# MECHANICAL MANUFACTURING

# DIEMAKING

## *PROGRAM OF STUDY*

*5541*

*VOCATIONAL and TECHNICAL EDUCATION*

Québec

# DIEMAKING

## *PROGRAM OF STUDY*
*5541*

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# MECHANICAL MANUFACTURING

# DIEMAKING

## PROGRAM OF STUDY
## 5541

The *Diemaking* program leads to
the Attestation of Vocational Specialization (AVS)
and prepares the student to practise the trade of

**DIEMAKER**

**Direction générale de la formation professionnelle et technique**

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This program of study, *Diemaking*, is issued in accordance with section 461 of the *Education Act* (R.S.Q., c. I-13.3).

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# INTRODUCTION

The *Diemaking* program is based on the orientations for secondary school vocational education adopted by the Québec government in 1986. It was designed on the basis of a new framework for developing vocational education programs that calls 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, which are organized into teaching blocks. 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 900 hours, which includes 540 hours spent on the specific competencies required to practise the trade and 360 hours on general competencies. The program of study is divided into 18 modules, which vary in length from 15 to 120 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: 18
Duration in hours: 900
Credits: 60

Diemaking
CODE: 5541

| CODE | TITLE OF THE MODULE | HOURS | CREDITS* |
|---|---|---|---|
| 866 301 | 1. The Trade and the Training Process | 15 | 1 |
| 866 312 | 2. Mathematics Applied to Tool and Die Making | 30 | 2 |
| 866 323 | 3. Jig Boring and Jig Grinding | 45 | 3 |
| 866 332 | 4. Metallurgy Applied to Production Machinery | 30 | 2 |
| 866 342 | 5. Metrology Applied to Dies | 30 | 2 |
| 866 353 | 6. Techniques for Assembling Dies | 45 | 3 |
| 866 362 | 7. Functional Study of a Press | 30 | 2 |
| 866 371 | 8. Machining Materials with Low Machinability Ratings | 15 | 1 |
| 866 388 | 9. Making a Simple Cutting Die | 120 | 8 |
| 866 392 | 10. Spark Erosion Machining | 30 | 2 |
| 866 402 | 11. Analyzing a Drawing of a Press Tool | 30 | 2 |
| 866 412 | 12. Surface Grinding Irregular Shapes | 30 | 2 |
| 866 421 | 13. Communication in the Workplace | 15 | 1 |
| 866 432 | 14. Grinding Irregular Shapes on a Cylindrical Grinder | 30 | 2 |
| 866 448 | 15. Making a Bottoming Bending Die | 120 | 8 |
| 866 456 | 16. Entering the Labour Market | 90 | 6 |
| 866 467 | 17. Making a Progressive Cutting Die | 105 | 7 |
| 866 476 | 18. Assembling a Progressive Cutting Die | 90 | 6 |

* 15 hours = 1 credit
This program leads to an AVS in Diemaking.

# 2. PROGRAM TRAINING GOALS

The training goals of the *Diemaking* program are based on the general goals of vocational education and take into account the specific nature of the trade. These goals are:

**To develop effectiveness in the practice of a trade.**

- To teach students to perform diemaking tasks and activities correctly, at an acceptable level of competence for entry into the job market.

- To prepare students to perform satisfactorily on the job by fostering:
  - the intellectual and psychomotor skills needed to carry out job-related tasks;
  - the development of a concern for effective communication with superiors and colleagues;
  - the development of professional ethics and a sense of responsibility;
  - habits of order, cleanliness and precision in the practice of the trade;
  - a constant concern for occupational health and safety.

**To ensure integration into the job market.**

- To familiarize students with the job market in general and the trade of diemaker in particular.

- To familiarize students with their rights and responsibilities as workers.

**To foster personal development and the acquisition of occupational knowledge.**

- To foster independence, a sense of responsibility and the desire to succeed.

- To help students develop the desire for excellence and the basic attitudes required for success.

- To help students understand the principles underlying the techniques used.

- To help students acquire good work habits and a sense of discipline.

**To ensure job mobility.**

- To help students develop a positive attitude toward technological change and new situations.

- To help students increase their ability to learn and find information.

# 3. COMPETENCIES

The competencies to be developed in the *Diemaking* 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 (△) indicates a correlation between a specific competency and a step in the work process. The symbol (○) indicates a correlation between a general and a specific competency.

The symbols (▲) and (●) 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 IN *DIEMAKING*

| | SPECIFIC COMPETENCIES (directly related to the practice of the specific occupation) | FIRST-LEVEL OPERATIONAL OBJECTIVES | DURATION (IN HOURS) | WORK PROCESS (major steps) | | | | | | | | | | | | GENERAL COMPETENCIES (related to technology, subjects, personal development, etc.) | | | | | | | | | | | | | TOTALS | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Read and interpret the drawing for the assembly or the tool | Determine and draw the parts and tools required for manufacture | Give instructions and test machined parts | Machine complex parts on specialized machine tools | Grind the part after heat treatment | Finish the parts | Plan the assembly | Make the subassemblies | Do a test without load or produce a sample | Study the components and kinematic chain of the machine tool | Mount the tool on the production machine | Make the final adjustments to the tool and the production machine | Apply concepts of mathematics to the manufacture of production machinery | Use jig boring and jig grinding techniques | Apply the concepts of metallurgy to the manufacture of production machinery | Apply concepts of metrology to the production of jigs | Apply techniques for assembling jigs | Do a functional study of a machine tool | Apply knowledge related to the machining of materials with low machinability ratings | Do a spark erosion machining operation | Analyze the construction of a press tool in a drawing | Grind a workpiece with complex, irregular shapes on a surface grinder | Communicate in the workplace | Grind a workpiece with complex, irregular shapes on a cylindrical grinder | Apply occupational health and safety rules | NUMBER OF OBJECTIVES | DURATION (IN HOURS) |
| MODULES | MODULES | | | | | | | | | | | | | | | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 10 | 11 | 12 | 13 | 14 | | | |
| | FIRST-LEVEL OCCUPATIONAL OBJECTIVES | | | | | | | | | | | | | | | B | B | B | B | B | B | B | B | B | B | S | B | | 12 | |
| | DURATION | | | | | | | | | | | | | | | 30 | 45 | 30 | 30 | 45 | 30 | 15 | 30 | 30 | 30 | 15 | 30 | | | 360 |
| 1 | Determine their suitability for the trade and the training process | S | 15 | △ | △ | △ | △ | △ | △ | △ | △ | △ | △ | △ | △ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | |
| 9 | Manufacture, assemble and adjust a simple cutting die | B | 75 | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | ● | ● | ● | ● | ● | ● | ● | ○ | ○ | ○ | ○ | ○ | | | |
| 15 | Manufacture, assemble and adjust a bottoming bending die | B | 90 | ▲ | ▲ | △ | ▲ | ▲ | ▲ | ▲ | ▲ | △ | △ | ▲ | ▲ | ● | ● | ● | ● | ● | ○ | ● | ○ | ● | ● | ○ | ○ | | | |
| 16 | Enter the labour market in die making | S | 120 | △ | △ | △ | △ | △ | △ | △ | △ | △ | △ | △ | △ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | | |
| 17 | Manufacture a two-stage progressive cutting die | B | 60 | ▲ | ▲ | ▲ | ▲ | ▲ | ▲ | | | | | | | ● | ● | ● | ● | ● | | ● | ○ | ● | ● | ○ | ○ | | | |
| 18 | Assemble and adjust a two-stage progressive cutting die | B | 90 | | | | | | | ▲ | ▲ | ▲ | △ | ▲ | ▲ | ○ | ○ | ○ | ● | ● | ○ | ○ | | ○ | ○ | ○ | ○ | | | |
| NUMBER OF OBJECTIVES | | 6 | | | | | | | | | | | | | | | | | | | | | | | | | | | 18 | |
| DURATION (IN HOURS) | | | 540 | | | | | | | | | | | | | | | | | | | | | | | | | | | 900 |

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 *Diemaking* 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.
- Enter the labour market in diemaking.

**To develop in the students the competencies required to carry out diemaking tasks.**

- Manufacture, assemble and adjust a simple cutting die.
- Manufacture, assemble and adjust a bottoming bending die.
- Manufacture a two-stage progressive cutting die.
- Assemble and adjust a two-stage progressive cutting die.

**To develop in the students the competencies required to work with metals.**

- Apply concepts of metallurgy to the manufacture of production machinery.
- Apply knowledge related to the machining of materials with low machinability ratings.

**To develop in the students the competencies required to grind and assemble production tools.**

- Use jig boring and jig grinding techniques.
- Grind a workpiece with complex, irregular shapes on a surface grinder.
- Grind a workpiece with complex, irregular shapes on a cylindrical grinder.
- Apply techniques for assembling dies.

**To develop in the students the basic competencies required to practise the trade of diemaker.**

- Apply concepts of mathematics to the manufacture of production machinery.
- Analyze the construction of a press tool in a drawing.
- Apply concepts of metrology to the production of dies.
- Communicate in the workplace.

**To develop in the students the competencies required to use electro-erosion machining techniques and to operate production machines.**

- Do a spark erosion machining operation.
- Do a functional study of a press.

# 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. Output and results 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 students must acquire 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, see 5.2) 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: 866 301** **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

At the end of this module, the students will:

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

### LEARNING CONTEXT

PHASE 1: **Information on the Trade**

- Learning about the job market in diemaking—work environments (types of companies, products), job prospects, wages, opportunities for advancement and transfer, candidate selection and female representation in the field—through visits, interviews, reference materials, and so on.

- Learning about the nature and requirements of the trade—tasks, working conditions, evaluation criteria and rights and responsibilities of workers—through visits, interviews, reference materials, and so on.

- Presenting the information gathered at a group meeting and discussing their views on the trade, i.e. advantages, disadvantages, requirements.

FIRST-LEVEL OPERATIONAL OBJECTIVE
**SITUATIONAL OBJECTIVE**

## LEARNING CONTEXT

PHASE 2: **Information on and Participation in the Training Process**

- Discussing the skills, aptitudes, habits and knowledge required to practise the trade.

- Becoming familiar with the training process, i.e. program of study, training process, evaluation methods, certification of studies.

- Discussing how the training program prepares them for work as diemakers.

- Sharing their initial reactions to the trade and the training process.

PHASE 3: **Evaluation and Confirmation of Career Choice**

- Preparing a report in which they:
  - specify their preferences, aptitudes and interests with respect to diemaking;
  - assess their career choice by comparing the nature and requirements of the trade with their preferences, aptitudes and interests.

## INSTRUCTIONAL GUIDELINES

The teacher should:

- Create a climate that favours the students' personal growth and integration into the job market.
- Encourage the students to engage in discussions and express their opinions.
- Motivate the students to take part in the suggested activities.
- Help the students to arrive at an accurate perception of the trade.
- Provide the students with the means to assess their career choice honestly and objectively.
- Make available all pertinent reference materials, e.g. information on the trade, training programs, guides.
- Organize a meeting with specialists in the field.
- Organize visits to companies that are representative of the workplace in diemaking.

FIRST-LEVEL OPERATIONAL OBJECTIVE
**SITUATIONAL OBJECTIVE**

**PARTICIPATION CRITERIA**

PHASE 1:

- Gather information on most of the topics to be covered.
- Adequately express their views on the trade during a group discussion, relating them to the information they have gathered.

PHASE 2:

- Give their opinions on some requirements for practising the trade.
- Study the documents provided.
- Listen attentively to explanations.
- Adequately express their views on the training program during a group meeting.
- Clearly express their opinions.

PHASE 3:

- Write a report that:
  - sums up their preferences, interest and aptitudes with respect to the trade;
  - clearly explains how they arrived at their career choice.

## 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 any of the activities:**

1. Be receptive to information about the trade and the training process.
2. Be willing to share their views on the trade with their classmates.

**Before undertaking the activities of Phase 1:**

3. Find information.
4. Determine how to record and present information.
5. Explain the term *entry-level qualifications*.
6. Explain the main rules governing group discussion.

**Before undertaking the activities of Phase 2:**

7. Differentiate between the skills and the aptitudes and knowledge required to practise a trade.
8. Describe the nature, purpose and content of a program of study.

**Before undertaking the activities of Phase 3:**

9. Differentiate between preferences, and aptitudes and interests.
10. Describe the main parts of a report confirming their career choice.

# MODULE 2: MATHEMATICS APPLIED TO TOOL AND DIE MAKING

**CODE: 866 312** **Duration: 30 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**apply concepts of mathematics to the manufacture of production machinery**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given
  - drawings of parts of complex shapes to be machined or inspected
  - the necessary technical documentation
- Using a calculator
- Following the teacher's instructions

### GENERAL PERFORMANCE CRITERIA

- Mastery of imperial and metric measurement systems
- Accurate calculations
- Proper use of formulas and work methods
- Clean work

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Interpret the drawing. | - Accurate interpretation of symbols<br>- Complete list of dimensions and tolerances |
| B. Solve algebraic equations for the creation and rearrangement of formulas related to the manufacture of production machinery. | - Proper use of method for creating formulas<br>- Proper use of method for rearranging formulas |
| C. Solve chain of dimensions problems. | - Accurate calculation of:<br>• the missing dimension<br>• the minimum and maximum dimensions<br>• the perimeter of the part<br>• the volume of the part<br>• the centre of gravity |
| D. Solve complex angle problems on jig parts or dies. | - Proper construction of triangles in accordance with the geometrical problems to be solved<br>- Proper use of trigonometric formulas related to triangles |

**FIELD OF ACTIVITY**

Tool and die making

## 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 drawing (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Translate the information contained in a drawing.

**Before learning how to solve algebraic equations for the creation and rearrangement of formulas related to the manufacture of production machinery (B):**

3. Solve basic algebraic equations.
4. Solve algebraic equations of the first degree.

**Before learning how to solve chain of dimensions problems (C):**

5. Solve basic geometrical problems.
6. Calculate the minimum and maximum dimensions and the tolerance ranges.

**Before learning how to solve complex angle problems on jig parts or dies (D):**

7. Solve basic trigonometric problems.
8. Solve simple trigonometric problems.
9. Solve basic trigonometric problems related to triangles.
10. Show concern for accurate calculations.
11. Show concern for neatness.

# MODULE 3: JIG BORING AND JIG GRINDING

**CODE: 866 323** **Duration: 45 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**use jig boring and jig grinding techniques**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - a drawing
  - a milled and ground mild steel part
  - all the relevant technical documentation
- Using:
  - a jig borer or very good quality conventional vertical milling machine
  - the accessories necessary for mounting and clamping the workpiece
  - precision moving and positioning equipment
  - an internal grinder
  - the appropriate measuring instruments

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

**GENERAL PERFORMANCE CRITERIA**

- Conformity with occupational health and safety standards
- Mastery of techniques for using a jig borer or vertical milling machine
- Mastery of jig boring and jig grinding techniques
- Mastery of techniques for using measuring instruments and devices
- Quality of product:
  - conformity of machined part with drawing
  - observance of tolerances (imperial and metric systems):
    - diameter
    - position
    - centre to centre
    - parallelism
    - condition of surface
      - boring
      - grinding
- Observance of time limit

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Interpret the drawing. | - Accurate interpretation of symbols<br>- Complete list of dimensions and tolerances<br>- Accurate interpretation of specific information |
| B. Lay out the work. | - Accurate layout<br>- Conformity with drawing<br>- Accurate calculation of rectangular coordinates<br>- Accurate calculation of polar coordinates |

FIRST-LEVEL OPERATIONAL OBJECTIVE
**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| C. Mount and position the workpiece. | - Appropriate selection of mounting accessories according to the type of machining to be done<br>- Accurate positioning of workpiece on machine table<br>- Proper clamping of piece<br>- Accurate location of point of origin<br>- Conformity with isostatic principles |
| D. Mount the tools and adjust the machine. | - Appropriate selection of tools or grinding wheel according to the type of machining to be done<br>- Proper mounting of tools or grinding wheel<br>- Accurate adjustment of revolution and feed according to the tool or grinding wheel used<br>- Proper dressing of grinding wheel |
| E. Drill, bore and grind holes according to the dimensions and tolerances specified in the drawing. | - Effective work methods<br>- Safe use of machine tool<br>- Proper use of coolants<br>- Conformity of dimensions with drawing |
| F. Inspect the finished part. | - Proper cleaning and deburring of the part<br>- Complete verification of dimensions and surfaces of the part |
| G. Tidy up the work station. | - Cleanliness of machine tool and work area<br>- Conformity with manufacturer's standards with respect to the lubrication of the machine<br>- Proper storage of tools, accessories and measuring instruments |

FIRST-LEVEL OPERATIONAL OBJECTIVE
**BEHAVIOURAL OBJECTIVE**

**FIELD OF APPLICATION**

Tool and die making

## 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 drawing (A):**

1. Learn about the targeted competency and the proposed learning process.

**Before learning how to lay out the work (B):**

2. Clean a workpiece before laying out the work.
3. Determine the appropriate dye for a given job.
4. Distinguish between conventional dimensioning and coordinate dimensioning.
5. Recognize rectangular and polar coordinates in a drawing.
6. Describe the toolmaker's button method.

**Before learning how to mount and position the workpiece (C):**

7. Recognize the mounting accessories.
8. Identify the methods of positioning a workpiece on the table.
9. Identify the methods of locating a point of origin.

**Before learning how to mount the tools and adjust the machine (D):**

10. Recognize jig boring and jig grinding tools with respect to the operations to be performed.
11. Ensure the cutting quality of the jig boring tools.
12. Calculate the rotary speed of the tools.
13. Calculate the feed speed of the tools.
14. Distinguish among the different types of grinding wheels used on a jig grinder.
15. Recognize the safety devices on the machine.

## 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 drill, bore and grind holes according to the dimensions and tolerances specified in the drawing (E):**

16. Identify the methods of controlling movements.
17. Be familiar with the safety rules related to the use of the machine.

**Before learning how to inspect the finished part (F):**

18. Select the measuring instruments and the testing devices.

# MODULE 4: METALLURGY APPLIED TO PRODUCTION MACHINERY

**CODE: 866 332** **Duration: 30 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**apply concepts of metallurgy to the manufacture of production machinery**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - a drawing of a production tool
  - pieces of steel to be treated
  - course notes
  - steel manufacturers' documentation
  - non-destructive testing devices

### GENERAL PERFORMANCE CRITERIA

- Proper selection of steels and treatments
- Concern for precision

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Interpret a drawing of a production tool. | - Accurate identification of the function of the tool<br>- Accurate list of dimensions |

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| B. Determine the physical and mechanical properties of the materials to be used. | - Method of determining the different physical and mechanical properties of non-ferrous metals and alloy steels according to the tool to be manufactured |
| C. Select the steels to be used. | - Accurate interpretation of manufacturers' charts |
| D. Determine the characteristics of the heat treatment. | - Appropriate choice of heat treatment<br>- Appropriate choice of method of heating metals<br>- Heating temperature accurate to ±25°F<br>- Heating time accurate to ±5 min, at a constant temperature<br>- Appropriate choice of steel tempering method<br>- Tempering temperature accurate to ±25°F<br>- Tempering time appropriate to the desired hardness |
| E. Determine the heat treatments required to change certain mechanical properties of materials used to manufacture production machinery. | - Heat treatments for:<br>• quenching<br>• tempering<br>• annealing<br>• normalizing<br>• spheroidizing<br>• carburizing<br>• carbonitriding<br>• nitriding |

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| F. Perform non-destructive testing on a piece of steel:<br>• hardness<br>• cracks<br>• distortion | - Appropriate choice of hardness tester<br>- Appropriate choice of liquid penetrant<br>- Appropriate choice of measurement scale<br>- Accurate performance of liquid penetrant test<br>- Detection of physical deformations of the metal<br>- Accurate explanation of quenching defects, such as:<br>• insufficient hardness<br>• fractures<br>• burns<br>• deformation |
| G. Apply health and safety rules. | - Observance of health and safety rules |

### FIELD OF APPLICATION

Tool and die making

## 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 a drawing of a production tool (A):**

1. Learn about the targeted competency and the proposed learning process.

**Before learning how to determine the physical and mechanical properties of the materials to be used (B):**

2. Identify the different ferrous and nonferrous metals used in production machinery.
3. Indicate the properties of the different metals used for alloys.

**Before learning how to determine the characteristics of the heat treatment (D):**

4. Describe the function, adjustment and use of heating devices.
5. Describe the function, adjustment and use of quenching baths.
6. Describe the function, adjustment and use of tempering ovens.
7. Indicate the safety measures to be taken when handling workpieces and using accessories and furnaces.

**Before learning how to determine the heat treatments required to change certain mechanical properties of materials used to manufacture production machinery (E):**

8. Select the metals and ferrous and nonferrous alloys for industrial applications.
9. Identify the different carbon steels.

**Before learning how to perform non-destructive testing on a piece of steel for:**
- **hardness**
- **cracks**
- **distortion (F):**

10. Describe the method for preparing surfaces to be tested.

# MODULE 5: METROLOGY APPLIED TO DIES

**CODE: 866 342** **Duration: 30 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**apply concepts of metrology to the production of dies**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - a quenched and ground punch and die with linear dimensions, angular and circular shapes, different surfaces and different degrees of hardness
  - drawings indicating the dimensions and tolerances for shapes and positions as well as the surfaces and degrees of hardness
  - a precision surface plate
  - all the necessary documentation
- Using assembly tools and instruments for inspecting the geometrical positions of the elements

### GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Mastery of techniques for using the different measuring instruments and testing devices
- Cleanliness of work area and parts to be tested
- Concern for precision

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Interpret the drawings. | - Accurate interpretation of symbols<br>- Complete list of dimensions, shapes, surfaces and degrees of hardness<br>- Accurate interpretation of tolerances<br>- Proper use of the two measuring systems |
| B. Select the measuring instruments and testing devices. | - Proper selection given the dimensions, shapes and geometrical elements to be inspected |
| C. Inspect the dimensions and relative positions of the geometrical elements of cutting or shaping punches and dies. | - Accurate calibration and adjustment of comparators<br>- Proper use of comparators and gauges<br>- Accurate testing of geometrical elements<br>- Proper verification of the relative position of the elements<br>- Accurate reading of dimensions, i.e. ±10% of determined tolerance ranges |
| D. Inspect the surface of the parts. | - Accurate calibration and adjustment of roughness tester<br>- Proper use of roughness tester<br>- Identification of condition of surfaces, i.e. ±2 micro inches (0.05 micron) |
| E. Test the hardness of the quenched or case hardened parts. | - Accurate calibration and adjustment of hardness tester<br>- Proper use of hardness tester<br>- Identification of hardness, i.e. ±1 Rockwell |

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| F. Detect quenching defects in punches and dies. | - Complete list of quenching defects:<br>• breaks<br>• fractures<br>• cracks<br>• burns<br>• deformations |
| G. Write the different measurements on the quality control sheet. | - Accurate indication of:<br>• condition of the surfaces<br>• degrees of hardness<br>- Legibility |
| H. Maintain and put away the measuring instruments and testing devices. | - Maintenance and storage in conformity with manufacturer's 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 interpret the drawings (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Apply basic knowledge about drawing.

**Before learning how to select the measuring instruments and testing devices (B):**

3. Identify the different measuring and testing instruments and devices.

**Before learning how to inspect the dimensions and relative positions of the geometrical elements of cutting or shaping punches and dies (C):**

4. Recognize the geometrical elements of the punches and dies.
5. Show concern for the careful handling of measuring instruments and assembly tools on a surface plate.
6. Show concern for the effects of temperature on the precision of the instruments.
7. Show concern for safety in the workplace.

**Before learning how to inspect the surface of the parts (D):**

8. Describe the characteristics and method for using and maintaining comparator specimens.
9. Recognize surface defects and irregularities by sight.

**Before learning how to test the hardness of the case hardened parts (E):**

10. Describe the characteristics of the different hardness testers.

## 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 detect quenching defects in punches and dies (F):**

11. Describe the components of Magnaflux heat treatment defect testers.

**Before learning how to write the different measurements on the quality control sheet (G):**

12. Demonstrate the importance of quality control.

# MODULE 6: TECHNIQUES FOR ASSEMBLING DIES

**CODE: 866 353** **Duration: 45 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**apply techniques for assembling dies**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - an assembly drawing for a die set with two guide posts and two bushings, as well as the different parts of the die
  - parts of the die and die set corresponding to the drawing
- Using:
  - the necessary tools and assembly elements
  - the necessary measuring instruments
  - a good quality drill or vertical milling machine to drill the holes
  - a press or an oven and dry ice to assemble tight-fitting parts

### GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Observance of sequence of steps involved in assembling the die
- Quality product:
  - accurate alignment of guides on the die set (imperial and metric systems)
  - accurate alignment of punches with die in accordance with the type, hardness and thickness of the material used
- Cleanliness of work area and workpieces

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Determine the methods for assembling dies. | – Proper selection of assembly methods to:<br>• facilitate the work<br>• obtain a solid, precise assembly<br>• facilitate the mounting and removal of workpieces |
| B. Select the fasteners. | - Proper selection of fasteners according to:<br>• the assembly methods<br>• the composition of the workpieces to be assembled |
| C. Select the necessary tools. | - Proper selection of transfer and cutting tools in accordance with the work to be done |
| D. Assemble the parts. | - Observance of techniques for transferring stud and screw hole locations<br>- Observance of technique for tight-fitting assembly<br>- Accurate alignment of pilots and punches with die |
| E. Check the diameters of the bored holes and the alignment of the parts. | - Proper selection of instruments<br>- Proper use of instruments<br>- Accurate indication of any difference in tolerances<br>- Accurate indication of the alignment of the parts |

## 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 determine the methods for assembling dies (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Interpret the standardized indications on the drawings of a die.
3. Recognize the different assembly methods.

**Before learning how to select the fasteners (B):**

4. Recognize the different fasteners.

**Before learning how to select the necessary tools (C):**

5. Recognize the different cutting tools.
6. Inspect the cutting tools.

**Before learning how to assemble the parts (D):**

7. Explain the operation of the machinery and machine tools necessary for assembly.

**Before learning how to check the diameters of the bored holes and the alignment of the parts (E):**

8. Identify the different measuring instruments.

# MODULE 7: FUNCTIONAL STUDY OF A PRESS

**CODE: 866 362** **Duration: 30 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**do a functional study of a press**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - a mechanical or hydraulic press
  - a list of elements to be inspected
  - the manufacturer's manual
  - all the appropriate documentation

### GENERAL PERFORMANCE CRITERIA

- Conformity with occupational health and safety standards
- Complete and proper inspection of components and mechanisms of the press
- Accurate and complete evaluation of the operation of the press

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Inspect the kinematic chain of a press. | - Complete inspection of feed and rotary motion of the press<br>- Accurate description of the rectilinear feed motion and rotary motion of a mechanical and a hydraulic press |
| B. Evaluate the capacity and power of a press. | - Accurate evaluation of the maximum capacity of the press<br>- Determination of the power of a press given the manufacturer's specifications |
| C. Study the auxiliary mechanisms of a press and the motion of a press tool. | - Accurate description of mechanisms and categories of motion:<br>• clutch mechanisms<br>• categories of stroke<br>• single-action or multislide |
| D. Select the press accessories. | - Proper selection of accessories in accordance with the press tool and the part to be made |
| E. Run a press without load. | - Proper lubrication of press<br>- Measures taken to ensure safety and proper operation of press:<br>• manual inspection of clutch mechanism<br>• inspection of bottom dead centre of ram<br>- Accurate adjustment of shut height of die<br>- Detection of operating anomalies in automatic mode |

## 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 inspect the kinematic chain of a press (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Recognize the different types of press frames.
3. Describe the characteristics of a mechanical press.
4. Describe the characteristics of a hydraulic press.
5. Define the term *kinematic chain* with respect to presses.

**Before learning how to evaluate the capacity and power of a press (B) and to study the auxiliary mechanisms of a press and the motion of a press tool (C):**

6. Recognize the different clutch mechanisms on a press.
7. Recognize the different categories of stroke on a press.

**Before learning how to select the press accessories (D):**

8. Describe the different press accessories.

**Before learning how to run a press without load (E):**

9. Recognize different safety mechanisms on a press.

# MODULE 8: MACHINING MATERIALS WITH LOW MACHINABILITY RATINGS

**CODE: 866 371** **Duration: 15 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**apply knowledge related to the machining of materials with low machinability ratings**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - drawings of mechanical parts to be machined, made of high alloy materials
  - various catalogues of cutting tools provided by the teacher
  - the necessary technical documentation
- Using:
  - real tools or graphic representations of tools
  - real machine tools or graphic representations of machine tools

### GENERAL PERFORMANCE CRITERIA

- Selection of cutting tools, rotational speeds and feed rates promoting optimal performance of the machine tool

FIRST-LEVEL OPERATIONAL OBJECTIVE

## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Determine the factors inherent in the performance and quality of a cut. | - Determination of the main factors that influence performance and quality:<br>• materials used<br>• cutting tool materials<br>• lubrication<br>• types of machining and assembly<br>• fastening of tool<br>• power and rigidity of machine |
| B. Demonstrate the optimal operating conditions for the tools. | - Clear justification of economical and optimal cutting conditions taking into account:<br>• the selection of tools<br>• the use of charts<br>• cutting problems<br>• cutting parameters<br>• mounting and fastening of tools |

### FIELD OF APPLICATION

Tool and die making

## 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 determine the factors inherent in the performance and quality of a cut (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Distinguish between materials with low machinability ratings and materials with high machinability ratings.
3. Associate cutting tools with different operations or with the machining of different shapes.
4. Distinguish between high-speed steel tools on the one hand, and carbide, ceramic and diamond-tipped tools on the other.
5. Summarize the characteristics of the materials used for making tips.
6. Explain the effects of cutting fluids.
7. Demonstrate the importance of the mounting of the workpiece.
8. Detect cutting problems specific to different machine tools.
9. Show concern for performance when selecting and using tools.

**Before learning how to demonstrate the optimal operating conditions for the tools (B):**

10. Identify the tools and toolholders used on the different machine tools.
11. Summarize the action of cutting tools.
12. Demonstrate the importance of correctly installing the tools.
13. Use charts.
14. Recognize cutting problems by sight.

# MODULE 9: MAKING A SIMPLE CUTTING DIE

**CODE: 866 388** **Duration: 120 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**manufacture, assemble and adjust a simple cutting die**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - the drawing of a simple cutting die provided by the teacher
  - a planning sheet previously produced by the student
  - all the necessary documentation
- Using the necessary machine tools, accessories and instruments

### GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Mastery of techniques for adjusting and using machine tools
- Proper use of measuring instruments used to check tolerances for shapes and positions
- Result:
  - conformity of parts produced by the tool with the drawing
  - cleanliness and appearance of the tool
- Accurate calculations

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| **SPECIFICATIONS OF THE EXPECTED BEHAVIOUR** | **SPECIFIC PERFORMANCE CRITERIA** |
|---|---|
| A. Interpret the drawing of the tool. | - Recognition of the function of the tool<br>- Correct interpretation of standardized notes and symbols<br>- Recognition of surfaces and shapes to be machined<br>- Correct interpretation of allowances and tolerances<br>- Recognition of all devices used to position and hold the strip on the die<br>- Gathering of information necessary to make the cutting die:<br>• parts to be made<br>• parts to be purchased<br>• transfer of dimensions<br>• tolerances for shapes and positions<br>- Proper choice of steels |

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| B. Produce the planning sheet. | - Complete planning sheet for each part of the jig, according to:<br>• the routines, subroutines and operations<br>• the types of machines selected for each routine<br>• the tools, equipment and testing instruments for each operation<br>• the sketches dimensioned in machining position for each subroutine<br>• the appropriate symbols for the elimination of degrees of freedom in accordance with the principles of isostatics<br>• specifications for the assembly and machining of subassemblies and the entire jig for each part to be machined |
| C. Premachine the parts of the tool. | - Mastery of techniques for using machining accessories<br>- Parts oversized in accordance with their shape and dimensions |
| D. Apply heat treatments. | - Proper choice of temperature and duration of:<br>• quenching<br>• tempering<br>- Hardness accurate to ±2 HRC<br>- Proper use of hardness tester |

FIRST-LEVEL OPERATIONAL OBJECTIVE
**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| E. Do the final machining and inspection of the parts. | - Mastery of techniques for using grinders<br>- Mastery of techniques for using precision machining accessories<br>- Observance of tolerances:<br>• shapes<br>• positions<br>• surfaces<br>• allowances<br>- Cleanliness of parts<br>- Complete inspection of parts purchased |
| F. Plan the assembly. | - Complete planning of the following elements of the assembly and subassemblies:<br>• routines, subroutines and operations<br>• the necessary tools for each operation<br>• sketches dimensioned in assembly position for each of the subroutines<br>• observance of symbols for adjustments and allowances |
| G. Assemble the simple cutting die. | - Observance of assembly sequence for assemblies and subassemblies<br>- Observance of tolerances for shapes, positions and allowances<br>- Accurate alignment of punches with die<br>- Solid assembly |

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| **SPECIFICATIONS OF THE EXPECTED BEHAVIOUR** | **SPECIFIC PERFORMANCE CRITERIA** |
|---|---|
| H. Run the tool without load. | - Proper manual inspection of:<br>• vertical travel of the tool<br>• alignment of punches with die<br>• operation of systems for stopping the strip<br>- Accurate and complete list of all defects<br>- Necessary corrections made to the tool |
| I. Mount the tool on a press. | - Accurate and complete evaluation of the operation of the press<br>- Observance of method for mounting the tool on the press<br>- Accurate adjustment of shut height of tool<br>- Solid assembly |
| J. Make the final adjustments to the tool on the press. | - Accurate adjustment of tool on press |

## 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 drawing of the tool (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Distinguish between the parts to be made and those that can be purchased.

**Before learning how to produce the planning sheet (B):**

3. Choose the symbols for isostatic location.
4. Choose the methods for machining the parts.
5. Select the machine tools, accessories and cutting tools.
6. Select the measuring instruments.

**Before learning how to apply heat treatments (D):**

7. Indicate the changes to the physical and mechanical properties of steel that result from the different heat treatments.
8. Recognize the different hardness testers.
9. Describe the method for preparing surfaces to be tested after quenching.

**Before learning how to do the final machining and inspection of the parts (E):**

10. Identify the surfaces to be machined and the quantity of material to be removed with respect to a reference point on the workpiece.
11. Select the measuring instruments and testing devices.

**Before learning how to plan the assembly (F) and to assemble the simple cutting die (G):**

12. Describe the different methods of aligning parts.
13. Select the methods for transferring hole locations.
14. Describe the different methods of keying.
15. Machine keyways.
16. Inspect the parts to be assembled.

## 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 run the tool without load (H):**

17. Describe the different methods of inspecting the alignment of the punches with the die.
18. Describe the methods of inspecting the alignment of the guide posts and bushings.

**Before learning how to mount the tool on a press (I):**

19. Select the type of press necessary for the job.
20. Identify the methods of mounting and fastening the press tool.

# MODULE 10: SPARK EROSION MACHINING

**CODE: 866 392** **Duration: 30 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**do a spark erosion machining operation**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Working alone
- Given:
  - a drawing of a tool part
  - the necessary technical documentation
- Using:
  - a wire or electrode electrical discharge machine
  - mounting accessories

### GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Mastery of techniques for using spark erosion machining procedures
- Conformity of machined part with drawing
- Clean work

FIRST-LEVEL OPERATIONAL OBJECTIVE

## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Interpret the drawing of a part to be machined. | - Accurate interpretation of:<br>• symbols<br>• instructions |
| B. Determine the need to use a spark erosion machining process. | - Relevant choice of operation and process according to:<br>• the complexity of the shape<br>• the dimensional and surface precision<br>• the machining time |
| C. Plan the work. | - Proper selection of measuring instruments<br>- Calculation of movements and missing dimensions<br>- Determination of sequence of operations<br>- Determination of reference point of workpiece<br>- Proper choice of flushing system |
| D. Mount the workpiece on the machine. | - Proper choice of mounting accessories and type of assembly<br>- Accurate positioning of fasteners<br>- Solid assembly |
| E. Prepare and mount the electrode. | - Proper choice of material of electrode according to:<br>• the type of part to be produced<br>• the quality of part to be produced<br>- Proper choice of means of fastening the electrode to the machine head<br>- Accurate positioning of electrode in electrode holder |

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| F. Prepare the machine and attach the wire. | - Proper choice of size and material for wire<br>- Determination of feed on X and Y axes<br>- Machine programming in conformity with drawing |
| G. Machine the workpiece. | - Observance of technique<br>- Dimensions and shapes in conformity with drawing<br>- Accurate positioning of electrode or wire in accordance with the job to be done |
| H. Deburr and clean the workpiece. | - No burrs<br>- Clean workpiece |
| I. Control the quality of the work. | - Accurate measurements taken<br>- Proper use of measuring instruments:<br>• delicate handling<br>• dexterity |
| J. Tidy up the work station. | - Complete cleanup of machine<br>- Proper greasing and lubrication of machine |

### FIELD OF APPLICATION

Tool and die making

## 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 drawing of a part to be machined (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Do the necessary calculations.

**Before learning how to determine the need to use a spark erosion machining process (B):**

3. Explain the principle of alternating current.
4. Explain the principle of direct current.
5. Describe the role of a rectifier.
6. Describe the role of a transformer.
7. Describe the role of dielectric fluid.
8. Explain the principle of electrical discharge machining.
9. Identify the main materials used in making electrodes.
10. Identify the different types of electrodes.

**Before learning how to mount the workpiece on the machine (D):**

11. Evaluate the condition of the tools and measuring instruments by sight.
12. Calibrate the measuring instruments.
13. Inspect the electrical discharge machine.
14. Indicate the functions of the different controls.

**Before learning how to deburr and clean the workpiece (H):**

15. Identify the methods for cleaning and deburring.

**Before learning how to control the quality of the work (I):**

16. Use direct and indirect measuring instruments.

## 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 tidy up the work station (J):**

17. Learn about the importance of maintaining the work station.

# MODULE 11: ANALYZING A DRAWING OF A PRESS TOOL

**CODE: 866 402** **Duration: 30 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**analyze the construction of a press tool in a drawing**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - the drawing of the part to be made
  - a general drawing of a simple press tool
  - drawings of the components of the press tool
  - manufacturers' recommendations
  - information about the tool's design:
    - number of parts to be machined
    - degree of precision required
    - finish quality desired
    - allowances, tolerances, etc.
  - all the appropriate documentation
- Using a calculator

### GENERAL PERFORMANCE CRITERIA

- Accurate and complete list of errors in the drawing and of improvements that could be made
- Relevance of changes suggested
- Clear, accurate explanations

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| **SPECIFICATIONS OF THE EXPECTED BEHAVIOUR** | **SPECIFIC PERFORMANCE CRITERIA** |
|---|---|
| A. Interpret the drawing of the part to be machined. | - Identification of all the information necessary for making the part:<br>• shapes<br>• angles and radii<br>• composition of the material used<br>• hardness<br>• dimensions<br>• tolerances |
| B. Find the general information on the drawing of the press tool. | - Recognition of the press tool and the press on which it will be used<br>- Recognition of the different components of the press tool |
| C. Evaluate the positioning and assembly of the components of the press tool. | - Relevant judgment of:<br>• the size of the die<br>• the positions of the guide posts and bushings<br>• the positions of the punches<br>• the fasteners and assembly methods<br>• the size of the die set<br>• the devices for positioning and fastening the strip or the workpiece to the die |
| D. Evaluate the allowance between the dimensions of the punch and the dimensions of the die opening. | - Accurate calculation of allowance between the dimensions of the punch and the dimensions of the die opening<br>- Correct judgment of result obtained with respect to the material, thickness and hardness of the part to be made |

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| E. Evaluate the position and the dimensions of the assembly holes in accordance with the die opening. | - Correct judgment of the position and dimensions of the assembly holes taking into account the manufacturer's recommendations |
| F. Evaluate the device for fastening the strip or workpiece. | - Correct judgment of the device suggested in the drawing |
| G. Evaluate the suggested steels. | - Correct judgment of:<br>• the types of steels<br>• the hardness of the steels |
| H. Evaluate the quality of the finish of the parts of the tool. | - Correct judgment taking into account:<br>• the quantity of parts to be made<br>• the dimensions and tolerances required |

## 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 drawing of the part to be machined (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Apply basic knowledge about drawing.

**Before learning how to find the general information on the drawing of the press tool (B):**

3. Recognize the different types of press tools.
4. Recognize the different types of presses.

**Before learning how to evaluate the positioning and assembly of the components of the press tool (C):**

5. Define the factors that determine the design of the press tool.

**Before learning how to evaluate the allowance between the dimensions of the punch and the dimensions of the die opening (D):**

6. Define the factors that influence the allowance.

**Before learning how to evaluate the position and the dimensions of the assembly holes in accordance with the die opening (E):**

7. Recognize the different pins and screws.

**Before learning how to evaluate the device for fastening the strip or workpiece (F):**

8. Define isostatics.
9. Use the technical documentation on the devices for positioning and fastening the strip.

## 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 evaluate the suggested steels (G):**

10. Differentiate between carbon steels and tool steels.
11. Determine the heat treatments according to the desired results.

**Before learning how to evaluate the quality of the finish of the parts of the tool (H):**

12. Interpret the tables of finishing standards for parts in accordance with how they are machined and their role in the tool.

# MODULE 12: SURFACE GRINDING IRREGULAR SHAPES

**CODE: 866 412** **Duration: 30 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**grind a workpiece with complex, irregular shapes on a surface grinder**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - a drawing of a part with complex, irregular shapes
  - a premachined and quenched workpiece with at least one concave shape and one convex shape with parallel and angular connections
  - the necessary documentation
- Using:
  - a surface grinder, preferably numerically controlled
  - the necessary dressing instruments
  - an optical comparator

### GENERAL PERFORMANCE CRITERIA

- Conformity with occupational health and safety standards
- Mastery of techniques for using surface grinders and their accessories, as well as measuring and testing instruments and devices
- Quality of finished work:
  - conformity of part with drawing
  - observance of tolerances with respect to shapes, positions and surfaces (imperial and metric systems)
- Cleanliness of machined part, instruments and work area
- Observance of time limit

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Interpret the drawing. | - Accurate interpretation of symbols for shapes and positions<br>- Complete list of dimensions and tolerances for the shapes to be ground |
| B. Determine and calculate the tangential coordinates necessary for grinding the shapes of the part. | - Accurate determination of coordinates<br>- Accurate calculations |
| C. Produce the planning sheet. | - Proper choice of surface grinder<br>- Logical grinding sequence<br>- Accurate indication of adjustment points on wheel dressers<br>- Choice of grinding wheel appropriate to the characteristics of the part to be machined:<br>• types of materials used<br>• hardness<br>• shape<br>- Choice based on manufacturer's recommendations<br>- Proper choice of tools and measuring and testing instruments<br>- Clear, precise sketches |
| D. Inspect the workpiece before grinding. | - Accurate inspection of:<br>• dimensions<br>• distortion<br>• hardness of the piece |
| E. Mount the grinding wheel. | - Observance of process for inspecting and balancing the grinding wheel |

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| F. Prepare the tools and measuring instruments. | - Accurate calibration and adjustment of measuring and testing instruments, as well as the device for cutting complex profiles |
| G. Inspect and lubricate the grinder. | - Accurate evaluation of operating condition<br>- Conformity with manufacturer's lubrication and maintenance standards |
| H. Dress the grinding wheel. | - Proper choice of diamond<br>- Proper choice of method for cutting the grinding wheel<br>- Observance of technique for dressing the profile of the grinding wheel |
| I. Install the fasteners. | - Proper selection of fasteners<br>- Appropriate, safe installation technique |
| J. Adjust the grinder. | - Mastery of process of adjusting feed and depth of cut<br>- Proper use of numerical controls |
| K. Do the work. | - Proper, safe mounting of workpiece<br>- Conformity with planning sheet<br>- Conformity of part with drawing<br>- Safe use of machine tool<br>- Proper use of coolants |
| L. Inspect the finished part. | - Proper cleaning and deburring of part<br>- Complete verification of measurements of part |

FIRST-LEVEL OPERATIONAL OBJECTIVE
**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| M. Tidy up the work station. | - Cleanliness of machine tool and work area<br>- Conformity with manufacturer's lubrication standards<br>- Proper disassembly and storage of tools, accessories and measuring instruments |

**FIELD OF APPLICATION**

Tool and die making

## 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 drawing (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Apply basic knowledge about drawing.

**Before learning how to determine and calculate the tangential coordinates necessary for grinding the shapes of the part (B):**

3. Apply basic concepts of plane geometry.
4. Apply basic concepts of trigonometry.

**Before learning how to produce the planning sheet (C):**

5. Identify surface grinders.
6. Use manufacturers' tables related to grinding wheels.
7. Recognize the characteristics of a grinding wheel.
8. Identify the different types of wheel dressers for surface grinders.

# MODULE 13: COMMUNICATION IN THE WORKPLACE

**CODE: 866 421** **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
**communicate in the workplace.**

### SPECIFICATIONS

At the end of this module, the students will:

- Be familiar with the different aspects of communication in the workplace.
- Apply techniques related to oral and written communication in the workplace.
- Be familiar with their strengths and weaknesses with respect to communication.

### LEARNING CONTEXT

PHASE 1: **Familiarity with the General Principles of Communication in the Workplace**

- Participating in an activity that will help them become aware of the importance of communication in the workplace.
- Discussing the differences, in terms of communication, between personal and professional relationships.
- Learning about the different elements of the communication process.
- Learning, during a simulation, about the different levels of communication.

FIRST-LEVEL OPERATIONAL OBJECTIVE
**SITUATIONAL OBJECTIVE**

**LEARNING CONTEXT**

- Discussing the basic elements of good communication.

- Discussing, using examples, the use of different means of communication in the workplace.

PHASE 2: **Familiarity with the Different Aspects of Communication in the Workplace**

- Participating in learning situations that will help them recognize the main difficulties related to communication in the workplace.

- Discussing, on the basis of observations made during the learning situations, the different factors underlying the difficulties identified.

- Learning the rules of effective communication in the workplace.

PHASE 3: **Use of the Different Techniques Related to Oral and Written Communication in the Workplace**

- Participating in group activities that will allow them to practise different oral communication techniques.

- Participating in activities that will allow them to practise written communication techniques.

PHASE 4: **Evaluation of Their Ability to Communicate**

- Analyzing, in teams, situations in which their strengths and weaknesses with respect to communication were revealed.

- Discussing, as a group, means of improving their communication skills.

FIRST-LEVEL OPERATIONAL OBJECTIVE
**SITUATIONAL OBJECTIVE**

## INSTRUCTIONAL GUIDELINES

The teacher should:

- Create a climate of trust and openness.
- Facilitate communication by using leadership techniques.
- Encourage students to take risks and commit themselves.
- Develop learning situations related to the workplace.
- Carefully prepare structured activities taking into account objectives, materials, instructions, durations and evaluation grids.

## PARTICIPATION CRITERIA

PHASE 1:

- Participate actively in the activities.
- Show an interest in the topics discussed during the activities.

PHASE 2:

- Attempt to contribute positively to the learning situations aimed at highlighting the main difficulties related to communication in the workplace.
- Participate actively in the discussions and contribute relevant points.
- Attempt to illustrate the rules of communication necessary for effective relationships in the workplace.

PHASE 3:

- Show an interest and attempt to correctly apply oral and written communication techniques.

PHASE 4:

- Report seriously on their strengths and weaknesses with respect to communication.
- Attempt to find ways of improving their communication skills.

## 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. Learn about the targeted competency and the proposed learning process.
2. Be receptive to information related to communication in the workplace.
3. Participate and share their perceptions with their classmates.
4. Define the term *communication*.

**Before undertaking the activities of Phase 4:**

5. Describe the characteristics of effective feedback.

# MODULE 14: GRINDING IRREGULAR SHAPES ON A CYLINDRICAL GRINDER

**CODE: 866 432** **Duration: 30 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**grind a workpiece with complex, irregular shapes on a cylindrical grinder**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - a drawing of a cylindrical part with complex, irregular shapes
  - a premachined and quenched workpiece with cylindrical or conical surfaces and at least one concave connection and one convex connection
  - the necessary documentation
- Using:
  - a cylindrical grinder, preferably numerically controlled
  - the necessary dressing instruments
  - an optical comparator

### GENERAL PERFORMANCE CRITERIA

- Conformity with occupational health and safety standards
- Mastery of techniques for using cylindrical grinders and their accessories, as well as measuring and testing instruments and devices
- Quality of finished work:
  - conformity of part with drawing
  - observance of tolerances with respect to shapes, positions and surface (imperial and metric systems)
- Cleanliness of machined part, instruments and work area
- Observance of time limit

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| **SPECIFICATIONS OF THE EXPECTED BEHAVIOUR** | **SPECIFIC PERFORMANCE CRITERIA** |
|---|---|
| A. Interpret the drawing. | - Accurate interpretation of symbols for shapes and positions<br>- Complete list of dimensions and tolerances for the shapes to be ground |
| B. Determine and calculate the tangential coordinates necessary for grinding the shapes of the part. | - Accurate determination of coordinates<br>- Accurate calculations |
| C. Produce the planning sheet. | - Proper choice of cylindrical grinder<br>- Logical grinding sequence<br>- Accurate indication of adjustment points on wheel dressers<br>- Choice of grinding wheel appropriate to the characteristics of the part to be machined:<br>• types of materials used<br>• hardness<br>• shape<br>- Choice based on manufacturer's recommendations<br>- Proper choice of tools and measuring and testing instruments<br>- Clear, precise sketches |
| D. Inspect the workpiece before grinding. | - Accurate inspection of:<br>• dimensions<br>• distortion<br>• hardness of the piece |
| E. Mount the grinding wheel. | - Observance of process for inspecting and balancing the grinding wheel |

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| F. Prepare the tools and measuring instruments. | - Accurate calibration and adjustment of measuring and testing instruments, as well as the device for cutting complex profiles |
| G. Inspect and lubricate the grinder. | - Accurate evaluation of operating condition<br>- Conformity with manufacturer's lubrication and maintenance standards |
| H. Dress the grinding wheel. | - Proper choice of diamond<br>- Proper choice of method for cutting the grinding wheel<br>- Observance of technique for dressing the profile of the grinding wheel |
| I. Install the fasteners. | - Proper selection of fasteners<br>- Appropriate, safe installation technique |
| J. Adjust the grinder. | - Mastery of process of adjusting feed and depth of cut<br>- Proper use of numerical controls |
| K. Do the work. | - Proper, safe mounting of workpiece<br>- Proper adjustment of table or grinding head<br>- Conformity with planning sheet<br>- Conformity of part with drawing<br>- Safe use of machine tool<br>- Proper use of coolants |
| L. Inspect the finished part. | - Proper cleaning and deburring of part<br>- Complete verification of measurements of part |

FIRST-LEVEL OPERATIONAL OBJECTIVE

## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| M. Tidy up the work station. | - Cleanliness of machine tool and work area<br>- Conformity with manufacturer's lubrication standards<br>- Proper disassembly and storage of tools, accessories and measuring instruments |

**FIELD OF APPLICATION**

Tool and die making

## 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 drawing (A):**

1. Learn about the targeted competency and the proposed learning process.

**Before learning how to produce the planning sheet (C):**

2. Distinguish between the characteristics of universal cylindrical grinders and those of plain cylindrical grinders.
3. Describe the main techniques for external and internal cylindrical/conical grinding.

**Before learning how to dress the grinding wheel (H):**

4. Name the factors that determine the need to dress a grinding wheel.

# MODULE 15: MAKING A BOTTOMING BENDING DIE

**CODE: 866 448** **Duration: 120 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**manufacture, assemble and adjust a bottoming bending die**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - the drawing of a simple part to be made using a bending die
  - sketches of a bottoming bending die designed by the student
  - a planning sheet produced by the student
  - all the necessary documentation
- Using the necessary machine tools, accessories and measuring instruments

### GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Mastery of techniques for adjusting and using machine tools
- Proper use of measuring instruments used to check tolerances of shapes and positions
- Result:
  - conformity of tool-made parts with the drawing
  - cleanliness and appearance of the tool

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Interpret the drawing of the part to be made. | - Identification of all the information necessary for making the part:<br>• shapes<br>• angles and radii<br>• composition of the material used<br>• hardness<br>• dimensions<br>• tolerances |
| B. Design a bottoming bending die for the part to be made. | - Proper choice of size of die set<br>- Accurate determination of size of die<br>- Accurate positioning of the workpiece on the die<br>- Proper choice of means of positioning the workpiece on the die<br>- Proper choice of type of press<br>- Proper choice of steels |
| C. Make the sketches. | - Clear sketch of bottoming bending die<br>- Observance of conventions:<br>• dimensions<br>• cut-away views<br>• symbols<br>• manufacturing notes, allowances and tolerances<br>- Clear sketch of each part to be made<br>- Accurate calculation of dimensions<br>- Proper positioning of dimensions on the sketches |

FIRST-LEVEL OPERATIONAL OBJECTIVE
**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| D. Produce the planning sheet. | - Complete planning sheet for each piece of the jig, according to:<br>• the routines, subroutines and operations<br>• the types of machines selected for each routine<br>• the tools and testing instruments for each operation<br>• the sketches dimensioned in machining position for each subroutine<br>• the appropriate symbols for the elimination of degrees of freedom in conformity with isostatic principles<br>• the specifications for the assembly of the subassemblies and the entire bending die, for each of the parts to be machined |
| E. Premachine the parts of the tool. | - Mastery of techniques for using machining accessories<br>- Parts oversized in accordance with their shape and dimensions |
| F. Apply heat treatments. | - Proper choice of temperature and duration of:<br>• quenching<br>• tempering<br>- Hardness accurate to ±2 HRC<br>- Proper use of hardness tester |

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| G. Do the final machining and inspection of the parts. | - Mastery of techniques for using grinders<br>- Mastery of techniques for using precision machining accessories<br>- Observance of tolerances:<br>• shapes<br>• positions<br>• surfaces<br>• allowances<br>- Measures taken to ensure the safety of persons and materials when mounting and using accessories<br>- Cleanliness of parts and work area |
| H. Plan the assembly. | - Complete planning of the following elements of the assembly and subassemblies:<br>• routines, subroutines and operations<br>• the necessary tools for each operation<br>• sketches dimensioned in assembly position for each of the subroutines<br>• observance of symbols for adjustments and allowances |
| I. Assemble the bending die. | - Observance of procedure for making assemblies and subassemblies<br>- Observance of tolerances for shapes, positions and allowances<br>- Uniform gap between the shape on the punch and the shape on the die<br>- Accurate positioning of workpiece in die<br>- Solid assembly |

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| J. Make the final adjustments to the tool on the press. | - Accurate adjustment of tool on press<br>- Proper operation of bottoming bending die for the production of the first parts<br>- Observance of method of mounting the tool on the press<br>- Accurate adjustment of shut height of tool<br>- Solid assembly<br>- Safe handling of tool during mounting |

## 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 drawing of the part to be made (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Apply basic knowledge about drawing.

**Before learning how to design a bottoming bending die for the part to be made (B):**

3. Define the factors that determine the design of a bottoming bending die.
4. Define isostatics.
5. Use catalogues of bending die accessories.
6. Recognize the different processes for making a bending die.
7. Distinguish the parts to be made from those that can be purchased.

**Before learning how to produce the planning sheet (D):**

8. Choose the symbols for isostatic location.
9. Analyze the feasibility of the assembly.
10. Select the methods of machining the parts.
11. Select the machine tools, accessories and cutting tools.
12. Select the measuring instruments.

**Before learning how to apply heat treatments (F):**

13. Indicate the changes to the physical and mechanical properties of steel that result from the different heat treatments.
14. Recognize the different hardness testers.
15. Describe the method of preparing surfaces to be tested after quenching.

**Before learning how to do the final machining and inspection of the parts (G):**

16. Identify the surfaces to be machined and the quantity of material to be removed with respect to a reference point on the workpiece.

## 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 assemble the bending die (I):**

17. Describe the different methods of aligning parts.
18. Select the methods of transferring hole locations.
19. Describe the different methods of assembling parts.

**Before learning how to make the final adjustments to the tool on the press (J):**

20. Select the type of press required for a given job.
21. Recognize the safety devices ~~with which a machine~~ is equipped in a machine.

# MODULE 16: ENTERING THE LABOUR MARKET

**CODE: 866 456** **Duration: 90 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
**enter the labour market in diemaking.**

### SPECIFICATIONS

During this module, the students will:

- Consolidate the competency acquired with respect to the use of job search techniques.
- Become familiar with the performance of diemakers' tasks in a work setting.
- Situate the role and functions of diemakers with respect to related roles and functions, such as those of machinists, mouldmakers, toolmakers and drafters.
- Become aware of the changes in perception brought about by a diemaking practicum in the workplace: work context, occupational practices, aptitudes, tastes, interests and training received.

### LEARNING CONTEXT

PHASE 1: **Preparation for the Practicum in the Workplace**

- Learning about the competency to be acquired and the terms and conditions of the practicum.

- Learning about the types of companies likely to hire students for a practicum in the workplace.

FIRST-LEVEL OPERATIONAL OBJECTIVE
**SITUATIONAL OBJECTIVE**

**LEARNING CONTEXT**

- Learning about the role and functions of diemakers with respect to related roles and functions, such as those of machinists, mouldmakers, toolmakers and drafters.

- Approaching companies likely to hire students for a practicum in the workplace.

PHASE 2: **Participation in Work-related Activities**

- Observing tasks performed by diemakers.

- Performing certain diemaking tasks.

- Observing, during their daily tasks, people performing tasks related to those of diemakers.

- Asking for feedback on their performance and behaviour during the practicum.

- Noting the important aspects of the feedback as well as the other observations made.

PHASE 3: **Comparison of Initial Perceptions with the Reality of the Workplace**

- Listing aspects of the trade that differ from the training received.

- Listing their strengths and weaknesses with respect to their performance and behaviour during the practicum.

- Producing a brief report about the two aspects mentioned above.

- Discussing the accuracy of their perception of the trade before and after the practicum.

- Discussing the consequences of their experience on the rest of their training and their eventual integration into the job market.

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## SITUATIONAL OBJECTIVE

### INSTRUCTIONAL GUIDELINES

The teacher should:

- Create a climate that encourages students to take charge of their learning throughout the modules.
- Maintain close cooperation between the school and businesses likely to hire students for a practicum.
- Provide the students with various information resources during the preparation stage.
- Provide the students with observation and feedback checklists.
- Make sure that the companies provide students with the conditions necessary for performing the activities of the practicum.
- Make sure that there is a person in the company available to supervise the student.
- Ensure the proper support and supervision of each student during the practicum.
- Intervene in case of difficulties or problems.
- Promote exchanges of opinion among the students, as well as freedom of expression, particularly when the students are comparing their initial perceptions with the reality of the workplace.

### PARTICIPATION CRITERIA

PHASE 1:

- Perform seriously the different activities related to gathering information about the types of companies likely to hire students, as well as the roles and functions of diemakers and related specialists.
- Contact the companies likely to hire students in order to request an interview with the employer.
- Meet with a representative of the company and come to an agreement in accordance with the requirements of the practicum.
- Inform the teacher in writing of their procedure and of the agreement made with the company.

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## SITUATIONAL OBJECTIVE

PHASE 2:

- Show an interest and attempt to make relevant observations given the objectives of the practicum.
- Attempt to carefully perform the tasks and operations assigned to them.
- Note properly, on sheets or in their log, the important aspects of the feedback received, as well as their observations on the following:
  - the work of diemakers
  - the work of specialists in related fields
  - the performance of certain diemaking tasks

PHASE 3:

- Write a report containing relevant information on:
  - the aspects of the specialty that differ from the training received;
  - the strengths and weaknesses with respect to their behaviour and performance during the practicum.
- Discuss seriously the changes in their perception of the trade following the practicum.
- Show an interest in using their experience in the workplace to improve their behaviour and performance at work.

## 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. Use job search techniques.
2. List the attitudes required for a dynamic practicum search.

**Before undertaking the activities of Phase 2:**

3. Describe the main aspects to observe during the practicum.
4. Describe the behaviour to adopt in the workplace.
5. Describe the purpose and characteristics of effective feedback.

**Before undertaking the activities of Phase 3:**

6. List their aptitudes, preferences and interests.

# MODULE 17: MAKING A PROGRESSIVE CUTTING DIE

**CODE: 866 467** **Duration: 105 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**manufacture a two-stage progressive cutting die**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - the drawing of a simple part to be made using a two-stage progressive cutting die
  - all the necessary documentation
- Using the necessary machine tools, accessories and measuring instruments

### GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Mastery of techniques for adjusting and using machine tools
- Proper use of measuring instruments used to check tolerances for shapes and positions
- Design of die appropriate to part to be made
- Conformity of parts machined with sketches

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| **SPECIFICATIONS OF THE EXPECTED BEHAVIOUR** | **SPECIFIC PERFORMANCE CRITERIA** |
|---|---|
| A. Interpret the drawing of the part to be made. | - Complete list of information necessary to make the part:<br>• shapes<br>• angles and radii<br>• composition of material used<br>• hardness<br>• dimensions<br>• tolerances |
| B. Design a two-stage progressive cutting die. | - Proper choice of size of die set<br>- Accurate determination of position of workpiece on strip<br>- Accurate determination of position of punches and pilots<br>- Proper choice of system for aligning and fastening the strip on the die<br>- Accurate calculations of force necessary to produce the part<br>- Accurate determination of size of die<br>- Proper choice of type of press<br>- Proper choice of steels |
| C. Make the sketches. | - Clear sketch of entire progressive cutting die<br>- Observance of drafting conventions:<br>• dimensions<br>• cut-away views<br>• symbols<br>• manufacturing notes, allowances and tolerances<br>- Clear sketches of each part to be made<br>- Accurate calculation of dimensions<br>- Proper positioning of dimensions on the sketches |

FIRST-LEVEL OPERATIONAL OBJECTIVE
**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| D. Produce the planning sheet. | - Complete planning sheet for each part of the jig, according to:<br>• the routines, subroutines and operations<br>• the types of machines selected for each routine<br>• the tools, equipment and testing instruments for each operation<br>• the choice of heat treatments<br>• the sketches dimensioned in machining position for each subroutine<br>• the appropriate symbols for the elimination of degrees of freedom in accordance with the principles of isostatics<br>• specifications for the assembly and machining of subassemblies and the entire tool for each part to be machined |
| E. Premachine the parts of the tool. | - Mastery of techniques for using precision machining accessories<br>- Parts oversized in accordance with their shape and dimensions |
| F. Apply heat treatments. | - Proper choice of temperature and duration of:<br>• quenching<br>• tempering<br>- Hardness accurate to ±2 HRC<br>- Proper use of hardness tester |

FIRST-LEVEL OPERATIONAL OBJECTIVE
**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| G. Do the final machining and inspection of the parts. | - Mastery of techniques for using surface grinders<br>- Mastery of lapping and polishing techniques<br>- Observance of tolerances:<br>• shapes<br>• positions<br>• surfaces<br>• allowances<br>- Cleanliness of parts<br>- Complete inspection of parts purchased |

## 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 drawing of the part to be made (A):**

1. Learn about the targeted competency and the proposed learning process.
2. Apply basic knowledge about drawing.

**Before learning how to design a two-stage progressive cutting die (B):**

3. Define the factors that determine the design of a progressive cutting die.
4. Describe the cutting action of the different types of punches.
5. Use catalogues of cutting die accessories.
6. Recognize the different processes for making cutting dies.
7. Distinguish the parts to be made from those that can be purchased.

**Before learning how to produce the planning sheet (D):**

8. Choose the symbols for isostatic location.
9. Analyze the feasibility of the assemblies.
10. Select the methods for machining the parts.
11. Select the machine tools, accessories and cutting tools.
12. Select the measuring instruments.

**Before learning how to apply heat treatments (F):**

13. Indicate the changes to the physical and mechanical properties of steel that result from the different heat treatments.
14. Recognize the different hardness testers.
15. Describe the method of preparing surfaces to be tested after quenching.

**Before learning how to do the final machining and inspection of the parts (G):**

16. Identify the surfaces to be machined and the quantity of material to be removed with respect to a reference point on the workpiece.

# MODULE 18: ASSEMBLING A PROGRESSIVE CUTTING DIE

**CODE: 866 476** **Duration: 90 hours**

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

### EXPECTED BEHAVIOUR

To demonstrate the required competency, the students must
**assemble and adjust a two-stage progressive cutting die**
in accordance with the following conditions, criteria and specifications.

### CONDITIONS FOR PERFORMANCE EVALUATION

- Given:
  - sketches of the progressive cutting die previously made by the student
  - all the necessary documentation
- Using the necessary tools, accessories and measuring instruments

### GENERAL PERFORMANCE CRITERIA

- Observance of occupational health and safety rules
- Proper use of the tools and instruments required to assemble the parts
- Results:
  - conformity of die-made parts with the drawing
  - cleanliness and appearance of the die

## FIRST-LEVEL OPERATIONAL OBJECTIVE
## BEHAVIOURAL OBJECTIVE

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| A. Plan the assembly. | - Complete planning of the following elements of the assembly and subassemblies:<br>• routines, subroutines and operations<br>• the necessary tools for each operation<br>• sketches dimensioned in assembly position for each of the subroutines<br>• observance of symbols for adjustments and allowances |
| B. Assemble the progressive cutting die. | - Observance of procedure for making assemblies and subassemblies<br>- Observance of tolerances for shapes, positions and allowances<br>- Accurate alignment of pilots and punches with die<br>- Solid assembly |
| C. Run the tool without load. | - Proper manual inspection of:<br>• vertical travel of tool<br>• alignment of pilots and punches with die<br>• operation of systems for stopping the strip<br>- Accurate and complete list of defects<br>- Necessary corrections made for the proper operation of the tool |
| D. Mount the tool on a press. | - Accurate and complete evaluation of the operation of the press<br>- Observance of method for mounting the tool on the press<br>- Accurate adjustment of shut height of tool<br>- Solid assembly |

FIRST-LEVEL OPERATIONAL OBJECTIVE

**BEHAVIOURAL OBJECTIVE**

| SPECIFICATIONS OF THE EXPECTED BEHAVIOUR | SPECIFIC PERFORMANCE CRITERIA |
|---|---|
| E. Make the final adjustments to the tool on the press. | - Accurate adjustment of tool on press |

## 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 plan the assembly (A):**

1. Learn about the targeted competency and the proposed learning process.

**Before learning how to assemble the progressive cutting die (B):**

2. Describe the different methods of aligning parts.
3. Describe the methods of transferring hole locations.
4. Describe the different methods of assembling parts.
5. Inspect the parts to be assembled.

**Before learning how to run the tool without load (C):**

6. Describe the different methods of inspecting the alignment of the punches with the die.
7. Describe the methods of inspecting the alignment of the guide posts and bushings.
8. Check the allowance between the guide posts and bushings.

**Before learning how to mount the tool on a press (D):**

9. Recognize the type of press necessary for a given job.
10. Identify the methods of mounting and fastening the tool to the press.

Gouvernement du Québec
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**de l'Éducation**

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