PROGRAM OUTLINE

Machinist
MACHINIST
HARMONIZED PROGRAM OUTLINE

APPROVED BY INDUSTRY
FEBRUARY 2019

BASED ON
RSOS 2017

Developed by
Industry Training Authority
Province of British Columbia
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Section 1
INTRODUCTION

Machinist
Introduction

Foreword

The Program Standards for Machinist were updated through a Standards Review project funded by the Industry Training Authority. These revised standards incorporate changes made to the 2017 Red Seal Occupational Standard (RSOS).

This Program Outline is for use in Machinist industry apprenticeship training classes sponsored by the Industry Training Authority and will be used as a curriculum planning guide for instructors in the formal classroom portions of apprenticeship training. Safe working practices, though not always specified in each of the competencies and learning tasks, are an implied part of the program and should be stressed throughout the apprenticeship.

This Program Outline was reviewed and adjusted by a group of Subject Matter Experts (SMEs), during a five day workshop in March 2018. Thanks are extended to the SMEs for their dedication and participation in keeping the Machinist Program Standards technologically current and aligned with the needs of industry.

SAFETY ADVISORY

Be advised that references to the WorkSafeBC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: http://www.worksafebc.com).

Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.
Acknowledgements

Subject Matter Experts (SMEs) retained to assist in the development of the Program Outline:

- Marte Arreola BCIT
- Thomas Green BCIT
- Mike Hall Mearl’s Machine Works Ltd.
- Karl Reichenback BCIT
- Daniel Smith West Fraser Plywood
- Richard Turnbull Department of National Defense
- Rob Vanderstarren Customized CNC Solutions Inc.
- Reinhard Wildauer College of New Caledonia

The Industry Training Authority would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Machinist occupation.
# 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.

<table>
<thead>
<tr>
<th>Section</th>
<th>Training Providers</th>
<th>Employers/ Sponsors</th>
<th>Apprentices</th>
<th>Challengers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Credentialing Model</strong></td>
<td>Communicate program length and structure, and all pathways to completion</td>
<td>Understand the length and structure of the program</td>
<td>Understand the length and structure of the program, and pathway to completion</td>
<td>Understand challenger pathway to Certificate of Qualification</td>
</tr>
<tr>
<td><strong>OAC</strong></td>
<td>Communicate the competencies that industry has defined as representing the scope of the occupation</td>
<td>Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification</td>
<td>View the competencies they will achieve as a result of program completion</td>
<td>Understand the competencies they must demonstrate in order to challenge the program</td>
</tr>
<tr>
<td><strong>Training Topics and Suggested Time Allocation</strong></td>
<td>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</td>
<td>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</td>
<td>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</td>
<td></td>
</tr>
<tr>
<td><strong>Program Content</strong></td>
<td>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</td>
<td>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</td>
<td>Provides detailed information on program content and performance expectations for demonstrating competency</td>
<td>Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels</td>
</tr>
</tbody>
</table>
## Introduction

<table>
<thead>
<tr>
<th>Section</th>
<th>Training Providers</th>
<th>Employers/ Sponsors</th>
<th>Apprentices</th>
<th>Challengers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Training Provider Standards</strong></td>
<td>Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program</td>
<td>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</td>
<td>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</td>
<td>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</td>
</tr>
<tr>
<td><strong>Appendix—Assessment Guidelines</strong></td>
<td>Identifies the percentage weight of theory and practical assessment in technical training</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Appendix—Glossary of Acronyms</strong></td>
<td></td>
<td>Defines program specific acronyms</td>
<td></td>
<td>Defines program specific acronyms</td>
</tr>
<tr>
<td><strong>Appendix—Previous Contributors</strong></td>
<td>Provides information on previous contributors to the Program Outline review</td>
<td>Provides information on previous contributors to the Program Outline review</td>
<td>Provides information on previous contributors to the Program Outline review</td>
<td>Provides information on previous contributors to the Program Outline review</td>
</tr>
</tbody>
</table>
Section 2

PROGRAM CONTENT

Machinist
Program Credentialing Model

Apprenticeship Pathway

This graphic provides an overview of the Machinist apprenticeship pathway.

C of Q = Certificate of Qualification
C of A = Certificate of Apprenticeship
C of C = Certificate of Completion
WBT = Work Based Training

CROSS-PROGRAM CREDITS

Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program.
### Occupational Analysis Chart

**MACHINIST**

**Occupation Description:** A Machinist is someone who turns blocks of metal into complex, intricate metal parts for other products. They fit and assemble metal parts and sub-assemblies, ensuring the parts in these products meet exacting standards in size, strength and hardness. A Machinist sets up and operates all machine tools such as Lathes, Milling Machines Saws, Grinding Machines, Drilling and Boring Machines, Shapers, Planers, Precision Measuring tools, Hand and Power tools, and the related attachments and accessories, including C.N.C. machining, selection, use and maintenance of cutting tools.

<table>
<thead>
<tr>
<th>PERFORM SAFETY RELATED TASKS</th>
<th>A</th>
<th>Describe Occupational Health and Safety Regulations</th>
<th>Describe WHMIS and Hazardous Materials Safety (HAZMAT)</th>
<th>Apply safety practices for shop areas</th>
<th>Use lifting equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>1</td>
<td></td>
<td></td>
<td>A2</td>
<td>A4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PERFORM HAND PROCESSES</th>
<th>B</th>
<th>Use and maintain hand tools</th>
<th>Use layout tools</th>
<th>Use and maintain handheld power tools</th>
<th>Mark material and workpiece for identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>1</td>
<td></td>
<td></td>
<td>B2</td>
<td>B4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE APPLIED MATHEMATICS</th>
<th>C</th>
<th>Solve problems involving formulas</th>
<th>Perform metric/imperial conversions</th>
<th>Solve problems involving geometry</th>
<th>Solve problems involving mass, area and volume</th>
<th>Solve problems involving trigonometry</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>1</td>
<td></td>
<td>C2</td>
<td>C3</td>
<td>C4</td>
<td>C5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USE MEASURING TOOLS</th>
<th>D</th>
<th>Use linear and Vernier scales</th>
<th>Use micrometers</th>
<th>Use calipers and gauges</th>
<th>Use dial indicators and digital readouts</th>
<th>Use optical measuring equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>1</td>
<td></td>
<td>D2</td>
<td>D3</td>
<td>D4</td>
<td>D5</td>
</tr>
</tbody>
</table>
# Harmonized Program Outline

## Program Overview

<table>
<thead>
<tr>
<th>Category</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interpret Drawings and Reference Materials</td>
<td>Interpret information found on drawings</td>
</tr>
<tr>
<td></td>
<td>Determine project requirements</td>
</tr>
<tr>
<td></td>
<td>Sketch machined parts</td>
</tr>
<tr>
<td></td>
<td>Use Machinery's Handbook and other reference materials</td>
</tr>
<tr>
<td></td>
<td>Describe fits and tolerances</td>
</tr>
<tr>
<td>Select Materials</td>
<td>Describe principles of metallurgy</td>
</tr>
<tr>
<td></td>
<td>Describe characteristics of ferrous metals</td>
</tr>
<tr>
<td></td>
<td>Describe characteristics of non-ferrous metals</td>
</tr>
<tr>
<td></td>
<td>Describe characteristics of non-metals</td>
</tr>
<tr>
<td></td>
<td>Perform heat treating</td>
</tr>
<tr>
<td></td>
<td>Perform materials testing</td>
</tr>
<tr>
<td>Refurbish Components</td>
<td>Identify fasteners</td>
</tr>
<tr>
<td></td>
<td>Identify lubricants and sealants</td>
</tr>
<tr>
<td></td>
<td>Describe bearings, seals and bearing materials</td>
</tr>
<tr>
<td>Use Drilling Machines</td>
<td>Describe drilling machines</td>
</tr>
<tr>
<td></td>
<td>Select and maintain cutting tools</td>
</tr>
<tr>
<td></td>
<td>Operate and maintain drilling machines</td>
</tr>
<tr>
<td>Use Power Saws</td>
<td>Describe power saws</td>
</tr>
<tr>
<td></td>
<td>Select and maintain band saw blades</td>
</tr>
<tr>
<td></td>
<td>Operate and maintain band saws</td>
</tr>
<tr>
<td></td>
<td>Operate and maintain other saws</td>
</tr>
</tbody>
</table>

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*Machinist Harmonized Program Outline*  
02/19  
*Industry Training Authority*  
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HARMONIZED PROGRAM OUTLINE
Program Overview

USE LATHES

<table>
<thead>
<tr>
<th>J</th>
<th>Describe lathes</th>
<th>Describe cutting tools and holders</th>
<th>Operate and maintain lathes</th>
<th>Cut tapers</th>
<th>Cut threads</th>
<th>Describe vertical lathes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J1</td>
<td>J2</td>
<td>J3</td>
<td>J4</td>
<td>J5</td>
<td>J6</td>
</tr>
</tbody>
</table>

USE MILLING MACHINES

<table>
<thead>
<tr>
<th>K</th>
<th>Describe milling machines</th>
<th>Describe cutting tools and holders</th>
<th>Use dividing heads and rotary tables</th>
<th>Operate and maintain milling machines</th>
<th>Describe boring mills</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>K1</td>
<td>K2</td>
<td>K3</td>
<td>K4</td>
<td>K5</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

USE SUPPORT MACHINES

<table>
<thead>
<tr>
<th>L</th>
<th>Operate and maintain pedestal grinder</th>
<th>Operate and maintain arbor and hydraulic presses</th>
<th>Operate and maintain hones and lapping machines</th>
<th>Operate and maintain gear cutting machines</th>
<th>Operate and maintain electrical discharge machines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L1</td>
<td>L2</td>
<td>L3</td>
<td>L4</td>
<td>L5</td>
</tr>
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<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

USE PRECISION GRINDERS

<table>
<thead>
<tr>
<th>M</th>
<th>Describe types of precision grinders</th>
<th>Select abrasives</th>
<th>Operate and maintain grinders</th>
</tr>
</thead>
<tbody>
<tr>
<td>M1</td>
<td></td>
<td>M2</td>
<td>M3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

USE CNC MACHINES

<table>
<thead>
<tr>
<th>N</th>
<th>Describe CNC turning centres</th>
<th>Establish co-ordinate systems and apply programming codes for turning centres</th>
<th>Operate and maintain CNC turning centres</th>
<th>Describe CNC machining centres</th>
<th>Establish co-ordinate systems and apply programming codes for machining centres</th>
<th>Operate and maintain CNC machining centres</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
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<td>N2</td>
<td>N3</td>
<td>N4</td>
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<td>N6</td>
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<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Create 2D and 3D models | Program using CAM

3 4 | 3 4
Training Topics and Suggested Time Allocation

Training Topics and Suggested Time Allocation shows the 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.

### MACHINIST – LEVEL 1

<table>
<thead>
<tr>
<th>Line A</th>
<th>PERFORM SAFETY RELATED TASKS</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Describe Occupational Health and Safety Regulations</td>
<td>11%</td>
<td>80%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>A2</td>
<td>Describe WHMIS and Hazardous Materials Safety (HAZMAT)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>Apply safety practices for shop areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>Use lifting equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line B</td>
<td>PERFORM HAND PROCESSES</td>
<td>9%</td>
<td>40%</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td>B1</td>
<td>Use and maintain hand tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>Use layout tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>Use and maintain handheld power tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>Mark material and workpiece for identification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line C</td>
<td>USE APPLIED MATHEMATICS</td>
<td>11%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>C1</td>
<td>Solve problems involving formulas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Perform metric/imperial conversions</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>C3</td>
<td>Solve problems involving geometry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Solve problems involving mass, area and volume</td>
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<td></td>
</tr>
<tr>
<td>C5</td>
<td>Solve problems involving trigonometry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line D</td>
<td>USE MEASURING TOOLS</td>
<td>9%</td>
<td>40%</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td>D1</td>
<td>Use linear and Vernier scales</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Use micrometers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>Use calipers and gauges</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>Use dial indicators and digital readouts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>Use optical measuring equipment</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Line E</td>
<td>INTERPRET DRAWINGS AND REFERENCE MATERIALS</td>
<td>8%</td>
<td>80%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>E1</td>
<td>Interpret information found on drawings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>Determine project requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E3</td>
<td>Sketch machined parts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td>Use Machinery’s Handbook and other reference materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E5</td>
<td>Describe fits and tolerances</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line F</td>
<td>SELECT MATERIALS</td>
<td>8%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>F1</td>
<td>Describe principles of metallurgy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>Describe characteristics of ferrous metals</td>
<td></td>
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</tr>
</tbody>
</table>
## Program Overview

### % of Time Allocated to:

<table>
<thead>
<tr>
<th>Line</th>
<th>Component</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>F7</td>
<td>Describe the use and maintenance of fuel gas equipment</td>
<td>3%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>G1</td>
<td>Identify fasteners</td>
<td>3%</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>Identify lubricants and sealants</td>
<td>3%</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G1</td>
<td>Identify fasteners</td>
<td>3%</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>Identify lubricants and sealants</td>
<td>3%</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H1</td>
<td>Describe drilling machines</td>
<td>9%</td>
<td>40%</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td>H2</td>
<td>Select and maintain cutting tools</td>
<td>9%</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>H3</td>
<td>Operate and maintain drilling machines</td>
<td>9%</td>
<td>✓</td>
<td>✓</td>
<td></td>
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<tr>
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<td>J2</td>
<td>Describe cutting tools and holders</td>
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Total Percentage for Machinist Level 1: 100%
## Training Topics and Suggested Time Allocation

### MACHINIST – LEVEL 2

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<td>D4</td>
<td>Use dial indicators and digital readouts</td>
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<tr>
<td>D5</td>
<td>Use optical measuring equipment</td>
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<td>E5</td>
<td>Describe fits and tolerances</td>
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<td>K3</td>
<td>Use dividing heads and rotary tables</td>
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<td>K4</td>
<td>Operate and maintain milling machines</td>
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Total Percentage for Machinist Level 2: 100%
Training Topics and Suggested Time Allocation

MACHINIST – LEVEL 3

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<td>D4 Use dial indicators and digital readouts</td>
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<td>N4 Describe CNC machining centres</td>
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<td>N5 Establish co-ordinate systems and apply programming codes for machining centres</td>
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<td>N7 Create 2D and 3D models</td>
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<td>N8 Program using CAM</td>
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Total Percentage for Machinist Level 3 | 100% |
## Training Topics and Suggested Time Allocation

**MACHINIST – LEVEL 4**

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**Total Percentage for Machinist Level 4**

100%
Section 3

PROGRAM CONTENT

Machinist
Level 1
Machinist
## Line (GAC): A PERFORM SAFETY RELATED TASKS

**Competency:** A1 Describe Occupational Health and Safety Regulations

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

- Describe the Federal-Provincial Occupational Health and Safety Regulations.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>Task</th>
<th>CONTENT</th>
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</table>
| 1. Define terms used in Federal-Provincial Occupational Health and Safety Regulations | - Workers Compensation Act  
- Industrial Health and Safety Regulations  
- Federal Regulations  
- Other Federal jurisdictions  
- WHMIS (Workplace Hazardous Materials Information System) Definitions, Section 1 of the Act |
| 2. Describe the Occupational Health and Safety Regulations | - Housekeeping  
  - Confined Space  
  - Material Storage  
  - Ladders/Scaffolding  
  - Fall Arrest  
  - WHMIS  
  - Lockout/Tagout procedures  
  - Ventilation requirements  
  - Chemical and Biological substances  
  - Noise, vibration, radiation and temperature  
  - Personal protective equipment requirements  
  - Accident reporting requirements |
Line (GAC): A PERFORM SAFETY RELATED TASKS

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

- Describe the HAZMAT (Hazardous Materials Safety) and the WHMIS regulations.
- Interpret material information sheets (SDS (Safety Data Sheets) and HAZMAT).
- Apply knowledge of WHMIS and HAZMAT regulations to maintain a safe working environment.

LEARNING TASKS

1. Describe HAZMAT regulations for the transportation of hazardous materials
   - Signage
   - Reporting incidents
   - Safe handling and cleanup procedures
   - Transporting

2. State the legislation that requires suppliers of hazardous materials to provide SDS and label products as a condition of sale and importation
   - Hazardous Product Act
   - Controlled Products Regulations
   - Ingredient Disclosure List
   - Hazardous Materials Information Review Act
   - Hazardous Material Information Review Regulations

3. State the work purpose of the Workplace Hazardous Materials Information System (WHMIS)
   - Protection of Canadian workers from the adverse effects of hazardous materials through the provision of relevant information while minimizing the economic impact on industry and the disruption of trade
   - Recognition of rights
     - Workers
     - Employers
     - Suppliers
     - Regulations

4. Describe the key elements of WHMIS
   - Safety Data Sheets (SDSs)
   - Labeling of containers of hazardous materials
   - Worker educational programs

5. Describe the responsibilities of suppliers under WHMIS
   - Provide
     - SDSs
     - Labels

6. Describe the responsibilities of employers under WHMIS
   - Provide
     - SDSs
LEARNING TASKS

7. Describe information to be disclosed on a SDS
   - Hazardous ingredients
   - Preparation information
   - Product information
   - Physical data
   - Fire or explosion
   - Reactivity data
   - Toxicological properties
   - Preventive measures
   - First Aid measures

8. Identify symbols found on WHMIS labels and their meaning
   - Compressed gases
   - Flammable and combustible materials
   - Oxidizing materials
   - Poisonous and infectious materials
     - Materials causing immediate and serious side effects
     - Materials causing other toxic effects
     - Biohazardous infectious materials
   - Corrosive materials
   - Dangerously reactive materials

9. Apply WHMIS regulations as they apply to hazardous materials used in the shop
   - Use, storage and disposal of
     - Solvents
     - Cutting fluids
     - Materials
       - Metals
       - Plastic
     - Caustic cleaners
     - Cleaning solutions
     - Alcohol used for cleaning
     - Oxy-acetylene
     - Asbestos
     - Tracer dyes

10. Maintain safe working area
    - HAZMAT
    - WHMIS
Line (GAC): A
Competency A3

PERFORM SAFETY RELATED TASKS
Apply safety practices for shop areas

Objectives
To be competent in this area, the individual must be able to:
- Apply personal safety measures.
- Identify and use shop emergency equipment.
- Prevent, identify and extinguish various classes of fires.

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<td>o Hair and beards</td>
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<td>• Personal protection</td>
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<td>• Equipment and machine lock-out</td>
</tr>
<tr>
<td></td>
<td>• Ventilation systems</td>
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<td></td>
<td>• Adequate lighting</td>
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<td></td>
<td>• Clear-headed</td>
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<td></td>
<td>o Substance abuse</td>
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<td></td>
<td>o Sleep deprivation</td>
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<td></td>
<td>o Personal distractions</td>
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<td></td>
<td>• Horseplay</td>
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<td></td>
<td>• Respect for others safety</td>
</tr>
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<td></td>
<td>• Constant awareness of surroundings</td>
</tr>
<tr>
<td></td>
<td>• Lifting</td>
</tr>
<tr>
<td></td>
<td>• WorkSafe BC requirements</td>
</tr>
<tr>
<td></td>
<td>• Electrical isolation</td>
</tr>
<tr>
<td>2. Lock-out equipment prior to service</td>
<td>• Lock and tag</td>
</tr>
<tr>
<td></td>
<td>• Secure other systems</td>
</tr>
<tr>
<td></td>
<td>o Mechanical</td>
</tr>
<tr>
<td></td>
<td>o Hydraulic</td>
</tr>
<tr>
<td></td>
<td>• Pneumatic</td>
</tr>
</tbody>
</table>
LEARNING TASKS

3. Locate shop emergency equipment and means of egress
   - Emergency shutoffs
   - Fire control systems
   - Eye wash facilities
   - Emergency exits
   - First aid facilities
   - Emergency contact phone numbers
   - Evacuation procedures
   - Outside meeting place
   - Disaster meeting place

4. Describe the conditions necessary to support a fire
   - Air
   - Fuel
   - Heat

5. Describe the classes of fires according to the materials being burned
   - Class A
   - Class B
   - Class C
   - Class D
   - Symbols and colours

6. Apply preventative fire safety precautions when working near, handling or storing flammable liquids or gases, combustible materials and electrical apparatus
   - Solvents
   - Heat treatment salts
   - Oxygen
   - Acetylene
   - LPG and CNG
   - Ventilation
     - Purging
   - Lubricants
   - Oily rags
   - Combustible metals
   - Aerosols

7. Describe the considerations and steps to be taken prior to fighting a fire
   - Warning others and fire departments
   - Evacuation of others
   - Containable fire
   - Personal escape route
   - Training

8. Describe the procedure for using a fire extinguisher
   - P.A.S.S.
     - Pull
     - Aim
     - Squeeze
     - Sweep

9. Explain how a mentor can help an apprentice
   - Acceptance of constructive criticism
LEARNING TASKS

CONTENT

- Listening skills
- Accountability
- Patience
- Share
  - Experiences
  - Knowledge
- Pride in trade
### A PERFORM SAFETY RELATED TASKS

#### Competency A4 Use lifting equipment

#### Objectives
To be competent in this area, the individual must be able to:
- Apply the Occupational Health and Safety Regulation to lifting and blocking applications.
- Select, use and maintain lifting, securing and blocking equipment.

#### LEARNING TASKS

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>LEARNING TASKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply the Occupational Health and Safety Regulation</td>
<td>1. Apply the Occupational Health and Safety Regulation</td>
</tr>
<tr>
<td>Types</td>
<td>2. Determine load masses</td>
</tr>
<tr>
<td>Capacities</td>
<td>• Types</td>
</tr>
<tr>
<td>Manufacturer’s specification</td>
<td>• Capacities</td>
</tr>
<tr>
<td>Estimation</td>
<td>• Load capacities</td>
</tr>
<tr>
<td>Types</td>
<td>3. Select, use and maintain securing equipment</td>
</tr>
<tr>
<td>Types</td>
<td>• Types</td>
</tr>
<tr>
<td>Clamps</td>
<td>• Capacities</td>
</tr>
<tr>
<td>Material racks</td>
<td>• Load capacities</td>
</tr>
<tr>
<td>Blocking</td>
<td>4. Select, use and maintain wire ropes, chains and lifting straps</td>
</tr>
<tr>
<td>Types</td>
<td>• Types</td>
</tr>
<tr>
<td>Capacities</td>
<td>• Capacities</td>
</tr>
<tr>
<td>Rigging attachments</td>
<td>• Load capacities</td>
</tr>
<tr>
<td>Lifting attachments</td>
<td>5. Use visual and sound signals</td>
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<tr>
<td>Types</td>
<td>• Occupational Health and Safety Regulation (Part 15)</td>
</tr>
<tr>
<td>Capacities</td>
<td>6. Select, use and maintain hoisting equipment</td>
</tr>
<tr>
<td>Operation</td>
<td>• Types</td>
</tr>
<tr>
<td>Equipment storage</td>
<td>• Capacities</td>
</tr>
<tr>
<td>Visual inspection</td>
<td>• Load capacities</td>
</tr>
<tr>
<td>Expiry date</td>
<td>7. Lift, hoist and move loads</td>
</tr>
<tr>
<td>Damage</td>
<td>• Determine safe working load</td>
</tr>
<tr>
<td>Defects</td>
<td>• Determine correct slinging procedure</td>
</tr>
<tr>
<td>Sling or chain placement</td>
<td>8. Manoeuvre large objects</td>
</tr>
<tr>
<td>Flipping</td>
<td>• Centre of gravity</td>
</tr>
<tr>
<td>Rotating</td>
<td>• Sling or chain placement</td>
</tr>
<tr>
<td>Centre of gravity</td>
<td></td>
</tr>
<tr>
<td>Sling or chain placement</td>
<td></td>
</tr>
</tbody>
</table>
### Line (GAC): B  
PERFORM HAND PROCESSES

**Competency:** B1  
Use and maintain hand tools

#### Objectives

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

- Select, use and maintain hand tools.
- Select, use and maintain appropriate guarding and personal protective equipment.

#### LEARNING TASKS

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>LEARNING TASKS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CONTENT</strong></td>
<td>1. Use protective equipment associated with the use of tools and shop equipment</td>
</tr>
<tr>
<td><strong>Personal protection</strong></td>
<td>• Plan sequence of operations</td>
</tr>
<tr>
<td>o Head</td>
<td>• Wrenches</td>
</tr>
<tr>
<td>o Hands</td>
<td>• Screwdrivers</td>
</tr>
<tr>
<td>o Lungs</td>
<td>• Cutting</td>
</tr>
<tr>
<td>o Eyes</td>
<td>o Saws</td>
</tr>
<tr>
<td>o Ears</td>
<td>o Abrasives</td>
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<tr>
<td>o Feet</td>
<td>o Files</td>
</tr>
<tr>
<td>o Clothing</td>
<td>o Taps and dies</td>
</tr>
<tr>
<td>• Screening</td>
<td>• Hammers</td>
</tr>
<tr>
<td>• Guarding</td>
<td>• Chisels/punches</td>
</tr>
<tr>
<td>• Ventilation</td>
<td>• Clamping tools</td>
</tr>
<tr>
<td>• Clean up</td>
<td>• Pullers</td>
</tr>
<tr>
<td>• Lock out</td>
<td>• Vises</td>
</tr>
<tr>
<td>2. Select, use and maintain hand tools</td>
<td><strong>CONTENT</strong></td>
</tr>
</tbody>
</table>

### Machinist Industry Training Authority 28

Harmonized Program Outline  
02/19

**Machinist Harmonized Program Outline**  
Industry Training Authority  
28
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

Achievement Criteria

Performance  The learner will be able to produce a drill-point gauge.

Conditions  The learner will be given:
  - Material
  - Measuring tools
  - Layout tools
  - Files
  - Hacksaws
  - Drills

Criteria  The learner will be evaluated on:
  - Accuracy
  - Tolerances
  - Finish
Line (GAC): B PERFORM HAND PROCESSES
Competency: B2 Use layout tools

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

- Perform layout procedures.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Select layout tools</td>
<td>• Layout dye</td>
</tr>
<tr>
<td></td>
<td>• Scribers</td>
</tr>
<tr>
<td></td>
<td>• Dividers</td>
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<tr>
<td></td>
<td>• Centre punch</td>
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<td></td>
<td>• Height gauges</td>
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<td></td>
<td>• Rulers</td>
</tr>
<tr>
<td></td>
<td>• Combination set</td>
</tr>
<tr>
<td></td>
<td>• Surface gauge</td>
</tr>
<tr>
<td></td>
<td>• V-blocks</td>
</tr>
<tr>
<td></td>
<td>• Angle plates</td>
</tr>
<tr>
<td>2. Describe layout procedures</td>
<td>• Material selection</td>
</tr>
<tr>
<td></td>
<td>o Adequate stock size</td>
</tr>
<tr>
<td></td>
<td>• Establish procedures steps</td>
</tr>
<tr>
<td></td>
<td>• Datum points</td>
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<tr>
<td></td>
<td>• Datum faces</td>
</tr>
<tr>
<td></td>
<td>• Tool selection</td>
</tr>
<tr>
<td>3. Perform layout procedures</td>
<td>• As in Learning Task 1 and 2</td>
</tr>
</tbody>
</table>
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

Line (GAC): B PERFORM HAND PROCESSES
Competency: B3 Use and maintain handheld power tools

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

- Describe handheld power tool safety.
- Select, use and maintain handheld power tools and accessories.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe handheld power tool safety</td>
<td>• Personal protective equipment</td>
</tr>
<tr>
<td></td>
<td>• Guards</td>
</tr>
<tr>
<td></td>
<td>• Electrical cords</td>
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<tr>
<td></td>
<td>• Operating procedures</td>
</tr>
<tr>
<td></td>
<td>• Securing work</td>
</tr>
<tr>
<td></td>
<td>• Compressed air</td>
</tr>
<tr>
<td></td>
<td>• Tool maintenance</td>
</tr>
<tr>
<td>2. Select handheld power tools</td>
<td>• Electric</td>
</tr>
<tr>
<td></td>
<td>• Cutting</td>
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<tr>
<td></td>
<td>• Grinding</td>
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<td>• Drilling</td>
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<td>• Pneumatic</td>
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<td>• Cutting</td>
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<tr>
<td></td>
<td>• Grinding</td>
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<tr>
<td></td>
<td>• Drilling</td>
</tr>
<tr>
<td>3. Select and maintain handheld power tool accessories</td>
<td>• Grinding disk speeds</td>
</tr>
<tr>
<td></td>
<td>• Burr speeds</td>
</tr>
<tr>
<td></td>
<td>• Cut-off wheels</td>
</tr>
<tr>
<td></td>
<td>• Abrasive discs</td>
</tr>
<tr>
<td></td>
<td>• Saw blades</td>
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<tr>
<td></td>
<td>• Band</td>
</tr>
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<td></td>
<td>• Circular</td>
</tr>
<tr>
<td>4. Use handheld power tools</td>
<td>• As in learning tasks 2 and 3</td>
</tr>
</tbody>
</table>
Line (GAC): B PERFORM HAND PROCESSES
Competency: B4 Mark material and workpiece for identification

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

- Identify and describe marking procedures.
- Mark material and workpiece without causing functional damage.

LEARNING TASKS

1. Identify and describe material and workpiece marking procedures
   - Etching
   - Engraving
   - Colour coding
   - Stamping

2. Mark material and workpiece
   - Engraving
   - Colour coding
   - Ink stamping
   - Acid etching
Line (GAC): C USE APPLIED MATHEMATICS
Competency: C1 Solve problems involving formulas

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

- Perform calculations using formulas.
- Solve problems using algebra.
- Calculate ratios.

LEARNING TASKS

1. Use formulas
   - Trigonometry
   - Feeds and Speeds
   - Circumference
   - Area
   - Volume
   - Mass
   - Tapers

2. Use a scientific calculator
   - Brackets
   - Memory
   - Fractions
   - Percentages
   - Conversions
   - Trigonometry
   - Inversion
   - Power
   - Roots
   - Constants

3. Use algebra
   - Proportions
   - Transpose formulas

4. Apply ratios
   - Direct
   - Inverse
Line (GAC): C  USE APPLIED MATHEMATICS
Competency: C2  Perform metric/imperial conversions

Objectives
To be competent in this area, the individual must be able to:
• Perform metric/imperial conversions.

LEARNING TASKS

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Define metric units</td>
<td>Length, Mass, Volume, Temperature</td>
</tr>
<tr>
<td>2. Define metric prefixes</td>
<td>Place value, Scientific notation</td>
</tr>
<tr>
<td>3. Define imperial units</td>
<td>Length, Mass, Volume, Temperature</td>
</tr>
<tr>
<td>4. Calculate conversions</td>
<td>Length, Mass, Volume, Temperature</td>
</tr>
</tbody>
</table>
Line (GAC): C  USE APPLIED MATHEMATICS
Competency: C3  Solve problems involving geometry

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

- Identify types of angular geometric principles.
- Perform geometric constructions.

LEARNING TASKS

1. Identify geometric principles
   - Bisect lines
   - Bisect angles
   - Right angles
   - Perpendicular lines
   - Parallel lines
   - Arcs
   - Tangents

2. Describe geometric figures
   - Circle
   - Sphere
   - Rectangle
   - Triangle
   - Trapezoid
   - Ellipse

3. Perform geometric constructions
   - Generate basic geometric figures
     - Circle
     - Rectangle
     - Triangle
     - Trapezoid
   - Perpendicular bisector of a line
   - Perpendicular at point on a line segment
   - Lines parallel to a given line
   - Bisect a given angle
   - Tangents to a circle
   - Divide a line segment
Line (GAC): C USE APPLIED MATHEMATICS
Competency: C4 Solve problems involving mass, area and volume

Objectives
To be competent in this area, the individual must be able to:
• Calculate mass, area and volume.

LEARNING TASKS

1. Calculate mass

   - Weight
     - Steel
     - Aluminum
     - Fluids
   - Specific Gravity

2. Calculate area

3. Calculate volume

   - Two dimensional geometric shapes

   - Three dimensional geometric shapes
Line (GAC): C  USE APPLIED MATHEMATICS
Competency: C5  Solve problems involving trigonometry

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

• Apply trigonometry applications.

LEARNING TASKS

1. Describe trigonometry
   • Pythagoras theorem
   • Triangles
   • Sine
   • Cosine
   • Tangent

2. Use applied trigonometry
   • Bolt circles
   • Layout procedures
     ◦ Chords
Line (GAC): D USE MEASURING TOOLS
Competency: D1 Use linear and Vernier scales

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

- Use linear and Vernier scales.

LEARNING TASKS

1. Describe linear and Vernier scales
   - Imperial rule
   - Metric rule
   - Decimal rule
   - Caliper and Height Gauges
     - Vernier
     - Dial
     - Digital
   - Protractor
   - Care and maintenance

2. Use linear and Vernier scales
   - Imperial rule
   - Metric rule
   - Decimal rule
   - Caliper and Height Gauges
     - Vernier
     - Dial
     - Digital
   - Protractor
   - Care and maintenance
Line (GAC): D USE MEASURING TOOLS
Competency: D2 Use micrometers

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

- Use and maintain a micrometer.

LEARNING TASKS

1. Describe micrometers
   - Types
     - Outside
     - Inside
     - Depth
     - Thread
   - Parts
   - Calibrate
   - Care and Maintenance

2. Use micrometers
   - Types
     - Outside
     - Inside
     - Depth
     - Thread
   - Parts
   - Calibrate
   - Care and Maintenance
Line (GAC): D USE MEASURING TOOLS
Competency: D3 Use calipers and gauges

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

- Use calipers and gauges.

LEARNING TASKS

1. Describe calipers

   • Types
     o Inside
     o Outside
     o Hermaphrodite
     o Transfer

2. Describe gauges

   • Types
     o Radius
     o Telescopic

3. Use calipers

   • Types
     o Inside
     o Outside
     o Hermaphrodite
     o Transfer

4. Use gauges

   • Types
     o Radius
     o Telescopic
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

Line (GAC): D USE MEASURING TOOLS
Competency: D4 Use dial indicators and digital readouts

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

• Use dial indicators.

LEARNING TASKS

1. Describe dial indicators
   • Types and features
     o Clock type
     o Finger type
   • Graduations
   • Accessories
   • Care and maintenance

2. Use dial indicators
   • True workpiece
     o Lathe
   • Comparing measurements
   • Setting up
   • Measuring
   • Workpiece inspection
   • Care and maintenance
Line (GAC): D USE MEASURING TOOLS
Competency: D5 Use optical measuring equipment

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

- Describe optical measuring equipment.

LEARNING TASKS

1. Describe optical comparators

CONTENT

- Types
  - Profiles
  - Reflection
- Components
  - Light source
  - Screen
  - Lenses
  - Table with micrometer adjustment
  - Centre
  - Vise
  - Angle plate
- Applications
  - Measuring
    - Thread forms
    - Profiles
    - Engraving
    - Angles
    - Radii
### Program Content

**Line (GAC):** E  **INTERPRET DRAWINGS AND REFERENCE MATERIALS**

**Competency:** E1 Interpret information found on drawings

#### Objectives

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

- Identify information found on drawings.

#### LEARNING TASKS

<table>
<thead>
<tr>
<th>No.</th>
<th>Task Description</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Identify lines found in drawings</td>
<td>Line types</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Solid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Centre</td>
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<td>- Hidden</td>
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<td>- Extension</td>
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<td>- Dimension</td>
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<td>- Section</td>
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<td></td>
<td></td>
<td>- Construction</td>
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<td>Purpose</td>
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<tr>
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<td></td>
<td>Application</td>
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<tr>
<td>2.</td>
<td>Identify symbols found in drawings</td>
<td>Symbol types</td>
</tr>
<tr>
<td></td>
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<td>- Surface finish</td>
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<tr>
<td></td>
<td></td>
<td>- Welding</td>
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<td>- Datum</td>
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<td></td>
<td></td>
<td>- Geometric tolerance</td>
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<td>- Diameter</td>
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<td>- ISO</td>
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<td>Purpose</td>
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<td></td>
<td></td>
<td>Application</td>
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<tr>
<td>3.</td>
<td>Identify views and projections</td>
<td>Types</td>
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<tr>
<td></td>
<td></td>
<td>- Orthographic projections</td>
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<tr>
<td></td>
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<td>- 1st and 3rd angle</td>
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<tr>
<td></td>
<td></td>
<td>- Isometric views</td>
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<td>- Oblique views</td>
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<td>- Shop Sketches (working drawings)</td>
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<tr>
<td></td>
<td></td>
<td>Purpose</td>
</tr>
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<td></td>
<td></td>
<td>Application</td>
</tr>
</tbody>
</table>
LEARNING TASKS

4. Interpret title block information

CONTENT

- Scale
- Revisions
- Date
- Material
  - Type
  - Size
- Tolerances
- Projection type
- Measurement system
Line (GAC): E   INTERPRET DRAWINGS AND REFERENCE MATERIALS
Competency: E2  Determine project requirements

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

• Determine project requirements from a drawing or sample.

LEARNING TASKS

1. Determine project requirements

CONTENT

• Drawing / sample assessment
  o Requirements
    − Tooling
    − Benchwork
    − Machines
    − Materials
    − Fixturing
  • QC / QA
Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS
Competency: E3 Sketch machined parts

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

- Sketch and dimension an orthographic drawing from an existing part.
- Sketch and dimension an orthographic drawing from an isometric or oblique view.

LEARNING TASKS

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information required for part manufacture</td>
</tr>
<tr>
<td>Necessary views</td>
</tr>
<tr>
<td>Dimensioning</td>
</tr>
<tr>
<td>Material</td>
</tr>
<tr>
<td>Tolerances</td>
</tr>
</tbody>
</table>

1. Sketch and dimension an orthographic drawing from an existing part

2. Sketch and dimension an orthographic drawing from an isometric or oblique view

Achievement Criteria

Performance
The learner will be able to sketch an isometric and orthographic drawing.

Conditions
The learner will be given:
- Part / drawing
- Ruler
- Graph paper

Criteria
The learner will be evaluated on:
- Clarity
- Neatness
- Dimensioning
Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS
Competency: E4 Use Machinery’s Handbook and other reference materials

Objectives
To be competent in this area, the individual must be able to:
- Identify and locate information in the Machinery’s Handbook.
- Use other reference materials and resources to locate information.

LEARNING TASKS

1. Identify information found in the Machinery’s Handbook
   • Types
     o Charts
     o Tables
     o Threads

2. Locate information in the Machinery’s Handbook
   • Familiarization with book layout
   • Index
   • Section tabs
   • Tables
   • Thread data
   • Fits and tolerances
   • Formulas
   • Speeds and feeds

3. Use other reference materials
   • Tooling catalogues
   • Trade specific magazines
   • Trade bulletins
   • Internet
   • Machine manuals
   • Job plan
     o Machine limitations
   • Quality Control Documentation
     o Inspection sheets
     o Blueprints
Line (GAC): E  INTERPRET DRAWINGS AND REFERENCE MATERIALS

Competency: E5  Describe fits and tolerances

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

- Describe fits and tolerances.

**LEARNING TASKS**

1. Describe fits and tolerances

   - Standards
     - ANSI
     - ISO
   - Types
     - Fits
     - Tolerances
   - Applications

2. Describe surface finishes

   - Types
   - Methods of Measurement
     - Comparative
     - Stylus
   - Applications
Line (GAC):       F SELECT MATERIALS
Competency:       F1 Describe principles of metallurgy

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

- Describe the manufacture of iron and steel.

LEARNING TASKS
1. Describe smelting process

   - Coke
   - Iron ore
   - Limestone
   - Process

2. Describe steel manufacturing processes

   - Pig iron
   - Cast iron
   - Hot rolled & cold rolled
     - Plain carbon steel
     - Alloy Steel
Line (GAC): F SELECT MATERIALS
Competency: F2 Describe characteristics of ferrous metals

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

- Describe the SAE and AISI classifications.
- Identify steel characteristics by their designations.

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<th>LEARNING TASKS</th>
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<tr>
<td>1. Describe Society of Automotive Engineers (SAE) and American Iron and Steel Institute (AISI) classifications</td>
<td>Plain carbon steels</td>
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<td>Standard alloy steels</td>
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<td>- Applications</td>
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</table>

Machinist
Harmonized Program Outline
02/19
Line (GAC): F SELECT MATERIALS
Competency: F7 Describe the use and maintenance of fuel gas equipment

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

- Describe the operation and maintenance of fuel gas equipment.

LEARNING TASKS

1. Describe the operation and maintenance of fuel gas equipment

CONTENT

- Safety considerations
- System set-up
- Torch Operations
  - Welding
  - Cutting
  - Soldering
  - Brazing
- Oxyacetylene and MAPP gas
  - Flashback arrestors
  - Regulators
- Propane
  - Liquid and gas
  - Temperature
  - Ventilation
- Maintenance of fuel gas equipment
- Storage of fuel gas equipment
  - Recognizing worn, damaged or defective fuel gas equipment
Line (GAC): G REFURBISH COMPONENTS
Competency: G1 Identify fasteners

Objectives
To be competent in this area, the individual must be able to:
• Identify fasteners for applications.

LEARNING TASKS

1. Identify fastener types

CONTENT
• Rivets
• Dowels/pins
• Threaded fasteners
  o Metric/Imperial
  o Grades/Markings
• Washers
• Locking devices
• Retainers
Line (GAC): G  REFURBISH COMPONENTS
Competency: G2  Identify lubricants and sealants

Objectives
To be competent in this area, the individual must be able to:
• Describe lubricants and sealants and their applications

LEARNING TASKS

1. Describe lubricants
   • Purpose
   • Types
     o Oils
     o Greases
     o Dry Lubricants
   • Applications

2. Describe sealants
   • Purpose
   • Types
   • Applications
Line (GAC):  H  USE DRILLING MACHINES
Competency:  H1  Describe drilling machines

Objectives
To be competent in this area, the individual must be able to:
- Describe drilling machines and their applications.

LEARNING TASKS

1. Describe drilling machines
   - Types
     - Sensitive
     - Radial arm
     - Magnetic base
     - Upright
   - Machine size
   - Applications

2. Identify the parts of the drilling machines
   - Column
   - Table
   - Base
   - Spindle
   - Chuck
   - Quill feed
   - Power feed

3. Describe work holding devices
   - Types
     - V-block
     - Vise
     - Angle plate
     - Jigs and fixtures
       - Drill bushings
   - Clamps and hold-downs
Line (GAC): H USE DRILLING MACHINES
Competency: H2 Select and maintain cutting tools

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

- Select and maintain cutting tools.

LEARNING TASKS

1. Select cutting tools

- Drill sharpening
  - Point-angle
  - Flat bottom
  - Split point
  - Web thinning
  - Brassing

2. Maintain cutting tools

- Types
  - Drills
  - Reamers
  - Countersinks
  - Counterbores
  - Spot facer
  - Taps
  - Boring bars
  - Hole saws

- Boring tools
Line (GAC): H USE DRILLING MACHINES
Competency: H3 Operate and maintain drilling machines

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

- Perform clamping and fixturing.
- Operate and maintain drilling machine.

LEARNING TASKS

1. Calculate speeds (RPM) and feeds
   - Surface speed
   - Diameter of cutter
   - Chip load

2. Perform clamping
   - Safety concerns
   - Types
     - V-blocks
     - Vises
     - Angle plates
     - Jigs and fixtures
       - Drill bushings
   - Clamps and hold-downs

3. Install and remove tooling
   - Types
     - Chucks
     - Sleeves
     - Tapping heads
     - Boring bar
   - Accessories
     - Drift
     - Chuck key
### LEARNING TASKS

<table>
<thead>
<tr>
<th>Task</th>
<th>Content</th>
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</thead>
</table>
| 3. Operate drilling machines                                         | • Layout material  
|                                                                      | • Centre punch  
|                                                                      | • Pulling a drill  
|                                                                      | • Pilot drill  
|                                                                      | • Drill  
|                                                                      | • Chamfer  
|                                                                      | • Ream  
|                                                                      | • Counter bore  
|                                                                      | • Tap  |
| 5. Maintain drilling machines                                        | • Lubricate  
|                                                                      | • Clean  
|                                                                      | • Housekeeping  |
| 6. Describe the purpose and usage of cutting fluids with drilling machines | • Lubrication  
|                                                                      | • Cooling  
|                                                                      | • Chip removal  
|                                                                      | • Tool life  |
| 7. Select types of cutting fluids for specific applications          | • Types  
|                                                                      |   o Straight oils  
|                                                                      |   o Soluble oils  
|                                                                      |   o Semi-synthetic  
|                                                                      |   o Synthetic  
|                                                                      |   o Misting  |

### Achievement Criteria

**Performance**  The learner will be able to drill and tap a block to specifications.

**Conditions**  The learner will be given:
- Material  
- Measuring tools  
- Layout tools  
- Drills  
- Taps

**Criteria**  The learner will be evaluated on:
- Accuracy  
- Tolerances  
- Finish
Line (GAC): I USE POWER SAW
Competency: I1 Describe power saws

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

- Describe power saws and their applications.

LEARNING TASKS

<table>
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<tr>
<th>CONTENT</th>
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<tr>
<td><strong>1.</strong> Describe power saws</td>
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<tr>
<td>- Types</td>
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<tr>
<td>- Band saw</td>
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<td>- Parts</td>
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<tr>
<td>- Accessories</td>
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</tbody>
</table>

| **2.** Describe power saw applications |
| - Cut off |
| - Contour |

| **3.** Describe work holding devices |
| - Types |
| - V-block |
| - Vises |
| - Fixtures |
### Line (GAC): I USE POWER SAWS

**Competency:** I2 Select and maintain band saw blades

#### Objectives
To be competent in this area, the individual must be able to:
- Select and maintain band saw blades.

#### LEARNING TASKS

<table>
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<th>LEARNING TASKS</th>
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<td>1. Select band saw blades</td>
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<td>- Thickness</td>
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<td></td>
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<td>Silver solder</td>
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<tr>
<td></td>
<td>Storage procedures</td>
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</tbody>
</table>
Line (GAC): I USE POWER SAWS
Competency: I3 Operate and maintain band saws

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

• Install and remove blades.
• Operate and maintain band saws.

LEARNING TASKS

1. Set speeds and feeds
   - Material
     o Type
     o Size
     o Profile
   - Blade
     o Size
     o Type
     o Pitch
     o Tooth style
     o Tooth set

2. Perform clamping
   - Types
     o V-block
     o Vise
     o Fixtures

3. Install and remove blades
   - Clamps and hold-downs
   - Blade
     o Inspection
     o Direction
     o Alignment
     o Tension
     o Break in procedures
     o Coiling
   - Guide selection
   - Clean guide wheels and guides
   - Cut-off
4. Operate band saws
   • Cut-off
     o Speed and feed
     o Power feed
     o Coolants and lubricants
     o Clamping
     o Work support aids
   • Contour
     o Speed and feed
     o Power feed
     o Coolants and lubricants
     o Cutting aids
     o Circle attachment
   • Pusher

5. Quality control for component
   • First article inspection
   • Verify
     o Material
     o Drawing
       − Revision
     o Traceability
   • Dimensional conformance
   • Measuring tools calibrated

6. Maintain band saws
   • Lubricate
   • Clean
   • Housekeeping

7. Describe the purpose and usage of cutting fluids with band saws
   • Lubrication
   • Cooling
   • Chip removal
   • Tool life

8. Select types of cutting fluids for applications
   • Types
     o Straight oils
     o Soluble oils
     o Semi-synthetic
     o Synthetic
     o Misting
Line (GAC):  I  USE POWER SAWS
Competency:  I4  Operate and maintain other saws

Objectives
To be competent in this area, the individual must be able to:
• Operate and maintain cold saws, abrasive saws, and reciprocating saws.

LEARNING TASKS

1. Operate and maintain cold saws
   • Set speeds
   • Work holding
   • Blade selection
   • Blade removal and installation
   • Operation
   • Maintenance
     o Lubricate
     o Clean
     o Housekeeping

2. Operate and maintain abrasive saws
   • Work holding
   • Wheel removal and installation
   • Operations
   • Maintenance
     o Lubricate
     o Clean
   • Housekeeping
Line (GAC): J USE LATHES
Competency: J1 Describe lathes

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

• Describe lathes and their applications.
• Identify parts of lathes and their functions.

LEARNING TASKS

1. Describe lathes

   • Types
     o Engine
     o Turret
     o Vertical
       – Boring
       – Turret
     o Tool room
     o Screw type
     o Swiss
     o CNC
   • Size
     o Swing
     o Length

2. Identify the parts of the lathe and their function

   • Bed
     o Ways
     o Gap
   • Headstock
     o Spindle
     o Speed change
     o Spindle nose style
   • Feed system
     o Feed shaft
     o Lead screw
     o Change gears
     o Quick change gearbox
   • Carriage
     o Saddle
     o Compound slide
     o Cross slide
     o Apron
     o Thread chasing dial
3. Describe lathe accessories
   - Face plate
   - Steady rest
   - Follower rest
   - Cat head
   - Spider
   - Taper turning attachment
   - Radius cutting attachment
   - Tool post
     - American style
     - Square/Four-way box
     - Quick change
     - Boring bar holder
   - Chuck
     - Three-jaw
     - Four-jaw
     - Six-jaw
     - Collet
     - Magnetic
   - Centers

4. Describe lathe applications
   - Turning
   - Drilling
   - Boring
   - Threading
     - Internal
     - External
   - Facing
   - Tapers
   - Knurling
   - Contour
   - Profile
   - Parting
   - Spring winding
   - Radius turning
**Objectives**
To be competent in this area, the individual must be able to:

- Describe tool geometry.
- Describe cutting tools and holders and their applications.

**LEARNING TASKS**

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<th>LEARNING TASKS</th>
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<td></td>
<td>• Parting</td>
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</tbody>
</table>
Line (GAC): J USE LATHES
Competency: J3 Operate and maintain lathes

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

- Calculate RPM.
- Operate and maintain lathes.

LEARNING TASKS

1. Calculate speeds (RPM) and feeds
   - Surface speed
   - Diameter of work
   - Chip load

2. Determine depth of cut
   - Rigidity
   - Horsepower
   - Tooling

3. Support and clamp workpiece
   - Material
     - Size
     - Shape
   - Machining operation
   - Rigidity
   - Power

4. Install and remove tooling
   - Select tool for application
   - Maintain tool
   - Tool height
   - Tool angle

5. Operate lathes
   - Plan sequence of operation
   - Set-up sequence
     - Mounting workpiece
     - Truing workpiece
     - Balancing workpiece
     - Centering workpiece
   - Roughing
     - Speeds and feeds
     - Cutters
     - Depth of cut
     - Measuring
     - Material allowance for finishing
LEARNING TASKS

6. Quality control for component

7. Maintain lathes

8. Describe the purpose and usage of cutting fluids with lathes

9. Select types of cutting fluids for applications

CONTENT

- Finishing
  - Speeds and feeds
  - Cutter
  - Depth of cut
  - Deburring
  - Measuring

- Operations
  - Facing
  - Turning
  - Drilling
  - Boring
  - Tapers
  - Knurling
  - Parting
  - Forming
  - Radius
  - Chamfer

- First article inspection
- Verify
  - Material
  - Drawing
    - Revision
  - Traceability
- Dimensional conformance
- Measuring tools calibrated

- Lubricate
- Clean
- Housekeeping
- Coolant / cutting fluid

- Lubrication
- Cooling
- Chip removal
- Tool life

- Types
  - Straight oils
  - Soluble oils
  - Semi-synthetic
  - Synthetic
Achievement Criteria

Performance  Using a lathe, the learner will be able to turn diameters and shoulders to specifications.

Conditions  The learner will be given:
  • Drawing
  • Material
  • Tools and equipment
  • Measuring tools

Criteria  The learner will be evaluated on:
  • Accuracy
  • Tolerances
  • Finish
Line (GAC): J USE LATHES
Competency: J4 Cut Tapers

Objectives
To be competent in this area, the individual must be able to:
• Cut and measure tapers.

LEARNING TASKS

1. Describe tapers
   • Standard
     o Morse
     o Jarno
     o Milling machine (NMTB)

2. Describe methods of cutting tapers
   • Taper attachment
     o Plain
     o Telescoping
   • Compound slide
   • Tailstock offset

3. Calculate tapers
   • Taper angle
     o Center line
     o Included
   • Taper per inch/foot
   • Taper (metric)
   • Calculate tailstock offset

4. Cut tapers
   • Plan sequence of operation
   • Set-up sequence
     o Angle set-up
     o Mounting workpiece
     o Truing workpiece
     o Balancing workpiece
     o Centering workpiece
   • Roughing
     o Speeds and feeds
     o Tools
     o Depth of cut
     o Measuring
     o Material allowance for finishing
   • Finishing
     o Speeds and feeds
     o Depth of cut
LEARNING TASKS

CONTENT

- Deburring
- Measuring

- Measure
  - Gauge
  - Micrometer
  - Dial indicator

Achievement Criteria

Performance
Using a lathe, the learner will be able to turn tapers to specifications

Conditions
The learner will be given:
- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria
The learner will be evaluated on:
- Accuracy
- Tolerances
- Finish
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

Line (GAC): K USE MILLING MACHINES
Competency: K1 Describe milling machines

Objectives
To be competent in this area, the individual must be able to:
• Describe milling machines and their accessories.

LEARNING TASKS

1. Describe types of milling machines
   • Vertical spindle
     o Ram type
     o Ram turret
     o Gear head
   • Horizontal spindle
     o Plain
     o Universal
   • Planer mill
   • Bed mill
   • CNC

2. Identify the parts of the milling machine and their function
   • Base
   • Column
   • Knee
   • Saddle
   • Table
   • Spindle nose
   • Quill
   • Backlash eliminator
   • Over arm support
   • Ram
   • Turret
Line (GAC): K USE MILLING MACHINES
Competency: K2 Describe cutting tools and holders

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

- Describe cutting tools and holders.

LEARNING TASKS

1. Describe types of cutters and holders

CONTENT

- Horizontal and vertical
  - Face mill
  - End mill
- Arbor
  - Style C
- Holders
  - Morse taper
  - Collet
  - End mill
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

Line (GAC): L USE SUPPORT MACHINES
Competency: L1 Operate and Maintain Pedestal Grinders

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

- Operate and maintain pedestal grinders.

LEARNING TASKS

1. Identify abrasives and their applications
   - Aluminum dioxide
   - Silicon carbide
   - Cubic boron nitride (CBN)
   - Diamond

2. Describe the Standard Marking System
   - Grit
   - Grade
   - Structure
   - Bond

3. Operate and maintain pedestal grinder to sharpen a drill
   - Personal Protective Equipment
   - Wheel
     - Selection
     - Safe operating speed
     - Ring test
     - Mounting
     - Guards
     - Tool rest
     - Truing and dressing
   - Maintenance
     - Cleaning
     - Visual inspection
   - Housekeeping

Achievement Criteria

Performance Using a pedestal grinder, the learner will be able to sharpen a drill to specifications.

Conditions The learner will be given:

- Drills
- Tools and equipment
- Measuring tools
Criteria | The learner will be evaluated on:
---|---
• Hole size produced
• Proper drill geometry
Objectives
To be competent in this area, the individual must be able to:

- Operate and maintain arbor and hydraulic presses.

LEARNING TASKS

1. Operate arbor presses
   - Safety precautions
     - Guards
     - Personal protective equipment
     - Housekeeping
   - Press set-up
     - Workpiece alignment
   - Fixturing

2. Maintain arbor presses
   - Lubricate
   - Clean
   - Housekeeping

3. Operate hydraulic presses
   - Safety precautions
     - Guards
     - Personal protective equipment
     - Housekeeping
   - Press set-up
     - Workpiece alignment
     - Fixturing
     - Table
     - Adjustment
     - Alignment
     - Securement
     - Ram positioning
   - Relationship between force, pressure and area

4. Maintain hydraulic presses
   - Hydraulics
     - Inspection
     - Fluid levels
   - Lubricate
   - Clean
   - Housekeeping
Line (GAC): L USE SUPPORT MACHINES
Competency: L3 Operate and maintain hones and lapping machines

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

- Describe hones and lapping machines.

LEARNING TASKS

1. Describe hones and lapping machines

CONTENT

- Hones
  - Purpose
  - Construction
  - Applications

- Lapping machines
  - Purpose
  - Construction
  - Applications
Level 2
Machinist
### Line (GAC): C USE APPLIED MATHEMATICS

**Competency:** C1 Solve Problems Involving Formulas

#### Objectives

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

- Perform calculations using formulas.

#### LEARNING TASKS

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<thead>
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<th>CONTENT</th>
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<tbody>
<tr>
<td>Chords</td>
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<tr>
<td>Pitch circles</td>
</tr>
</tbody>
</table>

1. Use formulas
Line (GAC): C USE APPLIED MATHEMATICS
Competency: C3 Solve problems involving geometry

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

- Solve geometric problems.

LEARNING TASKS

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<tr>
<th>CONTENT</th>
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<tbody>
<tr>
<td>Point of tangency</td>
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<tr>
<td>Corresponding angles</td>
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<tr>
<td>- Complimentary angles</td>
</tr>
<tr>
<td>- Supplimentary angles</td>
</tr>
</tbody>
</table>

1. Solve geometric problems
Line (GAC): C USE APPLIED MATHEMATICS
Competency: C5 Solve problems involving trigonometry

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

- Apply trigonometry applications.

LEARNING TASKS

1. Use applied trigonometry

   CONTENT
   - Layout procedures
     - Chords
     - Bolt-hole pattern
   - Sine bar calculations
Line (GAC): D USE MEASURING TOOLS
Competency: D3 Use calipers and gauges

Objectives
To be competent in this area, the individual must be able to:
- Use gauges.
- Describe gauge blocks and sine bars

LEARNING TASKS

1. Describe gauges
   - Types
     - Thread
     - Plug
     - Taper
     - Snap
     - Ring

2. Use gauges
   - Types
     - Thread
     - Plug
     - Taper
     - Snap
     - Ring

3. Describe gauge blocks
   - Types
   - Materials
   - Grades

4. Describe sine bars
   - Types
   - Sizes
**HARMONIZED PROGRAM OUTLINE**  
Program Content  
Level 2

**Line (GAC):** D  USE MEASURING TOOLS  
**Competency:** D4  Use dial indicators and digital readouts

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

- Use dial indicators and digital readouts.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>1.  Use dial indicators</td>
<td>• True workpiece&lt;br&gt;○ Milling machine&lt;br&gt;• Workpiece inspection&lt;br&gt;• Comparing measurements&lt;br&gt;• Setting up&lt;br&gt;• Measuring&lt;br&gt;• Workpiece inspection&lt;br&gt;• Care and maintenance</td>
</tr>
<tr>
<td>2.  Describe digital readouts</td>
<td>• Types&lt;br&gt;○ Manual&lt;br&gt;○ Programmable&lt;br&gt;• Parts&lt;br&gt;• Uses&lt;br&gt;○ Lathe&lt;br&gt;○ Milling machine&lt;br&gt;• Care and maintenance</td>
</tr>
<tr>
<td>3.  Use digital readouts</td>
<td>• Presets&lt;br&gt;• Types&lt;br&gt;• Manual&lt;br&gt;• Programmable&lt;br&gt;• Lathe&lt;br&gt;• Milling machine&lt;br&gt;• Care and maintenance</td>
</tr>
</tbody>
</table>
Line (GAC): D USE MEASURING TOOLS
Competency: D5 Use optical measuring equipment

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

• Use optical measuring equipment.

LEARNING TASKS

1. Use optical comparators

CONTENT

• Applications
  o Measuring
    – Thread forms
    – Profiles
    – Angles
    – Radii
    – Dimensions
Line (GAC): E  INTERPRET DRAWINGS AND REFERENCE MATERIALS
Competency: E4  Use Machinery’s Handbook and other reference materials

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

- Identify and locate information found in the Machinery’s Handbook.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Content</th>
</tr>
</thead>
</table>
| 1. Identify information found in the Machinery's Handbook | - Types
  - Materials |
| 2. Locate information in the Machinery's Handbook | - Material information
  - Advanced thread data
  - Fits and tolerances
  - Formulas
  - Speeds and feeds |
| 3. Use other reference materials | - Job plan
  - Machine limitations
  - Quality Control Documentation
    - Inspection sheets
    - Blueprints |
**Line (GAC):** E  **INTERPRET DRAWINGS AND REFERENCE MATERIALS**  
**Competency:** E5 Describe fits and tolerances

### Objectives
To be competent in this area, the individual must be able to:
- Describe geometric dimensions and tolerances.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe geometric dimensions and tolerances</td>
</tr>
</tbody>
</table>

### CONTENT

- Application
  - Concentricity
  - Roundness
  - Parallelism
  - Angularity
  - Line and surface
  - Flatness
  - Perpendicularity
  - Runout
  - Total runout
  - Datums
HARMONIZED PROGRAM OUTLINE
Program Content
Level 2

Line (GAC): F SELECT MATERIALS
Competency: F3 Describe characteristics of non-ferrous metals

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

- Describe the characteristics of non-ferrous metals.

LEARNING TASKS

1. Describe the classification of aluminum alloys

   - Designations
     - Alloys
     - Temper
   - Physical properties
     - Wear resistance
     - Weight
     - Flexibility
     - Hardness
     - Toughness
     - Corrosion resistance
     - Ductility
     - Machinability
     - Conductivity
     - Thermal
     - Electrical

2. Describe the UNS classifications of copper alloys

   - Alloys
   - Physical properties
     - Wear resistance
     - Weight
     - Flexibility
     - Hardness
     - Toughness
     - Corrosion resistance
     - Ductility
     - Machinability
     - Conductivity
     - Thermal
     - Electrical
LEARNING TASKS

1. Describe the characteristics of other non-ferrous metals
   - Designations
     - Alloys
     - Temper
   - Physical properties
     - Wear resistance
     - Weight
     - Flexibility
     - Hardness
     - Toughness
     - Corrosion resistance
     - Ductility
     - Machinability
     - Conductivity
     - Thermal
     - Electrical
   - Heat treatment
   - Applications

2. Applications
   - Electrical components
   - Brass
   - Ornamental castings
   - Bronze
   - Bearings

3. Describe the characteristics of other non-ferrous metals
   - Designations
     - Alloys
     - Temper
   - Physical properties
     - Wear resistance
     - Weight
     - Flexibility
     - Hardness
     - Toughness
     - Corrosion resistance
     - Ductility
     - Machinability
     - Conductivity
     - Thermal
     - Electrical
   - Heat treatment
   - Applications
Line (GAC):   F    SELECT MATERIALS
Competency:   F4    Describe characteristics of non-metals

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

• Describe the characteristics of non-metals.

LEARNING TASKS

1. Describe plastics

CONTENT

• Types
• Properties
  o Machinability
  o Thermal expansion
  o Hardness
  o Corrosion resistance
  o Moisture absorption
• Applications
Line (GAC): F SELECT MATERIALS
Competency: F5 Perform heat treating

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

- Describe heat treating and surface treatment.

LEARNING TASKS

1. Describe surface treatments
   - Plating
     - Chrome
     - Gold
     - Nickel
     - Brass
     - Copper
   - Anodizing
   - Blueing
   - Spray welding

2. Describe heat treating equipment
   - Oxy-acetylene
   - Furnaces
     - Gas
     - Electric
   - Induction

3. Describe heat treating
   - Case hardening
   - Through hardening
   - Normalizing
   - Annealing
   - Flame hardening
   - Induction hardening
   - Tempering
     - Colours
Line (GAC): J USE LATHES
Competency: J2 Describe cutting tools and holders

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

• Describe the use of advanced cutting tools.

LEARNING TASKS

1. Describe the use of advanced cutting tools

CONTENT

• Materials
  o Coated carbide
  o Cermet
  o Ceramic
  o CBN
  o PCD

• Indexable insert numbering system
  o Shape
  o Dimensions
  o Geometry

• Threading inserts
  o Lay down
  o Full profile
  o Stand up
  o General purpose
  o Multi-pitch
Line (GAC): J USE LATHES
Competency: J5 Cut threads

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

- Calculate imperial threads.
- Cut and measure imperial threads.

LEARNING TASKS

1. Describe threads
   - Types
     - Standard
     - Unified
     - Metric
     - Acme
     - Pipe
     - Whitworth
     - API
     - Non-standard
       - Multiple start
   - Theory
     - Angle
     - Pitch
     - Lead
     - Thread form
     - Lead angle
   - Measurement
     - Three-wire
     - Nut
     - Snap gauge
     - Micrometer
     - Optical comparator

2. Describe methods of threading
   - Internal
     - Compound offset
     - Compound (90 degrees)
     - Graduation
     - Tapping
     - Metric threads
   - External
     - Compound offset
     - Compound (90 degrees)
     - Graduation
LEARNING TASKS

3. Calculate threads

- Pitch
- Lead
- Depth of thread
- Angle
- Pitch diameter
- Minor diameter
- Major diameter
- Three-wire

4. Cut threads

- Inch / metric
- Plan sequence of operation
  - Engagement points (chasing dial)
  - Speed, lead and depth of cut
  - Tool choice
  - Tool alignment
- Set-up sequence
  - Mounting workpiece
  - Truing workpiece
  - Balancing workpiece
  - Centering workpiece
- Roughing
  - Depth of cut
  - Measuring
  - Material allowance for finishing
- Finishing
  - Depth of cut
  - Deburring
  - Measuring
- Measuring
  - Gauge
  - Micrometer
  - Three-wire
  - Optical comparator

Achievement Criteria

Performance
Using a lathe, the learner will be able to calculate, cut and measure imperial threads.

Conditions
The learner will be given:
• Drawing
• Material
• Tools and equipment
• Measuring tools

Criteria The learner will be evaluated on:
• Accuracy
• Tolerances
• Finish
LINE (GAC): K USE MILLING MACHINES
Competency: K1 Describe milling machines

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

- Describe milling machine accessories.
- Describe work holding devices.
- Describe milling applications.

LEARNING TASKS

1. Describe milling machine accessories

2. Describe work holding devices

3. Describe milling machine applications

CONTENT

- Rotary table
- Dividing head
- Vertical milling heads
  - Plain
  - Universal
- Clamp and hold-downs
- Vises
  - Plain
  - Swivel
  - Compound
  - Shaft
- Dividing heads
  - Plain
  - Universal
- Rotary table
- Sine table
- Fixtures
- Angle plates
- V-blocks
- Mill
  - Flat surfaces
  - Shapes
  - Keyways
  - Slots
  - Hole making
  - Counter bore
  - Counter sink
  - Spot face
  - Angles
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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<td>• Radii</td>
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<td>• Dovetails</td>
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<td>• Gears and racks</td>
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<td>• Helical contours</td>
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<td>• Gang milling</td>
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<td>• Straddle milling</td>
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<tr>
<td></td>
<td>• Indexing heads</td>
</tr>
<tr>
<td></td>
<td>• Rotary tables</td>
</tr>
</tbody>
</table>
Line (GAC): K USE MILLING MACHINES
Competency: K2 Describe cutting tools and holders

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

- Describe cutting tools and holders and their applications.

LEARNING TASKS

1. Describe types of cutters
   - Horizontal and vertical
     - Plain milling
     - Side and face
     - Stagger tooth
     - Form cutters
     - Face mill
     - End mill
     - Woodruff
     - Dovetail
     - Slitting
     - Thread cutters

2. Describe cutter applications
   - Flat surfaces
     - Face milling
     - Plain milling
   - Slots / Keyseat
     - End milling
     - Side and face cutting
     - Stagger tooth cutting
     - Woodruff keyseat cutting
   - Shapes
     - Gear teeth cutting
     - Form relief cutting
     - Splines
     - T-slots
     - Dovetails
     - Gang milling
   - Drill
     - Ream
     - Bore
     - Counter bore
     - Counter sink
     - Spot face
LEARNING TASKS

3. Describe tool holding devices

CONTENT

- Arbours
  - Styles A, B and C
- Holders
  - Morse taper
  - Collet
  - End mill
- Boring heads
  - Plain
  - Facing
Line (GAC): K USE MILLING MACHINES  
Competency: K3 Use dividing heads and rotary tables

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

- Use dividing heads and rotary tables.

LEARNING TASKS

1. Describe dividing heads

   - Construction
     - Hole plates
     - Chuck
     - Centre
     - Foot stock
     - Head/gear ratio
   - Applications
     - Milling
       - Hexagons
       - Keyways
   - Indexing
     - Direct
     - Simple
     - Angular
     - Differential
   - Universal dividing heads

2. Use dividing heads

   - Plan sequence of operation
   - Angular alignment
   - Linear alignment
   - Determine indexing
     - Direct
     - Simple
     - Angular
   - Calculate number of rotations and divisions
   - Select circle on hole plate
   - Set sector arms
LEARNING TASKS

3. Describe rotary tables

- Construction
  - Hole plates
  - Chuck
  - Head/gear ratio
  - Angular increments
- Indexing
  - Direct
  - Simple
  - Angular
- Applications
  - Milling
    - Contours
    - Drilling hole patterns
    - Radii

4. Use rotary tables

- Plan sequence of operation
- Workpiece alignment
- Milling spindle alignment
- Cutter offset
- Fixtures
- Determine indexing
  - Direct
  - Simple
  - Angular
- Calculate number of rotations and divisions
- Select circle on hole plate
- Set sector arms

Achievement Criteria

Performance Using a milling machine and dividing head, the learner will be able to calculate, cut and produce a hexagon.

Conditions The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish
Line (GAC): K USE MILLING MACHINES
Competency: K4 Operate and maintain milling machines

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

- Operate and maintain milling machines.

LEARNING TASKS

1. Calculate speeds (RPM) and feeds
   - Surface speed
   - Diameter of cutter
   - Chip load

2. Determine depth of cut
   - Rigidity
   - Horsepower
   - Tooling

3. Select work holding device and secure the work
   - Work holding devices
     - Clamp and hold-downs
     - Vises
     - Dividing heads
     - Rotary table
     - Sine table
     - Fixtures
     - Angle plates
     - V-blocks

4. Install and remove tooling
   - Application
     - Cutter
     - Holder
LEARNING TASKS

5. Operate milling machines

   • Plan sequence of operation
   • Align machine
     o Spindle alignment
     o Table alignment
     o Accessory alignment
   • Set-up sequence
     o Mounting workpiece
     o Aligning workpiece
   • Climb versus conventional
   • Roughing
     o Speeds and feeds
     o Cutters
     o Depth of cut
     o Measuring
     o Material allowance for finishing
   • Finishing
     o Speeds and feeds
     o Cutters
     o Depth of cut
     o Debur
     o Chamfer
     o Measuring

6. Quality control for component

   • First article inspection
   • Verify
     o Material
     o Drawing
       – Revision
     o Traceability
   • Dimensional conformance
   • Measuring tools calibrated

7. Maintain milling machines

   • Lubricate
   • Clean
   • Housekeeping
   • Coolant / cutting fluid
LEARNING TASKS

8. Describe the purpose and usage of cutting fluids with milling machines

9. Select types of cutting fluids for specific applications

CONTENT

- Lubrication
- Cooling
- Chip removal
- Tool life

- Types
  - Straight oils
  - Soluble oils
  - Semi-synthetic
  - Synthetic

Achievement Criteria

Performance Using a milling machine, the learner will be able to machine a block square and bore a hole to specifications.

Conditions The learner will be given:
- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria The learner will be evaluated on:
- Accuracy
- Tolerances
- Finish
Line (GAC):  L  USE SUPPORT MACHINES
Competency:  L3  Operate and maintain hones and lapping machines

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

- Operate and maintain hones.
- Describe lapping.

LEARNING TASKS

1. Operate and maintain hones

   • Safety precautions
     o Guards
     o Personal protective equipment
       o Housekeeping
   • Positioning tool
   • Securing workpieces
   • Speeds and feeds
   • Cleaning
   • Lubrication

2. Describe lapping

   • Lapping compounds
   • Charging
   • Cleaning

Achievement Criteria

Performance Using a honing machine, the learner will be able to hone a bore to specifications.

Conditions The learner will be given:
- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria The learner will be evaluated on:
- Accuracy
- Tolerances
- Finish
Line (GAC): M USE PRECISION GRINDERS
Competency: M1 Describe types of precision grinders

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

- Describe types of precision surface grinders and their applications.
- Describe tool and cutter grinders.

LEARNING TASKS

1. Describe precision grinders

CONTENT

- Surface
  - Horizontal spindle
    - Purpose
    - Construction
    - Operation
  - Vertical spindle
    - Purpose
    - Construction
    - Operation

- Tool and cutter
  - Purpose
  - Construction
  - Operation
Line (GAC): M USE PRECISION GRINDERS
Competency: M2 Select abrasives

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

• Select abrasives and applications.
• Describe the Standard Marking System.

LEARNING TASKS

1. Identify abrasives and applications
   • Aluminum oxide
   • Silicon carbide
   • Cubic boron nitride (CBN)
   • Diamond

2. Describe the Standard Marking System
   • Grit
   • Grade
   • Structure
   • Bond
   • Thickness
     o Diamond
     o CBN

3. Select abrasives for applications
   • Workpiece material
     o Hardness
     o Toughness
     o Grindability
   • Surface finish requirements
   • Abrasive characteristics
     o Friability
   • Machine type
   • Area of contact
   • Shape
Objectives
To be competent in this area, the individual must be able to:
• Operate and maintain surface grinders.

LEARNING TASKS

1. Mount grinding wheel
   • Ring test
   • Balance / truing
   • Mounting
   • Guard

2. Operate and maintain surface grinders
   • Workpiece material
     o Type
     o Size
   • Calculate work speeds and feeds
   • Rigidity
   • Workholding devices
     o Magnetic chuck
     o Fixture
     o Vise
   • Set-up sequence
   • Roughing and finishing
     o Dressing
     o Depth of cut
     o Step over
   • Maintenance
     o Cleaning
     o Lubricating
     o Housekeeping

3. Quality control for component
   • First article inspection
   • Verify
     o Material
     o Drawing
       - Revision
     o Traceability
   • Dimensional conformance
   • Measuring tools calibrated
Achievement Criteria

Performance Using a surface grinder, the learner will be able to grind a block square to specifications.

Conditions The learner will be given:
- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria The learner will be evaluated on:
- Accuracy
- Tolerances
- Finish
Line (GAC): N USE CNC MACHINES
Competency: N1 Describe computer numerical control (CNC) turning centres

Objectives
To be competent in this area, the individual must be able to:
• Describe CNC turning centres.

LEARNING TASKS
1. Describe CNC turning centres

CONTENT
- Components
  o Controller
  o Tool changer / turret
  o Chuck / collet
  o Spindle
- Principles of operation
  o Computer control
  o Axis
- Applications
  o Turning
  o Drilling
  o Boring
  o Facing
  o Tapers
  o Knurling
  o Grooving
  o Parting
  o Threading
    - Internal
    - External
  o Contours
Line (GAC): N USE CNC MACHINES
Competency: N2 Establish co-ordinate systems and apply programming codes for turning centres

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

- Create a manual input program.

LEARNING TASKS

1. Describe co-ordinate systems

2. Describe programming codes

3. Describe program writing procedures

4. Plan a sequence of operation

CONTENT

- Types
  - Rectangular
  - Polar
- Machine co-ordinates
- Work co-ordinates
- Positioning
  - Absolute
  - Incremental
- Codes
  - G & M
  - Circular interpolation
  - Linear interpolation
  - Tool nose radius compensation
- Auxillary addresses
- Alarms
- Canned cycles
  - Rough and finish
    - Turning
    - Facing
  - Threading
  - Grooving
  - Drilling
- Program format
  - Sequence of commands
  - Order of information
- Workpiece drawing interpretation
- Material selection
- Machining order of operations
LEARNING TASKS

5. Create manual input program

CONTENT

• Tooling
• Define datum
• Entry and exit points

• Calculate
  o Program points
  o Speeds and feeds
• Safety blocks
• Programming code use
• Format structure
• Interpret and review

Achievement Criteria

Performance  The learner will be able to manually create a program.

Conditions  The learner will be given:
  • Drawing
  • Simulator (preferred)

Criteria  The learner will be evaluated on:
  • Structure
  • Accuracy
  • Syntax
<table>
<thead>
<tr>
<th>Line (GAC):</th>
<th>USE CNC MACHINES</th>
<th>Competency:</th>
<th>Operate and maintain CNC turning centre</th>
</tr>
</thead>
</table>

**Objectives**
To be competent in this area, the individual must be able to:
- Program, operate and maintain CNC turning centre.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>TASK</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Start-up CNC turning centre | Start-up procedures  
- Power on  
- Home axis  
- Warm up |
| 2. Set-up tooling | Tooling  
- Selection  
- Installation  
- Offsets |
| 3. Set-up the workpiece | Hydraulic chucks / collet  
- Clamping pressure  
- Secure work  
- Offsets |
| 4. Verify the program | Graphics simulation  
- Dry run |
LEARNING TASKS

5. Operate CNC turning centre

• Rapid override
• Optional stop on
• Single block
• Monitor machining processes
  o Machine alarms and codes
  o Signs of tool wear (vibration, noise)
  o Overrides (rapid, speed and feed)
  o Chip control problems
  o Cutting fluid delivery
• Cycle interruption
  o Stop procedures
  o Corrective actions
  o Cycle restart
• Adjust offset parameters
  o Length
  o Diameter
  o Tool nose radius
• Program restart

6. Quality control for component

• First article inspection
• Verify
  o Material
  o Drawing
    – Revision
  o Traceability
• Dimensional conformance
  o Measuring tools calibrated

Achievement Criteria

Performance The learner will be able to set up and operate a CNC turning centre to produce a part to specifications.

Conditions The learner will be given:
• Material
• Tools and equipment
• Drawing

Criteria The learner will be evaluated on:
• Set up
• Safety procedures followed
• Accuracy
• Tolerances
• Finish
Level 3

Machinist
Line (GAC): C USE APPLIED MATHEMATICS
Competency: C1 Solve problems involving formulas

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

- Calculate ratios.

LEARNING TASKS

1. Apply ratios

CONTENT

- Pulley
- Gear
- Mechanical advantage
  - Levers
  - Incline plane
  - Screws
Line (GAC): C USE APPLIED MATHEMATICS
Competency: C5 Solve problems involving trigonometry

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

- Apply trigonometry applications.

LEARNING TASKS

1. Use applied trigonometry

CONTENT

- Measurements
  - Internal/external taper
  - Pin in V
  - Dovetails
Line (GAC): D  USE MEASURING TOOLS
Competency: D3  Use calipers and gauges

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

- Use gauge blocks.

LEARNING TASKS

1. Use gauge blocks

CONTENT

- Care and cleaning
- Calculate combinations
- Wear blocks
- Wringing
- Sine bar
Line (GAC): D USE MEASURING TOOLS
Competency: D4 Use dial indicators and digital readouts

Objectives
To be competent in this area, the individual must be able to:
• Use dial indicators and digital readouts.

LEARNING TASKS CONTENT
1. Use dial indicators
   • True workpiece
     o Grinders
   • Workpiece inspection
   • Comparing measurements
   • Setting up
   • Measuring
   • Workpiece inspection
   • Care and maintenance

2. Use digital readouts
   • Presets
   • Types
     o Manual
     o Programmable
   • Uses
     o Grinders
       – Surface
       – Cylindrical
   • Care and maintenance
Line (GAC): E INTERPRET DRAWINGS AND REFERENCE MATERIALS
Competency: E4 Use Machinery’s Handbook and other reference materials

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

• Identify and locate information in the Machinery’s Handbook.

LEARNING TASKS

1. Identify information found in the Machinery’s Handbook

2. Locate information in the Machinery’s Handbook

3. Use other reference materials

CONTENT

• Types
  o Heat treatment
  o Helical milling

• Formulas
• Speeds and feeds
• Heat treatment

• Job plan
• Quality control documentation
  o Inspection sheets
  o Blueprints
Line (GAC): F SELECT MATERIALS
Competency: F5 Perform heat treating

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

- Perform heat treating and oxy-acetylene processes.

LEARNING TASKS

1. Perform heat treating processes
   - Normalizing
   - Annealing
   - Flame hardening
   - Induction hardening
   - Tempering

2. Perform oxy-acetylene processes
   - Safety
   - System set-up
   - Torch operation
     - Heating
     - Heat treating

Achievement Criteria

Performance The learner will be able to harden and temper a workpiece to specifications.

Conditions The learner will be given:
- Specifications
- Tools and equipment
- Workpiece

Criteria The learner will be evaluated on:
- Rockwell hardness
Objectives
To be competent in this area, the individual must be able to:

- Describe the physical properties and characteristics of steel.
- Perform hardness testing.

LEARNING TASKS

1. Describe the physical properties and characteristics of steel
   - Hardness
   - Tensile strength
   - Shear strength

2. Describe destructive testing methods
   - Hardness
   - Tensile
   - Impact

3. Describe non-destructive testing
   - Dye penetrant tests
   - Magnetic particle inspection
   - Ultrasound
   - X-ray

4. Perform hardness tests
   - Rockwell

Achievement Criteria

Performance Using a Rockwell hardness tester, the learner will be able to measure the hardness of a heat-treated workpiece.

Conditions The learner will be given:
- Tools and equipment
- Workpiece

Criteria The learner will be evaluated on:
- Correct use of equipment
Line (GAC): G
Competency: G3 Describe bearings, seals and bearing materials

Objectives
To be competent in this area, the individual must be able to:
• Describe bearings, seals and bearing materials.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe bearings</td>
<td>• Types of bearings</td>
</tr>
<tr>
<td></td>
<td>o Friction</td>
</tr>
<tr>
<td></td>
<td>o Anti-friction</td>
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<tr>
<td></td>
<td>• Principles of operation</td>
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<td></td>
<td>o Sliding</td>
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<tr>
<td></td>
<td>o Rolling</td>
</tr>
<tr>
<td></td>
<td>• Types of loads</td>
</tr>
<tr>
<td></td>
<td>o Radial</td>
</tr>
<tr>
<td></td>
<td>o Thrust</td>
</tr>
<tr>
<td></td>
<td>o Combination</td>
</tr>
<tr>
<td>2. Describe friction bearings</td>
<td>• Types</td>
</tr>
<tr>
<td></td>
<td>o Bushing</td>
</tr>
<tr>
<td></td>
<td>o Sleeve</td>
</tr>
<tr>
<td></td>
<td>o Split</td>
</tr>
<tr>
<td></td>
<td>• Housing styles</td>
</tr>
<tr>
<td></td>
<td>o Flange</td>
</tr>
<tr>
<td></td>
<td>o Pillow block</td>
</tr>
<tr>
<td>3. Describe friction bearing materials</td>
<td>• Types</td>
</tr>
<tr>
<td></td>
<td>• Applications</td>
</tr>
<tr>
<td>4. Describe anti-friction bearings</td>
<td>• Construction</td>
</tr>
<tr>
<td></td>
<td>o Rolling elements</td>
</tr>
<tr>
<td></td>
<td>- Ball</td>
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<tr>
<td></td>
<td>- Roller</td>
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<td></td>
<td>- Spherical</td>
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<tr>
<td></td>
<td>- Cylindrical</td>
</tr>
<tr>
<td></td>
<td>- Tapered roller</td>
</tr>
<tr>
<td></td>
<td>• Bearing codes</td>
</tr>
<tr>
<td>5. Describe types of seals</td>
<td>• Types</td>
</tr>
<tr>
<td></td>
<td>• Applications</td>
</tr>
</tbody>
</table>
Line (GAC): J USE LATHES
Competency: J5 Cut threads

**Objectives**

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

- Use gear ratio applications on lathes.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>Task</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe advanced thread cutting</td>
<td></td>
</tr>
<tr>
<td>2. Use gear ratio applications on lathes</td>
<td></td>
</tr>
</tbody>
</table>

**Achievement Criteria**

**Performance**

Using a lathe, the learner will be able to calculate, cut and measure metric threads.

**Conditions**

- Drawing
- Material
- Tools and equipment
- Measuring tools

**Criteria**

The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish
Line (GAC): J USE LATHES
Competency: J6 Describe vertical lathes

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

- Describe vertical lathes.

LEARNING TASKS

1. Describe vertical lathes

CONTENT

- Types
  - Mill
  - Turret lathe

- Components
  - Mill
    - Chuck / table
    - Ram
    - Bridge
    - Column
    - Cross rail
  - Turret lathe
    - Chuck / table
    - Ram slide
    - Bridge
    - Column rail
    - Turret

- Accessories
  - Jaws
  - Clamps

- Operations
  - Boring
  - Turning
  - Taper
  - Facing
  - Drilling
HARMONIZED PROGRAM OUTLINE
Program Content
Level 3

Line (GAC): K USE MILLING MACHINES
Competency: K3 Use dividing heads and rotary tables

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

• Apply advanced applications using a dividing head.

LEARNING TASKS

1. Describe the advanced use of dividing heads

   • Applications
     o Milling
       − Splines / serrations
       − Helical milling

2. Apply advanced applications for using a dividing head

   • Mill
     o Splines / serrations
     o Helical milling

Achievement Criteria

Performance
Using a milling machine and dividing head, the learner will be able to calculate, cut and measure splines and a helical groove.

Conditions
The learner will be given:

• Drawing
• Material
• Tools and equipment
• Measuring tools

Criteria
The learner will be evaluated on:

• Accuracy
• Tolerances
• Finish
Line (GAC): K USE MILLING MACHINES
Competency: K4 Operate and maintain milling machines

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

- Operate milling machines.

LEARNING TASKS

1. Operate milling machines

CONTENT

- Plan sequence of operation
- Operations
  - Mill
    - Radii
    - Dovetails
    - Helical contours
    - Splines / serrations

Achievement Criteria

Performance Using a milling machine, the learner will be able to machine radii and dovetails.

Conditions The learner will be given:

- Drawing
- Material
- Tools and equipment
- Measuring tools

Criteria The learner will be evaluated on:

- Accuracy
- Tolerances
- Finish
Line (GAC): K USE MILLING MACHINES
Competency: K5 Describe boring mills

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

- Describe horizontal boring mills.

LEARNING TASKS

1. Describe horizontal boring mills

CONTENT

- Types
  - Table
  - Saddle
  - Planer

- Components
  - Bed
  - Saddle
  - Table
    - Fixed
    - Rotary
  - Columns
  - Tool heads
  - Facing slides
  - Spindles
  - Outboard support

- Accessories
  - Boring heads
  - Star wheel feed attachment
  - Measuring devices
  - Optics
  - Digital readouts
  - Line boring attachment

- Operations
  - Drilling
  - Boring
  - Line boring
  - Facing
  - Milling
  - Threading

- Layout of castings
- Layout of fabrication
- Work holding devices
Line (GAC): M USE PRECISION GRINDERS
Competency: M1 Describe types of precision grinders

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

- Describe precision grinders and their applications.

**LEARNING TASKS**

1. Describe grinders

**CONTENT**

- Centreless
  - Purpose
  - Construction
  - Operation
- Cylindrical
  - Internal
    - Purpose
    - Construction
    - Operation
  - External
    - Purpose
    - Construction
    - Operation
Line (GAC): M USE PRECISION GRINDERS
Competency: M3 Operate and maintain grinders

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

- Operate and maintain cylindrical grinders.

LEARNING TASKS

1. Operate and maintain cylindrical grinders

CONTENT

- Workpiece material
  - Type
  - Size

- Calculate work speeds and feeds

- Wheel
  - Selection
  - Balancing
  - Truing and dressing

- Rigidity

- Work holding devices
  - Chucks, faceplates, collets
  - Between centres
    - Drive dog
  - Steady rest/follower rest

- Set-up sequence
  - Mounting workpiece
  - Truing workpiece

- Roughing and finishing
  - Dressing
  - Depth of cut
  - Traverse speed

- Maintenance
  - Cleaning
  - Lubricating
  - Housekeeping

Achievement Criteria

Performance Using a cylindrical grinder, the learner will be able to grind an external cylindrical feature to specifications.

Conditions The learner will be given:
• Drawing
• Material
• Tools and equipment
• Measuring tools

Criteria The learner will be evaluated on:
• Accuracy
• Tolerances
• Finish
Line (GAC): N USE CNC MACHINES
Competency: N4 Describe computer numerical control (CNC) machining centres

Objectives
To be competent in this area, the individual must be able to:
- Describe CNC machining centres.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe CNC machining centres | • Components  
  - Controller  
  - Tool changer  
  - Table  
  - Spindle  
  • Principles of operation  
  - Computer control  
  - Axis  
  • Applications  
  - Facing  
  - Drilling  
  - Boring  
  - Tapping  
  - Profiling  
  - Engraving |
HARMONIZED PROGRAM OUTLINE
Program Content
Level 3

Line (GAC): N USE CNC MACHINES
Competency: N5 Establish co-ordinate systems and apply programming codes for machining centres

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

- Create a manual input program.

LEARNING TASKS

1. Describe co-ordinate systems

   - Types
     - Rectangular
     - Polar
   - Machine co-ordinates
   - Work co-ordinates
   - Positioning
     - Absolute
     - Incremental

2. Describe programming codes

   - Absolute
   - Incremental
   - Codes
     - G & M
     - Circular interpolation
     - Linear interpolation
     - Cutter radius compensation
   - Auxillary addresses
   - Alarms
   - Canned cycles
     - Drilling
     - Tapping
     - Boring

3. Describe program writing procedures

   - Program format
     - Sequence of commands
     - Order of information

4. Plan a sequence of operation

   - Workpiece drawing interpretation
   - Material selection
   - Machining order of operations
   - Tooling
   - Define datum
   - Entry and exit points
LEARNING TASKS

5. Create manual input program

CONTENT

• Calculate
  o Program points
  o Speeds and feeds
• Safety blocks
• Programming code use
• Format structure
• Interpret and review

Achievement Criteria

Performance  The learner will be able to manually create a program.

Conditions  The learner will be given:
  • Drawing
  • Simulator (preferred)

Criteria  The learner will be evaluated on:
  • Structure
  • Accuracy
  • Syntax
Line (GAC): N USE CNC MACHINES
Competency: N6 Operate and maintain CNC machining centres

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

- Program, operate and maintain a CNC machining centre.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>Task</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Start-up CNC machining centre | • Start-up procedures  
  o Power on  
  o Home axis  
  o Warm up |
| 2. Set-up tooling | • Tooling  
  o Selection  
  o Installation  
  • Offsets |
| 3. Set-up the workpiece | • Vises  
  • Tombstones  
  • Fixtures  
  • Secure work  
  • Offsets |
| 4. Verify the program | • Graphics simulation  
  • Dry run |
LEARNING TASKS

5. Operate CNC machining centre

CONTENT

- Rapid override
- Optional stop on
- Single block
- Monitor machining processes
  - Machine alarms and codes
  - Signs of tool wear (vibration, noise)
  - Overrides (rapid, speed and feed)
  - Chip control problems
  - Cutting fluid delivery
- Cycle interruption
  - Stop procedures
  - Corrective actions
  - Cycle restart
- Adjust work offset parameters
- Adjust tool offset parameters
  - Length
  - Radius (diameter)
- Program restart

6. Quality control for component

CONTENT

- First article inspection
- Verify
  - Material
  - Drawing
    - Revision
  - Traceability
- Dimensional conformance
- Measuring tools calibrated

Achievement Criteria

Performance The learner will be able to set up and operate a CNC machining centre to produce a part to specifications.

Conditions The learner will be given:
- Material
- Tools and equipment
- Drawing

Criteria The learner will be evaluated on:
- Set up
- Safety procedures followed
- Accuracy
- Tolerances
- Finish
Line (GAC): N USE CNC MACHINES
Competency: N7 Create 2D and 3D Models

Objectives
To be competent in this area, the individual must be able to:
- Describe 2D and 3D models.

LEARNING TASKS

<table>
<thead>
<tr>
<th>TASK</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Describe 2D and 3D models</td>
</tr>
<tr>
<td></td>
<td>• CAD software</td>
</tr>
<tr>
<td></td>
<td>• Complex shapes</td>
</tr>
</tbody>
</table>
Line (GAC): N USE CNC MACHINES
Competency: N8 Program using CAM

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

• Describe CAM.

LEARNING TASKS

1. Describe CAM

CONTENT
• CAM software
• Generating code
Level 4
Machinist
Line (GAC): A PERFORM SAFETY RELATED TASKS
Competency A3 Apply safety practices for shop areas

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

- Describe mentoring techniques.

LEARNING TASKS

1. Describe characteristics of being a journeyperson / mentor

CONTENT

- Listening skills
- Supportive
- Guidance
  - Positive reinforcement
  - Discipline / constructive criticism
- Patience
- Leadership
- Share
  - Experiences
  - Knowledge
- Pride in trade
Line (GAC): E  INTERPRET DRAWINGS AND REFERENCE MATERIALS
Competency: E4  Use Machinery's Handbook and other reference materials

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

- Locate information in the Machinery's Handbook and other reference materials.

LEARNING TASKS

1. Locate information in the Machinery's Handbook
   - Formulas
   - Splines
   - Cams
   - Gears

2. Use other reference materials
   - Job plan
     - Machine limitations
   - Quality Control Documentation
     - Inspection sheets
     - Blueprints
Line (GAC): L USE SUPPORT MACHINES
Competency: L4 Operate and maintain gear cutting machines

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

• Operate and maintain gear cutting machines.

LEARNING TASKS

1. Describe gear cutting machines
   • Types
     o Gear hobbing
     o Gear shaper
   • Purpose
   • Construction
   • Applications

2. Operate and maintain gear cutting machines
   • Safety precautions
     o Guards
     o Personal protective equipment
     o Housekeeping
   • Positioning and securing workpiece
   • Coolant
   • Cutters
   • Cleaning
   • Lubrication

Achievement Criteria

Performance The learner will be able to set up and operate a gear cutting machine to produce a part to specifications.

Conditions The learner will be given:
• Material
• Tools and equipment
• Drawing

Criteria The learner will be evaluated on:
• Accuracy
• Tolerances
• Finish
Line (GAC): L USE SUPPORT MACHINES
Competency: L5 Operate and maintain electrical discharge machines

Objectives
To be competent in this area, the individual must be able to:
• Operate and maintain electric discharge machines.

LEARNING TASKS

1. Describe electrical discharge machines
   • Types
     o Ram
     o Wire
   • Purpose
   • Construction
   • Applications

2. Operate and maintain electrical discharge machines
   • Safety precautions
     o Personal protective equipment
     o Housekeeping
   • Positioning and securing workpiece
   • Mounting and aligning electrode
   • Surface finish
   • Spark gap
   • Electrode size
   • Control setting
   • Flushing
   • Cleaning
HARMONIZED PROGRAM OUTLINE
Program Content
Level 4

Line (GAC): N USE CNC MACHINES
Competency: N7 Create 2D and 3D models

Objectives
To be competent in this area, the individual must be able to:
• Create 2D and 3D models

LEARNING TASKS

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEARNING TASKS</td>
</tr>
</tbody>
</table>

1. Describe interface
   • Menus
   • Toolbars

2. Establish co-ordinate system
   • Planes
   • Datum

3. Create geometry
   • Points
   • Lines
   • Circles
   • Arcs

4. Edit geometry
   • Trim
   • Extend
   • Delete
   • Copy

5. Geometry dimensioning
   • Inch / metric

6. Create solid
   • Extrude
   • Revolve

7. Save file
   • Formats

Achievement Criteria
Performance The learner will be able to create a 2D and a 3D model using software.

Conditions The learner will be given:
• Drawing

Criteria The learner will be evaluated on:
• Completion in time allotted
• Accuracy
## Line (GAC): N USE CNC MACHINES

Competency: N8 Program using CAM

### Objectives

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

- Generate a tool paths using CAM software.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe interface</td>
<td>• Menus</td>
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<tr>
<td></td>
<td>• Toolbars</td>
</tr>
<tr>
<td>2. Import geometry</td>
<td>• Edit</td>
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<tr>
<td></td>
<td>• Establish origin</td>
</tr>
<tr>
<td>3. Select machine</td>
<td>• Lathe</td>
</tr>
<tr>
<td></td>
<td>• Mill</td>
</tr>
<tr>
<td>4. Plan sequence of operations</td>
<td>• Machining sequence</td>
</tr>
<tr>
<td>5. Determine tooling</td>
<td>• Select</td>
</tr>
<tr>
<td></td>
<td>• Define</td>
</tr>
<tr>
<td>6. Select machining operations</td>
<td>• According to planned sequence</td>
</tr>
<tr>
<td>7. Create tool path</td>
<td>• Select</td>
</tr>
<tr>
<td></td>
<td>o Geometry</td>
</tr>
<tr>
<td></td>
<td>o Tool</td>
</tr>
<tr>
<td></td>
<td>o Parameters</td>
</tr>
<tr>
<td>8. Verify program</td>
<td>• Backplot</td>
</tr>
<tr>
<td></td>
<td>• Verify</td>
</tr>
<tr>
<td></td>
<td>• Render</td>
</tr>
<tr>
<td>9. Create G-code</td>
<td>• Post-processor selection</td>
</tr>
<tr>
<td></td>
<td>• Code verification</td>
</tr>
<tr>
<td>10. Save program</td>
<td>• Format</td>
</tr>
</tbody>
</table>
Achievement Criteria

Performance  The learner will be able to create tool paths and generate a G-code program using software.

Conditions  The learner will be given:
- Drawing

Criteria  The learner will be evaluated on:
- Completion in time allotted
- Accuracy
- Functional program using a simulator
Section 4

ASSESSMENT GUIDELINES
Assessment Guidelines – Level 1

Assessment Guidelines are the percentage weight of theory and practical assessment in technical training

Level 1 Grading Sheet: Subject Competency and Weightings

<table>
<thead>
<tr>
<th>PROGRAM: IN-SCHOOL TRAINING:</th>
<th>MACHINIST LEVEL 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBJECT COMPETENCIES</td>
<td>THEORY WEIGHTING</td>
</tr>
<tr>
<td>A PERFORM SAFETY RELATED TASKS</td>
<td>15%</td>
</tr>
<tr>
<td>B PERFORM HAND PROCESSES</td>
<td>10%</td>
</tr>
<tr>
<td>C USE APPLIED MATHEMATICS</td>
<td>10%</td>
</tr>
<tr>
<td>D USE MEASURING TOOLS</td>
<td>10%</td>
</tr>
<tr>
<td>E INTERPRET DRAWINGS AND REFERENCE MATERIALS</td>
<td>8%</td>
</tr>
<tr>
<td>F SELECT MATERIALS</td>
<td>8%</td>
</tr>
<tr>
<td>G REFURBISH COMPONENTS</td>
<td>5%</td>
</tr>
<tr>
<td>H USE DRILLING MACHINES</td>
<td>8%</td>
</tr>
<tr>
<td>I USE POWER SAWS</td>
<td>6%</td>
</tr>
<tr>
<td>J USE LATHES</td>
<td>10%</td>
</tr>
<tr>
<td>K USE MILLING MACHINES</td>
<td>2%</td>
</tr>
<tr>
<td>L USE SUPPORT MACHINES</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

In-school theory / practical subject competency weighting

Final in-school mark

<table>
<thead>
<tr>
<th>In-school Mark</th>
<th>80%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined theory and practical subject competency multiplied by</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard Level Exam (SLE) Mark</th>
<th>20%</th>
</tr>
</thead>
<tbody>
<tr>
<td>The exam score is multiplied by</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Final Level Mark</th>
<th>FINAL%</th>
</tr>
</thead>
</table>
### Assessment Guidelines – Level 2

#### Level 2 Grading Sheet: Subject Competency and Weightings

<table>
<thead>
<tr>
<th>LINE</th>
<th>SUBJECT COMPETENCIES</th>
<th>THEORY WEIGHTING</th>
<th>PRACTICAL WEIGHTING</th>
</tr>
</thead>
<tbody>
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<tr>
<td>E</td>
<td>INTERPRET DRAWINGS AND REFERENCE MATERIALS</td>
<td>5%</td>
<td>0%</td>
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<tr>
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<tr>
<td>J</td>
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<td>20%</td>
</tr>
<tr>
<td>K</td>
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<td>15%</td>
<td>20%</td>
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<tr>
<td>L</td>
<td>USE SUPPORT MACHINES</td>
<td>4%</td>
<td>15%</td>
</tr>
<tr>
<td>M</td>
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<tr>
<td>N</td>
<td>USE CNC MACHINES</td>
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<td>25%</td>
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<td></td>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

**In-school theory / practical subject competency weighting**

- **60%**
- **40%**

**Final in-school mark**

- **IN-SCHOOL %**

**In-school Mark**

Combined theory and practical subject competency multiplied by 80%

**Standard Level Exam (SLE) Mark**

The exam score is multiplied by 20%

**Final Level Mark**

**FINAL%**
Assessment Guidelines – Level 3

Level 3 Grading Sheet: Subject Competency and Weightings

<table>
<thead>
<tr>
<th>PROGRAM: IN-SCHOOL TRAINING:</th>
<th>MACHINIST LEVEL 3</th>
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<tbody>
<tr>
<td></td>
<td>THEORY WEIGHTING</td>
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<tr>
<td>C  USE APPLIED MATHEMATICS</td>
<td>7%</td>
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<tr>
<td>E  INTERPRET DRAWINGS AND REFERENCE MATERIALS</td>
<td>5%</td>
</tr>
<tr>
<td>F  SELECT MATERIALS</td>
<td>5%</td>
</tr>
<tr>
<td>G  REFURBISH COMPONENTS</td>
<td>3%</td>
</tr>
<tr>
<td>J  USE LATHES</td>
<td>10%</td>
</tr>
<tr>
<td>K  USE MILLING MACHINES</td>
<td>20%</td>
</tr>
<tr>
<td>M  USE PRECISION GRINDERS</td>
<td>15%</td>
</tr>
<tr>
<td>N  USE CNC MACHINES</td>
<td>30%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

In-school theory / practical subject competency weighting

| In-school theory / practical subject competency weighting | 60% | 40% |

Final in-school mark

| Final in-school mark | IN-SCHOOL % |

In-school Mark
Combined theory and practical subject competency multiplied by 80%

Standard Level Exam (SLE) Mark
The exam score is multiplied by 20%

Final Level Mark

| Final Level Mark | FINAL% |
## Assessment Guidelines – Level 4

### Level 4 Grading Sheet: Subject Competency and Weightings

<table>
<thead>
<tr>
<th>PROGRAM: IN-SCHOOL TRAINING:</th>
<th>MACHINIST LEVEL 4 / FINAL LEVEL</th>
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<tr>
<td>LINE</td>
<td>SUBJECT COMPETENCIES</td>
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<tr>
<td>A</td>
<td>PERFORM SAFETY RELATED TASKS</td>
</tr>
<tr>
<td>E</td>
<td>INTERPRET DRAWINGS AND REFERENCE MATERIALS</td>
</tr>
<tr>
<td>L</td>
<td>USE SUPPORT MACHINES</td>
</tr>
<tr>
<td>N</td>
<td>USE CNC MACHINES</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

In-school theory / practical subject competency weighting 60% 40%

### Final in-school Mark

Apprentices must achieve a minimum 70% as the final in-school percentage score to be eligible to write the Interprovincial Red Seal or ITA CofQ exam.

<table>
<thead>
<tr>
<th>IN-SCHOOL %</th>
</tr>
</thead>
</table>

All apprentices who complete Level 4 of the Machinist program with a FINAL level percentage score of 70% or greater will write the Interprovincial Red Seal examination as their final assessment.

ITA will enter the apprentices’ Machinist Interprovincial Red Seal examination percentage score in ITA Direct Access.

A minimum percentage score of 70% on the examination is required for a pass.
Section 5

TRAINING PROVIDER STANDARDS
Facility Requirements

Classroom Area
- 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

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

Lab Requirements
- See Shop Area

Student Facilities
- 20 sq. ft. per student for tools storage (indoors)
- Student locker and changeroom facilities

Instructor’s Office Space
- 150 sq. ft. per instructor, with a desk, chairs and materials storage / filing system

Other
- 200 sq. ft. raw materials storage (may be outdoors)
Tools and Equipment

Shop Equipment

Required

- Band saw (horizontal and vertical)
- Computer numeric control (CNC) simulator
- Drilling machines
- Grinders (cylindrical, surface, pedestal)
- Hydraulic press
- Indexing heads
- Lathe (engine, CNC)
- Milling machines (vertical, horizontal Milling centres, CNC)

Recommended

- Hobbing machine
- Key seater
- Abrasive cut-off saw
- Boring machines (horizontal and vertical)
- Electrical discharge machine (EDM)
- Grinders (tool and cutter, tool post profile)
- Milling machines (universal)

Shop (Facility) Tools

Standard Tools

- Abrasive cut off wheels
- Air grinder
- Air-driven hand tools
- Boring bars
- Boring heads
- Broaches
- Carbides (brazed, inserts, solid)
- Changeable pilot counterbores
- Circular saw
- Dies
- Disc grinder
- 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, 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
- Portable key seater
- Cold saw
- Disk grinder
### Hand Tools
- Acetylene torch
- Allen keys
- Arbor press
- Bearing extractor
- Brushes
- Buffing wheels
- Chisels
- Chuck key
- Clamps
- Cloths
- Deburrers
- Die stock
- Drill drift
- Drill gauge
- Dressing stick
- Emery cloth
- File cards
- File handles
- Files
- Grease guns
- Hacksaws and blades
- Hand broaches
- Hand reamers
- 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
- Vises
- Wheel dressers (hand held)
- Wrenches

### Measuring and Layout Tools
- Angle plate
- Bore gauge
- Combination square
- Coordinate measuring machine (cmm)
- Depth gauge
- Dial indicators and magnetic base
- Digital readout
- Dividers
- Drill gauge
- Electronic measuring devices
- Etchers
- Feeler gauge
- Gauge blocks
- Gauge pins
- Gear measuring wire
- Go-no-go gauge (threads, diametrical)
- Height gauge
- Hermaphrodite calipers
- Inside calipers
- Layout dye
- Measuring rods
- Measuring tape
- Optical comparator
- Outside calipers
- Plug/ring gauge
- Precision blocks
- Precision level
- Protractor (universal, bevel, Vernier)
- Punches (centre, prick, transfer)
- Radius gauge
- Scale (steel, rule, hook rule)
- Scribers
- Sine bar
- Sine plate
- Small hole gauge
- Snap gauge
- Square (solid, adjustable, cylindrical)
- Surface finish comparator
- Surface gauge
- Surface plate
- Telescopic gauge
- Three wire set
- Transfer caliper
- Vernier caliper (dial, digital)
Set Up Accessories

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

Safety Equipment

- Eye wash station
- Face shield
- Required fire suppression equipment
- Required first aid coverage and equipment
- Safety barrier tapes

Specialty Tools

Software

- CAD/CAM software

Student Equipment (supplied by school)

Required

- Dust mask
- Hearing protectors

Student Tools (supplied by student)

Required

- Safety boots
- Safety glasses

Recommended

- Personal protective equipment (as determined by WorkSafeBC)
- Personal hearing protection
Required Reference Materials

- Individualized Learning Machinist Modules from Alberta Learning.
  - BC Level 1 and 2 package
- WorkSafe BC Regulations Online
- Technology of Machine Tools and Workbook
- Machinery’s Handbook
- Haas Programming Manual
- Haas Operator Manual

Recommended Resources

- Interpret Engineering Drawings (Canadian Edition)
- SKF Bearing Maintenance Handbook by the SKF Bearing Corporation
- Mathematics for Machine Technology, Smith
- Engineer’s Black Book: Machinist and Manufacturing Reference Guide, Pat Rapp

Suggested Texts

- IPT Trade Handbooks Series
- Machine Tool Practices
Instructor Requirements

**Occupation Qualification**
The instructor must possess:

- Machinist Red Seal certification

**Work Experience**
A minimum of 10 years’ experience working in the industry as a journeyperson.

**Instructional Experience and Education**
It is preferred that the instructor also possesses one of the following:

- 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
Appendices
Appendix A
Acronyms

AED  Automated external defibrillator
AISI  American Iron and Steel Institute
ANSI  American National Standards Institute
API  American Petroleum Institute
ASME  American Society of Mechanical Engineers
BSP  British standard pipe
CAD  Computer-aided design
CAM  Computer-aided manufacturing
CBN  Cubic boron nitride
CMM  Coordinate measuring machine
CNC  Computer numerical control
EDM  Electrical discharge machines
FPM  Feet per minute
HSS  High speed steel
IPM  Inches per minute
ISO  International Standards Organization
MPM  Metres per minute
MTR  Material test report
NDT  Non-destructive testing
NPS  National Pipe Straight
NPT  National Pipe Taper
PLC  Programmable logic controller
PPE  Personal protective equipment
RPM  Revolutions per minute
SAE  Society of Automotive Engineers
SDS  Safety data sheets
SFPM  Surface feet per minute
SMPM  Surface metres per minute
UN  Unified National
UNC  Unified National Course (a thread system for course threads)
UNF  Unified National Fine (a thread system for fine threads)
UNS  Unified National Special
WHMIS  Workplace Hazardous Materials Information System
Appendix B
Previous Contributors

Subject Matter Experts retained to assist in the development of the 2014 Program Outline:

- James Cai  BC Institute of Technology
- Ron Metcalfe  Murrey Latta Progressive Machine
- David Peare  Patton and Cooke
- Dave Sanford  Howe Sound Pulp and Paper (retired)
- Daniel Smith  Howe Sound Pulp and Paper

The Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the RTO (Resource Training Organization). Members include:

- Steve Anderson  Department of National Defense
- Danny Bradford  BC Federation of Labour
- Larry Dosalph  Teck
- Ralph Finch  Thompson Rivers University
- Dana Goedbloed  Kwantlen Polytechnic University
- Wayne Muzylo  West Fraser (Eurocan Pulp and Paper)
- James Piwek  Teck
- Brad Smith  Catalyst Paper
- Cindy Soderstrom  CAODC (Rig Tech Trade)
- Gene Von Matt  Elk Valley Coal
- Wayne Wetmore  Enform Training
- Trevor Williams  BC Institute of Technology

Subject Matter Experts retained to assist in the development of 2008 Program Outline:

- Dave Baker  Kodak Graphic Communication
- James Cai  BC Institute of Technology
- Tim Duthie  Elk Valley Coal Corp
- Paul Ghotra  CImtech Mfg Inc
- Alastair Haythornthwaite  International Association of Machinists DL 250
- Uwe zum Hingst  Zum Hingst Technologies Inc.
- John MacKinnon  Avcorp Industries Inc.
- Gary Markham  Raute Wood Ltd.
- Dave Sanford  Howe Sound Pulp and Paper
- Richard Turnbull  Department of National Defense
- Tim Walls  Pazmac Enterprises
- Guy Walton  Kodak Graphic Communication
- Reinhard Wildauer  College of New Caledonia