretation of drawing and procedure |
| <p>B. Prepare mild steel and stainless steel pipes.</p> | <ul style="list-style-type: none"> - Proper choice of pipes - Proper use of semi-automatic oxyacetylene cutting equipment - Observance of prescribed dimensions and bevel angles - Proper cleaning and finishing of cuts |
| <p>C. Do assemblies using V-groove welds and butt joints, in the flat position:</p> <ul style="list-style-type: none"> • mild steel pipes measuring 152 mm in diameter x 7.11 mm x 100 mm • mild steel pipes measuring 51 mm in diameter x 8.74 mm x 100 mm • stainless steel pipes measuring 51 mm in diameter x 5.54 mm x 75 mm | <ul style="list-style-type: none"> - Proper choice and use of tools and equipment - Proper alignment of pipes - Accurate positioning and sequence of tacking |
| <p>D. Weld pipe assemblies using the GTAW process for the root pass and the SMAW process for the subsequent passes, in the 1G, 2G, 5G and 6G positions.</p> | <ul style="list-style-type: none"> - Proper adjustment of welding parameters - Proper application of process - Observance of prescribed welding position - Quality welds |
| <p>E. Visually assess the quality of the welds.</p> | <ul style="list-style-type: none"> - Detection of any welding defects - Determination of causes of welding defects - Determination of corrective measures |

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

- F. Prepare the welded assemblies for destructive testing.

- G. Verify the quality of the welds using bend tests.

- H. Tidy up the work area.

**SPECIFIC PERFORMANCE
CRITERIA**

- Proper choice and use of tools and equipment
- Proper preparation of test coupons

- Detection of any welding defects
- Determination of causes of welding defects
- Determination of corrective measures

- Proper storage of equipment
- Clean work area

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the instructions (A):

1. List the tolerances prescribed in the standards for the type of assembly.
2. List the characteristics of a pipe assembly drawing.
3. List the specifications contained in GTAW and SMAW welding procedures.

Before learning how to prepare mild steel and stainless steel pipes (B):

4. Explain the health and safety measures to be taken.
5. Explain the steps involved in the preparation of mild steel and stainless steel pipes.

Before learning how to do assemblies using V-groove welds and butt joints, in the flat position:

- mild steel pipes measuring 152 mm in diameter x 7.11 mm x 100 mm
- mild steel pipes measuring 51 mm in diameter x 8.74 mm x 100 mm
- stainless steel pipes measuring 51 mm in diameter x 5.54 mm x 75 mm (C):

6. Explain the health and safety measures to be taken.
7. Describe the steps involved in the assembly of pipes.
8. Explain the methods of assembling pipes.
9. Explain the tacking sequences for pipes.

Before learning how to weld pipe assemblies using the GTAW process for the root pass and the SMAW process for the subsequent passes, in the 1G, 2G, 5G and 6G positions (D):

10. Explain the techniques for doing root passes using the GTAW process and hot and cover passes using the SMAW process.
11. Explain the characteristics of root passes using the GTAW process and hot and cover passes using the SMAW process.
12. Describe the causes of welding defects using the GTAW process for the root pass and the SMAW process for the subsequent passes, and the appropriate corrective measures.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to visually assess the quality of the welds (E):

13. Be familiar with the specifications in the standards related to high-pressure welding.
14. Be familiar with the tolerances applicable to the assessment of welds.
15. Detect welding defects.

Before learning how to prepare the welded assemblies for destructive testing (F):

16. Explain the methods of using the tools and equipment required to prepare test coupons.
17. Explain the methods of preparing test coupons for destructive tests.

Before learning how to verify the quality of the welds using bend tests (G):

18. Explain the criteria for assessing a weld after a bend test.

MODULE 8 : WELDING MILD STEEL AND STAINLESS STEEL PIPES

CODE: 802 575

Duration: 75 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **weld mild steel and stainless steel pipes using the GTAW process** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given a pipe assembly drawing and a welding procedure
- Working on stainless steel pipes measuring 76 mm in diameter x 5.5 mm x 100 mm in the 6G position

GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of welding technique
- Conformity with applicable standards
- Observance of prescribed time limit

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

- | | |
|--|--|
| A. Interpret the instructions. | - Accurate interpretation of drawing and welding procedure |
| B. Prepare steel pipes. | <ul style="list-style-type: none"> - Proper choice of pipes - Proper use of semi-automatic oxyacetylene cutting equipment - Observance of prescribed dimensions and bevel angles - Proper cleaning and finishing of cuts |
| C. Do assemblies using V-groove welds and butt joints, in the flat position: <ul style="list-style-type: none"> • mild steel pipes measuring 152 mm in diameter x 7.11 mm x 100 mm • stainless steel pipes measuring 76 mm in diameter x 5.5 mm x 100 mm | <ul style="list-style-type: none"> - Proper choice and use of tools and equipment - Proper alignment of pipes - Accurate positioning and sequence of tacking |
| C. Weld pipe assemblies in the 1G, 2G, 5G and 6G positions. | <ul style="list-style-type: none"> - Proper adjustment of parameters - Proper application of process - Observance of prescribed welding position - Quality welds |
| D. Visually assess the quality of the welds. | <ul style="list-style-type: none"> - Detection of any welding defects - Determination of causes of welding defects - Determination of corrective measures |
| E. Prepare the welded assemblies for destructive testing. | <ul style="list-style-type: none"> - Proper choice and use of tools and equipment - Proper preparation of test coupons |

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

G. Verify the quality of the welds using bend tests.

H. Tidy up the work area.

**SPECIFIC PERFORMANCE
CRITERIA**

- Detection of any welding defects
- Determination of causes of welding defects
- Determination of corrective measures

- Proper storage of equipment
- Clean work area

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the instructions (A):

1. List the tolerances prescribed in the standards for the type of assembly.
2. List the characteristics of a pipe assembly drawing.
3. List the specifications contained in a GTAW welding procedure.

Before learning how to prepare steel pipes (B):

4. Explain the health and safety measures to be taken.
5. Explain the steps involved in the preparation of mild steel and stainless steel pipes.

Before learning how to do assemblies using V-groove welds and butt joints, in the flat position:

- mild steel pipes measuring 152 mm in diameter x 7.11 mm x 100 mm
- stainless steel pipes measuring 76 mm in diameter x 5.5 mm x 100 mm (C):

6. Explain the health and safety measures to be taken.
7. Describe the steps involved in the assembly of pipes.
8. Explain the methods of assembling pipes.
9. Explain the tacking sequences for pipes.

Before learning how to weld pipe assemblies in the 1G, 2G, 5G and 6G positions (D):

10. Explain the techniques for doing root passes, hot passes and cover passes on pipes using the GTAW process.
11. Explain the characteristics of root passes, hot passes and cover passes using the GTAW process.
12. Describe the causes of welding defects using the GTAW process and the appropriate corrective measures.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to visually assess the quality of the welds (E):

13. Be familiar with the specifications in the standards related to high-pressure welding.
14. Be familiar with the tolerances applicable to the assessment of welds.
15. Detect welding defects.

Before learning how to prepare the welded assemblies for destructive testing (F):

16. Explain the methods of using the tools and equipment required to prepare test coupons.
17. Explain the methods of preparing test coupons for destructive tests.

Before learning how to verify the quality of the welds using bend tests (G):

18. Explain the criteria for assessing a weld after a bend test.

MODULE 9 : WELDING ALUMINUM PIPES USING THE GTAW PROCESS

CODE: 802 592

Duration: 30 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **weld aluminum pipes using the GTAW process** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given a pipe assembly drawing and a welding procedure
- Working on aluminum pipes measuring 152 mm in diameter x 7.11 mm x 100 mm in the 2G position

GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of welding technique
- Conformity with applicable standards
- Observance of prescribed time limit

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

- | | |
|--|--|
| A. Interpret the instructions. | - Accurate interpretation of drawing and welding procedure |
| B. Assemble aluminum pipes using U-groove welds and butt joints, in the flat position: <ul style="list-style-type: none"> • pipes measuring 152 mm in diameter x 7.11 mm x 100 mm | <ul style="list-style-type: none"> - Proper choice and use of tools and equipment - Proper alignment of pipes - Accurate positioning and sequence of tacking |
| C. Weld assemblies in the 2G position. | <ul style="list-style-type: none"> - Proper adjustment of parameters - Proper application of process - Observance of prescribed welding position - Quality welds |
| D. Visually assess the quality of the welds. | <ul style="list-style-type: none"> - Detection of any welding defects - Determination of causes of welding defects - Determination of corrective measures |
| E. Prepare the welded assemblies for destructive testing. | <ul style="list-style-type: none"> - Proper choice and use of tools and equipment - Proper preparation of test coupons |
| F. Verify the quality of the welds using bend tests. | <ul style="list-style-type: none"> - Detection of any welding defects - Determination of causes of welding defects - Determination of corrective measures |
| G. Tidy up the work area. | <ul style="list-style-type: none"> - Proper storage of equipment - Clean work area |

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the instructions (A):

1. List the tolerances prescribed in the standards for the type of assembly.
2. List the characteristics of a pipe assembly drawing.
3. List the specifications contained in GTAW welding procedure.

Before learning how to assemble aluminum pipes using U-groove welds and butt joints, in the flat position:

• pipes measuring 152 mm in diameter x 7.11 mm x 100 mm (B):

4. Explain the health and safety measures to be taken.
5. Describe the techniques for cleaning aluminum pipes.
6. Describe the steps involved in the assembly of aluminum pipes.
7. Explain the methods of assembling aluminum pipes.
8. Explain the tacking sequences for aluminum pipes.

Before learning how to weld assemblies in the 2G position (C):

9. Explain the techniques for doing passes using the GTAW process.
10. Explain the characteristics of passes done using the GTAW process.
11. Describe the causes of welding defects that may result when using the GTAW process and the appropriate corrective measures.

Before learning how to visually assess the quality of the welds (D):

12. Be familiar with the specifications in the standards related to high-pressure welding.
13. Be familiar with the tolerances applicable to the assessment of welds.
14. Detect welding defects.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to prepare the welded assemblies for destructive testing (E):

15. Explain the methods of using the tools and equipment required to prepare test coupons.
16. Explain the methods of preparing test coupons for destructive tests.

Before learning how to verify the quality of the welds using bend tests (F):

17. Explain the criteria for assessing a weld after a bend test.

MODULE 10 : WELDING PIPES USING THE GMAW AND FCAW PROCESSES

CODE: 802 602

Duration: 30 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **weld pipes using the GMAW and FCAW processes** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given a pipe assembly drawing and a welding procedure
- Working on mild steel pipes measuring 203 mm in diameter x 12.7 mm x 100 mm in the 1G position

GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of welding technique
- Conformity with applicable standards
- Observance of prescribed time limit

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

- | | |
|--|--|
| A. Interpret the instructions. | - Accurate interpretation of drawing and welding procedure |
| B. Prepare the pipes. | <ul style="list-style-type: none"> - Proper choice of pipes - Proper use of semi-automatic oxyacetylene cutting equipment - Observance of prescribed dimensions and bevel angles - Proper cleaning and finishing of cuts |
| C. Assemble mild steel pipes using V-groove welds and butt joints, in the flat position: <ul style="list-style-type: none"> • pipes measuring 203 mm in diameter x 12.7 mm x 100 mm • pipes measuring 152 mm in diameter x 10.97 mm x 100 mm | <ul style="list-style-type: none"> - Proper choice and use of tools and equipment - Proper alignment of pipes - Accurate positioning and sequence of tacking |
| D. Weld pipe assemblies using the GMAW process for the root pass and the FCAW process for the subsequent passes, in the 1G and 5G positions. | <ul style="list-style-type: none"> - Proper adjustment of parameters - Proper application of process - Observance of prescribed welding position - Quality welds |
| E. Visually assess the quality of the welds. | <ul style="list-style-type: none"> - Detection of any welding defects - Determination of causes of welding defects - Determination of corrective measures |
| F. Prepare the welded assemblies for destructive testing. | <ul style="list-style-type: none"> - Proper choice and use of tools and equipment - Proper preparation of test coupons |

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

G. Verify the quality of the welds using bend tests.

H. Tidy up the work area.

**SPECIFIC PERFORMANCE
CRITERIA**

- Detection of any welding defects
- Determination of causes of welding defects
- Determination of corrective measures

- Proper storage of equipment
- Clean work area

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the instructions (A):

1. List the tolerances prescribed in the standards for the type of assembly.
2. List the characteristics of a pipe assembly drawing.
3. List the specifications contained in GMAW and FCAW welding procedures.

Before learning how to prepare the pipes (B):

4. Explain the health and safety measures to be taken.
5. Explain the steps involved in the preparation of pipes.

Before learning how to assemble mild steel pipes using V-groove welds and butt joints, in the flat position:

- pipes measuring 203 mm in diameter x 12.7 mm x 100 mm
- pipes measuring 152 mm in diameter x 10.97 mm x 100 mm (C):

6. Explain the health and safety measures to be taken.
7. Describe the steps involved in the assembly of pipes.
8. Explain the methods of assembling pipes.
9. Explain the tacking sequences for pipes.

Before learning how to weld pipe assemblies using the GMAW process for the root pass and the FCAW process for the subsequent passes, in the 1G and 5G positions (D):

10. Explain the techniques for doing root passes using the GMAW process, and hot and cover passes using the FCAW process.
11. Explain the characteristics of root passes using the GMAW process, and hot and cover passes using the FCAW process.
12. Describe the causes of welding defects using the GMAW process for the root pass and the FCAW process for subsequent passes, and the appropriate corrective measures.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to visually assess the quality of the welds (E):

13. Be familiar with the specifications in the standards related to high-pressure welding.
14. Be familiar with the tolerances applicable to the assessment of welds.
15. Detect welding defects.

Before learning how to prepare the welded assemblies for destructive testing (F):

16. Explain the methods of using the tools and equipment required to prepare test coupons.
17. Explain the methods of preparing test coupons for destructive tests.

Before learning how to verify the quality of the welds using bend tests (G):

18. Explain the criteria for assessing a weld after a bend test.

MODULE 11 : TORCH BRAZING PIPES

CODE: 802 621

Duration: 15 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **torch braze pipes** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given a pipe assembly drawing and a torch brazing procedure
- Working on copper pipes
- Using the OAW process
- On a lap joint assembly in the A position

GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of torch brazing technique
- Conformity with applicable standards
- Observance of prescribed time limit

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

- | | |
|---|--|
| A. Interpret the instructions. | - Accurate interpretation of drawing and torch brazing procedure |
| B. Prepare the plates and pipes. | - Proper choice of pipes - Proper use of equipment - Proper preparation of cuts - Careful finishing |
| C. Assemble copper pipes measuring 51 mm in diameter x 1.6 mm x 100 mm using lap joints in the 5G position. | - Proper choice and use of tools and equipment - Proper installation of pipes in accordance with the type of assembly |
| D. Torch braze assemblies. | - Proper application of torch brazing process - Quality welds |
| E. Visually assess the quality of the welds. | - Detection of any welding defects - Determination of causes of welding defects - Determination of corrective measures |
| F. Tidy up the work area. | - Proper storage of equipment - Clean work area |

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the instructions (A):

1. List the specifications contained in a pipe assembly drawing.
2. List the tolerances prescribed in the standards related to torch brazing (ASME, Section IX).
3. List the specifications contained in a torch brazing procedure.

Before learning how to prepare the plates and pipes (B):

4. Explain the health and safety measures to be taken.
5. Explain the steps involved in the preparation of plates and pipes for torch brazing.
6. List the techniques for preparing surfaces.
7. List the different geometric tolerances.

Before learning how to assemble copper pipes measuring 51 mm in diameter x 1.6 mm x 100 mm using lap joints, in the 5G position (C):

8. Explain the health and safety measures to be taken.
9. Describe the steps involved in the assembly of pipes.
10. Explain the methods of assembling pipes.

Before learning how to torch braze assemblies (D):

11. Be familiar with the characteristics of soldering and brazing.
12. Explain the advantages and disadvantages of the different types of flames used in the torch brazing process.
13. List the parameters for adjusting the flame in the torch brazing process.
14. List the different types of filler metals and cleaners used in the torch brazing process.
15. Describe the causes of brazing defects using the torch brazing process and the appropriate corrective measures.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to visually assess the quality of the welds (E):

16. Be familiar with the specifications in the standards related to torch brazing (ASME, Section IX, and ANSI, Article 31.3).
17. Be familiar with the tolerances applicable to the assessment of braze welds.
18. Detect brazing defects.

MODULE 12 : WELDING AND REPAIRING PRESSURE VESSEL COMPONENTS

CODE: 802 632

Duration: 30 hours

FIRST-LEVEL OPERATIONAL OBJECTIVE BEHAVIOURAL OBJECTIVE

EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must **weld and repair pressure vessel components** in accordance with the following conditions, criteria and specifications.

CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given a drawing and a welding procedure
- Working on a fixed pipe assembly with elbows, in the 2G and 5G positions
- Using processes selected by the instructor

GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of welding techniques
- Conformity with applicable standards
- Observance of prescribed time limit

**FIRST-LEVEL OPERATIONAL OBJECTIVE
BEHAVIOURAL OBJECTIVE**

**SPECIFICATIONS OF THE EXPECTED
BEHAVIOUR**

**SPECIFIC PERFORMANCE
CRITERIA**

- | | |
|--|---|
| A. Interpret the instructions. | - Accurate interpretation of drawing and welding procedure |
| B. Prepare the components. | <ul style="list-style-type: none"> - Proper choice and use of preparation techniques - Proper application of cutting process - Observance of dimensions - Proper cleaning and finishing of cuts |
| C. Assemble the components. | <ul style="list-style-type: none"> - Proper installation of components in accordance with the type of assembly - Tacking in conformity with requirements |
| D. Weld component assemblies in the 2G and 5G positions. | <ul style="list-style-type: none"> - Proper application of welding processes selected - Observance of prescribed welding position - Quality welds |
| E. Repair welds. | - Proper repairs made to welds |
| F. Visually assess the quality of the welds. | <ul style="list-style-type: none"> - Detection of any welding defects - Determination of causes of welding defects - Determination of corrective measures |
| G. Tidy up the work area. | <ul style="list-style-type: none"> - Proper storage of equipment - Clean work area |

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to interpret the instructions (A):

1. List the characteristics of a drawing of pressure vessels.
2. List the tolerances prescribed in the standards related to the welding of pressure vessels (ASME, Section IX).
3. List the specifications contained in the procedures for welding pressure vessels.

Before learning how to prepare the components (B):

4. Explain the health and safety measures to be taken.
5. Explain the methods of marking out and cutting components of pressure vessels.

Before learning how to assemble the components (C):

6. Explain the safety measures to be taken.
7. List the different types of assemblies and welding positions for pressure vessels.
8. Explain the steps involved in the assembly of pressure vessels.
9. Explain the different methods of assembling pressure vessel components.
10. Explain the tacking sequences for pressure vessel components.

Before learning how to weld component assemblies in the 2G and 5G positions (D):

11. Explain the techniques for using the selected welding processes.
12. Describe welding defects using the selected welding processes, and the appropriate corrective measures.

SECOND-LEVEL OPERATIONAL OBJECTIVES

IN ORDER TO ACHIEVE THE FIRST-LEVEL OBJECTIVE, THE STUDENTS SHOULD HAVE PREVIOUSLY ATTAINED SECOND-LEVEL OBJECTIVES, SUCH AS:

Before learning how to repair welds (E):

13. List the methods used to remove the welds to be repaired.
14. Clean the area to be repaired.
15. List the techniques used to repair a weld.

Before learning how to visually assess the quality of the welds (F):

16. Be familiar with the specifications and tolerances in the standards related to the welding of pressure vessels applicable to the assessment of welds.
17. Detect welding defects.

Éducation

Québec 

17-1611-01A