

## PROGRAM OUTLINE

### Tool and Die Maker



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# **TOOL AND DIE MAKER PROGRAM OUTLINE**

**APPROVED  
OCTOBER 2010**

**BASED ON  
NOA 2005**

**Developed by  
Industry Training Authority  
Province of British Columbia**



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# **Section 1**

## **INTRODUCTION**

### **Tool and Die Maker**



## Foreword

The development of the Competencies for the Single Level Program for the BC Tool and Die Maker Trade was funded by the Industry Training Authority, and completed under the direction of the Resource Training Organization of BC. This Program's new model is designed to be integrated with the BC Machinist Program and as such is built on the prerequisite of an apprentice Tool and Die Maker having completed his Machinist apprenticeship and attained his Red Seal in this trade. Recognition is also given to Machinist apprentices who are able to serve their apprenticeship in a Tool and Die industrial workplace.

This document was developed in collaboration with a group of Subject Matter Experts (SMEs), all directly connected to the Tool and Die Making trade in BC, which met in June and November 2009 and also reviewed progressive drafts of this document.

The development of the OAC and Competencies for BC Tool and Die Makers is based on three key documents:

- National Occupational Analysis for Tool and Die Maker, published by Human Resources and Skills Development Canada, 2005
- BC Tool and Die Maker Apprenticeship Program Outline, published by the BC Ministry of Skills, Training and Labour – Apprenticeship Branch, 1995
- BC Machinist Apprenticeship Program Outline, draft document funded by the BC Industry Training Authority, 2009

The SMEs brought the perspectives of industry and education to the project and thanks are extended to them for their dedication and participation in keeping the Tool and Die Maker trade technologically current and aligned with the needs of industry.

### Tool and Die Maker Program Review SMEs

Name	Organization	Position	Sector
Andrew Byers	Department of National Defence	Tool and Die Maker	Shipbuilding and Maintenance
James Cai	BC Institute of Technology	Machinist Instructor	Training Provider
Uwe zum Hingst	Zum Hingst Technologies Inc.	Tool and Die Maker	Manufacturing
Russ Jones	Avcorp Industries Inc.	Tooling Manager	Aerospace
Karl Reichenback	BC Institute of Technology	Tool and Die Maker Instructor	Training Provider
Richard Turnbull	Department of National Defence	Machine Shop Supervisor	Shipbuilding and Maintenance



## How to Use this Document

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
<b>Program Credentialing Model</b>	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
<b>Program Assessment</b>	Communicate program completion requirements and assessment methods	Understand the various assessment requirements for the program	Understand the various assessment requirements for the program	Understand the assessment requirements they would have to fulfill in order to challenge the program
<b>OAC</b>	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
<b>Training Topics and Suggested Time Allocation</b>	Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application	Understand the relative weightings of various competencies of the occupation on which assessment is based
<b>Program Content</b>	Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component	Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels



Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
<b>Training Provider Standards</b>	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own	Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors	Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment



# **Section 2**

## **PROGRAM OVERVIEW**

### **Tool and Die Maker**

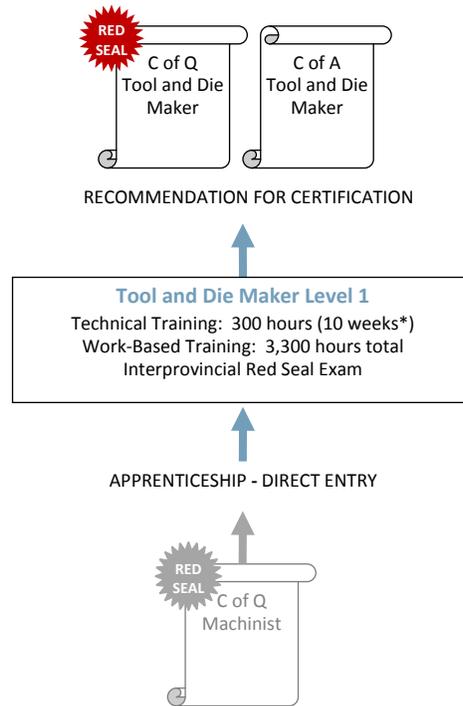


# Program Credentialing Model

## Apprenticeship Pathway

This graphic provides an overview of the Tool and Die Maker apprenticeship pathway.

C of Q = Certificate of Qualification  
 C of A = Certificate of Apprenticeship



*\*Suggested duration based on 30-hour week*

### CROSS-PROGRAM CREDITS

*Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program*

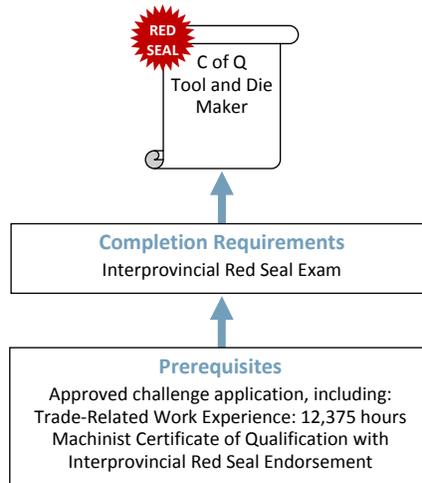
	<p>Technical Training: None                  WBT: Up to 1,650 hours</p> <p>Work experienced must be accumulated through Tool and Die Maker specific work</p>
--	--



### Challenge Pathway

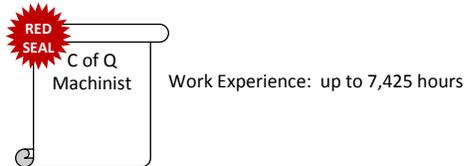
This graphic provides an overview of the Tool and Die Maker challenge pathway.

*C of Q = Certificate of Qualification*



**CREDIT FOR PRIOR LEARNING**

*Individuals who hold the credentials listed below are considered to have met or partially met the prerequisites for challenging this program*





## Occupational Analysis Chart

### TOOL AND DIE MAKER

**Occupational Description:** “Tool and Die Maker” means a person who makes, repairs and tests dies, cutting tools, jigs, fixtures, moulds, gauges and special hand tools by laying out, setting-up, machining, fitting and finishing metal stock and castings.

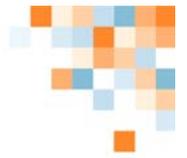
<b>C</b> <b>USE APPLIED MATHEMATICS</b>	<b>C4 K</b> Solve problems involving geometry M1         1	<b>C7 K</b> Solve problems involving trigonometry M1   M2   M3     1
<b>D</b> <b>USE MEASURING TOOLS</b>	<b>D6 K</b> Inspect workpieces         1	
<b>F</b> <b>SELECT MATERIALS</b>	<b>F5 K</b> Select materials for applications     M3     1	<b>F7 K</b> Describe materials testing     M3   M4   1
<b>G</b> <b>PLAN SEQUENCE OF OPERATION</b>	<b>G5 W</b> Deburr workpieces         1	
<b>I</b> <b>USE DRILLING MACHINES</b>	<b>I4 K</b> Perform drilling processes for tool and die making         1	
<b>K</b> <b>USE LATHES</b>	<b>K5 K</b> Describe the use of advanced cutting tools   M2       1	

**NOTE:** Competency numbering aligns with the BC Machinist 2009 OAC. Competency levels numbered “M#” here are pre-requisites under the Machinist program.



<b>L</b> <b>USE MILLING MACHINES</b>	<b>L5 K</b> Mill pockets and profiles for tool and die making         1			
<b>M</b> <b>USE SUPPORT MACHINES</b>	<b>M3 W</b> Operate and maintain gear cutting and electrical discharge machines       M4   1	<b>M4 K</b> Describe the use of wire electrical discharge machines in tool and die making           1		
<b>N</b> <b>USE GRINDERS AND ABRASIVES</b>	<b>N3 W</b> Operate and maintain grinders M1     M3     1	<b>N4 W</b> Operate and maintain sanders and polishers M1           1	<b>N5 K</b> Describe the operation and maintenance of surface grinders           1	<b>N6 W</b> Grind profiles for tool and die making           1
<b>Q</b> <b>DESCRIBE PROTOTYPES</b>	<b>Q1 K</b> Describe prototyping materials and processes           1			
<b>R</b> <b>BUILD JIGS AND FIXTURES</b>	<b>R1 K</b> Describe jigs and fixtures           1	<b>R2 W</b> Design jigs and fixtures           1	<b>R3 W</b> Build jigs and fixtures           1	
<b>S</b> <b>BUILD DIES</b>	<b>S1 K</b> Describe dies           1	<b>S2 W</b> Design dies           1	<b>S3 W</b> Build dies           1	<b>S4 K</b> Describe the setup of die and punch presses for safe operation           1
<b>T</b> <b>DESIGN AND MAINTAIN MOULDS</b>	<b>T1 K</b> Describe mould building           1	<b>T2 W</b> Design and maintain injection moulds           1		

**NOTE:** Competency numbering aligns with the BC Machinist 2009 OAC. Competency levels numbered “M#” here are pre-requisites under the Machinist program.



## Training Topics and Suggested Time Allocation

### TOOL AND DIE MAKER

		% of Time	Theory	Practical
<b>Line C</b>	<b>USE APPLIED MATHEMATICS</b>	4%		
C4	Solve problems involving geometry		√	
C7	Solve problems involving trigonometry		√	
<b>Line D</b>	<b>USE MEASURING TOOLS</b>	4%		
D6	Inspect workpieces		√	√
<b>Line F</b>	<b>SELECT MATERIALS</b>	4%		
F5	Select materials for applications		√	
F7	Describe materials testing		√	√
<b>Line G</b>	<b>PLAN SEQUENCE OF OPERATIONS</b>	4%		
G5	Deburr workpieces			√
<b>Line I</b>	<b>USE DRILLING MACHINES</b>	3%		
I4	Perform drilling processes for tool and die making		√	√
<b>Line K</b>	<b>USE LATHES</b>	4%		
K5	Describe the use of advanced cutting tools		√	√
<b>Line L</b>	<b>USE MILLING MACHINES</b>	5%		
L5	Mill pockets and profiles for tool and die making		√	√
<b>Line M</b>	<b>USE SUPPORT MACHINES</b>	5%		
M3	Operate and maintain gear cutting and electrical discharge machines			√
M4	Describe the use of wire electrical discharge machines in tool and die making		√	
<b>Line N</b>	<b>USE GRINDERS AND ABRASIVES</b>	5%		
N3	Operate and maintain grinders			√
N4	Operate and maintain sanders and polishers			√
N5	Describe the operation and maintenance of surface grinders		√	
N6	Grind profiles for tool and die making			√
<b>Line Q</b>	<b>DESCRIBE PROTOTYPES</b>	2%		



		% of Time	Theory	Practical
Q1	Describe prototyping materials and processes		√	
<b>Line R</b>	<b>BUILD JIGS AND FIXTURES</b>	21%		
R1	Describe jigs and fixtures		√	
R2	Design jigs and fixtures			√
R3	Build jigs and fixtures			√
<b>Line S</b>	<b>BUILD DIES</b>	28%		
S1	Describe dies		√	
S2	Design dies			√
S3	Build dies			√
S4	Describe the setup of die and punch presses for safe operation		√	
<b>Line T</b>	<b>DESIGN AND MAINTAIN MOULDS</b>	11%		
T1	Describe mould building		√	
T2	Design and maintain injection moulds			√
<b>Total Percentage for Tool and Die Maker – Level 1</b>		100%		



# **Section 3**

## **PROGRAM CONTENT**

### **Tool and Die Maker**



# Level 1

## Tool and Die Maker





<b>LINE (GAC):</b>	<b>C</b>	<b>USE APPLIED MATHEMATICS</b>
<b>Competency:</b>	<b>C7</b>	<b>Solve problems involving trigonometry</b>

### Objectives

To be competent in this area, the individual must be able to solve complex trigonometric problems related to tool and die making.

### LEARNING TASKS

1. Solve complex trigonometric problems related to designing and making tools and dies

### CONTENT

- Using rollers and pins to measure dimensions
- Calculating angles
  - A slider with feathered edges
  - Compound angles
  - Amount of draft over a given angle
- Creating construction surfaces



**LINE (GAC):**            **D**        **USE MEASURING TOOLS**

**Competency:**        **D6**        **Inspect workpieces**

**Objectives**

To be competent in this area, the individual must be able to inspect a finished workpiece.

**LEARNING TASKS**

**CONTENT**

1. Describe the inspection of finished workpieces

- Required dimensions
  - Required accuracy of dimensions
- Considerations of temperature control and variance
- Geometric dimensioning and tolerancing
- Inspection equipment
  - Optical comparators
  - Master square
  - Linear height gauge
  - Coordinate measuring machines
  - High precision micrometer
  - Manual measurements
  - Inspection grade gauge blocks and pins
  - Toolmaker’s microscope

2. Apply inspection techniques

- Use inspection tools and equipment (as above) in practical shop exercises
- Measuring pockets (cavities)
- High precision measuring standards
- Using rollers and pins for measurement



**LINE (GAC):**            **F**        **SELECT MATERIALS**  
**Competency:**        **F5**        **Select materials for applications**

**Objectives**

To be competent in this area, the individual must be able to select materials for tooling applications.

**LEARNING TASKS**

**CONTENT**

1. Describe tooling materials

- Types of tooling materials
  - Alloy compositions
- Standards for materials
  - DIN
  - SAE
  - Manufacturers' specifications
  - Materials identification numbers and names
- Tooling applications
- Mould materials
  - Hard
  - Flexible
- Punch materials
- Die materials

2. Select materials for specific applications

- Given a set of specifications, select appropriate materials in a practical shop exercise



**LINE (GAC): F SELECT MATERIALS**

**Competency: F7 Describe materials testing**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe non-destructive testing processes.
- Conduct non-destructive testing processes.

**LEARNING TASKS**

**CONTENT**

1. Describe non-destructive testing techniques
  
2. Conduct non-destructive testing

- Dye penetrant
- Magnetic particle inspection
  
- Given specific requirements, conduct non-destructive tests in a practical shop exercise



**LINE (GAC): G PLAN SEQUENCE OF OPERATION**

**Competency: G5 Deburr workpieces**

**Objectives**

To be competent in this area, the individual must be able to deburr a workpiece.

**LEARNING TASKS**

**CONTENT**

1. Use various deburring tools

- Files
- Rotary deburring tools
- Scrapers
- Abrasive stones
- Polish requirements
- Deburring techniques
  - Assess workpiece
  - Identify burrs
  - Rough edges

2. Remove burrs from a workpiece

- Given specifications, identify critical edges and define deburring requirements in a practical shop exercise
- Remove burrs to meet specifications





**LINE (GAC):**        **K**        **USE LATHES**

**Competency:**        **K5**        **Describe the use of advanced cutting tools**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe the use of advanced cutting tools for tool and die making.
- Make tools and dies using advanced cutting tools.

**LEARNING TASKS**

**CONTENT**

1. Describe the use of advanced cutting tools in tool and die making

- Concentricity
- Turning a hardened cavity
- Taper locks
- Special tools
- Tool post grinder

2. Use advanced cutting tools in tool and die making

- Given a set of specifications, fabricate tools and dies using advanced cutting tools in a practical shop exercise



<b>LINE (GAC):</b>	<b>L</b>	<b>USE MILLING MACHINES</b>
<b>Competency:</b>	<b>L5</b>	<b>Mill pockets and profiles for tool and die making</b>

**Objectives**

To be competent in this area, the individual must be able to:

- Describe pocket milling in tool and die making.
- Describe profile milling in tool and die making.
- Mill pockets and profiles in tool and die making.

**LEARNING TASKS**

**CONTENT**

<p>1. Describe milling pockets and profiles</p>	<ul style="list-style-type: none"> <li>• Alignment considerations in tool and die making</li> <li>• Pocketing for functionality of tool making</li> <li>• Machining special materials               <ul style="list-style-type: none"> <li>– Hardened tool steel</li> <li>– EDM Electrodes</li> </ul> </li> <li>• Profiling calculations</li> <li>• Pocketing</li> <li>• Square</li> <li>• Strength</li> <li>• Recognize functionality of pocket</li> </ul>
<p>2. Mill profiles and inserts</p>	<ul style="list-style-type: none"> <li>• Given a set of specifications, mill profiles and inserts in practical shop exercises</li> </ul>
<p>3. Mill pockets</p>	<ul style="list-style-type: none"> <li>• Given a set of specifications, mill pockets in a practical shop exercises</li> </ul>



<b>LINE (GAC):</b>	<b>M</b>	<b>USE SUPPORT MACHINES</b>
<b>Competency:</b>	<b>M3</b>	<b>Operate and maintain gear cutting and electrical discharge machines</b>

**Objectives**

To be competent in this area, the individual must be able to operate and maintain electric discharge machines in the tool and die making process.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Operate Wire EDM in tool and die making</li> </ol> | <ul style="list-style-type: none"> <li>• Given a set of specifications, operate a Wire EDM for tool and die making in a practical shop exercise</li> </ul> |
|--|--|



<b>LINE (GAC):</b>	<b>M</b>	<b>USE SUPPORT MACHINES</b>
<b>Competency:</b>	<b>M4</b>	<b>Describe the use of wire electric discharge machines in tool and die making</b>

**Objectives**

To be competent in this area, the individual must be able to describe the use of wire electric discharge machines in the tool and die making process.

**LEARNING TASKS**

**CONTENT**

1. Describe the use of Wire EDM in tool and die making

- Wire EDM
  - Speeds and feeds
  - Calculating spark gap
  - Specific surface finishing
  - Fixturing
- EDM sinker fixturing
- Calculating spark gap
- Specific EDM surface finishing
- Considerations in selecting electrode materials
- Machining electrodes
- Wear rates
- Mounting (lining up) electrodes



**LINE (GAC): N USE GRINDERS AND ABRASIVES**

**Competency: N3 Operate and maintain grinders**

**Objectives**

To be competent in this area, the individual must be able to operate and maintain a surface grinder for tool and die making.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| <ol style="list-style-type: none"> <li>1. Operate a surface grinder for tool and die making</li> </ol>      | <ul style="list-style-type: none"> <li>• Given a set of specifications, operate a surface grinder in a practical tool and die making shop exercise</li> </ul>     |
| <ol style="list-style-type: none"> <li>2. Maintain surface grinders used for tool and die making</li> </ol> | <ul style="list-style-type: none"> <li>• Given a set of specifications, maintain surface grinders used in practical tool and die making shop exercises</li> </ul> |



**LINE (GAC): N USE GRINDERS AND ABRASIVES**

**Competency: N4 Operate and maintain sanders and polishers**

**Objectives**

To be competent in this area, the individual must be able to finish a tool or die workpiece using hones and lapping machines.

**LEARNING TASKS**

**CONTENT**

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Describe finishing a workpiece using hones and lapping machines</li> <br/> <li>2. Finish a workpiece using hones and lapping machines</li> </ol> | <ul style="list-style-type: none"> <li>• Polishing and blending techniques</li> <br/> <li>• Given a set of specifications, finish a workpiece using hones and lapping machines in a practical shop exercise</li> </ul> |
|--|--|



<b>LINE (GAC):</b>	<b>N</b>	<b>USE GRINDERS AND ABRASIVES</b>
<b>Competency:</b>	<b>N5</b>	<b>Describe the operation and maintenance of surface grinders</b>

**Objectives**

To be competent in this area, the individual must be able to describe the operation and maintenance of surface grinders used in tool and die making.

**LEARNING TASKS**

**CONTENT**

- |  |   |
|--|---|
| <p>1. Describe the operation of surface grinders used in tool and die making</p>   | <ul style="list-style-type: none"> <li>• Calculate work speeds and feeds</li> <li>• Tool and die materials               <ul style="list-style-type: none"> <li>– Types</li> <li>– Sizes</li> </ul> </li> <li>• Wheel selection</li> <li>• Rigidity</li> <li>• Workholding devices               <ul style="list-style-type: none"> <li>– Fixtures for grinding</li> </ul> </li> <li>• Set-up sequence               <ul style="list-style-type: none"> <li>– Mounting workpiece</li> <li>– Truing workpiece</li> </ul> </li> </ul> |
| <p>2. Describe the maintenance of surface grinders used in tool and die making</p> | <ul style="list-style-type: none"> <li>• Wheel truing and dressing</li> <li>• Safety considerations in wheel dressing               <ul style="list-style-type: none"> <li>– Ventilation / evacuation</li> <li>– Dust mask</li> <li>– Proximity to dressing of the wheel</li> </ul> </li> <li>• Maintenance               <ul style="list-style-type: none"> <li>– Cleaning</li> <li>– Lubricating</li> <li>– Housekeeping</li> </ul> </li> </ul>   |



<b>LINE (GAC):</b>	<b>N</b>	<b>USE GRINDERS AND ABRASIVES</b>
<b>Competency:</b>	<b>N6</b>	<b>Grind profiles for tool and die making</b>

**Objectives**

To be competent in this area, the individual must be able to grind profiles for tool and die making.

**LEARNING TASKS**

1. Grind profiles

**CONTENT**

- Form grinding
- Spin fixtures
  - By hand
  - Automatically
- Cylindrical grinding applications
- Profile wheel dresser
- Given a set of specifications, grind profiles in a work piece in a practical shop exercise







**LINE (GAC): R BUILD JIGS AND FIXTURES**

**Competency: R2 Design jigs and fixtures**

**Objectives**

To be competent in this area, the individual must be able to:

- Design jigs.
- Design fixtures.

**LEARNING TASKS**

1. Design jigs for various applications
  
2. Design fixtures for various applications

**CONTENT**

- Given specific application requirements, design jigs in practical shop exercises
  
- Given specific application requirements, design fixtures in practical shop exercises



**LINE (GAC):** R **BUILD JIGS AND FIXTURES**

**Competency:** R3 **Build jigs and fixtures**

**Objectives**

To be competent in this area, the individual must be able to:

- Build jigs.
- Build fixtures.

**LEARNING TASKS**

1. Build jigs for various applications
  
2. Build fixtures for various applications

**CONTENT**

- Given specific application requirements, assemble jigs and verify their functions in practical shop exercises
  
- Given specific application requirements, assemble fixtures and verify their functions in practical shop exercises



<b>LINE (GAC):</b>	<b>S</b>	<b>BUILD DIES</b>
<b>Competency:</b>	<b>S1</b>	<b>Describe dies</b>

### Objectives

To be competent in this area, the individual must be able to describe dies.

### LEARNING TASKS

1. Describe dies and their applications

### CONTENT

- Die types
  - Compound
  - Progressive
- Die set components
  - Die shoe
- Machine die components
  - Punch block
  - Die block
  - Punches
  - Dies
  - Stripper
- Design considerations
- Clearance requirements
  - Materials type
  - Thickness
  - Profile of part
- Tonnage requirements
  - Materials type
  - Equipment requirements



**LINE (GAC):**      **S**      **BUILD DIES**  
**Competency:**    **S2**      **Design dies**

**Objectives**

To be competent in this area, the individual must be able to design dies.

**LEARNING TASKS**

1. Design dies for various applications

**CONTENT**

- Given specific application requirements, design dies in practical shop exercises



<b>LINE (GAC):</b>	<b>S</b>	<b>BUILD DIES</b>
<b>Competency:</b>	<b>S3</b>	<b>Build dies</b>

### Objectives

To be competent in this area, the individual must be able to build progressive dies.

### LEARNING TASKS

1. Build progressive dies for a specific application

### CONTENT

- Given specific application requirements, build progressive dies in practical shop exercises
- Assemble die components
- Setup die in punch press
- Produce blanked parts
  - Inspect parts
  - Compare to specifications



**LINE (GAC):**        **S**        **BUILD DIES**

**Competency:**      **S4**        **Describe the setup of die and punch presses for safe operation**

**Objectives**

To be competent in this area, the individual must be able to:

- Describe how to set up a die press for safe operation by production workers.
- Describe how to set up a punch press for safe operation by production workers.

**LEARNING TASKS**

**CONTENT**

- |   |   |
|---|---|
| <p>1. Setting up a die press for production</p>   | <ul style="list-style-type: none"> <li>• Safety considerations and WorkSafeBC regulations             <ul style="list-style-type: none"> <li>– Guards</li> <li>– Personal protective equipment</li> <li>– Safety switches</li> </ul> </li> <li>• Operational procedures             <ul style="list-style-type: none"> <li>– Step-by-step work tasks</li> </ul> </li> </ul> |
| <p>2. Setting up a punch press for production</p> | <ul style="list-style-type: none"> <li>• Safety considerations and WorkSafeBC regulations             <ul style="list-style-type: none"> <li>– Guards</li> <li>– Personal protective equipment</li> <li>– Safety switches</li> </ul> </li> <li>• Operational procedures             <ul style="list-style-type: none"> <li>– Step-by-step work tasks</li> </ul> </li> </ul> |



**LINE (GAC): T DESIGN AND MAINTAIN MOULDS**

**Competency: T1 Describe mould building**

### Objectives

To be competent in this area, the individual must be able to identify injection mould building tools, materials and components.

### LEARNING TASKS

1. Describe mould building machines and components

### CONTENT

- Types of moulds
  - Injection
  - Blow
  - Rotary
- Types of moulding machines
- Cavities and cores
- Gates and runners
- Ejection systems
- Temperature control
- Draft angles
- Cavity venting
- Design considerations
  - Mould temperatures
  - Materials
  - Shrinkage calculations
  - Draft
  - Ejection
- Hydraulic and pneumatic systems

2. Identify mould building tools and materials

- Plastics
  - Shrinkage calculations
- Tool steels
- Polishing tools
- Surface finishing



**LINE (GAC):** T      **DESIGN AND MAINTAIN MOULDS**

**Competency:** T2      **Design and maintain injection moulds**

**Objectives**

To be competent in this area, the individual must be able to design and maintain injection moulds.

**LEARNING TASKS**

1. Design an injection mould
  
2. Maintain injection moulds

**CONTENT**

- Given specific application requirements, design an injection moulds in a practical shop exercise
  
- Assemble a mould
- Disassemble a mould
- Inspection of mould components



# Section 4

## TRAINING PROVIDER STANDARDS



## Facility Requirements

### Classroom

- 900 sq. ft. for a class size of 12 - 16 students, with moveable tables and chairs.
- Instructional media to include multimedia projector, projection screen, DVD player, and whiteboard.

### Instructor's Office

- 150 sq. ft. per instructor, with a desk, chairs and materials storage / filing system

### Indoor Shop Area

- 175 sq. ft. per student
- Well heated and ventilated
- 22 ft. high ceilings
- Lighting appropriate to detailed work
- Student locker and changeroom facilities
- 200 sq. ft. clean-up / waste area

### Storage

- 200 sq. ft. raw materials storage (may be outdoors)
- 20 sq. ft. per student for tools storage (indoors)



## Tools and Equipment

### Machine Tools

- Abrasive cut-off saw
- Band saw (horizontal and vertical)
- Boring machines (horizontal and vertical)
- Computer numeric control (CNC) simulator
- drilling machines
- Electrical discharge machine (EDM)
- grinders (cylindrical, surface, tool and cutter, pedestal, tool post profile)
- hobbing machine (recommended)
- hydraulic press
- injection mould machine
- Lathe (turret, engine, tracer, CNC)
- Key seater (recommended)
- Milling machines (vertical, horizontal, universal milling centres, CNC)
- Punch press

### Measuring and Layout Tools

- Angle plate
- Bore gauge
- Combination square
- Coordinate measuring machine (CMM) (recommended)
- Depth gauge
- Dial indicators and magnetic base
- Digital readout
- Dividers
- Drill gauge
- Electronic measuring devices
- Etchers
- Feeler gauge
- Gauge blocks
- Gear measuring wire
- Go-no-go gauge (threads, diametrical)
- Height gauge
- Hermaphrodite callipers
- Inside callipers
- Layout fluid
- Measuring rods
- Micrometer (thread, inside, outside, depth)
- Measuring tape
- Optical comparator
- Outside callipers
- Plug/ring gauge
- Precision blocks
- Precision level
- Protractor (universal, bevel, vernier)
- Punches (centre, prick, transfer)

- Radius gauge
- Scale (steel, rule, hook rule)
- Scribes
- Sine bar (compound)
- Small hole gauge
- Snap gauge
- Square (solid, adjustable, cylindrical)
- Surface finish comparator
- Surface gauge
- Surface plate
- Telescopic gauge
- Three wire set
- Transfer calliper
- Vernier calliper (dial, digital)
- Vernier height gauge

### Handheld Air and Power Tools

- Air grinder
- Air-driven hand tools
- Circular saw
- Disc grinder
- Nibbler
- Portable drill
- Reciprocating saw

### Cutting Tools

- Abrasive cut off wheels
- Boring bars
- Boring heads
- Broaches
- Carbides (cemented, inserts, solid)
- Changeable pilot counterbores
- Dies
- Drills (centre, spade, twist drill, oil hole, straight fluid gun drills, hard steel drill, anular cutters, step drill, saw type hole cutter)
- Grinding wheels (aluminum oxide, silicon, carbide, boron carbide, cubicboron nitride, Diamond, buffing wheels)
- Knurling tools (straight, tangential, diamond)
- Milling cutters (dovetail, gear, keyway, end mill, t-slot, woodruff, side and face, slab, plain, chamfer, slitting saws, flycutters, formed, angle face, cemented carbide, carbide insert, solid carbide)
- Reamers (machine, hand, spiral flute, straight flute, expandable, rose, taper)
- Spotfacers
- Taps



### Hand Tools

- Acetylene torch
- Allen keys
- Arbour press
- Bearing extractor
- Brushes
- Buffing wheels
- Chisels
- Chuck key
- Clamps
- Cloths
- Deburrers
- Die stock
- Drill drift
- Drill gauge
- Emery cloth
- File cards
- File handles
- Files
- Grease guns
- Hacksaws and blades
- Hammers/mallets
- Honing stones
- Lapping plate
- Oil cans/guns
- Pliers
- Scrapers (flat, bearing)
- Screwdrivers
- Socket wrenches
- Soft jaws
- Tap extractors
- Tap wrenches
- Torch tip lighters
- Vices
- Wheel dressers (hand held)
- Wrenches

### Software

- CAD/CAM software

### Student Provided

- Safety glasses
- Safety boots
- Personal protective equipment

### Safety Equipment

- Dust mask
- Eye wash station
- Face shield
- Goggles
- Hand protection
- Hearing protectors
- Protective head gear
- Required fire suppression equipment
- Required first aid coverage and equipment
- Safety barrier tapes

### Set Up Accessories

- Adaptors
- Angle plates
- Arbours
- Centre and edge finders
- Centres (dead, half, rotating, spring)
- Chucks (3-jaw, 4-jaw, 6-jaw, magnetic, tail stock)
- Colletts
- Crane
- Degreasing tanks
- Dividing head
- Drill chuck
- Face plates
- Follower/travelling rest
- Grinding attachment
- Hoists
- Lathe dogs
- Machine vice
- Mandrels
- Parallels
- Quick change toolpost
- Rotary table
- Shim stock
- Slings
- Spacers
- Spin / indexing fixture
- Steady rest
- Taper sleeve
- Taper turning attachment
- Tapping head
- Tool holders
- Turret toolpost
- Vee block
- Wheel balancers



## Reference Materials

The following list of textbooks and learning materials may be needed to enhance the technical training component of the Tool and Die Maker Apprenticeship program.

### Required

1. WorkSafeBC Regulations Online
2. Machinery's Handbook
3. Basic Diemaking, Ostergaard, Glencoe / MacMillan / McGraw-Hill
4. Jig and Fixture Design – 5<sup>th</sup> Edn, Hoffman, Delmar Publishers
5. Moldmaking and Die Cast Dies for Metalworking Trainees, Kluz, National Tooling and Machining Association

### Recommended

1. NAIT Trade Mathematics for Machinists and Millwrights / Individualized Learning Millwright Modules from Alberta Learning
2. Interpret Engineering Drawings (Canadian Edition)
3. Mathematics for Machine Technology, Smith

### Other References

1. IPT Trade Handbooks Series
2. Machine Tool Practices



## Instructor Requirements

A Tool and Die Maker Training Instructor will have the following combination of qualifications and experience:

- Tool and Die Maker Red Seal certification, plus
- 10 years of hands-on working experience as a Tool and Die Maker after earning Red Seal certification, plus
- Demonstrated effectiveness of communication skills, instructional and interpersonal
- Experienced user of relevant software for:
  - Word processing
  - Spreadsheets
  - Presentations
  - CAD
  - CNC programming

Also preferred for a Tool and Die Maker Training Instructor:

- Provincial (BC) Instructor Diploma or completion of a similar Trainer Training / Instructional Methods program, plus
- 2 years of supervisory or administrative experience
- Experienced user of CAD / CAM software