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www.itabc.ca

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SHEET METAL WORKER
HARMONIZED PROGRAM OUTLINE

APPROVED BY INDUSTRY
JANUARY 2018

BASED ON
RSOS 2017

Developed by
Industry Training Authority
Province of British Columbia
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Section 1
INTRODUCTION
Sheet Metal Worker
Foreword

This revised Sheet Metal Worker Program Outline is intended as a guide for instructors, apprentices, and employers of apprentices as well as for the use of industry organizations, regulatory bodies, and provincial and federal governments. It reflects updated standards based on the new Sheet Metal Worker Red Seal Occupational Standard (2017) and British Columbia industry and instructor Subject Matter Experts.

Practical instruction by demonstration and student participation should be integrated with classroom sessions. Safe working practices, even though not always specified in each operation or topic, are an implied part of the program and should be stressed throughout the apprenticeship.

This Program Outline includes a list of recommended reference textbooks that are available to support the learning objectives and the minimum shop requirements needed to support instruction.

Each competency is to be evaluated through the use of written examination in which the learner must achieve a minimum of 70% in order to receive a passing grade. The types of questions used on these exams must reflect the cognitive level indicated by the learning objectives and the learning tasks listed in the related competencies.

Achievement Criteria are included for those competencies that require a practical component. The intent of including Achievement Criteria in the Program Outline is to ensure consistency in training across the many training institutions in British Columbia. Their purpose is to reinforce the theory and to provide a mechanism for evaluation of the learner’s ability to apply the theory to practice. It is important that these performances be observable and measureable and that they reflect the skills spelled out in the competency as those required of a competent journeyperson. The conditions under which these performances will be observed and measured must be clear to the learner as well as the criteria by which the learner will be evaluated. The learner must also be given the level of expectation of success.

The performance spelled out in the Achievement Criteria is a suggested performance and is not meant to stifle flexibility of delivery. Training Providers are welcome to substitute other practical performances that measure similar skills and attainment of the competency. Multiple performances may also be used to replace individual performances where appropriate. Where multiple performances are listed, Training Providers may choose to select one only, or more, for assessing performance.

While some competencies might appear to be very similar in different levels of training, more advanced skills are taught at each level. This can be seen in the types of fittings and components being taught and in the type of Achievement Criteria required in each competency. The fittings involve higher levels of skill to be used in both pattern development and in fabrication and assembly.

SAFETY ADVISORY

Be advised that references to the WorkSafe BC 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

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

- Brian Coey
- Antonio Henriques
- Greg McDonald
- Erich Moeller
- Bob Pascuzzi
- Doug Savory

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 Sheet Metal Worker 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>Program Credentialing Model</td>
<td>Communicates 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>OAC</td>
<td>Communicates 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>Training Topics and Suggested Time Allocation</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>Understand the relative weightings of various competencies of the occupation on which assessment is based</td>
</tr>
<tr>
<td>Program Content</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>
## HARMONIZED PROGRAM OUTLINE

### 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>
</tbody>
</table>
Section 2

PROGRAM OVERVIEW

Sheet Metal Worker
Program Credentialing Model

Apprenticeship Pathway
This graphic provides an overview of the Sheet Metal Worker apprenticeship pathway.

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

---

**Sheet Metal Worker Level 4**  
Technical Training: 240 hours  
Work-Based Training: 6,240 hours total  
Interprovincial Red Seal Exam

**Sheet Metal Worker Level 3**  
Technical Training: 240 hours  
Work-Based Training: Accumulate hours  
ITA Standardized Written Exam

**Sheet Metal Worker Level 2**  
Technical Training: 240 hours  
Work-Based Training: Accumulate hours  
ITA Standardized Written Exam

**Sheet Metal Worker Level 1**  
Technical Training: 240 hours  
Work-Based Training: Accumulate hours  
ITA Standardized Written Exam

---

**APPRENTICESHIP - DIRECT ENTRY**

---

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

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

---

**Technical Training: Level 1**  
**Work-Based Training: 900 hours**
Occupational Analysis Chart

SHEET METAL WORKER

Occupation Description: “Sheet Metal Worker” means a person who lays out, fabricates, assembles, welds, installs, and services the following: ducting, spouting, fittings cabinets, gutters, copings, flashings, supporting devices, wall systems, building envelope, ornamental work and integral equipment associated with the blowpipe, air pollution, heating, ventilating, air-conditioning, roofing, restaurant, kitchen, marine installations and hospital equipment fields.

PERFORM SAFETY RELATED FUNCTIONS

<table>
<thead>
<tr>
<th>A</th>
<th>Use personal protective equipment (PPE) and safety equipment</th>
<th>Maintain safe work environment</th>
<th>Perform lock-out and tag-out procedures</th>
<th>Use WHMIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>1</td>
<td>A2</td>
<td>1</td>
<td>A3</td>
</tr>
</tbody>
</table>

USE AND MAINTAIN TOOLS AND EQUIPMENT

<table>
<thead>
<tr>
<th>B</th>
<th>Use hand and portable power tools</th>
<th>Use shop tools and equipment</th>
<th>Use gas metal arc welding (GMAW) equipment</th>
<th>Use gas tungsten arc welding (GTAW) equipment</th>
<th>Use shielded metal arc welding (SMAW) equipment</th>
<th>Use oxy-fuel and plasma arc cutting equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>1</td>
<td>B2</td>
<td>1 2 3</td>
<td>B3</td>
<td>1 2 3 4</td>
<td>B4</td>
</tr>
<tr>
<td>B7</td>
<td>1 2</td>
<td>B8</td>
<td>1</td>
<td>B9</td>
<td>1 4</td>
<td>B10</td>
</tr>
</tbody>
</table>

ORGANIZE WORK

<table>
<thead>
<tr>
<th>C</th>
<th>Use trade related documentation</th>
<th>Interpret drawings</th>
<th>Organize materials and equipment for projects</th>
<th>Perform basic design and field modifications</th>
<th>Use mathematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>1 2</td>
<td>C2</td>
<td>1 2</td>
<td>C3</td>
<td>1 2</td>
</tr>
</tbody>
</table>
### Harmonized Program Outline

#### Program Overview

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>E1</td>
<td>F1</td>
<td>G1</td>
<td>H1</td>
<td>I1</td>
</tr>
<tr>
<td>D2</td>
<td>E2</td>
<td>F2</td>
<td>G2</td>
<td>H2</td>
<td>I2</td>
</tr>
<tr>
<td></td>
<td>E3</td>
<td>F3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E4</td>
<td>F4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>E5</td>
<td>F5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **D1**: Use communication techniques
- **D2**: Use mentoring techniques
- **E1**: Develop patterns using simple and straight line methods
- **E2**: Develop patterns using parallel line method
- **E3**: Develop patterns using radial line development
- **E4**: Develop patterns using triangulation method
- **E5**: Use computer technology for pattern development
- **F1**: Select materials for trade related products
- **F2**: Fabricate ductwork, fittings and components
- **F3**: Insulate ductwork, fittings and components
- **F4**: Fabricate material handling system components
- **F5**: Fabricate dampers
- **F6**: Fabricate hanger systems, supports and bases
- **G1**: Select material for flashing, roofing, sheeting and cladding
- **G2**: Fabricate flashing, roofing, sheeting and cladding
- **H1**: Select material for specialty products
- **H2**: Fabricate specialty products
- **I1**: Perform on-site measurements
- **I2**: Perform demolition for renovations
<table>
<thead>
<tr>
<th>INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLIANCES AND MECHANICAL EQUIPMENT</th>
<th>J</th>
<th>J1</th>
<th>J2</th>
<th>J3</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSTALL AIR HANDLING SYSTEM COMPONENTS</td>
<td>K</td>
<td>K1</td>
<td>K2</td>
<td>K3</td>
</tr>
<tr>
<td>INSTALL MATERIAL HANDLING SYSTEM COMPONENTS</td>
<td>L</td>
<td>L1</td>
<td>L2</td>
<td>L3</td>
</tr>
<tr>
<td>APPLY THERMAL INSULATION, LAGGING, CLADDING AND FLASHING</td>
<td>M</td>
<td>M1</td>
<td>M2</td>
<td></td>
</tr>
<tr>
<td>PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING</td>
<td>N</td>
<td>N1</td>
<td>N2</td>
<td>N3</td>
</tr>
</tbody>
</table>
HARMONIZED PROGRAM OUTLINE
Program Overview

INSTALL METAL ROOFING AND CLADDING/ SIDING SYSTEMS

<table>
<thead>
<tr>
<th>O</th>
<th>Lay out roof and walls</th>
<th>Install insulation, isolation material and building envelope components</th>
<th>Install roofing, cladding/siding system components</th>
<th>Seal exposed joints</th>
<th>Install decking</th>
</tr>
</thead>
<tbody>
<tr>
<td>O1</td>
<td>2</td>
<td>2</td>
<td>O2</td>
<td>O3</td>
<td>O4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

INSTALL EXTERIOR COMPONENTS

<table>
<thead>
<tr>
<th>P</th>
<th>Prepare surface</th>
<th>Fasten exterior components</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

INSTALL SPECIALTY PRODUCTS

<table>
<thead>
<tr>
<th>Q</th>
<th>Install stainless steel specialty products</th>
<th>Install non-stainless steel specialty products</th>
<th>Install marine products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>3</td>
<td>3</td>
<td>Q3</td>
</tr>
<tr>
<td>Q2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PERFORM SCHEDULED MAINTENANCE

<table>
<thead>
<tr>
<th>R</th>
<th>Diagnose system faults</th>
<th>Repair worn or faulty components</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>3</td>
<td>R2</td>
</tr>
<tr>
<td>R2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# HARMONIZED PROGRAM OUTLINE

## Program Overview

### Training Topics and Suggested Time Allocation: Level 1

**SHEET METAL WORKER – LEVEL 1**

<table>
<thead>
<tr>
<th>Line A</th>
<th>PERFORM SAFETY RELATED FUNCTIONS</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Use personal protective equipment (PPE) and safety equipment</td>
<td>7%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>A2</td>
<td>Maintain safe work environment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>A3</td>
<td>Perform lock-out and tag-out procedures</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>A4</td>
<td>Use WHMIS</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line B</th>
<th>USE AND MAINTAIN TOOLS AND EQUIPMENT</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>Use hand and portable power tools</td>
<td>25%</td>
<td>30%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>B2</td>
<td>Use shop tools and equipment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>B3</td>
<td>Use gas metal arc welding (GMAW) equipment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>B4</td>
<td>Use oxy-fuel and plasma arc welding equipment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>B5</td>
<td>Use shielding metal arc welding (SMAW) equipment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>B6</td>
<td>Use soldering and brazing equipment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>B7</td>
<td>Use measuring and layout equipment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>B8</td>
<td>Use stationary and mobile work platforms</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>B9</td>
<td>Use hoisting, rigging and positioning equipment</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line C</th>
<th>ORGANIZE WORK</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Use trade-related documentation</td>
<td>13%</td>
<td>85%</td>
<td>15%</td>
<td>100%</td>
</tr>
<tr>
<td>C2</td>
<td>Interpret drawings</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>C3</td>
<td>Organize materials and equipment for projects</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>C5</td>
<td>Use mathematics</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line D</th>
<th>USE COMMUNICATION AND MENTORING TECHNIQUES</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Use communication techniques</td>
<td>2%</td>
<td>50%</td>
<td>50%</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line E</th>
<th>PERFORM PATTERN DEVELOPMENT</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Develop patterns using simple and straight line methods</td>
<td>23%</td>
<td>80%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>E2</td>
<td>Develop patterns using parallel line method</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>E3</td>
<td>Develop patterns using radial line development</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>E4</td>
<td>Develop patterns using triangulation method</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line F</th>
<th>FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Select materials for trade related products</td>
<td>17%</td>
<td>30%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>F2</td>
<td>Fabricate ductwork, fittings and components</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>F3</td>
<td>Insulate ductwork, fittings and components</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>F6</td>
<td>Fabricate hanger systems, supports and bases</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>
## INSTALL AIR HANDLING SYSTEM COMPONENTS

<table>
<thead>
<tr>
<th>Line K</th>
<th>Task Description</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>Install air handling equipment</td>
<td>13%</td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>K3</td>
<td>Install sheet metal ducts, fittings and dampers</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>K5</td>
<td>Install registers, grilles, diffusers and louvers</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>K8</td>
<td>Install residential systems</td>
<td></td>
<td>✔</td>
<td>✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Total Percentage for Sheet Metal Worker Level 1: 100%
# HARMONIZED PROGRAM OUTLINE

**Program Overview**

## Training Topics and Suggested Time Allocation: Level 2

### SHEET METAL WORKER – LEVEL 2

<table>
<thead>
<tr>
<th>Line</th>
<th>Training Topic</th>
<th>% of Time Allocated to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% of Time</td>
</tr>
<tr>
<td><strong>Line B</strong></td>
<td><strong>USE AND MAINTAIN TOOLS AND EQUIPMENT</strong></td>
<td>17%</td>
</tr>
<tr>
<td>B2</td>
<td>Use shop tools and equipment</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>Use gas metal arc welding (GMAW) equipment</td>
<td></td>
</tr>
<tr>
<td>B5</td>
<td>Use shielded metal arc welding (SMAW) equipment</td>
<td></td>
</tr>
<tr>
<td>B7</td>
<td>Use soldering and brazing equipment</td>
<td></td>
</tr>
<tr>
<td><strong>Line C</strong></td>
<td><strong>ORGANIZE WORK</strong></td>
<td>10%</td>
</tr>
<tr>
<td>C1</td>
<td>Use trade-related documentation</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Interpret drawings</td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>Perform basic design and field modifications</td>
<td></td>
</tr>
<tr>
<td><strong>Line E</strong></td>
<td><strong>PERFORM PATTERN DEVELOPMENT</strong></td>
<td>20%</td>
</tr>
<tr>
<td>E1</td>
<td>Develop patterns using simple and straight line methods</td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>Develop patterns using parallel line method</td>
<td></td>
</tr>
<tr>
<td>E3</td>
<td>Develop patterns using radial line development</td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td>Develop patterns using triangulation method</td>
<td></td>
</tr>
<tr>
<td><strong>Line F</strong></td>
<td><strong>FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS</strong></td>
<td>17%</td>
</tr>
<tr>
<td>F2</td>
<td>Fabricate ductwork, fitting and components</td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>Fabricate material handling system components</td>
<td></td>
</tr>
<tr>
<td><strong>Line G</strong></td>
<td><strong>FABRICATE ARCHITECTURAL SHEET METAL PRODUCTS</strong></td>
<td>10%</td>
</tr>
<tr>
<td>G1</td>
<td>Select material for flashing, roofing, sheeting and cladding</td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>Fabricate flashing, roofing, sheeting and cladding</td>
<td></td>
</tr>
<tr>
<td><strong>Line I</strong></td>
<td><strong>PREPARE INSTALLATION SITE</strong></td>
<td>2%</td>
</tr>
<tr>
<td>I1</td>
<td>Perform on-site measurements</td>
<td></td>
</tr>
<tr>
<td>I2</td>
<td>Perform demolition for renovations</td>
<td></td>
</tr>
<tr>
<td><strong>Line J</strong></td>
<td><strong>INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLIANCES AND MECHANICAL EQUIPMENT</strong></td>
<td>5%</td>
</tr>
<tr>
<td>J1</td>
<td>Install chimneys</td>
<td></td>
</tr>
<tr>
<td>J2</td>
<td>Connect appliances or mechanical equipment to chimney and breeching</td>
<td></td>
</tr>
<tr>
<td>J3</td>
<td>Install high efficiency appliances and mechanical equipment</td>
<td></td>
</tr>
<tr>
<td><strong>Line K</strong></td>
<td><strong>INSTALL AIR HANDLING SYSTEM COMPONENTS</strong></td>
<td>9%</td>
</tr>
</tbody>
</table>
# Harmonized Program Outline

### Program Overview

<table>
<thead>
<tr>
<th>% of Time Allocated to:</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
</table>

| K1 | Install air handling equipment | ✓ | | |
| K2 | Install hangers, cables, braces and brackets | ✓ | | |
| K4 | Install penetrations and sleeves | ✓ | | |
| K7 | Install system component accessories | ✓ | | |

**Line O** INSTALL METAL ROOFING AND CLADDING/SIDING SYSTEMS

| O1 | Lay out roof and walls | ✓ | ✓ | 8% 75% 25% 100% |
| O2 | Install insulation, isolation material and building envelope components | ✓ | ✓ | |
| O3 | Install roofing, cladding/siding system components | ✓ | ✓ | |
| O4 | Seal exposed joints | ✓ | ✓ | |
| O5 | Install decking | ✓ | | |

**Line P** INSTALL EXTERIOR COMPONENTS

| P1 | Prepare surface | ✓ | | |
| P2 | Fasten exterior components | ✓ | | |

**Total Percentage for Sheet Metal Worker Level 2** 100%
# Training Topics and Suggested Time Allocation: Level 3

## SHEET METAL WORKER – LEVEL 3

<table>
<thead>
<tr>
<th>Line</th>
<th>Training Topic</th>
<th>% of Time Allocated to</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Line B</strong></td>
<td><strong>USE AND MAINTAIN TOOLS AND EQUIPMENT</strong></td>
<td>15%</td>
<td>30%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>B2</td>
<td>Use shop tools and equipment</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>Use gas metal arc welding (GMAW) equipment</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>Use gas tungsten arc welding (GTAW) equipment</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Line E</strong></td>
<td><strong>PERFORM PATTERN DEVELOPMENT</strong></td>
<td>24%</td>
<td>75%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>E2</td>
<td>Develop patterns using parallel line method</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E3</td>
<td>Develop pattern using radial line development</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td>Develop patterns using triangulation method</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Line F</strong></td>
<td><strong>FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS</strong></td>
<td>19%</td>
<td>35%</td>
<td>65%</td>
<td>100%</td>
</tr>
<tr>
<td>F2</td>
<td>Fabricate ductwork, fittings and components</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>Fabricate material handling system components</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Line H</strong></td>
<td><strong>FABRICATE PRODUCTS FROM SPECIALTY MATERIALS</strong></td>
<td>14%</td>
<td>30%</td>
<td>70%</td>
<td>100%</td>
</tr>
<tr>
<td>H1</td>
<td>Select material for specialty products</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2</td>
<td>Fabricate specialty products</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Line K</strong></td>
<td><strong>INSTALL AIR HANDLING SYSTEM COMPONENTS</strong></td>
<td>8%</td>
<td>90%</td>
<td>10%</td>
<td>100%</td>
</tr>
<tr>
<td>K6</td>
<td>Install terminal boxes and coils</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K7</td>
<td>Install system component accessories</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>K9</td>
<td>Install industrial, commercial and institutional systems</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
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<tr>
<td><strong>Line N</strong></td>
<td><strong>PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING</strong></td>
<td>7%</td>
<td>90%</td>
<td>10%</td>
<td>100%</td>
</tr>
<tr>
<td>N1</td>
<td>Perform leak tests</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N2</td>
<td>Perform testing, adjusting and balancing (TAB)</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N3</td>
<td>Participate in the commissioning of air and material handling systems</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Line Q</strong></td>
<td><strong>INSTALL SPECIALTY PRODUCTS</strong></td>
<td>8%</td>
<td>90%</td>
<td>10%</td>
<td>100%</td>
</tr>
<tr>
<td>Q1</td>
<td>Install stainless steel specialty products</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q2</td>
<td>Install non-stainless steel specialty products</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q3</td>
<td>Install marine products</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Line R</strong></td>
<td><strong>PERFORM SCHEDULED MAINTENANCE</strong></td>
<td>5%</td>
<td>90%</td>
<td>10%</td>
<td>100%</td>
</tr>
<tr>
<td>R1</td>
<td>Diagnose system faults</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>Repair work or faulty components</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Percentage for Sheet Metal Worker Level 3</strong></td>
<td>100%</td>
<td></td>
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</tbody>
</table>
## Training Topics and Suggested Time Allocation: Level 4

### SHEET METAL WORKER – LEVEL 4

<table>
<thead>
<tr>
<th>Line</th>
<th>Training Topic</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line B</td>
<td><strong>USE AND MAINTAIN TOOLS AND EQUIPMENT</strong></td>
<td>12%</td>
<td>40%</td>
<td>60%</td>
<td>100%</td>
</tr>
<tr>
<td>B3</td>
<td>Use gas metal arc welding (GMAW) equipment</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>B10</td>
<td>Use hoisting, rigging and positioning equipment</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Line D</td>
<td><strong>USE COMMUNICATION AND MENTORING TECHNIQUES</strong></td>
<td>2%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>D2</td>
<td>Use mentoring techniques</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Line E</td>
<td><strong>PERFORM PATTERN DEVELOPMENT</strong></td>
<td>23%</td>
<td>75%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>E4</td>
<td>Develop patterns using triangulation method</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>E5</td>
<td>Use computer technology for pattern development</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Line F</td>
<td><strong>FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS</strong></td>
<td>20%</td>
<td>35%</td>
<td>65%</td>
<td>100%</td>
</tr>
<tr>
<td>F2</td>
<td>Fabricate ductwork, fittings and components</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>Fabricate material handling system components</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td>Fabricate dampers</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Line K</td>
<td><strong>INSTALL AIR HANDLING SYSTEM COMPONENTS</strong></td>
<td>15%</td>
<td>75%</td>
<td>25%</td>
<td>100%</td>
</tr>
<tr>
<td>K1</td>
<td>Install air handling equipment</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>K7</td>
<td>Install system component accessories</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Line L</td>
<td><strong>INSTALL MATERIAL HANDLING SYSTEM COMPONENTS</strong></td>
<td>10%</td>
<td>90%</td>
<td>10%</td>
<td>100%</td>
</tr>
<tr>
<td>L1</td>
<td>Install pneumatic material handling system components</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>L2</td>
<td>Install gravity material handling system components</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>L3</td>
<td>Install mechanized material handling system components</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Line M</td>
<td><strong>APPLY THERMAL INSULATION, LAGGING, CLADDING AND FLASHING</strong></td>
<td>9%</td>
<td>80%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>M1</td>
<td>Apply lagging and cladding to components</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>M2</td>
<td>Apply flashing to components</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Line N</td>
<td><strong>PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING</strong></td>
<td>9%</td>
<td>80%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>N1</td>
<td>Perform leak tests</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>N2</td>
<td>Perform testing, adjusting and balancing (TAB)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>N3</td>
<td>Participate in the commissioning of air and material handling systems</td>
<td></td>
<td>✓</td>
<td>✓</td>
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</tbody>
</table>

**Total Percentage for Sheet Metal Worker Level 4**

|                                                      | 100% |
Section 3
PROGRAM CONTENT
Sheet Metal Worker
Level 1
Sheet Metal Worker
Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS

Competency: A1 Use personal protective equipment (PPE) and safety equipment

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

- Select and use personal protective equipment.

LEARNING TASKS

1. Describe personal protective equipment requirements

   - Safety footwear
   - Eye protection
   - Ear protection
   - Head protection
   - Respiratory protection
   - Clothing
   - Fall protection
   - CSA Standards
   - WorkSafeBC Standards

2. Use personal protective equipment

   - Use
   - Inspection
   - Maintenance
   - Storage
   - Limitations of PPE
   - Fit test
   - Training requirements

3. Describe the conditions necessary to support a fire

   - Air
   - Fuel
   - Heat

4. Describe the classes of fires according to the materials being burned

   - Class A
   - Class B
   - Class C
   - Class D
   - Symbols and colours
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 5. Apply preventative fire safety precautions when working near, handling or storing flammable liquids or gases, combustible materials and electrical apparatus | • Fuels  
  o Diesel  
  o Gasoline  
  o Propane  
  o Natural Gas  
 • Ventilation  
 • Purging  
 • Lubricants  
 • Oily rags  
 • Combustible metals  
 • Aerosols  
 • Warning others and fire department  
 • Evacuation of others  
 • Fire contained and not spreading  
 • Personal method of egress  
 • Training  
 • Extinguisher selection  
 • P.A.S.S.  
  o Pull  
  o Aim  
  o Squeeze  
  o Sweep |
| 6. Describe the considerations and steps to be taken prior to fighting a fire |                                                                         |
| 7. Describe the procedure for using a fire extinguisher                      |                                                                         |
Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS
Competency: A2 Maintain safe work environment

Objectives
To be competent in this area, the individual must be able to:
• Identify and describe workplace hazards.
• Manage workplace hazards.
• Demonstrate emergency procedures.
• Describe non-emergency injury reporting procedures.
• Describe how worksite safety policies are established.
• Locate information in regulations and standards.

LEARNING TASKS
1. Describe short term hazards in the sheet metal industry
   • Sharp objects
   • Ladders
   • Work platforms
   • Electrical
   • Compressed gas
   • Explosive material (dust)
   • Lifting
   • Personal apparel
      o Clothing
      o Hair and beards
      o Jewellery
   • Impairment
   • Horseplay
   • Housekeeping

2. Describe long term hazards in the sheet metal industry
   • Respiratory disease
   • Asbestos
   • Repetitive strain injuries
   • Management of hazards

3. Demonstrate safe attitude
   • Respect for others' safety
   • Constant awareness of surroundings
   • Management of hazards

4. Describe safety precautions when working at elevations
   • Wind
   • Floor openings
   • Guard rails
   • Safety lines
   • Weather
   • Stressed cables
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>5  Demonstrate emergency procedures</td>
<td>• Emergency shutoffs</td>
</tr>
<tr>
<td></td>
<td>• Fire control systems</td>
</tr>
<tr>
<td></td>
<td>• Eye wash facilities</td>
</tr>
<tr>
<td></td>
<td>• Emergency exits</td>
</tr>
<tr>
<td></td>
<td>• Emergency contact/phone numbers</td>
</tr>
<tr>
<td></td>
<td>• Outside meeting place</td>
</tr>
<tr>
<td></td>
<td>• Disaster meeting place</td>
</tr>
<tr>
<td>6.   Describe non-emergency injury reporting procedures</td>
<td>• First aid facilities</td>
</tr>
<tr>
<td></td>
<td>• Reports</td>
</tr>
<tr>
<td>7.   Describe how a workplace safety policy is established</td>
<td>• Process</td>
</tr>
<tr>
<td></td>
<td>o Hazard assessment</td>
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<tr>
<td></td>
<td>o Tool box meetings</td>
</tr>
<tr>
<td></td>
<td>o Conditions</td>
</tr>
<tr>
<td></td>
<td>o Meeting requirements</td>
</tr>
<tr>
<td></td>
<td>o Reporting hazards and incidents</td>
</tr>
<tr>
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<td>o Reporting injuries</td>
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<td>• Minimum standards</td>
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<td>o Acts and Regulations</td>
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HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

LEARNING TASKS
8. Locate information in the OHS regulation and WCB standards

CONTENT
• Definitions, Section 1 of the Act
• Part 1, Division 2 of the Act
• Part 2, Division 3, Sections 115-124 of the Act
• Part 1, Division 5, Sections 53 and 54 of the Act
• Definitions
• Application
• Rights and Responsibilities
  o Health and safety programs
  o Investigations and reports
  o Workplace inspections
  o Right to refuse work
• General Conditions
  o Building and equipment safety
  o Emergency preparedness
  o Preventing violence
  o Working alone
  o Ergonomics
  o Illumination
  o Indoor air quality
• Smoking and lunchrooms
• Chemical and biological substances
• Substance specific requirements
• Noise, vibration, radiation and temperature
• Personal protective clothing and equipment
• Confined spaces
• De-energization and lockout
• Fall protection
• Tools, machinery and equipment
• Ladders, scaffolds and temporary work platforms
• Cranes and hoists
• Rigging
• Mobile equipment
• Transportation of workers
• Traffic control
• Electrical safety
Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS
Competency: A3 Perform lock-out and tag-out procedures

Objectives
To be competent in this area, the individual must be able to:
- Identify workplace lock-out procedures and policies.
- Identify energy sources.
- Select correct lock-out device.
- Demonstrate competency in usage of selected devices.

LEARNING TASKS
1. Identify workplace lock-out procedures and policies
   - Coordination with others
     - Supervisors
     - Other trades
     - Appropriate authorities
     - Outside agencies
   - Application of devices
   - Removal of devices
   - Verify de-energized

2. Identify hazards and/or energy sources
   - Gravity
   - Hydraulic
   - Electrical
   - Steam
   - Mechanical
   - Magnetic
   - Gas
   - Air
   - Water
   - Pneumatic
   - Electric eyes
   - Battery operated
   - Back up energy sources

3. Select and demonstrate competency in use of lock-out devices
   - Devices
     - Padlocks
     - Scissor clamps
     - Lock boxes
     - Ball valve lock-outs
     - Circuit breaker lock-outs
   - Plug in boxes
HARMONIZED PROGRAM OUTLINE
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Level 1

Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS
Competency: A4 Use WHMIS

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

- Describe the purpose of the Workplace Hazardous Materials Information System (WHMIS) Regulations.
- Explain the contents of safety data sheets (SDS).
- Explain the contents of a WHMIS label.
- Apply WHMIS regulations.

LEARNING TASKS

1. State the legislation that requires suppliers of hazardous materials to provide SDSs 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 Materials Information Review Regulations

2. State the purpose of the Workplace Hazardous Materials Information System (WHMIS)
   - Protection
   - Provision of information
   - Safe use
   - Handling
   - Storage
   - Recognition of rights
     o Workers
     o Employers
     o Suppliers
     o Regulators

3. Describe the key elements of WHMIS
   - Safety data sheets (SDSs)
   - Labelling of containers of hazardous materials
   - Worker education programs

4. Describe the responsibilities of suppliers under WHMIS
   - Provision of
     o SDSs
     o Labels

5. Describe the responsibilities of employers under WHMIS
   - Provision of
     o SDSs
     o Labels
     o Work education programs in the workplace
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<thead>
<tr>
<th>LEARNING TASKS</th>
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<tr>
<td>6. Describe information to be disclosed on a SDS</td>
<td>- Hazardous ingredients</td>
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<td>- Preparation information</td>
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<td>- Product information</td>
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<td>- Reactivity data</td>
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<td>- Toxicological properties</td>
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<td>- Preventive measures</td>
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<td>- First-aid measures</td>
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<tr>
<td>7. Identify symbols found on WHMIS labels and their meaning</td>
<td>- Compressed gases</td>
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<td>- Flammable and combustible materials</td>
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<td>- Oxidizing materials</td>
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<td>- Poisonous and infectious materials</td>
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<tr>
<td></td>
<td>- Materials causing immediate and serious toxic effects</td>
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<td></td>
<td>- Materials causing other toxic effects</td>
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<td>- Biohazardous infectious materials</td>
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<td>8. Apply WHMIS regulations as they apply to hazardous materials used in the shop</td>
<td>- Corrosive materials</td>
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<td>- Dangerously reactive materials</td>
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<td>- Use</td>
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<td>- Storage</td>
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<td>- Disposal</td>
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</tbody>
</table>
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B1 Use hand and portable power tools

Objectives
To be competent in this area, the individual must be able to:
• Select hand and portable power tools appropriate to sheet metal processes.
• Use hand and portable power tools.
• Inspect and maintain tools.

LEARNING TASKS

1. Describe sheet metal hand tools
   • Squares
   • Rules
   • Dividers
   • Marking devices
   • Hammers
   • Punches
   • Chisels
   • Hack saws
   • Snips
   • Files
   • Pliers
   • Screw drivers
   • Folding tools
   • Pop riveter
   • Bubble level

2. Use hand and portable power tools
   • Types
   • Parts
   • Purpose/uses
   • Procedures/operations
   • Safety
   • Adjustment
   • Inspection
   • Maintenance
   • Tool manual
   • Storage

3. Use shop layout tools
   • Trammel points
   • Scratch awl
   • Scribers
   • Verification of layout and measuring tools accuracy
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 4. Describe portable power tools | • Drills  
  • Grinders  
  • Nibblers  
  • Shears  
  • Saws  
  • Electric seamers  
  • Gas powered tools  
  • Battery tools |
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B2 Use shop tools and equipment

Objectives
To be competent in this area, the individual must be able to:
- Select shop equipment appropriate to sheet metal processes.
- Use shop equipment.
- Inspect and maintain shop equipment.

LEARNING TASKS
1. Describe shop equipment
   - Squaring shears
   - Power shears
   - Bar folders
   - Rolls
   - Notcher
   - Hand brakes
   - Roll forming equipment
   - Punches
   - Rotary hand machines
   - Band saws
   - Bench grinders
   - Drill presses
   - Cleat benders
   - Forming stakes
   - Beverly shear

2. Use shop equipment
   - Types
   - Parts
   - Purpose/uses
   - Procedures/operations
   - Capacities
   - Safety
   - Adjustment
   - Inspection
   - Minor maintenance
   - Equipment manual
   - Storage
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B3 Use gas metal arc welding (GMAW) equipment

Objectives
To be competent in this area, the individual must be able to:
• Weld using GMAW.

LEARNING TASKS

1. Describe types of GMAW equipment
   • Push-pull guns
   • Spool guns
   • Foot pedals / remote controls
   • Portable machines
   • Stationary machines
   • Gas powered welding machine

2. Describe welding safety
   • Licensing and training requirements
   • Government regulations
   • Ventilation requirements
   • Flammable material recognition
   • Personal protective equipment
   • Compressed gas safety
   • Shock hazards

3. Describe gas metal arc welding (GMAW)
   • Terminology
   • Weld defects
   • Purpose/uses
   • Equipment
   • Materials to be welded
   • Consumables
   • Safety
   • Basic procedures/operations
   • Set-up
   • Adjustment
   • Take down
   • Inspection
   • Maintenance
   • Storage

4. Use welding tools
   • GMAW
Achievement Criteria

Performance  The learner will weld 16 gauge and 12 gauge mild steel coupons in flat position using GMAW.

Conditions  The learner will be given:
- Welding equipment
- Materials
- Coupons

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Continuous
- Heat setting
Line (GAC): B  USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B5 Use shielded metal arc welding (SMAW) equipment

Objectives
To be competent in this area, the individual must be able to:
• Weld using SMAW.

LEARNING TASKS
1. Describe types of welding equipment
   • Shielded metal arc welding (SMAW)
   • Equipment/hand tools

2. Describe welding safety
   • Licensing and training requirements
   • Government regulations
   • Ventilation requirements
   • Flammable material recognition
   • Personal protective equipment

3. Describe shielded metal arc welding (SMAW)
   • Terminology
   • Weld defects
   • Basic procedures/operations
   • Purpose/uses
   • Equipment
   • Materials to be welded
   • Electrode designation
   • Electrode storage
   • Safety
   • Set-up
   • Adjustment
   • Take down
   • Inspection
   • Maintenance
   • SMAW

4. Use welding tools
Achievement Criteria

Performance  The learner will weld 12 gauge mild steel coupon lap weld in flat position using SMAW.

Conditions    The learner will be given:
                • Welding equipment
                • Materials
                • Coupons

Criteria      The learner will score 70% or better on a rating sheet that reflects the following criteria:
                • Safety
                • Continuous
                • Heat setting
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT  
Competency: B6 Use oxy-fuel and plasma arc cutting equipment

Objectives
To be competent in this area, the individual must be able to:
- Cut using plasma and oxy-acetylene tools.

### LEARNING TASKS

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<th>CONTENT</th>
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</table>
| 1. Describe types of cutting and welding equipment | • Plasma cutting  
• Oxy-acetylene cutting  
• Equipment/hand tools  
• Propane cutting  
• Carbon arc  
• Natural gas  
• Mapp gas  |
| 2. Describe cutting and welding safety | • Licensing and training requirements  
• Government regulations  
• Ventilation requirements  
• Flammable material recognition  
• Personal protective equipment  
• Compressed gas safety  |
| 3. Describe plasma cutting | • Terminology  
• Weld defects  
• Purpose/uses  
• Limitations  
• Equipment  
• Materials to be cut  
• Consumables  
• Safety  
• Procedures/operations  
• Set-up  
• Adjustment  
• Take down  
• Inspection  
• Maintenance  
• Storage  
• Gas or compressed air selection  |
| 4. Describe oxy-acetylene cutting | • Purpose/uses  
• Limitations  
• Equipment  |
LEARNING TASKS

5. Use cutting tools

CONTENT

- Materials to be cut
- Consumables
- Safety
- Procedures/operations
- Set-up
- Adjustment
- Take down
- Inspection
- Maintenance
- Storage
- Plasma
- Oxy-acetylene

Achievement Criteria 1

Performance The learner will cut a pattern using mild steel and a plasma cutter.

Conditions The learner will be given:
- Steel
- Plasma cutter
- Pattern

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Clean cut
- Accuracy

And/or

Achievement Criteria 2

Performance The learner will cut a pattern using mild steel and oxy-acetylene cutting equipment.

Conditions The learner will be given:
- Steel
- Oxy-acetylene cutting equipment
- Pattern

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Clean cut
- Accuracy
**Line (GAC): B** USE AND MAINTAIN TOOLS AND EQUIPMENT

**Competency:** B7 Use soldering and brazing equipment

**Objectives**
To be competent in this area, the individual must be able to:
- Describe soldering and brazing equipment and techniques.
- Use soldering techniques.

**LEARNING TASKS**

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<th>1. Describe soldering and brazing equipment</th>
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<td>Materials to be soldered/brazed</td>
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<td>Transportation of Dangerous Goods Regulations</td>
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<td>Ventilation requirements</td>
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<td>Storage</td>
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<tr>
<th>CONTENT</th>
<th>2. Describe soldering techniques</th>
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<td>Solder selection</td>
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<td>Equipment selection</td>
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<td>Techniques</td>
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<td>Soldering</td>
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<td>Limitations</td>
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<th>3. Use soldering techniques</th>
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<tr>
<td>Selection</td>
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<td>Procedure</td>
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<tr>
<td>Inspection</td>
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Achievement Criteria

Performance  The learner will solder a project with various seams.

Conditions  The learner will be given:
  - Soldering tools
  - Materials
  - Project plan

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  - Safety
  - Setup
  - Material
  - Surface
  - Irons
  - Watertight
  - Appearance
  - Sweat versus skim
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B8 Use measuring and layout equipment

Objectives
To be competent in this area, the individual must be able to:
- Select hand tools appropriate to sheet metal processes.
- Use hand tools.
- Inspect and maintain tools.

LEARNING TASKS

1. Describe sheet metal hand tools
   - Squares
   - Rules
   - Dividers
   - Marking devices
   - Hammers

2. Use shop layout tools
   - Trammel points
   - Scratch awl
   - Scribes
   - Verification of layout and measuring tools accuracy

Achievement Criteria
Performance The learner will calculate the required system adjustments and generate a testing report.
Conditions The learner will be given:
- Test data
- System design data
- Tools and equipment
- Testing forms
Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Process
- Calculated adjustments
- Completed report
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B9 Use stationary and mobile work platforms

Objectives
To be competent in this area, the individual must be able to:
- Describe ladders, and stationary and mobile scaffolds.
- Use ladders and mobile and stationary scaffolds.

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<td>- Step</td>
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<td>• Uses</td>
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<td>• Safety</td>
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<td>2. Describe elevated work platforms</td>
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<td>- Scissor lift</td>
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<tr>
<td>3. Use ladders</td>
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<td>• Inspection</td>
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<td>• Maintenance</td>
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<td>• Storage</td>
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Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B10 Use hoisting, rigging and positioning equipment

Objectives
To be competent in this area, the individual must be able to:
• Identify hoisting, lifting and rigging equipment.
• Tie knots, bends and hitches.
• Select and use hoisting, lifting and rigging equipment.

LEARNING TASKS
1. Describe hoisting, lifting and rigging equipment
   • Types
     o Lifting equipment
     o Rigging equipment
     o Rolling equipment
   • Uses
   • Limitations and capacities
   • Government regulations
   • Safety

2. Tie knots bends and hitches
   • Rope types
   • Terms
   • General rules
   • Knot, bend and hitch types
   • Rope inspection
   • Maintenance
   • Storage

3. Identify hoisting, lifting and rigging equipment
   • Safety
   • Operating procedures
   • Communication and hand signals
   • Overhead crane
   • Duct lift
   • Come-alongs
   • Cable puller
   • Plate clamp
   • Inspection
   • Maintenance
   • Storage
   • Hand signals
   • 2-way radios
   • Centre of gravity
LEARNING TASKS

4. Use basic hoisting, lifting and rigging equipment

CONTENT

- Duct lift
- Come-alongs
- Cable puller
- Plate clamp
Line (GAC): C ORGANIZE WORK
Competency: C1 Use trade related documentation

Objectives
To be competent in this area, the individual must be able to:
• Describe pictorial drawing types.
• Develop pictorial and orthographic drawings.

LEARNING TASKS
1. Describe trade related documents
   • Time cards
   • First Aid forms
   • Safety action reports
   • Safety meeting minutes
   • WHMIS
   • SDS
   • Maintenance and repair manuals
   • Maintenance and repair records
   • Shop drawings
     o Material
     o Gauge
     o Quantity
     o Dimensions
   • Manufacturer’s drawings
   • Work orders
   • Technical Reference Manuals
   • Steel manufacturing / Sales manuals
   • Shear list
     o Material
     o Gauge
     o Quantity
     o Blank size
     o Grain direction
     o Painted material colour requirement

2. Describe pictorial drawings
   • Isometric
   • Perspective
   • Oblique
   • Dimensioning
   • Lettering
   • Scaling
   • Line types
   • Free hand sketches
Line (GAC): C ORGANIZE WORK
Competency: C2 Interpret drawings

Objectives
To be competent in this area, the individual must be able to:
- Interpret the information on an orthographic projection drawing.

LEARNING TASKS
1. Describe orthographic projection

CONTENT
- 3rd angle projection
- Views
  - Plan
  - Front
  - Bottom
  - Side
- 1st angle projection
- Auxiliary
- Profile
- Section
- Lines
  - Centre
  - Extension
  - Hidden
  - Dimension
  - Object
Line (GAC): C ORGANIZE WORK
Competency: C3 Organize materials and equipment for projects

Objectives
To be competent in this area, the individual must be able to:
• Describe considerations when handling materials.
• Select the proper procedure for handling materials.

LEARNING TASKS

1. Describe considerations when handling materials
   • Safety
   • Storage
   • Timing
   • Transportation
   • LEED (Leadership in Energy and Environmental Design)
   • Labelling
   • Moving
   • Product protection
   • Disposal
   • Recycling
   • Specialty materials
     o Architectural
     o Stainless
     o Panels
     o Decking
     o Round and square stock
     o Lagging material
     o Signage
     o Non-metals

2. Select procedures for handling materials
   • Safety
   • Procedures
   • Securing
   • Packaging/shipping
     o Required views
   • Mathematical formulas
   • Applications
     o Transition
     o Ogee offset
     o Duct elbows
   • Seam and joint allowances
   • Pattern labelling and forming instructions
Line (GAC):       C  ORGANIZE WORK  
Competency:      C5  Use mathematics  

Objectives  
To be competent in this area, the individual must be able to:  
• Use mathematical formulas to solve problems relating to sheet metal work.  

LEARNING TASKS  
1.  Describe geometric shapes  
2.  Describe mathematical formulas  
3.  Solve problems using formulas  
4.  Describe formulas used for triangles  
5.  Solve problems involving triangles  

CONTENT  
• Types  
• Linear measurement  
  o Metric  
  o Imperial  
• Stretch outs  
• Areas  
• Volumes  
• Capacities  
• Metric conversions  
• Squares  
• Square roots  
• Transposition to solve for different unknowns  
• Word problems  
• Sheet metal applications  
• Pythagorean Theorem  
• Trigonometric functions  
• Word problems  
• Sheet metal applications
Line (GAC): D  USE COMMUNICATION AND MENTORING TECHNIQUES  
Competency: D1  Use communication techniques

Objectives
To be competent in this area, the individual must be able to:
- Describe methods of communication.
- Communicate with others.

LEARNING TASKS
1. Describe methods of communication
   - Listening skills
   - Questioning skills
   - Following verbal directions
   - Body language
   - Written directions
   - Drawings
   - Trade terminology

2. Communicate with people
   - Interpersonal skills
   - Ethics
     - Time management
     - LEAN principles
     - Punctuality
     - Respect for authority
     - Stewardship of materials
   - Accepting constructive feedback
   - Respect for customer property
   - Respect for other trades
   - Customers (layperson terms)
   - Employer representation
   - First impression
Line (GAC): E  PERFORM PATTERN DEVELOPMENT
Competency: E1  Develop patterns using simple and straight line method

Objectives
To be competent in this area, the individual must be able to:
• Develop patterns for duct fittings and sheet metal components.

LEARNING TASKS
1. Select drafting equipment used to develop patterns for duct fittings
   • Tee squares
   • Dividers
   • Compasses
   • Rulers
   • Scales
   • Set squares
   • Protractors
   • Pencils
   • Calculators

2. Describe drafting techniques for duct fittings
   • Line development
     o Construction
   • Geometric construction
     o Front view
     o Plan view
     o Visualization in three dimensions
     o Required views
   • Mathematical formulas
   • Tools
   • Line development
     o Construction
   • Geometric construction
     o Front view
     o Plan view
     o Visualization in three dimensions
     o Required views
   • Mathematical formulas

3. Describe drafting techniques for sheet metal components and duct fittings
LEARNING TASKS
4. Develop patterns for sheet metal components and duct fittings

CONTENT
- Applications
  - Two way transition
  - Ogee offset
  - Square throat elbow
  - Radius throat elbow
  - Straight duct
  - Side take off
  - Drain pans
  - Boxes
  - End caps
- Seam and joint allowances
- Pattern labelling and forming instructions

5. Describe seams, locks and edges

- Types
- Patented duct connections (TDC, TDF)
  - Single and double seams
  - Standing seams
  - Riveted seam
  - Groove seams
  - Pocket lock
  - S-lock
  - Button lock
  - Pittsburgh lock
  - Lap and fasten
  - Hems
  - Flange connections
  - Slip and drive
  - Wired edge
Achievement Criteria 1

Performance  The learner will develop patterns for:
• Transitions
• Ogee offsets and/or
• Duct elbows

Conditions  The learner will be given:
• Project specifications
• Drafting equipment
• Paper
• Calculator

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
• Tools selection
• Procedure
• Patterns are complete and accurate to within +/- 1/32” of drawing specifications.

Achievement Criteria 2

Performance  The learner will develop patterns for:
• Straight duct
• Pan
• Ogee offset
• Duct elbows
• Transition
• End caps, and/or
• Boxes

Conditions  The learner will be given:
• Project specifications
• Patterns developed to seams and connections specified
• Drafting or layout tools

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
• Tools selection
• Procedure
• Patterns are complete and accurate to within +/- 1/16” of drawing specifications
Line (GAC): E PERFORM PATTERN DEVELOPMENT
Competency: E2 Develop patterns using parallel line method

Objectives
To be competent in this area, the individual must be able to:
• Develop patterns using parallel line development.

LEARNING TASKS

1. Select drafting equipment for parallel line development
   • Tee squares
   • Dividers
   • Compasses
   • Rulers
   • Scales
   • Set squares
   • Protractor
   • Pencils
   • Calculators

2. Describe drafting techniques for parallel line development
   • Views
     o Front
     o Plan
     o End
     o Which are required
     o Visualization in three dimensions
   • Line development
     o Construction
     o Projection
   • Geometric construction
   • Mathematical formulas

3. Develop patterns using parallel line development
   • Applications
     o Architectural mitres
     o Elbows
     o Tee branches on centre complete with main pipe hole patterns
     o Round pipes on slope complete with hole layout
   • Seam allowances
   • Pattern labelling and forming instructions
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

Achievement Criteria

Performance  The learner will use parallel line development to develop patterns for:

- Architectural mitres
- Tee branches on centre complete with main pipe and hole patterns
- Roof jacks on a slope, and/or
- Elbows

Conditions  The learner will be given:

- Drawing specifications
- Drafting equipment
- Paper
- Calculator

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:

- Tool selection
- Procedures
- Patterns complete and accurate to within +/- 1/32" of drawing specifications
Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E3 Develop patterns using radial line development

Objectives

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

- Develop patterns using radial line development.

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<thead>
<tr>
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<th>CONTENT</th>
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<tbody>
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<td>• Tee squares</td>
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<td>• Dividers</td>
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<tr>
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<td>• Compasses</td>
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<td>• Scales</td>
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<td>• Set squares</td>
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<td>• Protractors</td>
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<td>• Calculators</td>
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<tr>
<td>2. Describe drafting techniques for radial line development</td>
<td>• Line development</td>
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<tr>
<td></td>
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<td>• Required views</td>
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<td>• Mathematical formulas</td>
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<td></td>
<td>• Right cones (chimney cap)</td>
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<td>• Frustum (storm collar)</td>
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<td>• Truncated (roof jack on a slope)</td>
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<td></td>
<td>• Round reducer on centre</td>
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<tr>
<td>3. Develop patterns using radial line development</td>
<td>• Applications</td>
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<tr>
<td></td>
<td>• Seam allowances</td>
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<tr>
<td></td>
<td>• Pattern labelling and forming instructions</td>
</tr>
</tbody>
</table>
Achievement Criteria

Performance  The learner will use radial line development to develop patterns for:
  • Right cones
  • Frustum
  • Truncated, and/or
  • Round reducer on centre

Conditions  The learner will be given:
  • Drawing specifications
  • Drafting and lay out tools

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Tools selection
  • Procedure
  • Patterns are complete and accurate to within +/- 1/32" of drawing specifications.
Line (GAC): E  PERFORM PATTERN DEVELOPMENT
Competency: E4 Develop patterns using triangulation method

Objectives
To be competent in this area, the individual must be able to:
• Develop patterns using triangulation from the plan view.

LEARNING TASKS
1. Select drafting equipment for patterns using triangulation
   • Tee squares
   • Dividers
   • Compasses
   • Rulers
   • Scales
   • Set squares
   • Protractors
   • Pencils
   • Calculators

2. Describe drafting techniques for triangulation
   • Line development
     o Construction
     o Triangulation
   • Geometric construction
     o Front view
     o Plan view
     o Visualization in three dimensions
   • Mathematical formulas

3. Develop patterns using triangulation from the plan view
   • Applications
     o Square to round on centre
     o Square to round off centre
     o Round reducer off centre
   • Seam allowances
   • Pattern labelling and forming instructions
Achievement Criteria

Performance  The learner will use triangulation to develop patterns for:
  
  - Square to round on centre
  - Square to round off centre, and/or
  - Round reducer off centre

Conditions  The learner will be given:
  
  - Project specifications
  - Drafting and lay out tools.

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  
  - Tools selection
  - Procedure
  - Patterns are complete and accurate to within +/- 1/16” of drawing specifications
Line (GAC): F  FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F1  Select materials for trade related products

Objectives
To be competent in this area, the individual must be able to:
• Describe materials used in the sheet metal trade.

LEARNING TASKS
CONTENT
1. Describe type of materials and their properties
   • Metal types
      o Ferrous
         – Galvanized
         – Hot and cold rolled mild steel
         – Satin coat (Wipe coat, Paint lock)
         – Stainless steel
         – Pre-painted
         – Terne plate
      o Non ferrous
         • Aluminum
         • Copper
         • Zinc
         • Brass
         • Titanium
         • Monel
         • Bronze
         • Expanded
         • Perforated
         • Screen
         • Mesh
         • Checker plate
         • Profile shapes
         • Plastic
         • Composites
         • Fibreglass
         • Rubber
         • Polyvinylchloride (PVC)
         • Coatings
         • Material finishes
         • Properties
            o Ductility
            o Malleability
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

LEARNING TASKS

CONTENT

- Hardness
- Strength
- Elasticity
- Gauges
- Appearance
- Special design
- Extrusions
Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F2 Fabricate ductwork, fittings and components

Objectives
To be competent in this area, the individual must be able to:
• Produce a cutting list and fabricate components.

LEARNING TASKS
1. Describe sheet metal components
   • End caps
   • Spin-in collars
   • Flexible connections
   • Insulation stops
   • Volume dampers

2. Select tools
   • Layout tools
   • Hand tools
   • Shop equipment
   • Power tools

3. Select materials
   • Types
   • Gauges

4. Make a cutting list
   • Fitting requirements
   • Mathematics
   • Allowances
   • Material thickness allowance
   • Recording
   • Types
     o Single and double seams
     o Standing seams
     o Riveted seam
     o Groove seams
     o Pocket lock
     o S-lock
     o Button lock
     o Pittsburgh lock
     o Lap and spot weld
     o Hems

5. Describe seams, locks and edges
<table>
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<tr>
<th><strong>LEARNING TASKS</strong></th>
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</tr>
</thead>
</table>
| 6. Fabricate seams, locks and edges | - Types  
  - Double seam  
  - Pittsburgh lock  
  - Lap and spot weld  
  - Standing seams  
  - Groove seam  
  - Seam allowances |
| 7. Fabricate components | - Use of cutting list  
  - Notching  
  - Equipment selection  
  - Waste minimization  
  - Forming techniques  
  - Bending and bend sequence  
  - Cross-braking  
  - Rolling  
  - Rotary machine |
| 8. Select shop tools and equipment to fabricate ductwork and assemble fittings with components | - Layout tools  
  - Hand tools  
  - Shop equipment  
  - Power tools |
| 9. Describe shop layout techniques for duct fittings | - Line development  
  - Geometric construction  
  - Mathematical formulas  
  - Cut list  
  - Seam and joint allowances |
| 10. Fabricate duct fittings | - Applications  
  - Straight duct  
  - Transition  
  - Ogee offset  
  - Duct elbows  
  - Labelling |
| 11. Install components | - End caps  
  - Spin-in collars  
  - Flexible connections  
  - Insulation stops |
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

Achievement Criteria 1

Performance The learner will fabricate seams and locks:
- Double seam
- Pittsburgh lock
- Lap and spot weld
- Standing seams, and/or
- Groove seam

Conditions The learner will be given:
- Project specifications
- Tools and equipment

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Tools selection
- Procedure
- Seams and locks have no visible marks from hand tools
- Projects are complete and accurate to within specified standards.

Achievement Criteria 2

Performance The learner will fabricate components:
- End caps
- Spin-in collars
- Flexible connections and/or
- Insulation stops

Conditions The learner will be given:
- Project specifications
- Tools and equipment

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Tools selection
- Procedure
- Seams and locks have no visible marks from hand tools
- Seams and locks are accurate to specified standards.
Achievement Criteria 3

Performance  The learner will fabricate and assemble duct fittings with components.
- Straight duct
- Transition
- Ogee offset, and/or
- Duct elbows

Conditions  The learner will be given:
- Project specifications
- Tools and equipment

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Tools selection
- Procedure
- Project has no visible marks from hand tools
- Project is accurate to specified standards.
Line (GAC): F  FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F3  Insulate ductwork, fittings and components

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

- Describe insulation requirements, insulation types, fastener types and adhesives.

LEARNING TASKS

1. Describe insulation

   • Safety
   • Requirements
   • Types
     - Rigid/flexible
     - Acoustic/thermal
     - Fibreglass
     - Neoprene
     - Coatings
   • Densities
   • Thicknesses
   • Applications
   • Layout
   • Cutting

2. Describe fastening methods

   • Adhesives
     - Types
     - Uses
   • Pins
     - Placement
   • Lagging materials
     - Mastics
     - Perforated metal
   • Insulation stops
Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F6 Fabricate hanger systems, supports and bases

Objectives

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

- Describe types of hanger systems, equipment bases and supports and their purpose.
- Fabricate knee bracket hanger systems, equipment bases and supports to specifications.

LEARNING TASKS

1. Describe hanger systems
   - Purpose
   - Types
     - Strap hangers
     - Mathematics
     - Brackets
     - Saddles
     - Trapeze

2. Describe hanging considerations
   - Weight
   - Structure
   - Vibration
   - Fasteners/anchors
   - Environment
   - Manufacturers’ shop drawings
   - Seismic requirements

3. Describe the fabrication of knee bracket hanger systems
   - Safety
   - Tools
   - Cutting
   - Forming
   - Welding
   - Specifications
   - Materials
   - Layout
   - Mathematics
   - Assembly
   - Fastening

4. Describe equipment bases and supports
   - Purpose
   - Types
   - Size
   - Weights
## LEARNING TASKS

5. Describe the fabrication of equipment bases and supports

## CONTENT

- Design
- Specifications
- Materials
- Lay out
- Cutting
- Forming
- Welding
- Assembly
- Fastening
- Insulation
- Priming and painting
Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K1 Install air handling equipment

Objectives
To be competent in this area, the individual must be able to:
• Describe air handlers.
• Describe the installation of air handlers.

LEARNING TASKS
1. Describe air handlers
   • Purpose
   • Types
     o Furnaces
     o Fans
       - Supply
       - Exhaust
       - Make up air
   • Operation

2. Describe the installation of air handlers
   • Manufacturers’ specifications
   • Effect of weather on installation
   • Maintenance considerations
   • Curbs
   • Sleepers
   • Stands
   • Housekeeping pads
   • Flex connections
HARMONIZED PROGRAM OUTLINE
Program Content
Level 1

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K3 Install sheet metal ducts, fittings and dampers

Objectives
To be competent in this area, the individual must be able to:
- Describe installation procedure for duct work.
- Install damper in duct work.

LEARNING TASKS
1. Describe installation procedure for duct work

CONTENT
- LEED standards maintained
- Assemble fittings and duct
  - Work orders
  - Tagging
  - Shop drawings
- Accessories installed
- Lay out fittings and duct
  - Shop drawings
  - Mechanical drawings
- Connect fittings and duct
  - Maximum section length
  - Field openings
  - Accessories installed
  - Dampers installed
  - Duct runs aligned
- Seal fittings and duct
  - Pressure class
  - Trade standards
- Placement of duct work
  - Lift sections to hanger systems
  - Secure sections to hanger system
  - Connect sections
  - Seal section connections
LEARNING TASKS

2. Install damper in duct work

CONTENT

- Location determination
- Ensure access
- Size determination
- Securing
- Cycle and set
- Directional orientation
- Types
  - Control
  - Motorized
  - Shut-off
  - Iris
  - Balancing
  - Explosion proof

Achievement Criteria

Performance The learner will install a damper in duct:
- Round volume, Rectangular volume or Back draft

Conditions The learner will be given:
- Project specifications
- Duct
- Damper and hardware

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
- As per project specifications
Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K5 Install registers, grilles, diffusers and louvers

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

• Describe inlet and outlet covers.
• Install the installation of inlet and outlet covers.

LEARNING TASKS

1. Describe inlet and outlet covers

   • Types
     o Registers
     o Diffusers
     o Louvers
     o Troffers
     o Grilles
     o Linear slot
     o Egg crate
     o Transfer air

2. Describe the installation of inlet and outlet covers

   • Purpose
   • Directional consideration
   • Alignment
   • Reflected ceiling plan
   • Length of flex
   • Hard pipe
   • Cushion heads
   • Radiant fire dampers
   • Seismic
   • Cleanliness
   • Seal
   • Install access doors
Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K8 Install residential systems

Objectives
To be competent in this area, the individual must be able to:
- Describe residential heating, ventilation and air conditioning systems.
- Install residential heating, ventilation and air conditioning systems.

LEARNING TASKS

1. Describe residential heating, ventilation and air conditioning
   - Furnace types
   - Equipment
   - Locations

2. Describe residential duct systems
   - Types
     - Loop
     - Extended plenum
     - Graduated plenum
     - Radial
   - Advantages/disadvantages
   - Selection
   - Application
   - Limitations

3. Describe the installation of residential furnaces
   - Manufacturer’s requirements
   - Location of supply and return air outlets
   - Sealing methods

4. Describe residential slab duct
   - Contract drawings
   - Outlet locations
   - Inlet locations
   - Bracing / chairs
   - Length connections
   - Elbows 45 ° and 90 °
   - Sealing
   - Dryer vent
   - Run locations
   - Insulation wrap
   - Under slab duct
Level 2

Sheet Metal Worker
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B2 Use shop tools and equipment

Objectives
To be competent in this area, the individual must be able to:
- Select shop equipment appropriate to architectural sheet metal processes.
- Use shop equipment.
- Inspect and maintain shop equipment.

LEARNING TASKS
1. Describe advanced use of shop equipment
   - Power shears
   - Gap shears
   - Power rolls
   - Power notchers
   - Hand brakes
   - Roll forming equipment
   - Turret punches
   - Iron worker
   - Power rotary machines
   - Clinch lock machine
   - Dimpler
   - Cold cut saw
   - Horizontal band saws
   - Spot welders
   - Stud welders
   - Drill presses

2. Describe shop equipment used for architectural purposes
   - Roll forming machines
   - XYZ machines
   - Hand brake S-lock former
   - Slitter

3. Use shop equipment
   - Types
   - Parts
   - Purpose/uses
   - Procedures/operations
   - Capacities
   - Safety
   - Adjustment
   - Inspection
   - Minor maintenance
   - Storage
HARMONIZED PROGRAM OUTLINE
Program Content
Level 2

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B3 Use gas metal arc welding (GMAW) equipment

Objectives
To be competent in this area, the individual must be able to:
- Weld using GMAW.

**LEARNING TASKS**

1. Review types of welding equipment
   - Gas metal arc welding (GMAW)
   - Equipment/hand tools

2. Review welding safety
   - Licensing and training requirements
   - Government regulations
   - Ventilation requirements
   - Flammable material recognition
   - Personal protective equipment
   - Compressed gas safety
   - Shock hazard

3. Describe gas metal arc welding (GMAW)
   - Advanced procedures/operations
   - Purpose/Uses
   - Limitations
   - Equipment
   - Materials to be welded
   - Consumables
   - Safety
   - Set-up
   - Adjustment
   - Take down
   - Inspection
   - Leak Test
     - Light Test
     - Dye Test
     - Water Test
     - Smoke Test
   - Maintenance
   - Storage
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| 4. Interpret welding symbols | • Fillet  
• Spot  
• Flange  
• Bevel  
• Field  
• Weld all around  
• Length and pitch  
• Plug  
• Arrow side / other side |
| 5. Use welding tools | • GMAW  
• Weld inspection |

**Achievement Criteria 1**

**Performance** The learner will weld 16 gauge and 12 gauge mild steel coupons in flange, corner and fillet using GMAW.

**Conditions** The learner will be given:
- Welding equipment
- Materials
- Coupons

**Criteria** The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Continuous
- Heat setting
- Penetration
- Consistency
- Porosity
Achievement Criteria 2

Performance  The learner will plug weld an 18 gauge coupon to a 12 gauge mild steel coupon.

Conditions  The learner will be given:
- Welding equipment
- Materials
- Coupons

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Solid puddle
- Specified diameter

Achievement Criteria 3

Performance  The learner will fabricate and weld a project from a shop drawing.

Conditions  The learner will be given:
- Shop fabrication drawing complete with welding symbols and specifications
- Tools and equipment
- Materials

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Continuous
- Heat setting
- Penetration
- Consistency
- Porosity
- Welding symbols followed
- Specifications followed
HARMONIZED PROGRAM OUTLINE
Program Content
Level 2

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B5 Use shielded metal arc welding (SMAW) equipment

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

- Weld using SMAW.

LEARNING TASKS

1. Describe types of welding equipment
   - Shielded metal arc welding (SMAW)
   - Equipment/hand tools
   - Gas powered welding machine

2. Describe welding safety
   - Licensing and training requirements
   - Government regulations
   - Ventilation requirements
   - Flammable material recognition
   - Personal protective equipment

3. Describe shielded metal arc welding (SMAW)
   - Positional welding
   - Purpose/uses
   - Equipment
   - Materials to be welded
   - Electrode selection
   - Electrode storage
   - Safety
   - Basic procedures/operations
   - Set-up
   - Adjustment
   - Take down
   - Inspection
   - Leak Test
     - Light Test
     - Dye Test
     - Water Test
     - Smoke Test
   - Maintenance
   - Welding symbols

4. Use welding tools
   - SMAW
Achievement Criteria

Performance: The learner will weld mild steel in all positions using SMAW.

Conditions: The learner will be given:
- Welding equipment
- Materials

Criteria: The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Continuous
- Heat setting
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B7 Use soldering and brazing equipment

Objectives
To be competent in this area, the individual must be able to:
• Describe soldering and brazing equipment and techniques.
• Use soldering techniques.

LEARNING TASKS
1. Review soldering and brazing equipment
   • Types
   • Purpose
   • Materials to be soldered/brazed
   • Safety
   • Gases
   • Transportation of Dangerous Goods Regulations
   • Ventilation requirements
   • Flammable material recognition
   • Inspection
   • Maintenance
   • Storage

2. Review soldering techniques
   • Solder selection
   • Equipment selection
   • Fluxes
     o Types
     o Applications
   • Techniques
     o Safety
     o Cleaning
     o Forging
     o Tinning
     o Soldering
   • Limitations

3. Use soldering techniques
   • Selection
   • Procedure
   • Inspection
LEARNING TASKS
4. Describe brazing techniques

CONTENT
- Alloy selection
- Equipment selection
- Fluxes
  - Types
  - Applications
- Techniques
  - Safety
  - Cleaning
- Limitations
Line (GAC): C ORGANIZE WORK
Competency: C1 Use trade related documentation

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

• Develop a shop drawing using manufacturer’s drawings and technical reference material.

LEARNING TASKS

1. Identify bodies responsible for codes, regulations and standards related to the sheet metal industry
   - SMACNA (Sheet Metal and Air Conditioning Contractors National Association)
   - ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers)
   - NFPA (National Fire Protection Association)
   - NBC and BCBC (National Building Code and British Columbia Building Code)
   - Municipal Bylaws
   - RCABC (Roofing Contractors Association of British Columbia)
   - TABB (Testing Adjusting and Balancing Bureau)
   - CWB (Canadian Welding Bureau)
   - CSA (Canadian Standards Association)
   - ULC (Underwriters Laboratories of Canada)

2. Describe how codes, regulations and standards affect sheet metal fabrication and installations
   - Material selection
   - Construction and installation methods
   - Design characteristics
   - Site specific documentation, permits and signage

3. Describe documentation encountered in the sheet metal trade
   - Tool and equipment documentation
   - System component documentation
   - Proprietary product documentation
   - Certification agencies

4. Describe information contained in manufacturer and supplier documentation
   - Installation instructions and requirements
   - Operation and maintenance manuals
   - Product specifications
   - Warranty information
Achievement Criteria

Performance  The learner will develop a shop drawing using shop standards, technical reference and manufacturer’s drawings.

Conditions  The learner will be given:
- Drawing specifications
- Manufacturer’s drawing
- Technical reference material
- Drafting equipment

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Selection of appropriate tools
- Proper construction techniques applied
- Drawings are accurate to a tolerance of +/- 1/16”
HARMONIZED PROGRAM OUTLINE
Program Content
Level 2

Line (GAC): C ORGANIZE WORK
Competency: C2 Interpret drawings

Objectives
To be competent in this area, the individual must be able to:
• Describe drawings and specifications.
• Extract information from drawings and specifications.

LEARNING TASKS

1. Describe the different types and uses of drawings
   - Views
     - Orthographic
     - Isometric
     - Oblique
     - Perspective
   - Types of drawings
     - Civil
     - Architectural
     - Structural
     - Mechanical
     - Electrical
     - Shop
     - As built
     - Landscape

2. Describe line types, symbols and abbreviations used in drawings
   - Lines
   - Symbols
   - Abbreviations

3. Describe the scales used in drawings
   - Architect’s scale
   - Metric scale
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 4. Describe the purpose of drawings and their parts                         | • Plot plan  
• Foundation plan  
• Floor plan  
• Reflected ceiling plan  
• Roof plan  
• Elevation  
• Sections  
• Details  
• Title block  
• Revisions  
  o Requests for information  
  o Change orders  
  o Addendums  
• Schedules  
• Legends  
• Schematics  |
| 5. Describe contract documents                                              | • Types  
• Purpose  |
| 6. Describe construction specifications                                      | • Master format  
• Purpose  
• Addendums  |
| 7. Use contract documents and construction specifications                    | • Responsibilities and obligations  
• Extracting information  
• Penetrations for components  
• Quality control  
• Commissioning |
Line (GAC): C ORGANIZE WORK
Competency: C4 Perform basic design and field modifications

Objectives
To be competent in this area, the individual must be able to:
• Perform field measurements.
• Alter duct design to accommodate site conditions.
• Order duct fittings to accommodate changes.

LEARNING TASKS
1. Compare site to contract drawings
   • Obstacles
   • Other trades
   • Changes to contract drawings
   • Structural members
   • Change notices

2. Perform field measurements for the purpose of modifications
   • Reference points
   • Benchmark elevations
   • Other trade drawings
   • Penetration size
   • Penetration location
   • Clearances
   • Connection and seam allowances
   • Insulation allowances
   • Equipment clearances

3. Solve problems using formulas
   • Transposition to solve for different unknowns
   • Word problems
   • Sheet metal applications

4. Review formulas used for triangles
   • Pythagorean Theorem
   • Trigonometric functions

5. Apply mathematics for field modifications
   • Ogee offsets
   • Elbow formulas
   • Transition to equal area
   • Two given elbow offset
   • Two elbow 90°
   • Roof pitch
   • Mitre duct
LEARNING TASKS
6. Order fittings

CONTENT
- Sketching
- Work orders
- Templates
- E-mails
- Pictures
Line (GAC): E  PERFORM PATTERN DEVELOPMENT
Competency: E1  Develop patterns using simple and straight line method

Objectives
To be competent in this area, the individual must be able to:
• Develop patterns for advanced sheet metal components and duct fittings.

LEARNING TASKS

1. Review drafting techniques for sheet metal components and duct fittings
   • Tools
   • Line development
     o Construction
   • Geometric construction
     o Front view
     o Plan view
     o Visualization in three dimensions
     o Required views
   • Mathematical formulas

2. Develop patterns for advanced sheet metal components and duct fittings
   • Applications
     o Change cheek ogee offset
     o Drop cheek elbows
     o Transitional ogee offset
     o Two way transition
     o Drop cheek transitional elbow
   • Seam and joint allowances
   • Pattern labelling and forming instructions

CONTENT
3. Review seams, locks and edges

**CONTENT**
- **Types**
- Patented duct connections (TDC, TDF)
  - Single and double seams
  - Standing seams
  - Riveted seam
  - Groove seams
  - Pocket lock
  - S-lock
  - Button lock
  - Pittsburgh lock
  - Lap and spot weld
  - Lap and fasten
  - Hems
  - Flange connections
  - Slip and drive
  - Wired edge

**Achievement Criteria**

**Performance**
The learner will develop patterns for:
- Change cheek ogee offset
- Drop cheek elbows
- Transitional ogee offset
- Two way transition, and/or
- Drop cheek transitional elbow

**Conditions**
The learner will be given:
- Project specifications
- Patterns developed to seams and connections specified
- Drafting or layout tools

**Criteria**
The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Tools selection
- Procedure
- Patterns are complete and accurate to within +/- 1/16" of drawing specifications
Line (GAC): E  PERFORM PATTERN DEVELOPMENT
Competency: E2  Develop patterns using parallel line method

Objectives
To be competent in this area, the individual must be able to:
- Develop patterns using parallel line development.

LEARNING TASKS
1. Review drafting techniques for parallel line development
   - Tools
   - Views
     - Front
     - Plan
     - End
     - Which are required
     - Visualization in three dimensions
   - Line development
     - Construction
     - Projection
   - Geometric construction
   - Mathematical formulas

2. Develop patterns using parallel line development
   - Applications
     - Gutter mitres
     - Elbows by the rise method
     - Tee branches off centre
   - Seam allowances
   - Pattern labelling and forming instructions
Achievement Criteria

Performance  The learner will use parallel line development to develop patterns for:
  • Gutter mitres
  • Tee branches off centre, and/or
  • Elbows by the rise method

Conditions  The learner will be given:
  • Drawing specifications
  • Drafting equipment
  • Paper
  • Calculator

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Tool selection
  • Procedures
  • Patterns complete and accurate to within +/- 1/32” of drawing specifications
Line (GAC): E PERFORM PATTERN DEVELOPMENT
Competency: E3 Develop patterns using radial line development

Objectives
To be competent in this area, the individual must be able to:
- Develop patterns for oblique cones using radial line development.

### LEARNING TASKS

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<td>o Off centre roof jack</td>
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<td></td>
<td>o Flat back funnel</td>
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</tbody>
</table>
Achievement Criteria

Performance  The learner will use radial line development to develop patterns for Oblique cone.

Conditions  The learner will be given:
  - Drawing specifications
  - Drafting and lay out tools

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  - Tools selection
  - Procedure
  - Patterns are complete and accurate to within +/- 1/16” of drawing specifications
Line (GAC): E PERFORM PATTERN DEVELOPMENT
Competency: E4 Develop patterns using triangulation method

Objectives
To be competent in this area, the individual must be able to:
• Develop patterns using triangulation from elevation view.

LEARNING TASKS

1. Describe drafting techniques for triangulation

   CONTENT
   • Tools
   • Line development
     o Construction
     o Triangulation
   • Geometric construction
     o Front view
     o Plan view
     o Visualization in three dimensions
     o Required views
   • Mathematical formulas

2. Develop patterns using triangulation from elevation view

   CONTENT
   • Applications
     o Square to round on a pitch (Roof jack)
     o Round reducer on a pitch (Roof jack)
     o Drop cheek elbows
     o Two way transition
   • Seam allowances
   • Pattern labelling and forming instructions

Achievement Criteria

Performance The learner will use triangulation to develop patterns for:
• Square to round on a pitch (Roof jack) and/or
• Round reducer on a pitch (Roof jack)

Conditions The learner will be given:
• Project specifications
• Drafting and lay out tools

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
• Tools selection
• Procedure
• Patterns are complete and accurate to within +/- 1/32" of drawing specifications
Objective
To be competent in this area, the individual must be able to:
• Fabricate ductwork and assemble fittings with components.

LEARNING TASKS

1. Describe shop layout techniques for duct fittings
   • Tools and equipment
   • Line development
   • Geometric construction
   • Mathematical formulas
   • Cut list
   • Seam and joint allowances

2. Fabricate duct fittings
   • Applications
     o Two way transition
     o Change cheek ogee offset
     o Drop cheek elbows
     o Transitional ogee offset
     o Square throat square heel elbow
   • Cross-braking
   • Labelling
   • Transverse reinforcement

3. Install components
   • Turning vanes
   • Louver
   • Volume dampers
Achievement Criteria 1

Performance  The learner will fabricate and assemble duct fittings.
  • Two way transition
  • Change cheek ogee offset
  • Drop cheek elbows
  • Transitional ogee offset, and/or
  • Square throat square heel elbow

Conditions  The learner will be given:
  • Project specifications
  • Tools and equipment

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Safety
  • Tools selection
  • Procedure
  • Project has no visible marks from hand tools
  • Project is accurate to specified standards

Achievement Criteria 2

Performance  The learner will assemble a square throat square heel elbow complete with turning vanes, fire damper sleeve and louver.

Conditions  The learner will be given:
  • Project specifications
  • Tools and equipment

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Safety
  • Tools selection
  • Procedure
  • Project has no visible marks from hand tools
  • Project is accurate to specified standards
Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F4 Fabricate material handling system components

Objectives
To be competent in this area, the individual must be able to:
• Describe material handling system components and their fabrication.
• Fabricate material handling system components.

LEARNING TASKS

1. Describe material handling system components
   • Companion flanges
   • Welded duct
   • Small end big end
   • Welded round elbow
   • Clean outs
   • Belt guards
   • Hoppers
   • Chutes

2. Fabricate material handling system components
   • Safety
   • Tools and equipment
   • Mathematics
   • Procedure
   • Specifications

Achievement Criteria
Performance The learner will fabricate a 16 gauge mild steel welded belt guard.
Conditions The learner will be given:
• Project specifications
• Tools and equipment
• Materials
Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
• Safety
• Tools selection
• Procedure
• Project is accurate to specified standards
Line (GAC): G FABRICATE ARCHITECTURAL SHEET METAL PRODUCTS
Competency: G1 Select materials for flashing, roofing, sheeting and cladding

Objective
To be competent in this area, the individual must be able to:
• Describe materials and applications of these materials used in architectural sheet metal.

LEARNING TASKS
1. Describe considerations necessary when selecting metal for architectural applications
   • Corrosion resistance
   • Malleability
   • Ductility
   • Elasticity
   • Expansion and contraction
   • Cost
   • Durability
   • Appearance
   • Gauges
   • Galvanic scale
   • Weight
   • Material finishes

2. Describe other materials used in architectural applications
   • Plastic
   • Composites
   • Fibreglass
   • Rubber
   • Polyvinylchloride (PVC)
   • Ethylene Propylene Diene Monomer (EPDM)
   • Expanded Polystyrene (EPS)

3. Describe material applications
   • Roof drainage systems
   • Roofing/flashings
   • Cladding
   • Composite metal panels
   • Decking
   • Speed wall
   • Cornice/gutters
Line (GAC): G  FABRICATE ARCHITECTURAL SHEET METAL PRODUCTS
Competency: G2  Fabricate flashing, roofing, sheeting and cladding

Objectives
To be competent in this area, the individual must be able to:
- Describe roofing, decking and cladding and its purpose.
- Describe wall panel systems.
- Fabricate roofing, decking and cladding flashings.
- Fabricate architectural sheet metal components.

LEARNING TASKS
1. Use mathematics associated with fabricating flashing, roofing, sheeting and cladding
   - Perimeter
   - Circumference
   - Linear
   - Area
   - Profile
   - Pitch
   - Fastener spacing
   - Waste
   - Seam allowances
   - Expansion and contraction
   - Brake angles

2. Describe roofing, decking and cladding systems
   - Roof systems
     - Standing seam
     - Profiled
     - Batten
     - Bermuda
     - Flat seam
     - Drainage and related flashings
   - Decking
     - Form flashings
     - Reinforcing studs
   - Cladding
     - Profiled
     - Fibreglass
     - Related flashings
LEARNING TASKS  
3. Describe roof layout

CONTENT
- Roof structures
  - Pitched
  - Tapered
  - Domes
  - Spires
- Roof construction features
  - Hips
  - Ridges
  - Valleys
- Roof hatches
- Materials
- Procedures
- Tools
  - Transit
  - Level
  - Chalk line

4. Describe wall panel systems

CONTENT
- Wall panel systems
  - Composite panels
  - Sandwich panels
  - Related flashings
  - Sub-girts

5. Describe power tools used for architectural purposes

CONTENT
- Cut-off saw
- Blades
  - Abrasive
  - Carbide tipped metal cutting blades
- Types
  - Gas powered
  - Mitre
  - Chop
- Roof seamers
- Screw gun
- Impact guns
- Powder actuated tools
- Power shears
- Routers
- Portable band saw
- Nibblers
- Double-cutting sheers
- Electric seamers
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 6. Cut material for roofing, sheeting, cladding and flashing | • Safety/ hazards  
• Materials  
• Types  
• Seam allowances  
• Cutting equipment  
• Girth determination (Stretch-out)  
• Waste minimization |
| 7. Form flashing and roofing | • Materials  
• Types  
• Joints  
• "S"  
• Lap  
• Standing  
• Seam allowances  
• Joint forming  
• Soldering  
• Sealing |
| 8. Describe architectural components | • Louvers  
• Scuppers  
• Roof jack  
• Roofing  
• Decking  
• Cladding  
• Gutter mitre |
| 9. Fabricate architectural components | • Gutter mitre  
• Coping  
• Scupper  
• Roof jack  
• Flashing  
• Safety  
• Tools and equipment  
• Materials  
• Procedures |
Achievement Criteria

Performance  The learner will fabricate the following architectural components:
  • Gutter mitre
  • Coping
  • Scupper
  • Roof jack, and/or
  • Flashing

Conditions  The learner will be given:
  • Project specifications
  • Tools and equipment
  • Materials

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  Safety
    • Tools selection
    • Procedure
    • Project is accurate to specified standards
Line (GAC): I  
PREPARE INSTALLATION SITE

Competency: I1 Perform on-site measurements

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

- Use construction drawings, specifications and codes to measure and position components.

LEARNING TASKS

1. Select and use measuring tools and equipment
   - Levels
   - Laser levels
   - Tape measures
   - Scale rulers
   - Plumb bob
   - Chalk line

2. Use trade mathematics
   - Pythagoras
   - Trigonometry
   - Linear
   - Area
   - Volume
   - Pitch/slope

3. Use construction drawings, specifications and codes to measure and position components
   - Identification of hazards
   - Verification of duct design
   - Headroom
   - Size
   - Off sets
   - Identification of structural obstructions
   - Establishing elevations
   - Identification of other trades interference
   - Alignment
   - Orientation
Line (GAC):  I  PREPARE INSTALLATION SITE
Competency:  I2  Perform demolition for renovations

Objectives
To be competent in this area, the individual must be able to:
- Describe preparing removal plan.
- Describe dismantling and removing materials.

LEARNING TASKS
1. Describe preparing removal plan
   - Hazard identification
   - Demolition drawings
   - Jurisdictional regulations
     - Recycling
     - Environmental
     - Disposal
     - Containment
   - Tool and equipment selection
   - Site conditions
   - Construction schedule
   - Identification of material to be contained and removed

2. Describe dismantling and removing materials
   - Safety barricades
   - Sectioning
   - Recycling
   - Disposal
**Line (GAC):** J  
**INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLIANCES AND MECHANICAL EQUIPMENT**

**Competency:** J1 Install chimneys

**Objectives**
To be competent in this area, the individual must be able to:
- Describe venting and its purpose.

**LEARNING TASKS**
1. Describe venting and its purpose

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<td>• Draft control equipment</td>
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<tr>
<td>• Combustion air</td>
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</table>
LEARNING TASKS

2. Describe the installation of bracing, hangers and supports

CONTENT

- Requirements
  - Clearances
  - Weight
  - Spacing
  - Seismic
- Materials
- Fasteners
- Flashing
- Materials
- Selection
- Weatherproofing materials
- Fastening
- Sealants

3. Describe the installation of flashing
Line (GAC): J       INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLIANCES AND MECHANICAL EQUIPMENT

Competency: J2 Connect appliances or mechanical equipment to chimney and breeching

Objectives
To be competent in this area, the individual must be able to:
• Describe the connection of venting and breeching to appliances.

LEARNING TASKS
1. Describe breeching
   CONTENT
   • Expansion joints
   • Clean outs
   • Field joints
   • Draft control equipment
   • Materials
   • Manifold
   • Lagging

2. Describe the installation of bracing, hangers and supports
   CONTENT
   • Code requirements
   o Clearances
   o Weight
   o Spacing
   o Seismic
   • Fasteners/anchors
   • Slope
   • Flashing

3. Describe the connection of venting and breeching to appliances
   CONTENT
   • Types of appliances
   • Manufacturers’ specifications and codes
   o Location
   o Sealants
   o Assembly
   o Fastening
   o Materials
Line (GAC): J INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLIANCES AND MECHANICAL EQUIPMENT INSTALL AIR HANDLING SYSTEMS

Competency: J3 Install high efficiency appliances and mechanical equipment

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

- Describe the installation of high efficiency appliances and mechanical equipment.

LEARNING TASKS

1. Describe high efficiency appliances and mechanical equipment
   - Condensing appliances
     - Furnaces
     - Boilers
     - Water heaters
   - Fireplaces
   - Gas dryers

2. Describe the installation of high efficiency appliances and mechanical equipment
   - Safety and hazards
   - Manufacturer’s specifications
   - Codes
   - Materials
   - Clearances
   - Slope
   - Sealants
   - Penetrations
   - Weatherproofing

3. Describe venting requirements for high efficiency appliances and mechanical equipment
   - Underwriters’ Labs of Canada Standards (ULCS) 636
   - Planning location of venting
   - Selection of venting size and material
   - Z vent
   - Direct vent
   - Concentric vent
   - Termination
Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K1 Install air handling equipment

Objectives
To be competent in this area, the individual must be able to:
• Describe built-up units and roof-top units.
• Describe the installation of an exhaust fan.

LEARNING TASKS
1. Review air handling equipment
   • Purpose
   • Types
     o Furnaces
     o Fans
       − Supply
       − Exhaust
       − Make up air
   • Operation

2. Describe built-up units and roof-top units
   • Purpose
   • Types
     • Built-up systems
       o Individual components
       o Mechanical room
       o Plenum construction
         o Plenum housings
     • Rooftop units
       o Packaged
       o Pre-assembled
       o Set on curb
   • Operation
   • Manufacturers’ specifications
   • Effect of weather on installation
   • Maintenance considerations
   • Curbs
   • Penetration size
   • Penetration obstructions
   • Sleepers
   • Stands
   • Gasket isolator and seal
   • In line
   • Wall mounted
Achievement Criteria

Performance The learner will calculate the fabrication and installation requirements of an exhaust fan curb.

Conditions The learner will be given:
- Project specifications
- Manufacturer’s drawings
- Codes and regulations

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Procedure
- Project is accurate to specified standards
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Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K2 Install hangers, cables, braces and brackets

Objectives
To be competent in this area, the individual must be able to:
• Describe the installation of hangers, cables, braces and brackets.

LEARNING TASKS
1. Describe the installation of hangers

CONTENT
• Obstacles
• Elevations
• Mechanical drawings
• Reflected ceiling plans
• Plum level
• Specification requirements
• Trade Standards
• Codes and regulations
• Fasteners
  o Structure anchors
• Considerations
  o Weight
  o Structure
  o Vibration
  o Environment
  o Seismic
  o Manufacturer’s shop drawings
• Types
  o Strap
  o Wrap
  o Trapeze
  o Saddle
  o Rod wire
  o Threaded rod
• Total stations
• Stiffeners and cross braces
LEARNING TASKS
2. Describe the installation of cables

CONTENT
- Obstacles
- Elevations
- Mechanical drawings
- Reflected ceiling plans
- Plum level
- Specification requirements
- Trade Standards
- Codes and regulations
- Fasteners
- Considerations
  - Weight
  - Structure
  - Vibration
  - Environment
  - Manufacturer's shop drawings
- Manufactured cable grips
- Cable clamps
- Structure anchors
- Crimp ferrule
- Seismic
- Stiffeners and cross braces
- Obstacles
- Elevations
- Mechanical drawings
- Reflected ceiling plans
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- Specification requirements
- Trade Standards
- Codes and regulations
- Fasteners
  - Structure anchors
- Considerations
  - Weight
  - Structure
  - Vibration
  - Environment
  - Seismic
  - Manufacturer's shop drawings
- Field fabricated to site conditions
- Stiffeners and cross braces

3. Describe the installation of braces and brackets.
LEARNING TASKS
4. Calculate the hanger requirements

CONTENT
- Mathematics
  - Pythagoras
  - Trigonometry
  - Linear
  - Perimeter circumference
- Allowances
- Contract drawings
- Specifications
- Trade standards
- Anchor specifications
HARMONIZED PROGRAM OUTLINE
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Level 2

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K4 Install penetrations and sleeves

Objective
To be competent in this area, the individual must be able to:
• Describe fire dampers and the installation of fire dampers.

LEARNING TASKS

1. Describe fire dampers
   • Purpose
   • Style A
   • Style B
   • Style C
   • Fire / smoke dampers
   • Static and dynamic
   • Hourly rating
   • Horizontal (springs)
   • Vertical (gravity)
   • Fusible link
   • Operating temperatures

2. Describe the installation of fire dampers
   • Manufacturer’s specifications
   • Trade standards
   • Hole clearance
   • Damper sizing
   • Order sleeve
   • Retaining angle
   • Access door
   • Sleeve gauge
   • Maximum length
   • Breakaway connections
   • Blueprint symbols
   • Fire caulking
   • Fastener size / pitch / method
   • Testing
HARMONIZED PROGRAM OUTLINE  
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LEARNING TASKS  
3. Identify penetration location

CONTENT
• Manufacturer’s specifications
• Trade standards
• Measure from gridlines
• Contract drawings
• Structural Interference
• Hidden hazards
• Other trade interference
• Verification of penetration size
• Coordination
• Safety
• Mathematics
Line (GAC): K       INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K7    Install system component accessories

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

LEARNING TASKS
1. Describe system component accessories
   • Burglar bars
   • Access doors
   • Drain pans
   • Fire dampers
   • Splitter vanes
   • Turning vanes
   • Build outs / Hat sections
   • Insulation stops / nosing

2. Describe the installation of system component accessories
   • Location
   • Fasteners
   • Fire rated
   • Sealant
   • Finish
   • Manufacturer’s specifications
   • Contract specifications
   • Safety hazards
Line (GAC): O INSTALL METAL ROOFING AND CLADDING/ SIDING SYSTEMS

Competency: O1 Lay out roof and walls

Objectives
To be competent in this area, the individual must be able to:
• Describe roofing, decking and cladding and their purposes.
• Describe the layout of roofing, decking and cladding.

LEARNING TASKS

1. Describe site preparation
   • Exterior surfaces
     o Concrete
     o Metal
     o Stone
     o Wood
     o Composite
   • Surface preparation
     o Cleaning
     o Filling voids
     o Grouting mortar lines
     o Scoring surface for adherence
   • Cleaning compounds
   • Abrasives
   • Repair of waterproofing membrane

2. Describe roofing, decking and cladding systems
   • Roof systems
     o Standing seam
     o Profiled
     o Batten
     o Bermuda
     o Flat seam
     o Drainage and related flashings
   • Decking
     o Form flashings
     o Reinforcing studs
   • Cladding
     o Profiled
     o Fibreglass
     o Related flashings

3. Describe wall systems
   • Wall systems
     o Composite panels
     o Sandwich panels
     o Related flashings
4. Describe roof layout

- Roof structures
  - Pitched
  - Tapered
  - Domes
  - Spires
- Roof construction features
  - Hips
  - Ridges
  - Valleys
- Roof hatches
- Materials
- Procedures
- Mathematics
- Tools
  - Transit
  - Level
  - Chalk line
Line (GAC): O INSTALL METAL ROOFING AND CLADDING/ SIDING SYSTEMS

Competency: O2 Install insulation, isolation material, and building envelope components

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

- Describe the installation of roof and wall subsurface systems and their purposes.

LEARNING TASKS

1. Describe the installation of roof subsurface systems
   - Systems
     - Vapour barrier
     - Waterproof membrane
     - Slip sheet
     - Insulation
     - Isolation material
   - Building envelope
   - Sub girts
   - Fastener types
   - Manufacturers’ recommended installation methods
   - Cutting
   - Fitting
   - Securing
   - Sealing

2. Describe the installation of wall subsurface systems
   - Systems
     - Liner
     - Vapour barrier
     - Waterproof membrane
     - Slip sheet
     - Insulation types
     - Isolation material
   - Building envelope
   - Sub-girt
   - Fastener types
   - Manufacturers’ recommended installation
   - Methods
   - Cutting
   - Fitting
   - Securing
   - Sealing
HARMONIZED PROGRAM OUTLINE  
Program Content  
Level 2

**Line (GAC):**  O INSTALL METAL ROOFING AND CLADDING/SIDING SYSTEMS  

**Competency:**  O3 Install roofing and cladding/siding system components

**Objectives**
To be competent in this area, the individual must be able to:
- Describe the installation of roofing, cladding/siding and components.
- Install roofing, cladding/siding and components.

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- Types  
- Seam allowances  
- Cutting equipment  
- Waste minimization |
| 2. Prepare roofing and cladding/siding | - Materials  
- Types  
- Joints  
  - “S”  
  - Lap  
  - Standing  
- Seam allowances  
- Joint forming  
- Roll forming machines |
| 3. Install roofing, cladding/siding systems and components | - Seam Types  
- Fasteners  
- Sheet preparation  
- Thermal expansion and contraction  
- Expansion joints  
- Effects of weather conditions on material and installation  
- Components  
  - Joints  
  - Flashings  
  - Gutters  
  - Cornice  
- Cutting  
- Fitting  
- Field cut and mitre  
- Securing  
- Sealing |
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</table>
Line (GAC): O INSTALL METAL ROOFING AND CLADDING/ SIDING SYSTEMS

Competency: O4 Seal exposed joints

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

- Describe sealants.
- Use sealants.

LEARNING TASKS

1. Describe different types of sealants
   - Butyl
   - Latex
   - Mastic
   - Solder
   - Silicone
   - Fire rated
   - Gasket
   - Caulking tape
   - Closure strips
   - Two-part epoxy

2. Use sealants
   - Surface prep
   - Backer rod
   - Tooling
   - Caulking gun
   - Masking
   - Environmental
   - Clean up
   - Storage
   - Packing
   - Thermal limitations
   - Manufacturer’s specifications
Line (GAC): O INSTALL METAL ROOFING AND CLADDING/SIDING SYSTEMS

Competency: O5 Install decking

Objectives
To be competent in this area, the individual must be able to:
• Describe the installation of decking.

LEARNING TASKS
1. Describe the installation of decking
   • Specialty tools
   • Purpose
   • Types
     o Metal pan
     o “Q”
     o Acoustic deck
   • Materials applied on decking
   • Determining material requirements
   • Cutting
   • Fitting
   • Fastening
   • Forms around openings
   • Finishing of exposed welds

2. Install flashings
   • Materials
   • Types
   • Joints
     o “S”
     o Lap
     o Standing
   • Seam allowances
   • Joint forming
   • Field modifications
   • Soldering
   • Sealing
Program Content
Level 2

Line (GAC): P INSTALL EXTERIOR COMPONENTS
Competency: P1 Prepare surface

Objectives
To be competent in this area, the individual must be able to:
• Describe the preparation of a site for installation of external components.

LEARNING TASKS
1. Describe site preparation

CONTENT
• Exterior surfaces
  o Concrete
  o Metal
  o Stone
  o Wood
  o Composite

• Surface preparation
  o Cleaning
  o Filling voids
  o Grouting mortar lines
  o Scoring surface for adherence

• Cleaning compounds
• Abrasives
• Apply or repair of waterproofing membrane
Line (GAC): P  INSTALL EXTERIOR COMPONENTS  
Competency: P2  Fasten exterior components

Objectives
To be competent in this area, the individual must be able to:
• Describe the preparation of a site for installation of external components.
• Describe the installation of exterior components.

LEARNING TASKS
1. Describe the installation of exterior components

CONTENT
• Types
  o Awnings
  o Finials
  o Signage
  o Decorative fascia
  o Canopies
• Fasteners
  o Concealed
  o Anchors
  o Nail-ins
  o Screws
  o Adhesives
  o Selection
  o Application
• Compatibility of fasteners and components
• Final appearance
• Attachment points
• Modification of components to suit the application
• Sealing
Level 3

Sheet Metal Worker
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B2 Use shop tools and equipment

Objectives
To be competent in this area, the individual must be able to:
- Select shop equipment appropriate to sheet metal processes.
- Use shop equipment.
- Inspect and maintain shop equipment.

LEARNING TASKS
1. Describe shop equipment used for specialty purposes
   - CNC press brake
   - Iron worker
   - Spot welders
   - Power rolls
   - Angle iron rolls
   - Overhead crane
   - Drill presses
   - Hand brakes
   - Ring and circle shear
   - Stationary belt sander
   - Hydraulic knock-out tool
   - Hand plasma
   - Rod and tube bender

2. Use shop equipment
   - Types
   - CNC
   - Parts
   - Purpose/uses
   - Procedures/operations
   - Capacities
   - Safety
   - Adjustment
   - Inspection
   - Minor maintenance
   - Storage
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B3 Use gas metal arc welding (GMAW) equipment

Objectives
To be competent in this area, the individual must be able to:
• Weld using GMAW.

LEARNING TASKS
1. Review types of welding equipment
   • Gas metal arc welding (GMAW)
   • Equipment/ hand tools

2. Review welding safety
   • Licensing and training requirements
   • Government regulations
   • Ventilation requirements
   • Flammable material recognition
   • Personal protective equipment
   • Compressed gas safety
   • Shock hazard

3. Describe gas metal arc welding (GMAW) in all positions
   • Advanced procedures/operations
   • Purpose/uses
   • Limitations
   • Equipment
   • Materials to be welded
   • Safety
   • Set-up
   • Adjustment

4. Use welding tools
   • GMAW
   • Weld inspection, clean-up and testing
Achievement Criteria 1

Performance  The learner will weld 16 gauge coupons in all positions using GMAW.

Conditions  The learner will be given:
  • Welding equipment
  • Materials
  • Coupons

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Safety
  • Continuous
  • Heat setting
  • Penetration
  • Consistency
  • Porosity

Achievement Criteria 2

Performance  The learner will fabricate and weld in position a project from a shop drawing.

Conditions  The learner will be given:
  • Shop fabrication drawing complete with welding symbols and specifications
  • Tools and equipment
  • Materials

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Safety
  • Continuous
  • Heat setting
  • Penetration
  • Consistency
  • Porosity
  • Welding symbols followed
  • Specifications followed
Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B4 Use gas tungsten arc welding (GTAW) equipment

Objectives
To be competent in this area, the individual must be able to:
• Weld using GTAW.

LEARNING TASKS
1. Review welding safety
   • Licensing and training requirements
   • Government regulations
   • Ventilation requirements
   • Flammable material recognition
   • Personal protective equipment
   • Compressed gas safety

2. Describe gas tungsten arc welding (GTAW)
   • Terminology
   • Weld defects
   • Purpose/uses
   • Equipment limitations
   • Materials to be welded
   • Consumables
   • Safety
   • Procedures/operations
   • Set-up
   • Adjustment
   • Take down
   • Inspection
   • Maintenance
   • Storage

3. Use welding tools
   • GTAW
   • Weld inspection, clean-up and testing
Achievement Criteria

Performance  The learner will fabricate and GTAW a project from a shop drawing.

Conditions  The learner will be given:
- Shop fabrication drawing complete with welding symbols and specifications
- Tools and equipment
- Materials

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Continuous
- Heat setting
- Penetration
- Consistency
- Porosity
- Welding symbols followed
- Specifications followed
Line (GAC): E  PERFORM PATTERN DEVELOPMENT
Competency: E2  Develop patterns using parallel line method

Objectives
To be competent in this area, the individual must be able to:
• Develop advanced patterns using parallel line development.

LEARNING TASKS
1. Review drafting techniques for parallel line development

CONTENT
• Tools
• Views
  o Front
  o Plan
  o End
  o Which are required
  o Visualization in three dimensions
• Line development
  o Construction
  o Projection
• Geometric construction
• Mathematical formulas

2. Develop advanced patterns using parallel line development

• Applications
• Tee on a taper
• Clean out on round elbow throat
• Flat back elbow
• Tee on an offset
• Finial
• Seam allowances
• Pattern labelling and forming instructions
Achievement Criteria

Performance  The learner will use parallel line development to develop patterns for:
- Tee on a taper
- Clean out on round elbow throat
- Flat back elbow
- Tee on an offset, and/or
- Finial

Conditions  The learner will be given:
- Drawing specifications
- Drafting and lay out tools

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Tool selection
- Procedures
- Patterns complete and accurate to within +/- 1/32" of drawing specifications
Line (GAC): E PERFORM PATTERN DEVELOPMENT
Competency: E3 Develop patterns using radial line development

Objectives
To be competent in this area, the individual must be able to:
• Develop patterns for advanced fittings using radial line development.

LEARNING TASKS
1. Review the selection of drafting equipment for radial line development

2. Describe drafting techniques for advanced industrial fittings using radial line development

CONTENT
• Tee squares
• Dividers
• Compasses
• Rulers
• Scales
• Set squares
• Protractors
• Pencils
• Calculators
• Line development
  o Construction
  o Radial line
• Geometric construction
  o Front view
  o Plan view
  o Visualization in three dimensions
  o Required views
• Mathematical formulas
• Seam allowances
• Pattern labelling and forming instructions
• Applications
  o Cone on a pipe
  o Cone intersecting a cone
  o Pipe intersecting a cone
  o Rectangle intersecting a cone
Achievement Criteria

Performance  The learner will use radial line development to develop patterns for advanced industrial fittings using radial line development.

Conditions  The learner will be given:
- Drawing specifications
- Drafting and lay out tools

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Tools selection
- Procedure
- Patterns are complete and accurate to within +/- 1/16” of drawing specifications
HARMONIZED PROGRAM OUTLINE
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Line (GAC): E PERFORM PATTERN DEVELOPMENT
Competency: E4 Develop patterns using triangulation method

Objective
To be competent in this area, the individual must be able to:
• Develop complex patterns using triangulation.

LEARNING TASKS

1. Review drafting techniques for triangulation

CONTENT
• Tools
• Line development
  o Construction
  o Triangulation
• Geometric construction
  o Front view
  o Plan view
  o Visualization in three dimensions
  o Required views
• Mathematical formulas

2. Develop complex patterns using triangulation

CONTENT
• Applications
  o “Y” branch
  o Transitional duct “Y”
  o Drop cheek transitional elbow
  o Twisted fittings
• Pattern development using a combination of techniques
• Seam allowances
• Pattern labelling and forming instructions

Achievement Criteria

Performance The learner will use triangulation to develop patterns for:
• “Y” branch

Conditions The learner will be given:
• Project specifications
• Drafting and lay out

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
• Tools selection
• Procedure
• Patterns are complete and accurate to within +/- 1/32” of drawing specifications
HARMONIZED PROGRAM OUTLINE
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Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F2 Fabricate ductwork, fittings and components

Objectives
To be competent in this area, the individual must be able to:
- Fabricate ductwork and fittings.

LEARNING TASKS

1. Review shop layout techniques for duct fittings
   - Tools and equipment
   - Line development
   - Geometric construction
   - Mathematical formulas
   - Cut list
   - Seam and joint allowances

2. Fabricate duct fittings
   - Applications
     o Duct “Y” branch fittings
     o Drop cheek change elbow
   - Labelling

Achievement Criteria

Performance The learner will fabricate and assemble duct fittings.
- Duct “Y” branch fittings and/or
- Drop cheek change elbow

Conditions The learner will be given:
- Project specifications
- Tools and equipment

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Tools selection
- Procedure
- Project has no visible marks from hand tools
- Project is accurate to specified standards
Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F4 Fabricate material handling system components

Objectives
To be competent in this area, the individual must be able to:
- Describe types of basic industrial components and their purpose.
- Fabricate basic industrial components to specifications.

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2. Fabricate gravity material handling system components
Achievement Criteria

Performance  The learner will fabricate a material handling system component, such as:
  • Chute,
  • Hopper, or
  • Twist

Conditions  The learner will be given:
  • Project specifications
  • Tools and equipment
  • Materials

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Safety
  • Tools selection
  • Procedure
  • Final appearance
  • Project is accurate to specified standards
Line (GAC): H FABRICATE PRODUCTS FROM SPECIALTY MATERIALS

Competency: H1 Select material for specialty products

Objectives
To be competent in this area, the individual must be able to:
• Select materials and fastenings for specialty products.

LEARNING TASKS

1. Describe considerations necessary when selecting materials for specialty applications

CONTENT
• Types and properties of
  o Stainless steel
  o Aluminum
  o Hardened steel
  o Non-metals
  o Copper
  o Brass
  o Composites
  o PVC-coated
  o Black iron

• Profile Shapes
  o Round bar
  o Square bar
  o Tubing
  o Angle iron
  o Flat
  o Extrusion

2. Describe material applications

CONTENT
• Food service industry
• Industrial
• Laboratories
• Medical
• Signage
• Institutional
• Commercial
• Miscellaneous components
  o Column covers
  o Hand rails
  o Fireplace faces
• Marine
LEARNING TASKS
3. Describe fastening for specialty products

CONTENT
• Types
  o Blind rivets
  o Solid rivets
  o Machine screws
  o Sheet metal screws
  o Bolts and nuts
  o Rivet nuts
  o Solder
  o Welding
  o Caulking

• Considerations
  o Specifications and codes
  o Cost
  o Galvanic scale
  o Exposed
  o Tamper-proofing
  o Tensile strength
  o Shear strength
  o Sanitation
  o Corrosiveness
HARMONIZED PROGRAM OUTLINE  
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Line (GAC): H  FABRICATE PRODUCTS FROM SPECIALTY MATERIALS
Competency: H2  Fabricate specialty products

Objectives
To be competent in this area, the individual must be able to:
• Select shop equipment for specialty products.
• Fabricate specialty products.

LEARNING TASKS
1. Describe specialty applications and products

CONTENT
• Types
  o Food processing and service
  o Medical
  o Pharmaceutical
  o Laboratories
  o Institutional
    – Prison systems (tamper proof)
    – Security systems
    – Architectural features
    – Commercial displays
    – Baggage carousels
    – People movers (escalators, elevators)
  o Industrial
    – Corrosive
    – Abrasive
  o Decorative
  o Marine
    – Waterproof louver
    – Water tight joints
    – Fully welded seams
    – Marine terminology
    – Safety considerations
    – Metal properties
  o Awnings
  o Signage
• Purpose/applications
• Materials
• Considerations for specialty applications
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</thead>
</table>
| 2. Describe shop equipment used for specialty products | - Press brake  
- Power notchers  
- Iron worker  
- Power rolls  
- Ring and circle shear  
- Hand brakes  
- Drill presses  
- Shears  
- Spot welders |
| 3. Use shop equipment for specialty products | - Types  
- CNC  
- Parts  
- Purpose/uses  
- Procedures/operations  
- Capacities  
- Safety  
- Adjustment  
- Inspection  
- Minor maintenance  
- Storage |
| 4. Use power tools for specialty products | - Types  
  o Pneumatic  
  o Weld-finishing tools  
  o Hydraulic  
  o Electric  
- Safety and hazards  
- Purposes and uses  
- Procedures and operations  
- Adjustments  
- Maintenance  
- Storage |
LEARNING TASKS
5. Fabricate stainless steel products

CONTENT
- Safety
- Material selection
- Tools and equipment
- Layout
- Mathematics
- Cut
- Form
- Welding
  - Chill bars
  - Strong backs
  - Back up plates
  - Jigs
- Fastening
- Specifications
- Bend allowances
- Assemble
- Finish
  - Grinding and polishing
  - Plating
  - Passivation
  - Chemical Etching
  - Polishing compound
- Product protection

Achievement Criteria
Performance
The learner will fabricate a welded and finished stainless steel project.

Conditions
The learner will be given:
- Project specifications
- Tools and equipment
- Materials

Criteria
The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Safety
- Tools selection
- Procedure
- Final appearance
- Project is accurate to specified standards
Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K1 Install air handling equipment

Objectives
To be competent in this area, the individual must be able to:
- Describe air handling systems and their purposes.
- Describe the installation of air handling systems.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe air handlers | • Purpose  
  • Types  
  o Furnaces  
  o Booster  
  o Fans  
  - Axial  
  - Centrifugal  
  - Forward inclined  
  - Backward inclined  
  - Paddle  
  - Vane axial  
  o Fan laws  
  o Rooftop units  
  o Built-up systems  
  • Operation |
| 2. Describe the installation of air handlers | • Manufacturers’ specifications  
  • Effect of weather on installation  
  • Maintenance considerations  
  • Housekeeping pads  
  • Seismic restraints  
  • Isolators  
  o Inertia bases  
  o Isolation springs  
  o Isolation pads |
| 3. Describe heat and energy recovery ventilators | • Purpose  
  • Types  
  • Operation  
  • Applications |
| 4. Describe the installation of heat and energy recovery ventilators | • Codes and Regulations  
  • Manufacturer’s specifications  
  • Filter types  
  • Hanging hardware  
  • Stands |
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<tr>
<th>LEARNING TASKS</th>
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<td>5. Describe residential heating, ventilation and air conditioning</td>
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<td>• Furnace types</td>
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<td></td>
<td>• Equipment</td>
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<td></td>
<td>• Locations</td>
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<td>6. Describe the installation of residential furnaces</td>
<td>• Manufacturer’s requirements</td>
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<td></td>
<td>• Location of supply and return air outlets</td>
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<td></td>
<td>• Sealing methods</td>
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</tbody>
</table>
Line (GAC): K  INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K6  Install terminal boxes and coils

Objectives
To be competent in this area, the individual must be able to:
- Describe terminal boxes and their installation.
- Describe coils and their installation.

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<thead>
<tr>
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<td>o VAV</td>
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<td></td>
<td>o Mixing boxes</td>
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<td>o By-passes</td>
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<td>o Attenuating boxes</td>
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<td>• Controls</td>
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<td>o Motorized dampers</td>
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<td>o Sensors</td>
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<td>• Applications</td>
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<td>o Economy</td>
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<td>o Noise control</td>
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<td></td>
<td>o Reduced size duct</td>
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<tr>
<td>2. Describe the installation of terminal boxes</td>
<td>• Manufacturer’s specifications</td>
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<td>• Inlet length</td>
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<td>• Access door</td>
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<td>• Air flow directional</td>
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<td>• Seal</td>
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<td>• Support</td>
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<td></td>
<td>• Seismic</td>
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<td>• Trade standards</td>
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<tr>
<td>3. Describe coils</td>
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<td>o Refrigerated coil</td>
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<td>o Electric</td>
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<td>o Hydronic</td>
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<td></td>
<td>o Reheat</td>
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<td></td>
<td>o Pre-heat</td>
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</tbody>
</table>
LEARNING TASKS
4. Describe the installation of coils

CONTENT
- Location verification
- Size determination
  - BTU calculations
  - Heating loads
  - Cooling loads
- Drain pans
- Access doors
- Blanking
- Safing
- Refrigeration principles
- Codes and Regulations
- Trade standards
- Manufacturer’s specifications
- Securing
- Sealing
- Access doors
- Seismic
- Supports
Line (GAC): K        INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K7        Install system component accessories

Objectives
To be competent in this area, the individual must be able to:
• Describe system components and their installation.

LEARNING TASKS
1. Describe system component accessories
   • Humidifiers
   • De-humidifiers
   • Filtration
     o Air
       – Electronic / electrostatic
       – HEPA
       – Pleated
       – Pre-filter
     o Noise
       – Silencers
       – Sound traps
       – Acoustic liner
       – Sones / Decibels
       – Perforated
     o Odour
       – Activated carbon

2. Describe the installation of system component accessories
   • Grease
   • Identify hazards
   • Lock out
   • Maintenance
   • Location
   • Blanking
   • Hat sections
   • Filter rack
   • Access
   • Drainage
   • Order fittings
   • Trade standards
   • Seismic
   • Sealing
   • Support
   • Stiffeners
   • Blueprint symbols
Line (GAC): K  INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K9  Install commercial, industrial and institutional systems

Objectives
To be competent in this area, the individual must be able to:
• Describe commercial, industrial and institutional plenums and their installation.

LEARNING TASKS
1. Describe commercial, industrial and institutional plenums
   • Types
     o Single wall
     o Double wall
   • Drawings and specifications
   • Gauge and material
   • Reinforcement
   • Joint design
   • Blanking
   • Perforated
   • Housekeeping pad
   • Heat transfer

2. Describe commercial, industrial and institutional plenums components
   • Dampers
     o Balancing
     o Control
     o Motorized
     o Shut-off
     o Smoke
   • Filters
   • Coils
   • Fans
   • Drain pans
   • Safing
   • Blanking
   • Louvers
   • Access doors
   • Switches
   • Magnehelic
   • Silencers
   • Sound traps
   • Liner
LEARNING TASKS
3. Install commercial, industrial and institutional plenums

CONTENT
- Methods
  - Fasten sections
  - Stiffeners
  - Damper blade brackets
  - Linkage connections
  - Motor installation
- Filter racks
- Sealing
- Floor and ceiling tracks
- Flex connections
- Trade standards
- Contract drawings
- Other trade coordination
- Safety hazards
Line (GAC): N PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING

Competency: N1 Perform leak tests

Objectives
To be competent in this area, the individual must be able to:
  • Describe the purpose and application of leak testing.

LEARNING TASKS
1. Describe leak testing
   • Types
     o Smoke
     o Dye
     o Pressure
     o Fluid
     o Visual
     o Audible

2. Prepare for leak testing
   • System preparation for testing
     o Temporary caps
     o Access doors
     o Dampers in appropriate position and location
     o Sections, sealed and complete
   • Test ports
   • Techniques
   • System knowledge and understanding
Line (GAC): N PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING (Was SERVICE SYSTEMS)

Competency: N2 Perform testing, adjusting and balancing (TAB)

Objectives
To be competent in this area, the individual must be able to:
- Describe the purpose and application of air balancing.
- Calculate air flow system variables.

LEARNING TASKS

1. Describe indoor air quality
   - Contaminates
   - Irritants
   - Odours
   - Noise
   - Filtration
   - Relative humidity

2. Describe air flow in ducts
   - Air flow
   - Duct design
   - Fitting design

3. Describe air balancing instruments and techniques
   - Balancing instruments
     - Manometers
     - Velometer
     - Pitot tube
     - Anemometer
     - Multimeter
     - Ammeter
     - Ductulator
   - Techniques
   - System knowledge and understanding
   - Damper locations
   - Damper checking and adjusting
   - RPM testing
   - Test port installation
   - Velocity readings

4. Perform calculations to determine air flow
   - CFM
   - FPM
   - Pressure readings
   - Fan laws
   - Duct size
   - Air changes per hour
Achievement Criteria

**Performance**  The learner will calculate the air flow system variables.

**Conditions**  The learner will be given:

- Test data
- System design data
- Tools and equipment

**Criteria**  The learner will score 70% or better on a rating sheet that reflects the following criteria:

- Process
- Calculated adjustments
Line (GAC): N  PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING

Competency: N3  Participate in the commissioning of air and material handling equipment

Objectives
To be competent in this area, the individual must be able to:
• Describe knowledge of commissioning and its purpose.

LEARNING TASKS
1. Describe knowledge of commissioning and its purpose
   - Shop drawings
   - As builts
   - Job specifications
   - Manufacturer’s specifications

2. Describe knowledge of the procedures used to commission air and material handling systems and components
   - Shop drawings
   - As builts
   - Job specifications
   - Manufacturer’s specifications
Line (GAC): Q INSTALL SPECIALTY PRODUCTS
Competency: Q1 Install stainless steel specialty products

Objectives
To be competent in this area, the individual must be able to:
• Describe the installation of stainless steel specialty products.

LEARNING TASKS
1. Describe the different considerations between stainless steel and general construction
   - Safety
     - Fire considerations
     - Health considerations
   - Material contamination
   - Workplace contamination
   - Specialty tools
   - Surface protection
   - Codes and regulations
     - Health Canada
     - CSA-ULCA
     - NFPA
   - Job site management
   - Food grade caulking, solders and welding materials
   - Sanitary requirements
   - Manufacturer’s installation instructions
   - Finishing
   - Galvanic action
   - Kitchen preparation products
   - Pharmaceutical laboratory products
   - Food processing products
   - Medical facility products
   - Institutional installation

2. Describe the installation of stainless steel specialty products
Line (GAC): Q  INSTALL SPECIALTY PRODUCTS
Competency: Q2  Install non-stainless steel specialty products

Objectives
To be competent in this area, the individual must be able to:
• Describe the installation of specialty products.

LEARNING TASKS
1. Describe the different considerations between non-stainless steel and general construction
   • Safety
     o Fire considerations
     o Health considerations
   • Material contamination
   • Work place contamination
   • Specialty tools
   • Surface protection
   • Codes and regulations
     o Health Canada
     o CSA-ULCA
     o NFPA
   • Job site management
   • Food grade caulking, solders and welding materials
   • Sanitary requirements
   • Manufacturers’ installation instructions
   • Finishing
   • Galvanic action
   • Non-stainless steel metals
   • Plastic products
   • Fasteners
   • Manufacturers’ specifications
   • Installation procedure selection
   • Manufacturers’ installation procedures
   • Sealants
   • Coatings

2. Describe the installation of non-stainless steel specialty products
   • Kitchen preparation products
   • Pharmaceutical laboratory products
   • Food processing products
   • Medical facility products
   • Institutional installation
Line (GAC): Q INSTALL SPECIALTY PRODUCTS
Competency: Q3 Install marine products

Objectives
To be competent in this area, the individual must be able to:
• Install marine products.

LEARNING TASKS
1. Describe the different considerations needed between marine and general construction
   • Marine terminology
   • Measuring requirements
     o Level and square considerations
     o Single point (benchmark)
   • Standards
     o Transportation Safety Board (TSB)
   • Safety
     o Confined space
     o Fire watch
     o Ventilation
     o Muster point
     o Evacuation protocol
     o Life jackets
     o Asbestos / Hazardous materials
     o Lead paint
   • At sea considerations
     o Heightened safety

2. Describe marine installations and applications
   • Waterproof louver
   • Water tight joints
   • Metal properties
   • Typical installations
     o Lockers
     o Furniture
     o Galleys
     o Ceilings
Line (GAC): R PERFORM SCHEDULED MAINTENANCE

Competency: R1 Diagnose system faults

Objectives
To be competent in this area, the individual must be able to:
- Describe the normal operation of systems.
- Identify signs of abnormality.

LEARNING TASKS

1. Describe normal operation of a system
   - Sounds
   - Vibrations
   - Smells
   - Heat build-ups
   - Fan laws

2. Identify signs of abnormality
   - Sounds
   - Vibrations
   - Odours
   - Mould
   - Corrosion
   - Decreased air flow
   - Heat build-ups
   - Signs of wear and fatigue
   - Amperage/voltage/resistance
   - Air pressure readings
   - Temperature
HARMONIZED PROGRAM OUTLINE
Program Content
Level 3

Line (GAC): R PERFORM SCHEDULED MAINTENANCE
Competency: R2 Repair worn or faulty components

Objectives
To be competent in this area, the individual must be able to:
• Describe the servicing and repair of components.

LEARNING TASKS
1. Describe the servicing and repair of components

CONTENT
• Safety/lock out
• Frequency of scheduled servicing
• Warranty
• Devices
  o Belts
  o Pulleys
  o Bearings
  o Fan blades
  o Filters
  o Motors
  o Shafts
  o Gears/chains
• Inspection
• Cleaning
• Adjustment
• Lubrication
• Filters
  o Types
  o Construction
  o Applications
  o Locations
  o Changing
  o Cleaning
• Repair sequence
  o Removal
  o Replacement
  o Verification
• Patching methods
• Verification of compatibility of new components
• Modifying replacement components
• Coordinating replacement components
• Verifying repairs
• Service reports
Level 4
Sheet Metal Worker
Line (GAC): B  USE AND MAINTAIN TOOLS AND EQUIPMENT
Competency: B3 Use gas metal arc welding (GMAW) equipment

Objectives
To be competent in this area, the individual must be able to:
• Describe specialized welding processes.

LEARNING TASKS
1. Review types of welding equipment and processes
   • Gas metal arc welding (GMAW)
   • Equipment/hand tools

2. Review welding safety
   • Licensing and training requirements
   • Government regulations
   • Ventilation requirements
   • Flammable material recognition
   • Personal protective equipment
   • Compressed gas safety

3. Describe specialized welding processes and consumables
   • Flux core arc welding (FCAW)
   • Silicone bronze
   • Aluminium
   • Spool gun
   • Push-pull gun
   • Stainless GMAW
   • Types of gasses
   • Pulse

4. Perform specialized GMAW processes
   • Flux core arc welding (FCAW)
   • Silicone bronze
   • Aluminium
   • Stainless
Achievement Criteria

Performance  The learner will weld a fabricated material handling system component project using GMAW process:

Conditions  The learner will be given:

- Welding equipment
- Shop fabrication/assembly drawing
- Fabricated project

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:

- Safety
- Continuous
- Heat setting
- Penetration
- Consistency
- Porosity
- Weld symbols followed
- Specifications followed
Line (GAC): B  USE AND MAINTAIN TOOLS AND EQUIPMENT  
Competency: B10 Use hoisting, rigging and positioning equipment

Objectives
To be competent in this area, the individual must be able to:
- Describe hoisting, lifting and rigging equipment.
- Tie knots, bends and hitches.
- Select and use hoisting, lifting and rigging equipment.
- Calculate working load limits.

**LEARNING TASKS**

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<th>Task</th>
<th>Description</th>
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<td>Review hoisting, lifting and rigging equipment</td>
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<tr>
<td>2.</td>
<td>Review knots, bends and hitches</td>
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<tr>
<td>3.</td>
<td>Use hoisting, lifting and rigging equipment</td>
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</table>

**CONTENT**

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<th>Task</th>
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<td>Types</td>
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<td>Uses</td>
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<td>Crane and/or lifting equipment selection</td>
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<td>27.</td>
<td>Maintenance</td>
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<td>28.</td>
<td>Storage</td>
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</table>
LEARNING TASKS
4. Calculate working load limit

CONTENT
- Sling angles
- Sling types
- Hitch types
- Hardware
- Spreader bars
Line (GAC): D  USE COMMUNICATION AND MENTORING TECHNIQUES

Competency: D2  Use mentoring techniques

Objectives
To be competent in this area, the individual must be able to:
- Describe mentoring.
- Mentoring others.

LEARNING TASKS

1. Review methods of communication
   - Listening skills
   - Questioning skills
   - Following verbal directions
   - Body language
   - Written directions
   - Drawings
   - Trade terminology

2. Mentoring others
   - Interpersonal skills
     - Encouragement
     - Explaining
     - Following up
     - Showing
     - Leading by example
     - Respect for others
   - Ethics
     - Time management
     - LEAN principles
     - Punctuality
     - Respect for authority
     - Stewardship of materials
   - Deliver constructive feedback respectfully
   - Customers (layperson terms)
   - Employer representation
   - First impression
   - Identify learning needs
   - Teaching techniques
     - Patience
     - Clear explanations
     - Linking lessons
     - Allow practice
     - Expect mistakes
     - Assessment
Line (GAC): E  PERFORM PATTERN DEVELOPMENT
Competency: E4  Develop patterns using triangulation method

Objectives
To be competent in this area, the individual must be able to:
• Develop complex patterns using triangulation.

LEARNING TASKS
1. Review drafting techniques for triangulation
   • Tools
   • Line development
   • Construction
   • Triangulation
   • Geometric construction
   • Front view
   • Plan view
   • Auxiliary view
   • Visualization in three dimensions
   • Required views
   • Mathematical formulas

2. Develop patterns using triangulation
   • Applications
     o Round reducer elbow
     o Square to round elbow
   • Seam allowances
   • Connection allowances
   • Pattern labelling

3. Describe difference in profile triangulation
   • Method
   • Applications
     o Reducing elbow
   • Seam allowances
   • Connection allowances
   • Pattern labelling and forming instructions
Achievement Criteria

Performance  The learner will use triangulation and parallel line development to develop patterns for:
  • Round reducer elbow and/or
  • Square to round elbow

Conditions  The learner will be given:
  • Project specifications
  • Drafting and tool lay out equipment
  • Paper
  • Calculator

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Tools selection
  • Procedure
  • Patterns are complete and accurate to within +/- 1/16” of drawing specifications
HARMONIZED PROGRAM OUTLINE
Program Content
Level 4

Line (GAC): E PERFORM PATTERN DEVELOPMENT
Competency: E5 Use computer technology for pattern development

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

- Develop patterns using computer technology.

LEARNING TASKS

1. Describe software programs applicable to the sheet metal industry

2. Describe employment opportunities through enhanced computer skills

3. Describe the advantages and disadvantages of using computers to generate patterns and control cutting machines

4. Use software to develop patterns

5. Describe software programs that provide more than just pattern development

CONTENT

- CAD (Computer Aided Design) programs
- Office software
  - Word processing
  - Data base
  - Spreadsheets
  - E-mail
  - Presentation
  - Project management
  - Estimating
- Estimator
- Detailer
- Project manager
- Construction manager
- Advantages
  - Easy to make revisions
  - Storing patterns
  - Less waste in the nesting
  - Accuracy
  - Speed
  - Automatic labelling
- Disadvantages
  - Initial cost
  - Training requirements
  - Cutting machine consumables
- Enter fittings from shop fabrication drawings
- Package software which includes
  - Estimation
  - Design
  - Fabrication
  - Project management
Achievement Criteria

Performance  The learner will enter information from a shop fabrication drawing using computer aided sheet metal software program.

Conditions  The learner will be given:
- Project specifications
- Computer and software application

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Gauge
- Labelling
- Dimensioning
- Seams
- Joints
- Fittings entered according to information
Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F2 Fabricate ductwork, fittings and components

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

• Fabricate complex ductwork and fittings.

LEARNING TASKS

1. Review shop layout techniques for duct fittings
   • Tools and equipment
   • Line development
   • Geometric construction
   • Mathematical formulas
   • Cut list
   • Seam and joint allowances

2. Fabricate complex duct work and fittings
   • Applications
     o Square to round elbow
     o Drop cheek change elbow
     o Round reducing elbow
   • Labelling

Achievement Criteria

Performance
The learner will fabricate and assemble advanced duct fittings.

• Square to round elbow, and/or
• Round reducing elbow

Conditions
The learner will be given:

• Project specifications
• Tools and equipment

Criteria
The learner will score 70% or better on a rating sheet that reflects the following criteria:

• Safety
• Tools selection
• Procedure
• Project has no visible marks from hand tools
• Project is accurate to specified standards
**Line (GAC):** F  **FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS**  
**Competency:** F4  Fabricate material handling system components

### Objectives
To be competent in this area, the individual must be able to:
- Describe types of advanced industrial components and their purposes.
- Fabricate advanced industrial components to specifications.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>1. Describe pneumatic material handling systems</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Components</td>
<td></td>
</tr>
<tr>
<td>- Cyclone</td>
<td></td>
</tr>
<tr>
<td>- Feeder valves</td>
<td></td>
</tr>
<tr>
<td>- Air locks</td>
<td></td>
</tr>
<tr>
<td>- Positive/negative systems</td>
<td></td>
</tr>
<tr>
<td>- Bag house</td>
<td></td>
</tr>
<tr>
<td>- Heat recovery</td>
<td></td>
</tr>
<tr>
<td>- Wet scrubbers</td>
<td></td>
</tr>
<tr>
<td>- Hoppers</td>
<td></td>
</tr>
<tr>
<td>- Air moving devices (AMD)</td>
<td></td>
</tr>
<tr>
<td>- Abort gates</td>
<td></td>
</tr>
<tr>
<td>- Vacuum doors</td>
<td></td>
</tr>
<tr>
<td>- Explosion curtains</td>
<td></td>
</tr>
<tr>
<td>- Collection hoods</td>
<td></td>
</tr>
<tr>
<td>- Fittings</td>
<td></td>
</tr>
<tr>
<td>- Liners</td>
<td></td>
</tr>
</tbody>
</table>

- Purpose/applications
  - Classifications

### 2. Fabricate pneumatic material handling system components

- Components
- Cyclone
- Feeder valves
- Air locks
- Positive/negative systems
- Bag house
- Heat recovery
- Wet scrubbers
- Hoppers
- Air moving devices (AMD)
- Abort gates
- Vacuum doors
- Explosion curtains
LEARNING TASKS

CONTENT

- Collection hoods
- Fittings
- Liners
- Purpose/applications
- Classifications
- Materials

Achievement Criteria

Performance The learner will fabricate a pneumatic material handling system component, such as:

- Welded blow pipe elbow
- Square round elbow
- Collection hood
- Flat back elbow, and/or
- T on a taper (pipe on a cone)

Conditions The learner will be given:

- Project specifications
- Tools and equipment
- Materials

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:

- Safety
- Tools selection
- Procedure
- Final appearance
- Project is accurate to specified standards
Line (GAC): F  FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F5  Fabricate dampers

Objectives
To be competent in this area, the individual must be able to:
• Describe types of dampers.
• Fabricate dampers to specifications.

LEARNING TASKS

1. Describe single blade dampers
   • Volume damper
   • Flow control
   • Splitter
   • Round
   • Rectangular
   • Butterfly
   • Back draft
   • Balancing

2. Describe multi-blade dampers
   • Volume damper
   • Air flow characteristics
   • Motorized
   • Back draft
   • Opposed blade
   • Parallel blade
   • Dynamic / static
   • Balancing

3. Describe blast gate dampers
   • Material flow control
   • Balancing
   • Shut off
   • Wear and erosion

4. Describe damper hardware
   • Quadrant arms
   • Linkages
   • Ball joints
   • Bearings
   • Frames
Achievement Criteria 1

Performance The learner will fabricate a damper.
Conditions The learner will be given:
  • Project specifications
  • Tools and equipment
Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Safety
  • Tools selection
  • Procedure
  • Project is accurate to specified standards

Achievement Criteria 2

Performance The learner will fabricate saddle and trapeze hangers.
Conditions The learner will be given:
  • Project specifications
  • Tools and equipment
Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
  • Safety
  • Tools selection
  • Procedure
  • Project has no visible marks from hand tools
  • Project is accurate to specified standards
Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K1 Install air handling equipment

Objectives
To be competent in this area, the individual must be able to:
- Describe air handling systems and their purposes.
- Describe the installation of air handling systems.

LEARNING TASKS
1. Describe air moving devices

   • Centrifugal fans
     o Forward curved
     o Backward inclined
     o Straight blade
     o Rotation
     o Orientation
     o Inlet straight
     o Outlet straight

   • Axial fans
     o Vain axial
     o Tube axial
     o Disc blade
     o Propeller blade
     o Variable pitch

   • Fan wall technology

2. Describe the installation of centrifugal and axial fans

   • Manufacturer’s specifications
   • Effect of weather on installation
   • Maintenance considerations
   • Penetration size
   • Penetration obstructions
   • Sleepers
   • Stands
   • Housekeeping pads
   • Seismic restraints
   • Isolators
     o Inertia bases
     o Isolation springs
     o Isolation pads
LEARNING TASKS
3. Review the installation of air handling ductwork and fittings

CONTENT
- Components
- Installation drawings
  - Elevation
  - Plan
  - Specifications
- Tools and equipment
- Safety
- Hangers
- Fasteners
- Plumbing and levelling
- Connection
- Sealing
- Field cutting
- Field modification
- Seismic
Line (GAC): K  INSTALL AIR HANDLING SYSTEM COMPONENTS
Competency: K7  Install system component accessories

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

LEARNING TASKS
1. Describe system component accessories

   - Air flow sensors
     - Proves air flow
   - Temperature sensors
   - Controls
     - Damper controls
   - Spark arrestors
   - Smoke detectors
   - Air balancing test ports
   - High limit switches
   - Magnehelic gauge

2. Describe the installation of system component accessories

   - Identify hazards
   - Lock out
   - Maintenance
   - Location
   - Trade standards
   - Sealing
   - Blueprint symbols
Line (GAC): L INSTALL MATERIAL HANDLING SYSTEM COMPONENTS
Competency: L1 Install pneumatic material handling systems

Objectives
To be competent in this area, the individual must be able to:
- Describe pneumatic material and dust handling systems and their purpose.
- Describe the installation of pneumatic material and dust handling systems.

LEARNING TASKS

1. Describe material handling systems
   - Purpose
     - Product movement
     - Waste removal
     - Pollution control
   - Types
     - Air moving devices
     - Collection devices
     - Separating devices
     - Filtering devices
     - Heat recovery devices
     - Dampers
   - Components
     - Blast gates
     - Cleanouts
     - Slips
     - Cyclones
     - Abort gate
     - Systems service access
     - Fitting design
     - Explosion panels
     - Blow back box
     - Splitters / Diverters
     - Vacuum doors
   - Operation
   - Air flow

2. Describe the installation of supports and bases
   - Dimensions and weights of components
   - Orientation and location of units
   - Securing of equipment
### LEARNING TASKS

<table>
<thead>
<tr>
<th>Task</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 3. Describe the installation of air moving devices                   | • Purpose  
|                                                                      | • Types  
|                                                                      |   • Axial  
|                                                                      |   • Centrifugal  
|                                                                      |   • Forward inclined  
|                                                                      |   • Backward inclined  
|                                                                      |   • Paddle  
|                                                                      | • Codes and Regulations  
|                                                                      | • Manufacturer’s specifications  
|                                                                      | • Fastening  
| 4. Describe the installation of collection devices                   | • Purpose  
|                                                                      | • Types  
|                                                                      |   • Hoppers  
|                                                                      |   • Hoods  
|                                                                      |   • Bins  
|                                                                      | • Codes and Regulations  
|                                                                      | • Manufacturer’s specifications  
|                                                                      | • Positioning  
|                                                                      | • Fastening  
|                                                                      | • Effects of weather on installation  
| 5. Describe the installation of separating devices                   | • Purpose  
|                                                                      | • Types  
|                                                                      |   • Cyclones  
|                                                                      |   • Bag houses  
|                                                                      |   • Conveyor skirting  
|                                                                      | • Parts  
|                                                                      |   • Air locks/feeders  
|                                                                      | • Operation  
|                                                                      | • Codes and Regulations  
|                                                                      | • Manufacturer’s specifications  
|                                                                      | • Effects of weather on installation  
|                                                                      | • Positioning  
|                                                                      | • Fastening  

Line (GAC): L INSTALL MATERIAL HANDLING SYSTEM COMPONENTS
Competency: L2 Install gravity material handling system components

Objectives
To be competent in this area, the individual must be able to:
• Describe gravity material handling systems and their purpose.
• Describe the installation of gravity material handling systems.

LEARNING TASKS

1. Describe gravity material handling systems

CONTENT

- Purpose
  - Product movement
    - Baggage handling
    - Garbage
    - Product
    - Packaging
    - Manufacturing/ Production lines
    - Waste removal

- Types
  - Roller conveyors
  - Chutes and spouts

- Components
  - Hoppers
  - Liners
  - Fittings
    - Fitting design
  - Rollers
  - System service access

- Operation
LEARNING TASKS
2. Describe the installation of mechanized systems

CONTENT
- Supports and Bases
  - Dimensions and weights of components
  - Orientation and location of units
  - Securing of equipment
- Separating devices
  - Types
    - Hoppers
    - Bins
- Purpose
- Types
- Parts
- Operation
- Codes and Regulations
- Manufacturer’s specifications
- Positioning
- Fastening
- Effects of weather on installation
Line (GAC): L

INSTALL MATERIAL HANDLING SYSTEM COMPONENTS

Competency: L3 Install mechanized material handling system components

Objectives
To be competent in this area, the individual must be able to:
• Describe mechanized material handling systems and their purpose.
• Describe the installation of mechanized material handling systems.

LEARNING TASKS
1. Describe mechanized material handling systems

CONTENT
• Purpose
  o Product movement
    – Waste removal
    – Baggage handling
    – Garbage
    – Product
    – Packaging
    – Manufacturing/Production lines

• Types
  o Screw/auger
  o Bucket elevators
  o Conveyors

• Components
  o Liners
  o Fittings
    – Fitting design
  o Chutes
  o Belts
  o System service access

• Operation
LEARNING TASKS

2. Describe the installation of mechanized systems

CONTENT

- Supports and bases
  - Dimensions and weights of components
  - Orientation and location of units
  - Securing of equipment
  - Purpose
- Collection Devices
  - Hoppers
  - Bins
- Separating devices
  - Purpose
  - Types
- Parts
- Operation
- Codes and Regulations
- Manufacturer’s specifications
- Effects of weather on installation
- Positioning
- Fastening
Line (GAC): M APPLY THERMAL INSULATION, LAGGING, CLADDING AND FLASHING

Competency: M1 Apply lagging and cladding to components

Objectives
To be competent in this area, the individual must be able to:
• Describe the purpose of cladding and lagging.
• Describe the installation of cladding and lagging.

LEARNING TASKS

1. Describe the purpose of cladding and lagging
   - Purpose
   - Types

2. Describe the installation of cladding and lagging
   - Materials
     - Thermal expansion and contraction
     - Stainless steel
     - Aluminum
     - Coated steel
     - Membrane
     - Plastic
   - Insulation
     - Types
     - Application
     - Safe work practices and procedures
   - Lagging components
     - End caps
     - Pre-formed elbows
     - Stand offs
     - Tank ends
     - Gored elbows
     - T – branches
     - Bevels
     - Flat cladding
   - Mechanical equipment
     - Boilers
     - Piping
     - Pressure vessels
     - Cladding requirements
   - Process
     - Mathematics
     - Layout of components
HARMONIZED PROGRAM OUTLINE
Program Content
Level 4

LEARNING TASKS

CONTENT

  - Banding machines
  - Securing techniques
  - Installation techniques
  - Sealants
  - Safe work practices and procedures
Line (GAC): M APPLY THERMAL INSULATION, LAGGING, CLADDING AND FLASHING

Competency: M2 Apply flashing to components

Objectives
To be competent in this area, the individual must be able to:
- Describe the purpose of lagging flashings.
- Describe the installation of lagging flashings.

LEARNING TASKS

1. Describe the purpose of flashing for lagging
   - Purpose
   - Types
     - Base
     - Corner
     - Header
     - Butt straps
     - Component flashing

2. Describe the installation of flashing for lagging
   - Materials
     - Thermal expansion and contraction
     - Stainless steel
     - Aluminum
     - Coated steel
     - Membrane
     - Plastic
     - Galvanic reaction
   - Mechanical equipment
     - Boilers
     - Piping
     - Pressure vessels
     - Cladding requirements
   - Process
     - Mathematics
     - Layout
     - Forming
     - Securing techniques
     - Seams and joints
     - Sealants
     - Water shedding
     - Capillary actions
     - Field measuring and modifications
Line (GAC): N PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING

Competency: N1 Perform leak tests

Objectives
To be competent in this area, the individual must be able to:
- Describe leak testing.
- Perform and calculate leak testing.

LEARNING TASKS

1. Describe leak testing
   - Types
     - Smoke
     - Dye
     - Pressure
     - Fluid
     - Visual
     - Audible
   - Devices
     - Pitot
     - Pressure testing devices
   - Charts
   - Test section
   - Specifications
   - System preparation for testing

2. Calculate leakage amount
   - Testing report
   - Mathematics
   - Identify deficiencies
   - Recommended solutions to problems
HARMONIZED PROGRAM OUTLINE
Program Content
Level 4

Line (GAC): N PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING

Competency: N2 Perform testing, adjusting and balancing (TAB)

Objectives
To be competent in this area, the individual must be able to:
• Apply air balancing techniques.
• Calculate required system adjustments.

LEARNING TASKS
1. Describe air flow in ducts
   • Air flow
   • Duct design
   • Fitting design
   • Dynamic loss
   • System effect
   • Fan inlet and outlet effective lengths
   • Relative humidity

2. Use testing and balancing procedures
   • Purpose
   • Pressures
   • Mathematics

3. Use air balancing instruments and techniques
   • Balancing instruments
     o Manometers
     o Psychrometer
     o Velometer
     o Pitot tube
     o Anemometer
     o Magnehelic gauge
     o Flow hood
     o Multimeter
     o Tachometer
     o Ammeter
     o Ductulator
   • Techniques
   • System knowledge and understanding
   • Damper locations
   • Thermal overload
   • Damper checking and adjusting
   • RPM testing
   • Rotation testing
   • Adjustment
     o Belts
     o Pulleys
LEARNING TASKS

4. Balance an air system

CONTENT

- Sheaves
  - Test port installation
  - Amperage check
  - Velocity readings
  - Test running the system
  - Comparison to design specifications
  - Adjust components
  - Retest
  - Documentation

Achievement Criteria

Performance The learner will perform air balancing.

Conditions The learner will be given:
- Test data
- System design data
- Tools and equipment

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Process
- Calculated adjustments
Line (GAC): N PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING

Competency: N3 Participate in the commissioning of air and material handling equipment

Objectives
To be competent in this area, the individual must be able to:
• Complete commissioning report.

LEARNING TASKS

1. Use documentation to compile reports
   • Shop drawings
   • As built
   • Job specifications
   • Manufacturer’s specifications

2. Use calculations to complete reports
   • Rotation testing
   • BTU verification
   • Mechanical service connections
   • Air flow verifications
   • Temperature rise
   • Voltage and amps check
   • BHP
   • Indoor air quality

3. Address deficiencies in commissioning report
   • Identifying and labelling
   • Component check
   • Future maintenance
   • System operation education
Section 4

ASSESSMENT GUIDELINES
# Assessment Guidelines – Level 1

## Level 1 Grading Sheet: Subject Competency and Weightings

<table>
<thead>
<tr>
<th>PROGRAM: IN-SCHOOL TRAINING:</th>
<th>SHEET METAL WORKER LEVEL 1</th>
<th>THEORY WEIGHTING</th>
<th>PRACTICAL WEIGHTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>LINE</td>
<td>SUBJECT COMPETENCIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Perform Safety Related Functions</td>
<td>5%</td>
<td>0%</td>
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<tr>
<td>B</td>
<td>Use and Maintain Tools and Equipment</td>
<td>23%</td>
<td>35%</td>
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<tr>
<td>C</td>
<td>Organize Work</td>
<td>17%</td>
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<tr>
<td>D</td>
<td>Use Communication and Mentoring Techniques</td>
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<tr>
<td>E</td>
<td>Perform Pattern Development</td>
<td>25%</td>
<td>20%</td>
</tr>
<tr>
<td>F</td>
<td>Fabricate Sheet Metal Components for Air and Material Handling Systems</td>
<td>20%</td>
<td>40%</td>
</tr>
<tr>
<td>K</td>
<td>Install Air Handling System Components</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<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**

<p>| | |</p>
<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>In-school %</td>
<td>62%</td>
</tr>
<tr>
<td>Practical %</td>
<td>38%</td>
</tr>
</tbody>
</table>

**Final in-school mark**

Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Sheet Metal Worker Standardized Level exam.

<table>
<thead>
<tr>
<th>IN-SCHOOL %</th>
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<tbody>
<tr>
<td>Combined Theory</td>
<td>80%</td>
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<tr>
<td>Practical Theory</td>
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</table>

**Standardized Level Exam Mark**

The exam score is multiplied by 20%.

<table>
<thead>
<tr>
<th>Final Level Mark</th>
<th>Final%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Score</td>
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<tr>
<td>Multiplied by 20%</td>
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Sheet Metal Worker Harmonized Program Outline 01/19

Industry Training Authority 193
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>
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<tbody>
<tr>
<td>B</td>
<td>Use and Maintain Tools and Equipment</td>
<td>10%</td>
<td>25%</td>
</tr>
<tr>
<td>C</td>
<td>Organize Work</td>
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<tr>
<td>E</td>
<td>Perform Pattern Development</td>
<td>20%</td>
<td>20%</td>
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<tr>
<td>F</td>
<td>Fabricate Sheet Metal Components for Air and Material Handling Systems</td>
<td>10%</td>
<td>25%</td>
</tr>
<tr>
<td>G</td>
<td>Fabricate Flashing, Roofing, Sheet and Cladding</td>
<td>8%</td>
<td>15%</td>
</tr>
<tr>
<td>I</td>
<td>Prepare Installation Site</td>
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<td>0%</td>
</tr>
<tr>
<td>J</td>
<td>Install and Connect Chimneys, Breeching, and Venting to Exhaust Appliances and Mechanical Equipment</td>
<td>8%</td>
<td>0%</td>
</tr>
<tr>
<td>K</td>
<td>Install Air Handling System Components</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>O</td>
<td>Install Metal Roofing and Cladding/Siding Systems</td>
<td>8%</td>
<td>0%</td>
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<tr>
<td>P</td>
<td>Install Exterior Components</td>
<td>8%</td>
<td>0%</td>
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<tr>
<td></td>
<td>Total</td>
<td>100%</td>
<td>100%</td>
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</table>

In-school theory / practical subject competency weighting 62% 38%

Final in-school mark
Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Sheet Metal Worker Standardized Level exam.

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

Standardized Level Exam Mark
The exam score is multiplied by 20%
<table>
<thead>
<tr>
<th>Final Level Mark</th>
<th>Final%</th>
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</table>

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<th>PRACTICAL WEIGHTING</th>
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<tbody>
<tr>
<td>B</td>
<td>Use and Maintain Tools and Equipment</td>
<td>15%</td>
<td>23%</td>
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<tr>
<td>E</td>
<td>Perform Pattern Development</td>
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<tr>
<td>F</td>
<td>Fabricate Sheet Metal Components for Air and Material Handling Systems</td>
<td>13%</td>
<td>25%</td>
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<tr>
<td>H</td>
<td>Fabricate Specialty Products</td>
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<tr>
<td>K</td>
<td>Install Air Handling System Components</td>
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<tr>
<td>N</td>
<td>Perform Leak Testing, Air Balancing and Commissioning</td>
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<td>12%</td>
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<td>Q</td>
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In-school theory / practical subject competency weighting

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<tr>
<td></td>
<td>70%</td>
</tr>
</tbody>
</table>

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

Standardized Level Exam Mark
The exam score is multiplied by 20%

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

### Level 4 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>
<tr>
<td>B</td>
<td>Use and Maintain Tools and Equipment</td>
<td>8%</td>
<td>25%</td>
</tr>
<tr>
<td>D</td>
<td>Use Communication and Mentoring Techniques</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>E</td>
<td>Perform Pattern Development</td>
<td>20%</td>
<td>25%</td>
</tr>
<tr>
<td>F</td>
<td>Fabricate Sheet Metal Components for Air and Material Handling Systems</td>
<td>20%</td>
<td>30%</td>
</tr>
<tr>
<td>K</td>
<td>Install Air Handling System Components</td>
<td>15%</td>
<td>0%</td>
</tr>
<tr>
<td>L</td>
<td>Install Material Handling System Components</td>
<td>15%</td>
<td>0%</td>
</tr>
<tr>
<td>M</td>
<td>Apply Thermal Insulation, Lagging, Cladding and Flashing</td>
<td>12%</td>
<td>0%</td>
</tr>
<tr>
<td>N</td>
<td>Perform Leak Testing, Air Balancing and Commissioning</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<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**

<table>
<thead>
<tr>
<th></th>
<th>THEORY</th>
<th>PRACTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>62%</td>
<td>38%</td>
</tr>
</tbody>
</table>

**Final in-school mark**

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

All apprentices who complete Level 4 of the Sheet Metal Worker 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’ Sheet Metal Worker Interprovincial Red Seal examination percentage score into 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
- Minimum 30 square feet per student (accommodates drafting tables)
- Comfortable seating and tables suitable for learning
- Compliance with the local and national fire code and occupational safety requirements
- Meets applicable municipal zoning bylaws for technical instruction and education facilities
- Overhead and multimedia projectors with a projection screen
- Whiteboard with marking pens and erasers
- Lighting controls to allow easy visibility of the projection screen while allowing students to take notes
- Windows must have shades or blinds to adjust sunlight
- Heating/air conditioning for comfort all year round
- In-room temperature control to ensure comfortable room temperature
- Acoustics in the room must allow the instructor to be heard
- One drafting table per student

Shop Area
- Minimum 7,000 square feet of shop area including a tool crib and work stations
- 12 foot ceiling height
- Adequate heating, lighting and ventilation
- Refuse and recycling bins for used shop materials
- First-aid facilities
- Portable fire extinguishers as per WorkSafeBC requirements
- Posted evacuation plans
- Eye wash stations
- One work table per two students

Lab Requirements
Does not apply

Student Facilities
- Adequate eating area as per WorkSafeBC requirements (4.84 OHS Regulation and Guidelines)
- Adequate washroom facilities as per WorkSafeBC requirements (4.85 OHS Regulation and Guidelines)
- Personal storage lockers

Instructor’s Office Space
Does not apply
Other

- Desk and filing space
- Computer
- Phone
# Tools and Equipment

The following list is appropriate for a class of 16 students.

**HAND TOOLS: LEVELS 1 to 4**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjustable wrench</td>
<td>1</td>
<td>Hand seamers</td>
<td>1</td>
</tr>
<tr>
<td>Allen hex keys (Metric and Imperial)</td>
<td>4</td>
<td>Hole punches</td>
<td>4</td>
</tr>
<tr>
<td>Aviation snips R.H and L.H.</td>
<td>16</td>
<td>Levels</td>
<td>4</td>
</tr>
<tr>
<td>Ball peen hammers</td>
<td>8</td>
<td>Laser levels</td>
<td>2</td>
</tr>
<tr>
<td>Bulldog snips</td>
<td>16</td>
<td>Locking pliers</td>
<td>8</td>
</tr>
<tr>
<td>Caulking guns</td>
<td>2</td>
<td>Mallets</td>
<td>16</td>
</tr>
<tr>
<td>C-clamps</td>
<td>4</td>
<td>Pliers</td>
<td>2</td>
</tr>
<tr>
<td>Centre punches</td>
<td>16</td>
<td>Rivet sets</td>
<td>2</td>
</tr>
<tr>
<td>Chalk lines</td>
<td>2</td>
<td>Scratch awls</td>
<td>16</td>
</tr>
<tr>
<td>Chipping hammers</td>
<td>8</td>
<td>Screwdrivers</td>
<td>16</td>
</tr>
<tr>
<td>Chisels</td>
<td>4</td>
<td>Setting hammers</td>
<td>16</td>
</tr>
<tr>
<td>Combination snips</td>
<td>4</td>
<td>Side cutters</td>
<td>8</td>
</tr>
<tr>
<td>De-burring tool</td>
<td>1</td>
<td>Socket set</td>
<td>1</td>
</tr>
<tr>
<td>Dividers</td>
<td>16</td>
<td>Soldering copper</td>
<td>8</td>
</tr>
<tr>
<td>Drift pins</td>
<td>4</td>
<td>Straight edges (Circumference rules)</td>
<td>16</td>
</tr>
<tr>
<td>Duct puller/stretchers</td>
<td>2</td>
<td>Wire brushes (Mild steel and stainless steel)</td>
<td>16</td>
</tr>
<tr>
<td>Files</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Folding pliers</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groove seamers –hand groovers</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hacksaws</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand crimpers</td>
<td>2</td>
<td>Wrenches (Metric and Imperial)</td>
<td>16</td>
</tr>
<tr>
<td>Hand dolly (set)</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand notcher</td>
<td>1</td>
<td>Trammel points</td>
<td></td>
</tr>
</tbody>
</table>

**PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT: LEVELS 1 to 4**

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye protection</td>
<td></td>
</tr>
<tr>
<td>Eye wash station</td>
<td></td>
</tr>
<tr>
<td>Face shield</td>
<td></td>
</tr>
<tr>
<td>Fire extinguisher</td>
<td></td>
</tr>
<tr>
<td>First aid kit</td>
<td></td>
</tr>
<tr>
<td>Gloves</td>
<td></td>
</tr>
<tr>
<td>Hard hat</td>
<td></td>
</tr>
<tr>
<td>Hearing protection</td>
<td></td>
</tr>
<tr>
<td>Respiratory protection</td>
<td></td>
</tr>
<tr>
<td>Welding curtain</td>
<td></td>
</tr>
<tr>
<td>Welding jacket</td>
<td></td>
</tr>
<tr>
<td>Welding helmet</td>
<td></td>
</tr>
<tr>
<td>High visibility vests</td>
<td></td>
</tr>
</tbody>
</table>
LAYOUT AND DRAFTING EQUIPMENT: LEVELS 1 to 4

16 Combination squares
16 Framing squares
16 Drafting tables
16 Parallel bars

MEASURING TOOLS: LEVELS 1 to 4

2 Angle finders
16 Tape measures

LADDERS, PLATFORMS, AND HOISTING AND RIGGING EQUIPMENT: LEVELS 1 to 4

3 Ladders
1 Material lift

PORTABLE POWER TOOLS: ALL LEVELS

4 Angle grinder
1 Circular saw
1 Reciprocating saw
1 Hammer drill
1 Die grinder
2 Reciprocating saw
4 Drum sander
4 Uni-shear
1 Cordless drill
1 Inline belt sander
1 Electric drill motor
1 Orbital sander
1 Right angle drill
1 Cordless angle grinder
1 Jigsaw
1 DOUBLE CUTTER
1 Spot welder

WELDING, BRAZING, SOLDERING AND CUTTING EQUIPMENT: LEVELS 1 to 4

8 Gas metal arc welding equipment (GMAW)
2 Shielded metal arc welding equipment (SMAW)
1 Oxy-acetylene welding equipment
1 Nitrogen arc welding equipment
4 Spot welder
1 Gas tungsten arc welding equipment (GTAW)

WELDING, BRAZING, SOLDERING AND CUTTING EQUIPMENT: LEVELS 3 and 4

5 Gas tungsten arc welding equipment (GTAW)
## SHOP TOOLS AND EQUIPMENT: LEVELS 1 to 4

<table>
<thead>
<tr>
<th>Tool/Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut-off saw</td>
<td>1</td>
</tr>
<tr>
<td>Bar folder</td>
<td>3</td>
</tr>
<tr>
<td>Bench grinder</td>
<td>1</td>
</tr>
<tr>
<td>Bench vice</td>
<td>1</td>
</tr>
<tr>
<td>Box and pan brake</td>
<td>1</td>
</tr>
<tr>
<td>Compressor</td>
<td>1</td>
</tr>
<tr>
<td>Drill index</td>
<td>1</td>
</tr>
<tr>
<td>Drill press</td>
<td>1</td>
</tr>
<tr>
<td>Foot shear</td>
<td>1</td>
</tr>
<tr>
<td>Hand brake</td>
<td>3</td>
</tr>
<tr>
<td>Lever bench shear</td>
<td>1</td>
</tr>
<tr>
<td>Notcher</td>
<td>1</td>
</tr>
<tr>
<td>Pittsburgh machine</td>
<td>2</td>
</tr>
<tr>
<td>Power forming rolls</td>
<td>1</td>
</tr>
<tr>
<td>Power shear</td>
<td>1</td>
</tr>
</tbody>
</table>

## SHOP TOOLS AND EQUIPMENT: LEVELS 3 and 4

<table>
<thead>
<tr>
<th>Tool/Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNC Press Brake</td>
<td>1</td>
</tr>
<tr>
<td>Iron worker</td>
<td>1</td>
</tr>
</tbody>
</table>

## ROTARY MACHINES: LEVELS 1 to 4

<table>
<thead>
<tr>
<th>Machine</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beading machine</td>
<td>1</td>
</tr>
<tr>
<td>Burring machine</td>
<td>1</td>
</tr>
<tr>
<td>Crimping machine</td>
<td>1</td>
</tr>
<tr>
<td>Easy edger</td>
<td>2</td>
</tr>
<tr>
<td>Elbow seaming</td>
<td>1</td>
</tr>
<tr>
<td>Slip roll former</td>
<td>2</td>
</tr>
<tr>
<td>Turning machine</td>
<td>1</td>
</tr>
<tr>
<td>Combination rotary machine</td>
<td>1</td>
</tr>
</tbody>
</table>

## METAL FORMING STAKES: LEVELS 1 to 4

<table>
<thead>
<tr>
<th>Tool/Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beak horn</td>
<td>1</td>
</tr>
<tr>
<td>Bench plate</td>
<td>1</td>
</tr>
<tr>
<td>Blow horn</td>
<td>1</td>
</tr>
<tr>
<td>Candle mould</td>
<td>1</td>
</tr>
<tr>
<td>Common square</td>
<td>1</td>
</tr>
<tr>
<td>Copper smith</td>
<td>1</td>
</tr>
<tr>
<td>Creasing stake</td>
<td>1</td>
</tr>
<tr>
<td>Double seaming</td>
<td>1</td>
</tr>
<tr>
<td>Double seaming with heads</td>
<td>1</td>
</tr>
<tr>
<td>Hatchet</td>
<td>1</td>
</tr>
<tr>
<td>Hollow mandrel</td>
<td>1</td>
</tr>
<tr>
<td>Solid mandrel</td>
<td>1</td>
</tr>
<tr>
<td>Square</td>
<td>1</td>
</tr>
</tbody>
</table>

## COMPUTER ASSISTED TOOLS: LEVELS 2, 3 and 4

<table>
<thead>
<tr>
<th>Tool/Equipment</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer hardware</td>
<td>8</td>
</tr>
<tr>
<td>Printer</td>
<td>1</td>
</tr>
<tr>
<td>Software packages</td>
<td>8</td>
</tr>
</tbody>
</table>
Reference Materials

Required Reference Materials

- Contact Training Facility for Required Reference Material

NOTE:
This list of Reference Materials is for training providers. Apprentices should contact their preferred training provider for a list of recommended or required texts for this program.
Instructor Requirements

Occupation Qualification
The instructor must possess:
- A BC Certificate of Qualification preferably with a Red Seal Endorsement.
- Certificate of Qualification from another Canadian jurisdiction complete with Red Seal Endorsement only.

Work Experience
A minimum of five 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:
- An Instructor’s Diploma or equivalent
- A Bachelor’s Degree in Education
- A Master’s Degree in Education