PROGRAM OUTLINE

Sheet Metal Worker
SHEET METAL WORKER
PROGRAM OUTLINE

APPROVED BY INDUSTRY
SEPTEMBER 2011

BASED ON
NOA 2010

Developed by
Industry Training Authority
Province of British Columbia
# TABLE OF CONTENTS

Section 1 INTRODUCTION................................................................................................................ 4  
   Foreword ........................................................................................................................... 5  
   Acknowledgements ........................................................................................................... 6  
   How to Use this Document............................................................................................... 7  

Section 2 PROGRAM OVERVIEW.................................................................................................... 9  
   Program Credentialing Model ......................................................................................... 10  
   Occupational Analysis Chart ......................................................................................... 13  
   Training Topics and Suggested Time Allocation ............................................................. 16  

Section 3 PROGRAM CONTENT .................................................................................................... 20  
   Level 1 Sheet Metal Worker ............................................................................................ 21  
   Level 2 Sheet Metal Worker ............................................................................................ 60  
   Level 3 Sheet Metal Worker ............................................................................................ 94  
   Level 4 Sheet Metal Worker .......................................................................................... 123  

Section 4 TRAINING PROVIDER STANDARDS .......................................................................... 162  
   Facility Requirements .................................................................................................... 163  
   Tools and Equipment .................................................................................................... 164  
   Reference Materials ...................................................................................................... 167  
   Instructor Requirements ............................................................................................... 168  

Appendices .................................................................................................................................... 169  
   Appendix A – Assessment Guidelines ............................................................................ 170
Section 1
INTRODUCTION
Sheet Metal Worker
Introduction

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 National Occupational Analysis (2010) 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.

The Program Outline was prepared with the advice and assistance of the Sheet Metal Worker Review Committee and will form the basis for further updating of the British Columbia Sheet Metal Worker Program and learning resources by the Construction Industry Training Organization on behalf of the Industry Training Authority (ITA).

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.

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 WorkSafeBC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: http://www.worksafebc.com. Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.
Acknowledgements

This Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the Construction Industry Training Organization (CITO). Members include:

- Stephen Farmer
- Jeremy Hallman
- Jud Martell
- Greg McDonald
- Jim Paquette
- Bruce Sychuk

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

- Mark Curtis
- Miles Heck
- Eric Moeller
- Bob Pascuzzi
- Craig Weis
- Roger Hagan
- Antonio Henriques

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.
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>Communicate program length and structure, and all pathways to completion</td>
<td>Understand the length and structure of the program</td>
<td>Understand the length and structure of the program, and pathway to completion</td>
<td>Understand challenger pathway to Certificate of Qualification</td>
</tr>
<tr>
<td>Program Assessment</td>
<td>Communicate program completion requirements and assessment methods</td>
<td>Understand the various assessment requirements for the program</td>
<td>Understand the various assessment requirements for the program</td>
<td>Understand the assessment requirements they would have to fulfill in order to challenge the program</td>
</tr>
<tr>
<td>OAC</td>
<td>Communicate the competencies that industry has defined as representing the scope of the occupation</td>
<td>Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification</td>
<td>View the competencies they will achieve as a result of program completion</td>
<td>Understand the competencies they must demonstrate in order to challenge the program</td>
</tr>
<tr>
<td>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, measureable 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>
<tr>
<td>Section</td>
<td>Training Providers</td>
<td>Employers/ Sponsors</td>
<td>Apprentices</td>
<td>Challengers</td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------------------------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Training Provider Standards</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 Overview

Program Credentialing Model

Apprenticeship Pathway

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

\[ \text{C of Q} \] = Certificate of Qualification
\[ \text{C of A} \] = Certificate of Apprenticeship
\[ \text{C of C} \] = Certificate of Completion
\[ \text{WBT} = \text{Work-Based Training} \]

*Recommended duration based on 30-hour week

**CROSS-PROGRAM CREDITS**

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

Architectural Sheet Metal Worker – Level 1
Technical Training: None

Sheet Metal Worker – Level 1
Technical Training: 180 hours (6 weeks*)
Brazilian/Italian

Sheet Metal Worker – Level 2
Technical Training: 180 hours (6 weeks*)
Brazilian/Italian

Sheet Metal Worker – Level 3
Technical Training: 180 hours (6 weeks*)
Brazilian/Italian

Sheet Metal Worker – Level 4
Technical Training: 180 hours (6 weeks*)
Brazilian/Italian

Architectural Sheet Metal Worker – Level 1
Technical Training: 900 hours
Challenge Pathway
This graphic provides an overview of the Sheet Metal Worker challenge pathway.

Completion Requirements
Interprovincial Red Seal Exam

Prerequisites
Approved challenge application, including:
Trade-Related Work Experience: 8,520 hours

C of Q = Certificate of Qualification

CREDIT FOR PRIOR LEARNING
Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program
None
Program Assessment

Apprentices will be assessed fairly and accurately throughout the program on the various skills required to be a professional Sheet Metal Worker. Assessment activities are designed to provide feedback and allow for further development of skills that have been identified as essential for on the job performance.

The forms of assessment used in this program are described below.

<table>
<thead>
<tr>
<th>Completion Requirement</th>
<th>Evidence of Achievement</th>
<th>Level of Achievement Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 Technical Training</td>
<td>In-school testing and practical assessment</td>
<td>Minimum 70%</td>
</tr>
<tr>
<td>Level 2 Technical Training</td>
<td>In-school testing and practical assessment</td>
<td>Minimum 70%</td>
</tr>
<tr>
<td>Level 3 Technical Training</td>
<td>In-school testing and practical assessment</td>
<td>Minimum 70%</td>
</tr>
<tr>
<td>Level 4 Technical Training</td>
<td>In-school testing and practical assessment</td>
<td>Minimum 70%</td>
</tr>
<tr>
<td>Work-based Training Hours</td>
<td>Work-based training report completed by Sponsor or Employer</td>
<td>5680 hours completed</td>
</tr>
<tr>
<td>Interprovincial Red Seal Exam</td>
<td>ITA-administered exam</td>
<td>Minimum 70%</td>
</tr>
<tr>
<td>Recommendation for Certification</td>
<td>Approval or sign-off by Sponsor, Employer, or other individual with sign-off authority</td>
<td>Declared competent</td>
</tr>
</tbody>
</table>
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.

USE SAFE WORK PRACTICES

- Control workplace hazards
- Locate information in the OHS Regulation and WCB Standards
- Use WHMIS
- Use personal protective equipment
- Select fire extinguishers

USE TOOLS AND EQUIPMENT

- Use hand tools
- Use portable power tools
- Use shop equipment
- Use welding equipment
- Use soldering and brazing equipment
- Use fasteners
- Use ladders and platforms
- Use hoisting, lifting and rigging equipment

ORGANIZE WORK

- Use mathematics
- Read drawings and specifications
- Use codes, regulations, and standards
- Use manufacturer and supplier documentation
- Analyze project requirements
- Handle materials
- Communicate with others
<table>
<thead>
<tr>
<th>INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS</th>
<th>INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Install roofing, decking and cladding</td>
<td>Install panel systems</td>
</tr>
<tr>
<td>Install exterior components</td>
<td>Install specialty and stainless steel products</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SERVICE SYSTEMS</th>
<th>SERVICE SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test and adjust systems</td>
<td>Perform maintenance inspections and service</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>
## Training Topics and Suggested Time Allocation

### Sheet Metal Worker - Level 1

<table>
<thead>
<tr>
<th>Line A</th>
<th>USE SAFE WORK PRACTICES</th>
<th>Theory</th>
<th>Practical</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Control workplace hazards</td>
<td>5</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>A2</td>
<td>Locate information in the OHS Regulation and WCB Standard</td>
<td>34</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>A3</td>
<td>Use WHMIS</td>
<td>23</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>A4</td>
<td>Use personal protective equipment</td>
<td>11</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>A5</td>
<td>Select fire extinguishers</td>
<td>21</td>
<td>✓ 29</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line B</th>
<th>USE TOOLS AND EQUIPMENT</th>
<th>Theory</th>
<th>Practical</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1</td>
<td>Use hand tools</td>
<td>7</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>Use portable power tools</td>
<td>7</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>Use shop equipment</td>
<td>7</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>Use welding equipment</td>
<td>31</td>
<td>✓ 36</td>
<td></td>
</tr>
<tr>
<td>B5</td>
<td>Use soldering and brazing equipment</td>
<td>14</td>
<td>✓ 38</td>
<td></td>
</tr>
<tr>
<td>B6</td>
<td>Use fasteners</td>
<td>7</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>B7</td>
<td>Use ladders and platforms</td>
<td>13</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>B8</td>
<td>Use hoisting, lifting and rigging equipment</td>
<td>14</td>
<td>40</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line C</th>
<th>ORGANIZE WORK</th>
<th>Theory</th>
<th>Practical</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Use mathematics</td>
<td>57</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>Read drawings and specifications</td>
<td>20</td>
<td>✓ 42</td>
<td></td>
</tr>
<tr>
<td>C6</td>
<td>Handle materials</td>
<td>15</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>C7</td>
<td>Communicate with others</td>
<td>8</td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line D</th>
<th>LAYOUT AND DEVELOP PATTERNS</th>
<th>Theory</th>
<th>Practical</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td>Use drafting equipment to develop geometric constructions</td>
<td>7</td>
<td>✓ 45</td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Develop pictorial drawings and orthographic projections</td>
<td>22</td>
<td>✓ 46</td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>Develop patterns using parallel line development</td>
<td>24</td>
<td>✓ 47</td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>Develop patterns using radial line development</td>
<td>8</td>
<td>✓ 49</td>
<td></td>
</tr>
<tr>
<td>D5</td>
<td>Develop patterns using triangulation</td>
<td>15</td>
<td>✓ 50</td>
<td></td>
</tr>
<tr>
<td>D6</td>
<td>Develop patterns for duct fittings</td>
<td>24</td>
<td>✓ 51</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line E</th>
<th>FABRICATE TRADE RELATED PRODUCTS</th>
<th>Theory</th>
<th>Practical</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Select materials for trade related products</td>
<td>29</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>Fabricate components</td>
<td>29</td>
<td>✓ 53</td>
<td></td>
</tr>
<tr>
<td>E3</td>
<td>Fabricate ductwork and assemble fittings with components</td>
<td>26</td>
<td>✓ 55</td>
<td></td>
</tr>
<tr>
<td>E4</td>
<td>Insulate ductwork, fittings and components</td>
<td>7</td>
<td>56</td>
<td></td>
</tr>
<tr>
<td>E5</td>
<td>Fabricate hanger systems</td>
<td>9</td>
<td>✓ 57</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line F</th>
<th>INSTALL AIR HANDLING SYSTEMS</th>
<th>Theory</th>
<th>Practical</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2</td>
<td>Install air handling ductwork and components</td>
<td>100</td>
<td>✓ 58</td>
</tr>
</tbody>
</table>

Total Percentage for Sheet Metal Worker - Level 1: 100%
# Program Overview

## Training Topics and Suggested Time Allocation

### Sheet Metal Worker – Level 2

<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
<th>Theory</th>
<th>Practical</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line A</strong></td>
<td><strong>USE SAFE WORK PRACTICES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>Control workplace hazards</td>
<td>3</td>
<td>61</td>
<td>100</td>
</tr>
<tr>
<td><strong>Line B</strong></td>
<td><strong>USE TOOLS AND EQUIPMENT</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>Use hand tools</td>
<td>12</td>
<td>17</td>
<td>62</td>
</tr>
<tr>
<td>B2</td>
<td>Use portable power tools</td>
<td>4</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>B3</td>
<td>Use shop equipment</td>
<td>12</td>
<td>64</td>
<td>64</td>
</tr>
<tr>
<td>B4</td>
<td>Use welding equipment</td>
<td>57</td>
<td>✓</td>
<td>65</td>
</tr>
<tr>
<td>B6</td>
<td>Use fasteners</td>
<td>5</td>
<td>67</td>
<td>67</td>
</tr>
<tr>
<td><strong>Line C</strong></td>
<td><strong>ORGANIZE WORK</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>Use mathematics</td>
<td>14</td>
<td>4</td>
<td>68</td>
</tr>
<tr>
<td>C2</td>
<td>Read drawings and specifications</td>
<td>17</td>
<td>✓</td>
<td>69</td>
</tr>
<tr>
<td>C3</td>
<td>Use codes, regulations, and standards</td>
<td>6</td>
<td>71</td>
<td>71</td>
</tr>
<tr>
<td>C4</td>
<td>Use manufacturer and supplier documentation</td>
<td>12</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>C5</td>
<td>Analyse project requirements</td>
<td>12</td>
<td>73</td>
<td>73</td>
</tr>
<tr>
<td>C6</td>
<td>Handle materials</td>
<td>23</td>
<td>74</td>
<td>74</td>
</tr>
<tr>
<td><strong>Line D</strong></td>
<td><strong>LAYOUT AND DEVELOP PATTERNS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Develop pictorial drawings and orthographic projections</td>
<td>44</td>
<td>18</td>
<td>75</td>
</tr>
<tr>
<td>D3</td>
<td>Develop patterns using parallel line development</td>
<td>10</td>
<td>✓</td>
<td>76</td>
</tr>
<tr>
<td>D5</td>
<td>Develop patterns using triangulation</td>
<td>28</td>
<td>✓</td>
<td>77</td>
</tr>
<tr>
<td>D6</td>
<td>Develop patterns for duct fittings</td>
<td>28</td>
<td>✓</td>
<td>78</td>
</tr>
<tr>
<td>D7</td>
<td>Develop patterns using computer technology</td>
<td>3</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td><strong>Line E</strong></td>
<td><strong>FABRICATE TRADE RELATED PRODUCTS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1</td>
<td>Select materials for trade related products</td>
<td>19</td>
<td>43</td>
<td>80</td>
</tr>
<tr>
<td>E2</td>
<td>Fabricate components</td>
<td>23</td>
<td></td>
<td>81</td>
</tr>
<tr>
<td>E3</td>
<td>Fabricate ductwork and assemble fittings with components</td>
<td>18</td>
<td>✓</td>
<td>82</td>
</tr>
<tr>
<td>E5</td>
<td>Fabricate hanger systems</td>
<td>18</td>
<td>✓</td>
<td>84</td>
</tr>
<tr>
<td>E8</td>
<td>Fabricate architectural components</td>
<td>35</td>
<td>✓</td>
<td>85</td>
</tr>
<tr>
<td>E9</td>
<td>Fabricate industrial components</td>
<td>6</td>
<td>✓</td>
<td>86</td>
</tr>
<tr>
<td><strong>Line F</strong></td>
<td><strong>INSTALL AIR HANDLING SYSTEMS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>Install air handling ductwork and components</td>
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<td>5</td>
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<tr>
<td><strong>Line H</strong></td>
<td><strong>INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS</strong></td>
<td></td>
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<tr>
<td>H1</td>
<td>Install roofing, decking and cladding</td>
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<td>13</td>
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<td>H2</td>
<td>Install panel systems</td>
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<td>H3</td>
<td>Install exterior components</td>
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**Total Percentage for Sheet Metal Worker - Level 2**: 100% 100%
## Program Overview

### Training Topics and Suggested Time Allocation

**Sheet Metal Worker – Level 3**

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<thead>
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<th>Theory %</th>
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<td><strong>USE SAFE WORK PRACTICES</strong></td>
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<td>Control workplace hazards</td>
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<td><strong>Line B</strong></td>
<td><strong>USE TOOLS AND EQUIPMENT</strong></td>
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<td>B2</td>
<td>Use portable power tools</td>
<td>40</td>
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<td>B3</td>
<td>Use shop equipment</td>
<td>41</td>
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<td>Use welding equipment</td>
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<td><strong>ORGANIZE WORK</strong></td>
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<td>Use mathematics</td>
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<td>Use codes, regulations, and standards</td>
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<td>C4</td>
<td>Use manufacturer and supplier documentation</td>
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<td>Handle materials</td>
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<td><strong>LAYOUT AND DEVELOP PATTERNS</strong></td>
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<td>D3</td>
<td>Develop patterns using parallel line development</td>
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<td>D5</td>
<td>Develop patterns using triangulation</td>
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<td>✓</td>
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<td>D6</td>
<td>Develop patterns for duct fittings</td>
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<td>D7</td>
<td>Develop patterns using computer technology</td>
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<td><strong>FABRICATE TRADE RELATED PRODUCTS</strong></td>
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<td>E1</td>
<td>Select materials for trade related products</td>
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<td>Fabricate ductwork and assemble fittings with components</td>
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<td>E7</td>
<td>Fabricate specialty and stainless steel products</td>
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<td>Fabricate industrial components</td>
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<td><strong>INSTALL AIR HANDLING SYSTEMS</strong></td>
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<td>Install air handling ductwork and components</td>
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<td>Install residential heating, ventilating and air conditioning</td>
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<td><strong>Line G</strong></td>
<td><strong>INSTALL INDUSTRIAL SYSTEMS</strong></td>
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<td>G1</td>
<td>Install chimneys, breeching and venting</td>
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<td><strong>INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS</strong></td>
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<td>Install specialty and stainless steel products</td>
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<td>I1</td>
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Total Percentage for Sheet Metal Worker - Level 3: 100%
# Program Overview

## Training Topics and Suggested Time Allocation

### Sheet Metal Worker – Level 4

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<th>Topic</th>
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<td>USE SAFE WORK PRACTICES</td>
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<td>Control workplace hazards</td>
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<td>USE TOOLS AND EQUIPMENT</td>
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<td>B3</td>
<td>Use shop equipment</td>
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<td>Use welding equipment</td>
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<td>B6</td>
<td>Use fasteners</td>
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<td>Use hoisting, lifting and rigging equipment</td>
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<td>ORGANIZE WORK</td>
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<td>Analyse project requirements</td>
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<td>C7</td>
<td>Communicate with others</td>
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<td>D7</td>
<td>Develop patterns using computer technology</td>
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<td>FABRICATE TRADE RELATED PRODUCTS</td>
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<td>Fabricate ductwork and assemble fittings with components</td>
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<td>INSTALL AIR HANDLING SYSTEMS</td>
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<td>Install air handling system equipment</td>
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<td>Install air handling ductwork and components</td>
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<td><strong>Line G</strong></td>
<td>INSTALL INDUSTRIAL SYSTEMS</td>
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<td>G1</td>
<td>Install chimneys, breeching and venting</td>
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<tr>
<td>G2</td>
<td>Install gravity/conveyor material handling systems</td>
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<td>G3</td>
<td>Install pneumatic material and dust handling systems</td>
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<td>G4</td>
<td>Install lagging</td>
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<td>SERVICE SYSTEMS</td>
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<td>Test and adjust systems</td>
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<td>I2</td>
<td>Perform maintenance inspections and service</td>
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Total Percentage for Sheet Metal Worker - Level 4: 100% 100%
Section 3
PROGRAM CONTENT
Sheet Metal Worker
Level 1
Sheet Metal Worker
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.

LEARNING TASKS

1. Describe short term hazards in the sheet metal industry
   - Sharp objects
   - Ladders
   - Work platforms
   - Electrical
   - Lockout procedures
   - Compressed gas
   - Explosive material (dust)
   - Lifting
   - Personal apparel
     - Clothing
     - Hair and beards
     - Jewellery
   - Housekeeping
   - Clear head
   - Horseplay
   - Respect for others safety
   - Constant awareness of surroundings
   - Safe attitude
   - Management of hazards

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

3. Describe safety precautions when working at elevations
   - Wind
   - Floor openings
   - Guard rails
   - Safety lines
   - Weather
   - Stressed cables
LEARNING TASKS

4. Demonstrate emergency procedures

CONTENT

- Emergency shutoffs
- Fire control systems
- Eye wash facilities
- Emergency exits
- Emergency contact/phone numbers
- Outside meeting place
- Disaster meeting place

5. Describe non-emergency injury reporting procedures

CONTENT

- First aid facilities
- Reports

- Process
  - Hazard assessment
  - Tool box meetings
  - Conditions
  - Meeting requirements
  - Reporting hazards and incidents
  - Reporting injuries
  - Investigations
  - Committees
  - Employee orientation
  - First-aid
  - Hearing
  - Records and statistics
  - Lock-out
  - Non-compliance procedures

- Minimum standards
  - Acts and Regulations

6. Describe how a workplace safety policy is established
Program Content
Level 1

Line (GAC): A USE SAFE WORK PRACTICES
Competency: A2 Locate information in the OHS Regulation and WCB Standards

Objectives
To be competent in this area, the individual must be able to:
• Locate the parts of the Occupational Health and Safety Regulation as it applies to the Sheet Metal Worker’s workplace.

LEARNING TASKS
1. Locate terms used in the Workers’ Compensation Act
2. Locate the conditions under which compensation will be paid
3. Locate the general duties of employers, employees and others
4. Locate the Workers’ Compensation Act requirements for the reporting of accidents
5. Locate the “Core Requirements” of the Occupational Health and Safety Regulation

CONTENT
• Definitions, Section 1 of the Act
• Part 1, Division 2 of the Act
• Part 2, Division 3, Sections 115-124 of the Act
• Part1, 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
  o Smoking and lunchrooms
LEARNING TASKS

6. Locate the “General Hazard Requirements” of the Occupational Health and Safety Regulation

CONTENT

- 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 USE SAFE WORK PRACTICES
Competency: A3 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 material safety data sheets (MSDS).
- Explain the contents of a WHMIS label.
- Apply WHMIS regulations.

LEARNING TASKS

1. State the legislation that requires suppliers of hazardous materials to provide MSDSs 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 of Canadian workers from the adverse effects of hazardous materials through the provision of relevant information while minimizing the economic impact on industry and the disruption of trade
   - Recognition of rights
     - Workers
     - Employers
     - Suppliers
     - Regulators

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

4. Describe the responsibilities of suppliers under WHMIS
   - Provide
     - MSDSs
     - Labels

5. Describe the responsibilities of employers under WHMIS
   - Provide
     - MSDSs
     - Labels
     - Work education programs in the workplace

6. Describe information to be disclosed on a MSDS
   - Hazardous ingredients
   - Preparation information
   - Product information
   - Physical data
   - Fire or explosion
   - Reactivity data
   - Toxicological properties
   - Preventive measures
   - First-aid measures
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<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>
</tr>
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<td></td>
<td>o Materials causing immediate and serious toxic effects</td>
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<td></td>
<td>o Materials causing other toxic effects</td>
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<td></td>
<td>o Biohazardous infectious materials</td>
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<td>8. Apply WHMIS regulations as they apply to hazardous materials used in the shop</td>
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<td>• Dangerously reactive materials</td>
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Line (GAC): A USE SAFE WORK PRACTICES
Competency: A4 Use personal protective 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
LINE (GAC): A USE SAFE WORK PRACTICES
Competency: A5 Select fire extinguishers

Objectives
To be competent in this area, the individual must be able to:
- Prevent and identify various classes of fires.
- Select appropriate fire extinguishers for the class of fire and environmental condition.

LEARNING TASKS

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

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

3. Apply preventative fire safety precautions when working near, handling or storing flammable liquids or gases, combustible materials and electrical apparatus
   - Fuels
     - Diesel
     - Gasoline
     - Propane
     - Natural Gas
   - Ventilation
   - Purging
   - Lubricants
   - Oily rags
   - Combustible metals
   - Aerosols

4. Describe the considerations and steps to be taken prior to fighting a fire
   - Warning others and fire department
   - Evacuation of others
   - Fire contained and not spreading
   - Personal method of egress
   - Training

5. Describe the procedure for using a fire extinguisher
   - Extinguisher selection
   - P.A.S.S.
     - Pull
     - Aim
     - Squeeze
     - Sweep
Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B1 Use hand tools

Objectives
To be competent in this area, the individual must be able to:
- 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
   - Punches
   - Chisels
   - Hack saws
   - Snips
   - Files
   - Pliers
   - Screw drivers
   - Folding tools
   - Pop riveter
   - Bubble level

2. Use hand tools
   - Types
   - Parts
   - Purpose/uses
   - Procedures/operations
   - Safety
   - Adjustment
   - Inspection
   - Maintenance
   - Storage

3. Use shop layout tools
   - Trammel points
   - Scratch awl
   - Scribes
   - Verification of layout and measuring tools accuracy
**Line (GAC):** B  **USE TOOLS AND EQUIPMENT**

**Competency:** B2  **Use portable power tools**

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

### LEARNING TASKS

<table>
<thead>
<tr>
<th>Task</th>
<th>CONTENT</th>
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</table>
| 1. Describe portable power tools | - Drills  
- Grinders  
- Nibblers  
- Shears  
- Saws  
- Electric seamers  
- Gas powered tools |
| 2. Use portable power tools | - Types  
- Parts  
- Purpose/uses  
- Procedures/operations  
- Safety  
- Adjustment  
- Inspection  
- Maintenance  
- Equipment manual  
- Storage |
| 3. Use battery powered tools | - Types  
- Safety  
- Maintenance  
- Equipment manual  
- Charging |
Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B3 Use shop 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
Program Content
Level 1

Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B4 Use welding equipment

Objectives
To be competent in this area, the individual must be able to:
- Describe different methods of welding and cutting.
- Cut using plasma and oxy-acetylene tools.
- Weld using SMAW and GMAW.
- Use spot welding equipment.

LEARNING TASKS
CONTENT
1. Describe types of cutting and welding equipment
   - Plasma cutting
   - Oxy-acetylene cutting
   - Shielded metal arc welding (SMAW)
   - Gas metal arc welding (GMAW)
   - Equipment/hand tools
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
   - Purpose/uses
   - Limitations
   - Equipment
   - Materials to be cut
   - Consumables
   - Safety
   - Procedures/operations
   - Set-up
   - Adjustment
   - Take down
   - Inspection
   - Maintenance
   - Storage
LEARNING TASKS

4. Describe oxy-acetylene cutting
   - Purpose/uses
   - Limitations
   - Equipment
   - Materials to be cut
   - Consumables
   - Safety
   - Procedures/operations
   - Set-up
   - Adjustment
   - Take down
   - Inspection
   - Maintenance
   - Storage

5. Use cutting tools
   - Plasma
   - Oxy-acetylene

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

7. Describe shielded metal arc welding (SMAW)
   - Purpose/uses
   - Equipment
   - Materials to be welded
   - Consumables
   - Safety
   - Basic procedures/operations
   - Set-up
   - Adjustment
   - Take down
   - Inspection
   - Maintenance
   - Storage

8. Use spot welding equipment
   - Setup
   - Basic procedures/operations
   - Maintenance
   - Safety
   - Limitations

9. Use welding tools
   - GMAW
   - SMAW
Achievement Criteria

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

2. **Performance** The learner will cut a pattern using 16 gauge 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

3. **Performance** The learner will cut a pattern using 12 gauge mild steel and oxyacetylene cutting equipment.
   **Conditions** The learner will be given:
   - Steel
   - Oxyacetylene cutting equipment
   - Pattern
   **Criteria** The learner will score 70% or better on a rating sheet that reflects the following criteria:
   - Safety
   - Clean cut
   - Accuracy
Program Content
Level 1

Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B5 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. Describe 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. Describe soldering techniques
   - Solder selection
   - Equipment selection
   - Fluxes
     - Types
     - Applications
   - Techniques
     - Safety
     - Cleaning
     - Forging
     - Tinning
     - Soldering
   - Limitations

3. Use soldering techniques
   - Selection
   - Procedure
   - Inspection

4. Describe brazing techniques
   - Alloy selection
   - Equipment selection
   - Fluxes
     - Types
     - Applications
   - Techniques
     - Safety
     - Cleaning
   - Limitations
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 TOOLS AND EQUIPMENT
Competency: B6 Use fasteners

Objectives
To be competent in this area, the individual must be able to:
• Describe fasteners and fastening tools and their uses.
• Select and use fasteners and fastening tools.

LEARNING TASKS
1. Describe fasteners and their uses
   • Types
   • Purpose
   • Limitations

2. Describe fastening tools
   • Types
   • Procedures for use
   • Safety considerations
   • Inspection
   • Maintenance
   • Storage

3. Use fasteners
   • Selection of fastener
   • Selection of tools
   • Procedures
Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B7 Use ladders and platforms

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

LEARNING TASKS
1. Describe ladders and elevated platforms
   - Types
   - Uses
   - Safety
   - Hazard recognition
   - Government regulations

2. Use ladders and elevated platforms
   - Selection
   - Operating procedures
   - Limitations
   - Securing
   - Inspection
   - Maintenance
   - Storage
Program Content
Level 1

Line (GAC):       B  USE TOOLS AND EQUIPMENT
Competency:       B8  Use hoisting, lifting and rigging 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.

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
   - Working load limits
   - Terms
   - General rules
   - Knot, bend and hitch types
   - Inspection
   - Maintenance
   - Storage

3. Use hoisting, lifting and rigging equipment
   - Selection of equipment
   - Selection of lifting location or point
   - Safety
   - Operating procedures
   - Communication and hand signals
   - Securing of loads
   - Inspection
   - Maintenance
   - Storage
   - Hand signals
   - 2-way radios
   - Centre of gravity
Line (GAC): C   ORGANIZE WORK
Competency: C1   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
  - Metric
  - 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): C ORGANIZE WORK
Competency: C2 Read drawings and specifications

Objectives
To be competent in this area, the individual must be able to:
• Interpreting the information on a shop drawing.
• Constructing a project from a shop drawing.

LEARNING TASKS
1. Describe shop drawings
   • Purpose
   • Information contained
   • Generation process

2. Use a shop drawing
   • Shop project
   • Construction details

Achievement Criteria
Performance The learner will construct a project from a given shop drawing.
Conditions The learner will be given:
Shop drawing
Materials
Tools and equipment
Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
Safety
Project build according to shop drawing
Program Content
Level 1

Line (GAC): C ORGANIZE WORK
Competency: C6 Handle materials

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

2. Select procedures for handling materials
   • Safety
   • Procedures
   • Securing
   • Packaging/shipping
Line (GAC): C ORGANIZE WORK
Competency: C7 Communicate with others

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

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Listening</td>
</tr>
<tr>
<td>Verbal</td>
</tr>
<tr>
<td>Written</td>
</tr>
<tr>
<td>Drawings</td>
</tr>
<tr>
<td>Trade terminology</td>
</tr>
<tr>
<td>Hoisting signals</td>
</tr>
<tr>
<td>Use of</td>
</tr>
<tr>
<td>- Two-way radios</td>
</tr>
<tr>
<td>- Cell phones</td>
</tr>
<tr>
<td>- Fax machines</td>
</tr>
<tr>
<td>- Computers</td>
</tr>
<tr>
<td>Interpersonal skills</td>
</tr>
<tr>
<td>Ethics</td>
</tr>
</tbody>
</table>

2. Communicate with people

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other trades</td>
</tr>
<tr>
<td>Industry people</td>
</tr>
<tr>
<td>Apprentices mentoring</td>
</tr>
<tr>
<td>Customers (layperson terms)</td>
</tr>
</tbody>
</table>
Program Content
Level 1

Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D1 Use drafting equipment to develop geometric constructions

Objectives
To be competent in this area, the individual must be able to:
- Describe drafting equipment and its purpose.
- Use drafting equipment to develop geometric constructions.

LEARNING TASKS

1. Describe drafting equipment
   - Tee squares
   - Dividers
   - Compasses
   - Scale rulers
   - Set squares
   - Protractors
   - Pencils

2. Describe geometric shapes in pattern development
   - Circles
   - Squares
   - Rectangles
   - Triangles
   - Angles
   - Ellipses
   - Polygons

3. Develop geometric constructions
   - Develop and layout
     o Scales
     o Lines
     o Arcs
     o Angles
     o Shapes
     o Divisions

Achievement Criteria
Performance The learner will construct geometric lines, shapes, angles and circles.
Conditions The learner will be given:
- Drawing specifications
- Drafting equipment
- Paper
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
- Geometric shapes are accurate to a tolerance of +/- 1/32"
- To a given scale
Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D2  Develop pictorial drawings and orthographic projections

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

LEARNING TASKS

1. Describe pictorial drawings
   - Isometric
   - Perspective
   - Oblique
   - Dimensioning
   - Lettering
   - Scaling
   - Line types
   - Free hand sketches

2. Describe orthographic projection
   - 3rd angle projection

3. Select drafting equipment for pictorial and orthographic drawings
   - Tee squares
   - Dividers
   - Compasses
   - Rulers
   - Scales
   - Set squares
   - Protractor
   - Pencils
   - Calculators

4. Develop pictorial and orthographic drawings
   - Basic techniques
   - Pictorial from orthographic
   - Orthographic from pictorial

Achievement Criteria
Performance The learner will develop basic pictorial and orthographic drawings.
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:
- Selection of appropriate tools
- Proper construction techniques applied
- Drawings are accurate to a tolerance of +/- 1/32"
Line (GAC): D    LAYOUT AND DEVELOP PATTERNS
Competency: D3    Develop patterns using parallel line development

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

LEARNING TASKS

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Select drafting equipment for parallel line development</td>
</tr>
<tr>
<td>- Tee squares</td>
</tr>
<tr>
<td>- Dividers</td>
</tr>
<tr>
<td>- Compasses</td>
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<td>- Rulers</td>
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<tr>
<td>- Scales</td>
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<tr>
<td>- Set squares</td>
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<td>- Protractor</td>
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<td>- Pencils</td>
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<td>- Calculators</td>
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<th>CONTENT</th>
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<tbody>
<tr>
<td>2. Describe drafting techniques for parallel line development</td>
</tr>
<tr>
<td>- Views</td>
</tr>
<tr>
<td>- Front</td>
</tr>
<tr>
<td>- Plan</td>
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<tr>
<td>- End</td>
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<td>- Which are required</td>
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<tr>
<td>- Visualization in three dimensions</td>
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<tr>
<td>- Line development</td>
</tr>
<tr>
<td>- Construction</td>
</tr>
<tr>
<td>- Projection</td>
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<tr>
<td>- Geometric construction</td>
</tr>
<tr>
<td>- Mathematical formulas</td>
</tr>
</tbody>
</table>

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<tr>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>3. Develop patterns using parallel line development</td>
</tr>
<tr>
<td>- Applications</td>
</tr>
<tr>
<td>- Architectural mitres</td>
</tr>
<tr>
<td>- Elbows</td>
</tr>
<tr>
<td>- Tee branches on centre complete with main pipe hole patterns</td>
</tr>
<tr>
<td>- Round pipes on slope complete with hole layout</td>
</tr>
<tr>
<td>- Seam allowances</td>
</tr>
<tr>
<td>- Pattern labelling and forming instructions</td>
</tr>
</tbody>
</table>
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
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
Program Content
Level 1

Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D4  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.

LEARNING TASKS

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

2. Describe drafting techniques for radial line development
   • 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
   • Right cones (chimney cap)
     o Frustum (storm collar)
     o Truncated (roof jack on a slope)
     o Round reducer on centre.

3. Develop patterns using radial line development
   • Applications
   • Seam allowances
   • Pattern labelling and forming instructions

Achievement Criteria

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

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:
   Tools selection
   Procedure
   Patterns are complete and accurate to within +/- 1/32” of drawing specifications.
Program Content
Level 1

Line (GAC): D LAYOUT AND DEVELOP PATTERNS
Competency: D5 Develop patterns using triangulation

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

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
     o Required views
   • Mathematical formulas

3. Develop patterns using triangulation
   • 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
Round reducer off centre

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.
Line (GAC): D   LAYOUT AND DEVELOP PATTERNS
Competency: D6   Develop patterns for duct fittings

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

LEARNING TASKS

1. Select drafting equipment for patterns duct fittings
   - Tee squares
   - Dividers
   - Compasses
   - Rulers
   - Scales
   - Set squares
   - Protractors
   - Pencils
   - Calculators

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

3. Develop patterns using for duct fittings
   - Applications
     - Transition
     - Ogee offset
     - Duct elbows
   - Seam and joint allowances
   - Pattern labelling and forming instructions

Achievement Criteria

Performance   The learner will develop patterns for:
  Transitions
  Ogee offsets
  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.
Line (GAC): E  FABRICATE TRADE RELATED PRODUCTS
Competency: E1  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

1. Describe type of materials and their properties
   • Types
     o Ferrous
     o Non ferrous
     o Stainless steel
     o Copper
     o Aluminum
     o Zinc
     o Titanium
     o Plastic
     o Composites
     o Fibreglass
     o Rubber
     o Polyvinylchloride (PVC)
   • Coatings
   • Material finishes
   • Properties
   • Gauges
   • Appearance
   • Special design
   • Extrusions

2. Describe material applications
   • HVAC
   • Architectural sheet metal
   • Industrial sheet metal
   • Institutional
   • Commercial
   • Marine
   • Residential sheet metal
   • Food service industry
**Program Content**

**Level 1**

**Line (GAC):** E  
**Fabricate Trade Related Products**

**Competency:** E2  
**Fabricate Components**

**Objectives**

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

### LEARNING TASKS

<table>
<thead>
<tr>
<th>1. Describe sheet metal components</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• End caps</td>
<td></td>
</tr>
<tr>
<td>• Spin-in collars</td>
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<tr>
<td>• Flexible connections</td>
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<tr>
<td>• Insulation stops</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Select tools</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Layout tools</td>
<td></td>
</tr>
<tr>
<td>• Hand tools</td>
<td></td>
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<tr>
<td>• Shop equipment</td>
<td></td>
</tr>
<tr>
<td>• Power tools</td>
<td></td>
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</tbody>
</table>

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<thead>
<tr>
<th>3. Select materials</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Types</td>
<td></td>
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<td>• Gauges</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>4. Make a cutting list</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Fitting requirements</td>
<td></td>
</tr>
<tr>
<td>• Mathematics</td>
<td></td>
</tr>
<tr>
<td>• Allowances</td>
<td></td>
</tr>
<tr>
<td>• Material thickness allowance</td>
<td></td>
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<tr>
<td>• Recording</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Describe seams, locks and edges</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Types</td>
<td></td>
</tr>
<tr>
<td>o Single and double seams</td>
<td></td>
</tr>
<tr>
<td>o Standing seams</td>
<td></td>
</tr>
<tr>
<td>o Riveted seam</td>
<td></td>
</tr>
<tr>
<td>o Groove seams</td>
<td></td>
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<tr>
<td>o Pocket lock</td>
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<tr>
<td>o S-lock</td>
<td></td>
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<tr>
<td>o Button lock</td>
<td></td>
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<tr>
<td>o Pittsburgh lock</td>
<td></td>
</tr>
<tr>
<td>o Lap and spot weld</td>
<td></td>
</tr>
<tr>
<td>o Hems</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>6. Fabricate seams, locks and edges</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Types</td>
<td></td>
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<tr>
<td>o Double seam</td>
<td></td>
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<tr>
<td>o Pittsburgh lock</td>
<td></td>
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<td>o Lap and spot weld</td>
<td></td>
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<tr>
<td>o Standing seams</td>
<td></td>
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<tr>
<td>o Groove seam</td>
<td></td>
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<tr>
<td>• Seam allowances</td>
<td></td>
</tr>
</tbody>
</table>
LEARNING TASKS

7. Fabricate components

CONTENT

- Use of cutting list
- Notching
- Equipment selection
- Waste minimization
- Forming techniques
  - Bending and bend sequence
  - Rolling
  - Rotary machine

Achievement Criteria

1. Performance The learner will fabricate seams and locks:
   - Double seam
   - Pittsburgh lock
   - Lap and spot weld
   - Standing seams
   - 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.

2. Performance The learner will fabricate components:
   - End caps
   - Spin-in collars
   - Flexible connections
   - 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.
Line (GAC): E  FABRICATE TRADE RELATED PRODUCTS
Competency: E3  Fabricate ductwork and assemble fittings with components

Objectives
To be competent in this area, the individual must be able to:
• Fabricate ductwork and assemble fittings with components.

LEARNING TASKS
1. Select shop tools and equipment to fabricate ductwork and assemble fittings with components
   • Layout tools
   • Hand tools
   • Shop equipment
   • Power tools

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

3. Fabricate duct fittings
   • Applications
     o Straight duct
     o Transition
     o Ogee offset
     o Duct elbows
   • Labelling

4. Install components
   • End caps
   • Spin-in collars
   • Flexible connections
   • Insulation stops

Achievement Criteria
Performance  The learner will fabricate and assemble duct fittings with components.
   Straight duct
   Transition
   Ogee offset
   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): E FABRICATE TRADE RELATED PRODUCTS
Competency: E4 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
     o Rigid/flexible
     o Acoustic/thermal
   • Densities
   • Thicknesses
   • Applications
   • Layout
   • Cutting

2. Describe fastening methods
   • Adhesives
     o Types
     o Uses
   • Pins
     o Placement
   • Lagging materials
     o Mastics
     o Perforated metal
   • Insulation stops
Line (GAC): E  FABRICATE TRADE RELATED PRODUCTS
Competency: E5  Fabricate hanger systems

Objectives
To be competent in this area, the individual must be able to:
• Describe types of hanger systems and their purpose.
• Fabricate strap hanger systems to specifications.

LEARNING TASKS
1. Describe hanger systems
   • Purpose
   • Types
   o Strap hangers
   o Brackets
   o Saddles
   o Trapeze

2. Fabricate strap hanger systems
   • Safety
   • Tools
   • Hanger strap machine
     o Cutting
     o Forming
   • Specifications
   • Materials
   • Layout
   • Assembly
   • Fastening

Achievement Criteria
Performance  The learner will fabricate strap 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 is accurate to specified standards
Line (GAC): F  INSTALL AIR HANDLING SYSTEMS
Competency: F2  Install air handling ductwork and components

Objectives
To be competent in this area, the individual must be able to:
- Describe air handling ductwork and components.
- Install air handling ductwork and components.
- Describe slab duct systems.

LEARNING TASKS

1. Describe installation of air handling ductwork and components
   - Obstacles
   - Duct
   - Slab duct
   - Components
     - Access doors
     - Volume dampers
     - Back draft dampers

2. Install air handling ductwork and components
   - Components
   - Installation drawings
     - Elevation
     - Plan
     - Specifications
   - Tools and equipment
   - Safety
   - Hangers
   - Fasteners
   - Plumbing and levelling
   - Connection
   - Sealing
   - Field cutting

Achievement Criteria

1. Performance Conditions
   - The learner will install ductwork to specifications.
   - The learner will be given:
     - Project specifications
     - Ductwork
     - Tools and equipment
   - 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
2. **Performance**
   
   The learner will install components to specifications.

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

   **Criteria**
   
   - Safety
   - Tools selection
   - Procedure
   - Project is accurate to specified standards
Level 2
Sheet Metal Worker
Line (GAC): A USE SAFE WORK PRACTICES
Competency: A1 Control workplace hazards

Objectives
To be competent in this area, the individual must be able to:
• Use safe work practices.

LEARNING TASKS
1. Review safety practices

CONTENT
• Work procedures
• Working at elevations
• Long term and short term health hazards
• Personal protective equipment
• Fire extinguishers
• Lockout procedures
• Compressed gas
• Emergency procedures
• WorkSafeBC Regulation
Program Content
Level 2

Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B1 Use hand tools

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. Review sheet metal hand tools
   • Squares
   • Rules
   • Dividers
   • Marking devices
   • Hammers
   • Punches
   • Chisels
   • Hack saws
   • Snips
   • Files
   • Pliers
   • Screw drivers
   • Fold-up tools
   • Pop riveter
   • Bubble level

2. Describe sheet metal hand tools used in architectural and decking processes
   • Bavarian snips
   • Chalk line
   • Hand seamers
   • Deck crimpers
   • Laser level
   • Folding tools
   • Specialty hammers

3. Use hand tools
   • Types
   • Parts
   • Purpose/uses
   • Procedures/operations
   • Safety
   • Adjustment
   • Inspection
   • Maintenance
   • Storage
Line (GAC): B  USE TOOLS AND EQUIPMENT  
Competency: B2  Use portable power tools

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

LEARNING TASKS

1. Review portable power tools
   - Drills
   - Grinders
   - Nibblers
   - Shears
   - Saws
   - Electric seamers
   - Gas powered tools

2. Describe power tools used for architectural purposes
   - 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

3. Use portable power tools
   - Types
   - Parts
   - Purpose/uses
   - Procedures/operations
   - Safety
   - Adjustment
   - Inspection
   - Maintenance
   - Storage
Program Content
Level 2

Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B3 Use shop 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. Review shop equipment
   - Squaring shears
   - Power shears
   - Bar folders
   - Rolls
   - Notchers
   - Hand brakes
   - Roll forming equipment
   - Punches
   - Rotary hand machines
   - Band saws
   - Spot welders
   - Bench grinders
   - Drill presses
   - Cleat benders
   - Forming stakes
   - Beverly shears

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
Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B4 Use welding equipment

Objectives
To be competent in this area, the individual must be able to:
• Describe different methods of welding.
• Weld using SMAW and GMAW.

LEARNING TASKS

1. Review types of welding equipment
   • Shielded metal arc welding (SMAW)
   • 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 gas metal arc welding (GMAW)
   • Purpose/Uses
   • Limitations
   • Equipment
   • Materials to be welded
   • Consumables
   • Safety
   • Advanced procedures/operations
   • Set-up
   • Adjustment
   • Take down
   • Inspection
   • Maintenance
   • Storage

4. Describe shielded metal arc welding (SMAW)
   • Purpose/uses
   • Limitations
   • Equipment
   • Materials to be welded
   • Consumables
   • Electrode designation
   • Safety
   • Advanced procedures/operations
   • Set-up
   • Adjustment
   • Take down
   • Inspection
   • Maintenance
   • Storage
LEARNING TASKS

5. Use welding tools

CONTENT
- GMAW
- SMAW
- Weld inspection

Achievement Criteria

1. Performance The learner will weld 16 gauge and 12 gauge mild steel coupons in all positions using both GMAW and 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
- Penetration
- Consistency
- Porosity

2. Performance The learner will plug weld a 20 gauge galvanized 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

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 Safety
- Continuous
- Heat setting
- Penetration
- Consistency
- Porosity
- Welding symbols followed
- Specifications followed
Program Content
Level 2

Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B6 Use fasteners

Objectives
To be competent in this area, the individual must be able to:
- Describe fasteners and fastening tools and their uses including architectural fastening systems.
- Select and use fasteners and fastening tools.

LEARNING TASKS

1. Review fasteners and their uses
   - Types
   - Purpose
   - Limitations

2. Review fastening tools
   - Types
   - Procedures for use
   - Safety considerations
   - Inspection
   - Maintenance
   - Storage

3. Describe architectural and decking fastening systems
   - Panel clips
   - Cleats
   - Expansion and contraction joints
   - Shims
   - Powder actuated fasteners
   - Exposed fasteners
   - Compatibility of materials
     - Isolation

4. Use fasteners
   - Selection of fastener
   - Selection of tools
   - Procedures
Line (GAC): C  ORGANIZE WORK
Competency: C1  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. Review geometric shapes
2. Review mathematical formulas
   - Types
   - Linear measurement
     o Metric
     o Imperial
   - Stretch outs
   - Areas
   - Volumes
   - Capacities
   - Metric conversions
   - Squares
   - Square roots
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 to sheet metal related problems
   - Word problems
   - Ogee offsets
   - Elbow formulas
   - Cone formulas
   - Stretch out of an arc formulas
   - Companion flange hole space formulas
   - Two given elbow offset
   - Two elbow 90°
   - Roof pitch
Line (GAC): C ORGANIZE WORK
Competency: C2 Read drawings and specifications

Objectives
To be competent in this area, the individual must be able to:
- Describe drawings and specifications.
- Extract information from drawings and specifications.
- Generate a shop fabrication drawing.
- Interpret welding symbols.

LEARNING TASKS CONTENT
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. Interpret welding symbols
   - Location
   - Process
   - Type
   - Pitch and length

4. Describe the scales used in drawings
   - Architect’s scale
   - Metric scale
LEARNING TASKS

5. Describe the purpose of drawings and their parts

CONTENT

- Plot plan
- Foundation plan
- Floor plan
- Reflected ceiling plan
- Roof plan
- Elevation
- Sections
- Details
- Title block
- Revisions
  - Requests for information
  - Change orders
  - Addendums
- Schedules
- Legends
- Schematics

6. Describe contract documents

CONTENT

- Types
- Purpose

7. Describe construction specifications

CONTENT

- Master format
- Purpose
- Addendums

8. Use contract documents and construction specifications

CONTENT

- Responsibilities and obligations
- Extracting information
- Penetrations for components
- Quality control
- Commissioning

9. Describe shop fabrication drawings

CONTENT

- Purpose
- Information contained
- Generation process

10. Create a shop fabrication drawing

CONTENT

- Field measurements
- Complete information contained for fabrication
- Accuracy of information
- Proper drawing conventions used

Achievement Criteria

Performance Conditions
The learner will create a shop fabrication drawing from field measurements.
The learner will be given:
Site mock-up
Tools and equipment
Project specifications

Criteria
The learner will score 70% or better on a rating sheet that reflects the following criteria:
Proper drawing conventions
Completeness
Neatness
Legibility
Accurate information
Line (GAC): C ORGANIZE WORK
Competency: C3 Use codes, regulations and standards

Objectives
To be competent in this area, the individual must be able to:
- Identify bodies responsible for codes, regulations and standards related to the sheet metal industry.
- Describe how codes, regulations and standards affect sheet metal fabrication and installations.

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
Line (GAC): C  ORGANIZE WORK
Competency: C4  Use manufacturer and supplier documentation

Objectives
To be competent in this area, the individual must be able to:
- Describe documentation encountered in the sheet metal trade.
- Describe information contained in manufacturer and supplier documentation.

LEARNING TASKS
1. Describe documentation encountered in the sheet metal trade
2. Describe information contained in manufacturer and supplier documentation

CONTENT
- Tool and equipment documentation
- Material Safety and Data Sheets
- System component documentation
- Proprietary product documentation
- Certification agencies
- Installation instructions and requirements
- Operation and maintenance manuals
- Product specifications
- Warranty information
Line (GAC): C  ORGANIZE WORK
Competency: C5  Analyze project requirements

Objectives
To be competent in this area, the individual must be able to:
• Describe basic requirements for a sheet metal project.

LEARNING TASKS
1. Describe organization of a project

CONTENT
• Project specifications
• Safety
• Sequence of operation
• Coordination with other trades
• Estimate
  o Time
  o Material
  o Workforce
• Security
• Tools and equipment
• Inventory requirements
  o Secure storage
  o Time delivery
  o Labelling materials
  o Stock maintenance
  o Consumables
    - Fasteners
    - Sheets
    - Sealants
• Cost efficiency
• Post- job efficiency analysis
Line (GAC): C ORGANIZE WORK
Competency: C6 Handle materials

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

LEARNING TASKS
1. Describe considerations when handling architectural materials

   • Safety
   • Storage
   • Timing
   • Transportation
   • Hoisting and rigging
   • Work platforms
   • Labelling
   • Moving
   • Product protection
   • Disposal
   • Recycling

2. Select procedures for handling architectural materials

   • Safety
   • Procedures
   • Securing
   • Packaging/shipping
Objectives
To be competent in this area, the individual must be able to:
- Describe drawing projection types.
- Develop pictorial and orthographic drawings.

LEARNING TASKS
1. Review pictorial drawings
   - Isometric
   - Perspective
   - Oblique
   - Dimensioning
   - Lettering
   - Scaling
   - Line types
   - Free hand sketches
   - Tools

2. Review orthographic projection
   - 3rd angle projection

3. Develop pictorial and orthographic drawings
   - Tools
   - Free hand sketching techniques
   - Advanced techniques
     - Curved surfaces and edges
     - Complex shapes
   - Isometric
     - Circles
   - Oblique
   - Orthographic views
   - Pictorial from orthographic
   - Orthographic from pictorial

Achievement Criteria
Performance
The learner will develop advanced pictorial and orthographic drawings.

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:
- Selection of appropriate tools
- Proper construction techniques applied
- Drawings are accurate to a tolerance of +/- 1/32"
Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D3  Develop patterns using parallel line development

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
     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 patterns using parallel line development
   • Applications
     o Gutter mitres
     o Elbows by the rise method
     o 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
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
Program Content
Level 2

Line (GAC): D LAYOUT AND DEVELOP PATTERNS
Competency: D5 Develop patterns using triangulation

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

LEARNING TASKS
1. Describe drafting techniques for triangulation
   • 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 for architectural applications
   • Applications
     o Square to round on a pitch (Roof jack)
     o Round reducer on a pitch (Roof jack)
   • 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)
   Round reducer on a pitch (Roof jack)

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.
Line (GAC): D       LAYOUT AND DEVELOP PATTERNS
Competency: D6       Develop patterns for duct fittings

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

LEARNING TASKS

1. Describe drafting techniques for duct fittings
   CONTENT
   • 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 duct fittings
   CONTENT
   • Applications
     o Two way transition
     o Change cheek ogee offset
     o Drop cheek elbows
     o Transitional ogee offset
   • Seam and joint allowances
   • Pattern labelling and forming instructions

Achievement Criteria

Performance  The learner will develop patterns for:
Two way transition
Change cheek ogee offset
Drop cheek elbows
Transitional ogee offset

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
Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D7  Develop patterns using computer technology

Objectives
To be competent in this area, the individual must be able to:
• Describe computer assisted sheet metal processes.

LEARNING TASKS

1. Describe software programs applicable to the sheet metal industry
   • CAD (Computer Aided Design) programs
   • SDS (Shop Data Systems) programs
   • Office software
     o Word processing
     o Data base
     o Spreadsheets
     o E-mail
     o Presentation
     o Project management
     o Estimating

2. Describe employment opportunities through enhanced computer skills
   • Estimator
   • Detailer
   • Project manager
   • Construction manager

3. Describe the advantages and disadvantages of using computers to generate patterns and control cutting machines
   • Advantages
     o Easy to make revisions
     o Storing patterns
     o Less waste in the nesting
     o Accuracy
     o Speed
     o Automatic labelling
   • Disadvantages
     o Initial cost
     o Training requirements
     o Cutting machine consumables
Program Content
Level 2

Line (GAC): E FABRICATE TRADE RELATED PRODUCTS
Competency: E1 Select materials for trade related products

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 CONTENT
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 building envelope requirements
   • Rain screen
   • Flashings
   • Air/vapour barrier
   • Waterproofing membrane
   • Slip sheets
   • Sub-girt
   • Insulation

4. Describe material applications
   • Roof drainage systems
   • Roofing/flashings
   • Cladding
   • Composite metal panels
   • Decking
   • Speed wall
   • Cornice/gutters
Line (GAC): E  FABRICATE TRADE RELATED PRODUCTS
Competency: E2  Fabricate components

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

LEARNING TASKS

1. Describe fire dampers
   • Style A
   • Style B

2. Select materials
   • Types
   • Gauges

3. Fabricate fittings and components
   • Cutting list
   • Components
     o Turning vanes
     o Fire damper sleeves
     o Louver
   • Cutting
   • Forming and bend sequence

Achievement Criteria

Performance  The learner will make a cutting list and fabricate:
              Turning vanes
              Fire damper sleeves
              Louver

Conditions  The learner will be given:
             Project specifications
             Layout tools
             Shop equipment
             Calculator

Criteria  The learner will score 70% or better on a rating sheet that reflects the following criteria:
          Tools selection
          Procedure
          Components within +/- 1/16” of project specifications
          Layout lines are inside the project
          Overall appearance is free of defects
Line (GAC): E FABRICATE TRADE RELATED PRODUCTS
Competency: E3 Fabricate ductwork and assemble fittings with components

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

CONTENT
• Tools and equipment
• Line development
• Geometric construction
• Mathematical formulas
• Cut list
• Seam and joint allowances

2. Fabricate duct fittings

CONTENT
• 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

3. Install components

CONTENT
• Turning vanes
• Fire damper sleeves
• Louver

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
   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
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
Program Content
Level 2

Line (GAC): E FABRICATE TRADE RELATED PRODUCTS
Competency: E5 Fabricate hanger systems

Objectives
To be competent in this area, the individual must be able to:
- Describe types of hanger systems and their purpose.
- Fabricate saddle and trapeze hanger systems to specifications.

LEARNING TASKS CONTENT
1. Review hanger systems
   - Purpose
   - Types
   - Strap hangers
   - Brackets
   - Saddles
   - Trapeze

2. Fabricate saddle and trapeze hanger systems
   - Safety
   - Tools
   - Cutting
   - Forming
   - Welding
   - Specifications
   - Materials
   - Layout
   - Mathematics
   - Assembly
   - Fastening

Achievement Criteria
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
Objective
To be competent in this area, the individual must be able to:
• Fabricate architectural components.

LEARNING TASKS

1. Describe architectural components
   • Louvers
   • Scuppers
   • Roof jack
   • Roofing
   • Decking
   • Cladding
   • Gutter mitre

2. 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
   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): E  FABRICATE TRADE RELATED PRODUCTS
Competency: E9  Fabricate industrial components

Objectives
To be competent in this area, the individual must be able to:
- Describe industrial components and their fabrication.
- Fabricate industrial components.

LEARNING TASKS CONTENT

1. Describe industrial components
   - Companion flanges
   - Welded duct
   - Small end big ends
   - Welded round elbow
   - Clean outs
   - Belt guards
   - Hoppers
   - Chutes
   - Grain spouting

2. Fabricate industrial components
   - Safety
   - Tools and equipment
   - Mathematics
   - Procedure
   - Specifications

Achievement Criteria

Performance Conditions
The learner will fabricate a 16 gauge mild steel welded belt guard.
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
**Program Content**  
**Level 2**

**Line (GAC):**  
F INSTALL AIR HANDLING SYSTEMS

**Competency:**  
F2 Install air handling ductwork and components

**Objectives**

To be competent in this area, the individual must be able to:
- Describe air handling ductwork and components.
- Install air handling ductwork and components.

**LEARNING TASKS CONTENT**

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Install air handling ductwork and components</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Components</td>
</tr>
<tr>
<td></td>
<td>Installation drawings</td>
</tr>
<tr>
<td></td>
<td>o Elevation</td>
</tr>
<tr>
<td></td>
<td>o Plan</td>
</tr>
<tr>
<td></td>
<td>o Specifications</td>
</tr>
<tr>
<td></td>
<td>Tools and equipment</td>
</tr>
<tr>
<td></td>
<td>Safety</td>
</tr>
<tr>
<td></td>
<td>Hangers</td>
</tr>
<tr>
<td></td>
<td>Fasteners</td>
</tr>
<tr>
<td></td>
<td>Plumbing and levelling</td>
</tr>
<tr>
<td></td>
<td>Connection</td>
</tr>
<tr>
<td></td>
<td>Sealing</td>
</tr>
<tr>
<td></td>
<td>Field cutting</td>
</tr>
<tr>
<td></td>
<td>Field modification</td>
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</tbody>
</table>

**Achievement Criteria**

1. **Performance Conditions**  
The learner will install ductwork to specifications using trapeze hangers.  
The learner will be given:  
Project specifications  
Ductwork  
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

2. **Performance Conditions**  
The learner will install spiral pipe to specifications using saddle hangers.  
The learner will be given:  
Project specifications  
Spiral pipe  
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
Line (GAC): H  INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS

Competency: H1 Install roofing, decking and cladding

Objectives
To be competent in this area, the individual must be able to:
- Describe roofing, decking and cladding and its purpose.
- Describe the installation of roofing, decking and cladding.
- Fabricate and install roofing, decking and cladding flashings.

LEARNING TASKS

1. 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

2. Cut material for roofing and flashing

   - Materials
   - Types
   - Seam allowances
   - Cutting equipment
   - Girth determination (Stretch-out)
   - Waste minimization

3. Form flashing and roofing

   - Materials
   - Types
   - Joints
     - “S”
     - Lap
     - Standing
   - Seam allowances
   - Joint forming
   - Soldering
   - Sealing
LEARNING TASKS

4. Describe roof layout

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

5. Describe the installation of subsurface systems

- Systems
  - Vapour barrier
  - Waterproof membrane
  - Slip sheet
  - Insulation
  - Isolation material
- Building envelop
- Sub girts
- Fastener types
- Manufacturers’ recommended installation methods
- Cutting
- Fitting
- Securing
- Sealing

6. Install roofing and cladding system 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
- Securing
- Sealing
  - Sealants
- Use of reference lines
LEARNING TASKS

7. Describe the installation of decking

CONTENT

- Purpose
- Types
  - Metal pan
  - “Q”
  - Acoustic deck
- Materials applied on decking
- Determining material requirements
- Cutting
- Fitting
- Fastening
- Forms around openings
- Finishing of exposed welds

Achievement Criteria

Performance
The learner will install specified mitred flashings.

Conditions
The learner will be given:
- Project specifications
- Tools
- Flashings

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
Objectives
To be competent in this area, the individual must be able to:
• Describe wall systems.
• Describe the fabrication and installation of wall systems.
• Form flashings.

LEARNING TASKS
1. Describe wall systems

   • Wall systems
     o Composite panels
     o Sandwich panels
     o Related flashings

2. Describe the installation of subsurface systems

   • Systems
     o Liner
     o Vapour barrier
     o Waterproof membrane
     o Slip sheet
     o Insulation types
     o Isolation material
   • Building envelop
   • Sub-girt
   • Fastener types
   • Manufacturers’ recommended installation methods
   • Cutting
   • Fitting
   • Securing
   • Sealing

3. Describe the cutting of panels

   • Materials
   • Types
   • Seam allowances
   • Cutting equipment
   • Girth determination (Stretch-out)
   • Waste minimization
### LEARNING TASKS

4. Describe the installation of wall system components

5. Form flashings

### CONTENT

- Seam Types
- Fasteners
- Sheet preparation
- Thermal expansion and contraction
- Effects of weather conditions on material and installation
- Components
- Cutting
- Fitting
- Securing
- Sealing
  - Sealants
- Use of reference lines
- Materials
- Types
- Joints
  - “S”
  - Lap
  - Standing
- Seam allowances
- Joint forming
- Soldering
- Sealing
Line (GAC): H INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS
Competency: H3 Install 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.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe site preparation | - Exterior surfaces  
  - Concrete  
  - Metal  
  - Stone  
  - Wood  
  - Composite  
- Surface preparation  
  - Cleaning  
  - Filling voids  
  - Grouting mortar lines  
  - Scoring surface for adherence  
- Cleaning compounds  
- Abrasives  
- Repair of waterproofing membrane  
| 2. Describe the installation of exterior components | - Types  
  - Awnings  
  - Finials  
  - Signage  
  - Decorative fascia  
  - Canopies  
- Fasteners  
  - Concealed  
  - Anchors  
  - Nail-ins  
  - Screws  
  - Adhesives  
  - Selection  
  - 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): A  USE SAFE WORK PRACTICES
Competency: A1  Control workplace hazards

Objectives
To be competent in this area, the individual must be able to:
- Use safe work practices.

LEARNING TASKS
1. Review safety practices

CONTENT
- Work procedures
- Working at elevations
- Long term and short term health hazards
- Personal protective equipment
- Fire extinguishers
- Lockout procedures
- Compressed gas
- Emergency procedures
- WorkSafeBC Regulation
Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B2 Use portable power tools

Objectives
To be competent in this area, the individual must be able to:
- Select portable power tools appropriate for specialty applications.
- Use portable power tools.
- Inspect and maintain power tools.

LEARNING TASKS
1. Review portable power tools
   - Drills
   - Grinders
   - Nibblers
   - Shears
   - Saws
   - Electric seamers
   - Gas powered tools

2. Describe power tools used for specialty applications
   - Pneumatic tools
   - Stainless steel weld finishing tools
   - Hydraulic tools

3. Use portable power tools
   - Types
   - Parts
   - Purpose/uses
   - Procedures/operations
   - Safety
   - Adjustment
   - Inspection
   - Maintenance
   - Storage
Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B3 Use shop 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. Review shop equipment
   - Squaring shears
   - Power shears
   - Bar folders
   - Rolls
   - Notchers
   - Hand brakes
   - Roll forming equipment
   - Punches
   - Rotary hand machines
   - Band saws
   - Spot welders
   - Bench grinders
   - Drill presses
   - Cleat benders
   - Forming stakes
   - Beverly shears

2. Describe shop equipment used for specialty purposes
   - Press brake
   - Power notchers
   - Iron worker
   - Power rolls
   - Angle iron rolls
   - Overhead crane
   - Ring and circle shear

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

Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B4 Use welding equipment

Objectives
To be competent in this area, the individual must be able to:
- Describe different methods of welding.
- Weld using SMAW, GTAW and GMAW.

LEARNING TASKS

1. Review types of welding equipment
   - Shielded metal arc welding (SMAW)
   - 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. Review gas metal arc welding (GMAW)
   - Purpose/uses
   - Limitations
   - Equipment
   - Materials to be welded
   - Consumables
   - Safety
   - Advanced procedures/operations
   - Set-up
   - Adjustment
   - Take down
   - Inspection
   - Maintenance
   - Storage

4. Review shielded metal arc welding (SMAW)
   - Purpose/uses
   - Limitations
   - Equipment
   - Materials to be welded
   - Consumables
   - Safety
   - Advanced procedures/operations
   - Set-up
   - Adjustment
   - Take down
   - Inspection
   - Maintenance
   - Storage
LEARNING TASKS

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

6. Use welding tools
   • GMAW
   • SMAW
   • GTAW
   • Weld inspection

Achievement Criteria

1. Performance
   The learner will weld 16 gauge and 12 gauge coupons in all positions using GMAW, GTAW and 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
   Penetration
   Consistency
   Porosity

2. 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
Line (GAC): C ORGANIZE WORK
Competency: C1 Use mathematics

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

LEARNING TASKS

1. Review geometric shapes
   • Types

2. Review mathematical formulas
   • Linear measurement
     o Metric
     o Imperial
   • Stretch outs
   • Areas
   • Volumes
   • Capacities
   • Metric conversions
   • Squares
   • Square roots

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 to sheet metal related problems
   • Word problems
   • Review
     o Ogee offsets
     o Elbow formulas
     o Cone formulas
     o Stretch out of an arc formulas
     o Companion flange hole space formulas
     o Two given elbow offset
     o Two elbow 90°
     o Roof pitch
   • New applications
     o Air volumes and velocity
     o Heavy gauge bend allowances
     o Air changes per hour
Objectives
To be competent in this area, the individual must be able to:
- Describe drawings and specifications.
- Extract information from drawings and specifications.
- Generate a shop fabrication drawing.
- Interpret welding symbols.

LEARNING TASKS

1. Review 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. Review line types, symbols and abbreviations used in drawings
   - Lines
   - Symbols
   - Abbreviations

3. Review welding symbols
   - Location
   - Process
   - Type
   - Pitch and length

4. Review the scales used in drawings
   - Architect's scale
   - Metric scale
LEARNING TASKS

5. Review the purpose of drawings and their parts
   - Plot plan
   - Foundation plan
   - Floor plan
   - Reflected ceiling plan
   - Roof plan
   - Elevation
   - Sections
   - Details
   - Title block
   - Revisions
     - Requests for information
     - Change orders
     - Addendums
   - Schedules
   - Legends
   - Schematics

6. Review contract documents and construction specifications
   - Types
   - Purpose
   - Master format
   - Purpose
   - Addendums
   - Responsibilities and obligations
   - Extracting information
   - Quality control
   - Commissioning

7. Review shop fabrication drawings
   - Purpose
   - Information contained
   - Generation process

8. Create a shop fabrication drawing
   - Field measurements
   - Complete information contained for fabrication
   - Accuracy of information
   - Proper drawing conventions used

Achievement Criteria

Performance Conditions
The learner will create a shop fabrication drawing from plans and specifications.
The learner will be given:
- Plans and specifications
- Tools and equipment
- Project specifications

Criteria
The learner will score 70% or better on a rating sheet that reflects the following criteria:
- Proper drawing conventions
- Completeness
- Neatness
- Legibility
- Accurate information
Objectives

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

- Identify bodies responsible for codes, regulations and standards related to the sheet metal industry.
- Describe how codes, regulations and standards affect sheet metal fabrication and installations.

LEARNING TASKS

1. Review 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. Review how codes, regulations and standards affect sheet metal fabrication and installations
   - Material selection
   - Construction and installation methods
   - Design characteristics
Line (GAC): C ORGANIZE WORK
Competency: C4 Use manufacturer and supplier documentation

Objectives
To be competent in this area, the individual must be able to:
- Describe documentation encountered in the sheet metal trade.
- Describe information contained in manufacturer and supplier documentation.

LEARNING TASKS
1. Review documentation encountered in the sheet metal trade
   - Tool and equipment documentation
   - Material Safety and Data Sheets
   - System component documentation
   - Proprietary product documentation
   - Certification agencies

2. Review information contained in manufacturer and supplier documentation
   - Installation instructions and requirements
   - Operation and maintenance manuals
   - Product specifications
   - Warranty information
Line (GAC): C ORGANIZE WORK
Competency: C5 Analyze project requirements

Objectives
To be competent in this area, the individual must be able to:
- Describe requirements for a sheet metal project.
- Extract information from plans and specifications to organize a project.

LEARNING TASKS
1. Describe organization of a project
   - Project specifications
   - Safety
   - Sequence of operation
   - Coordination with other trades
   - Estimate
     - Time
     - Material
     - Workforce
   - Security
   - Tools and equipment
   - Inventory requirements
     - Secure storage
     - Time delivery
     - Labelling materials
     - Stock maintenance
     - Consumables
       - Fasteners
       - Sheets
       - Sealants
   - Cost efficiency
   - Post job efficiency analysis

2. Extract information from plans and specifications to organize projects
   - Plans
   - Specifications
   - Manufacturers information
   - Mathematics
   - Tools
Line (GAC): C  ORGANIZE WORK
Competency:  C6  Handle materials

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

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe considerations when handling specialty materials | • Safety  
• Storage  
• Timing  
• Transportation  
• Hoisting and rigging  
• Work platforms  
• Labelling  
• Moving  
• Product protection  
• Disposal  
• Recycling |
| 2. Select procedures for handling specialty materials | • Safety  
• Procedures  
• Securing  
• Packaging/shipping |
Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D3  Develop patterns using parallel line development

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
     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. Review the development of patterns using parallel line development
   • Applications
   • Seam allowances
   • Pattern labelling and forming instructions
Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D5  Develop patterns using triangulation

Objective
To be competent in this area, the individual must be able to:
• Develop 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. Review the development of patterns using triangulation (basic profiles)

   CONTENT
   • Applications
     o Square to round elbow
     o “Y” branch
   • Seam allowances
   • Pattern labelling and forming instructions

Achievement Criteria
Performance  The learner will use triangulation and parallel line development to develop patterns for:
              Square to round elbow
              “Y” branch
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
Program Content
Level 3

Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D6  Develop patterns for duct fittings

Objective
To be competent in this area, the individual must be able to:
• Develop patterns for duct fittings.

LEARNING TASKS

CONTENT
1. Review drafting techniques for duct fittings
   • Tools
   • Line development
     ○ Construction
   • Geometric construction
     ○ Front view
     ○ Plan view
     ○ Visualization in three dimensions
     ○ Required views
   • Mathematical formulas

2. Develop patterns for duct fittings
   • Applications
     ○ Duct “Y” branch fittings
     ○ Drop cheek change elbow
   • Seam and joint allowances
   • Pattern labelling and forming instructions

Achievement Criteria

Performance  The learner will develop patterns for:
Duct “Y” branch fittings
Drop cheek change elbow

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
Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D7  Develop patterns using computer technology

Objectives
To be competent in this area, the individual must be able to:
• Describe the application of computer aided sheet metal software.
• Create a pattern using computer aided sheet metal software.

LEARNING TASKS
1. Describe software programs for pattern development
2. Use software to develop patterns

CONTENT
• Proprietary software
• Enter fittings from shop fabrication drawings

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
Labeling
Dimensioning
Seams
Joints
Fittings entered according to information
Program Content
Level 3

Line (GAC): E  FABRICATE TRADE RELATED PRODUCTS
Competency: E1  Select materials for trade related products

Objectives
To be competent in this area, the individual must be able to:
• Describe materials and their applications within the sheet metal industry.

LEARNING TASKS
1. Describe considerations necessary when selecting materials for specialty applications
   • Types and properties of
     o Stainless steel
     o Aluminum
     o Hardened steel
     o Non-metals

2. Describe material applications
   • Food service industry
   • Industrial
   • Laboratories
   • Signage
   • Institutional
   • Commercial
   • Lagging
   • Ornamental
Program Content
Level 3

Line (GAC): E FABRICATE TRADE RELATED PRODUCTS
Competency: E3 Fabricate ductwork and assemble fittings with 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
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): E  FABRICATE TRADE RELATED PRODUCTS
Competency: E5  Fabricate hanger systems

Objectives
To be competent in this area, the individual must be able to:
- Describe types of hanger systems and their purpose.
- Fabricate knee bracket hanger systems to specifications.

LEARNING TASKS

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

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

3. Fabricate knee bracket hanger systems
   - Safety
   - Tools
   - Cutting
   - Forming
   - Welding
   - Specifications
   - Materials
   - Layout
   - Mathematics
   - Assembly
   - Fastening

Achievement Criteria
Performance  The learner will fabricate knee bracket 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 is accurate to specified standards
Program Content
Level 3

Line (GAC): E FABRICATE TRADE RELATED PRODUCTS
Competency: E7 Fabricate specialty and stainless steel products

Objectives
To be competent in this area, the individual must be able to:
• Describe types of specialty stainless steel products and their purpose.
• Fabricate specialty stainless steel products to specifications.

LEARNING TASKS

1. Describe stainless steel products
   • Types
   • Purpose/applications
   • Materials

2. Describe marine applications
   • Waterproof louver
   • Water tight joints
   • Fully welded seams
   • Marine terminology
   • Safety considerations
   • Metal properties

3. Fabricate stainless steel products
   • Safety
   • Material selection
   • Tools and equipment
   • Layout
   • Mathematics
   • Cut
   • Form
   • Welding
   • Fastening
   • Specifications
   • Bend allowances
   • Assemble
   • Finish
     o Grinding and polishing
     o Plating
     o Passivation
     o Chemical Etching
     o 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
Program Content
Level 3

Line (GAC): E FABRICATE TRADE RELATED PRODUCTS
Competency: E9 Fabricate industrial 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.

LEARNING TASKS

1. Describe basic industrial components
   • Components
     o Chutes
     o Hoppers
     o Conveyors
   • Purpose/applications
   • Materials

2. Fabricate basic industrial components
   • Safety
   • Material selection
   • Tools and equipment
   • Layout
   • Mathematics
   • Cut
   • Form
   • Welding
   • Fastening
   • Specifications
   • Bend allowances
   • Assemble
   • Finish
   • Product protection

Achievement Criteria

Performance The learner will fabricate a field measured, welded twist fitting.
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  INSTALL AIR HANDLING SYSTEMS
Competency: F2  Install air handling ductwork and components

Objectives
To be competent in this area, the individual must be able to:
• Install air handling ductwork and fittings.

LEARNING TASKS
1. Review the installation of air handling ductwork and fittings

CONTENT
• Components
• Installation drawings
  o Elevation
  o Plan
  o Specifications
• Tools and equipment
• Safety
• Hangers
• Fasteners
• Plumbing and levelling
• Connection
• Sealing
• Field cutting
• Field modification
• Seismic

Achievement Criteria
Performance  The learner will install ductwork to specifications using knee bracket hangers.
Conditions  The learner will be given:
  Project specifications
  Ductwork and fittings
  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
Line (GAC): F INSTALL AIR HANDLING SYSTEMS
Competency: F3 Install residential heating, ventilating and air conditioning

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
   - Heat transfer
   - Furnace types
   - Controls
   - 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
   - Manufacturers’ requirements
   - Location of supply and return air outlets
   - Sealing methods
Line (GAC): G  INSTALL INDUSTRIAL SYSTEMS  
Competency: G1 Install chimneys, breeching and venting

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

LEARNING TASKS

<table>
<thead>
<tr>
<th>LEARNING TASK</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe venting</td>
<td>• Types</td>
</tr>
<tr>
<td></td>
<td>• Purpose</td>
</tr>
<tr>
<td></td>
<td>o Combustion and emissions</td>
</tr>
<tr>
<td></td>
<td>o Types of appliances</td>
</tr>
<tr>
<td></td>
<td>o Chimney</td>
</tr>
<tr>
<td></td>
<td>o Venting</td>
</tr>
<tr>
<td></td>
<td>• Designs</td>
</tr>
<tr>
<td></td>
<td>o Manifold</td>
</tr>
<tr>
<td></td>
<td>o Multi-storey</td>
</tr>
<tr>
<td></td>
<td>• Components</td>
</tr>
<tr>
<td></td>
<td>o Bracing</td>
</tr>
<tr>
<td></td>
<td>o Hangers</td>
</tr>
<tr>
<td></td>
<td>o Supports</td>
</tr>
<tr>
<td></td>
<td>o Flashing</td>
</tr>
<tr>
<td></td>
<td>• Materials</td>
</tr>
<tr>
<td></td>
<td>• Draft control equipment</td>
</tr>
<tr>
<td>2. Describe the installation of bracing, hangers and supports</td>
<td>• Requirements</td>
</tr>
<tr>
<td></td>
<td>o Clearances</td>
</tr>
<tr>
<td></td>
<td>o Weight</td>
</tr>
<tr>
<td></td>
<td>o Spacing</td>
</tr>
<tr>
<td></td>
<td>o Seismic</td>
</tr>
<tr>
<td></td>
<td>• Materials</td>
</tr>
<tr>
<td></td>
<td>• Fasteners</td>
</tr>
<tr>
<td></td>
<td>• Flashing</td>
</tr>
<tr>
<td>3. Describe the installation of flashing</td>
<td>• Materials</td>
</tr>
<tr>
<td></td>
<td>• Selection</td>
</tr>
<tr>
<td></td>
<td>• Weatherproofing materials</td>
</tr>
<tr>
<td></td>
<td>• Fastening</td>
</tr>
<tr>
<td>4. Describe the connection of venting to appliances</td>
<td>• Types of appliances</td>
</tr>
<tr>
<td></td>
<td>• Manufacturers’ specifications</td>
</tr>
<tr>
<td></td>
<td>• Sealants</td>
</tr>
<tr>
<td></td>
<td>• Materials</td>
</tr>
<tr>
<td></td>
<td>• Fastening</td>
</tr>
</tbody>
</table>
Line (GAC): H INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS

Competency: H4 Install specialty and stainless steel 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 installation of stainless steel specialty products
   • Kitchen preparation products
   • Pharmaceutical laboratory products
   • Food processing products
   • Medical facility products
   • Food grade caulking, solders and welding materials
   • Manufacturers’ installation instructions
   • Sanitary requirements

2. Describe the installation of non-stainless steel specialty products
   • Non-stainless steel metals
   • Plastic products
   • Fasteners
   • Manufacturers’ specifications
   • Installation procedure selection
   • Manufacturers’ installation procedures
   • Isolation of materials/electrolysis
   • Sealants
   • Epoxy coating
Line (GAC): I SERVICE SYSTEMS
Competency: I1 Test and adjust systems

Objectives
To be competent in this area, the individual must be able to:
• Describe the purpose and application of leak testing and air balancing.
• Calculate required system adjustments.

LEARNING TASKS

1. Describe indoor air quality
   • Contaminates
   • Irritants
   • Odours
   • Noise
   • Filtration

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

3. Describe testing and balancing procedures
   • Purpose
   • Pressures
   • Mathematics

4. Describe leak testing
   • Types
     o Smoke
     o Dye
     o Pressure
     o Fluid
     o Visual
     o Audible
   • Charts
   • Test selection
   • Specifications
   • System preparation for testing
     o Temporary caps
     o Access doors
     o Test ports

5. Describe air balancing instruments and techniques
   • Balancing instruments
     o Manometers
     o Psychrometer
     o Velometer
     o Pitot tube
     o Anemometer
     o Magnehelic gauge
     o Flow hood
   • Techniques
   • System knowledge and understanding
   • Damper locations
   • Thermal overload
   • Damper checking and adjusting
   • RPM testing
LEARNING TASKS

6. Describe relative humidity
6. Perform calculations to determine air flow

CONTENT

- Rotation testing
- Adjustment
  - Belts
  - Pulleys
  - Sheaves
- Test port installation
- Amperage check
- Velocity readings
- Test running the system
- Psychrometric chart
- Comparison to design specifications
- Adjust components
- Retest
- Documentation

Achievement Criteria

Performance The learner will calculate the required system adjustments.

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
Level 4

Sheet Metal Worker
Line (GAC): A USE SAFE WORK PRACTICES
Competency: A1 Control workplace hazards

Objectives
To be competent in this area, the individual must be able to:
• Use safe work practices.

LEARNING TASKS
1. Review safety practices

CONTENT
• Work procedures
• Working at elevations
• Long term and short term health hazards
• Personal protective equipment
• Fire extinguishers
• Lockout procedures
• Compressed gas
• Emergency procedures
• WorkSafeBC Regulation
Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B3 Use shop 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. Review shop equipment

   CONTENT
   • Squaring shears
   • Power shears
   • Bar folders
   • Rolls
   • Notchers
   • Hand brakes
   • Roll forming equipment
   • Punches
   • Rotary hand machines
   • Band saws
   • Spot welders
   • Bench grinders
   • Drill presses
   • Cleat benders
   • Forming stakes
   • Beverly shears
   • Press brake
   • Power notchers
   • Iron worker
   • Power rolls
   • Angle iron rolls
   • Overhead crane
   • Ring and circle shear

2. Describe shop equipment used for specialty purposes

   CONTENT
   • Cut to length line
   • Duct line
   • Transverse joint machine
   • Spiral machine

3. Use shop equipment

   CONTENT
   • Types
   • CNC
   • Parts
   • Purpose/uses
   • Procedures/operations
   • Capacities
   • Safety
   • Adjustment
   • Inspection
   • Minor maintenance
   • Storage
Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B4 Use welding equipment

Objectives
To be competent in this area, the individual must be able to:
• Describe different methods of welding.

LEARNING TASKS
1. Review types of welding and cutting equipment and processes
   • Shielded metal arc welding (SMAW)
   • Gas metal arc welding (GMAW)
   • Gas tungsten arc welding (GTAW)
   • Oxy-acetylene
   • Plasma
   • Equipment/hand tools

2. Review welding and cutting safety
   • Licensing and training requirements
   • Government regulations
   • Ventilation requirements
   • Flammable material recognition
   • Personal protective equipment
   • Compressed gas safety
Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B6 Use fasteners

Objectives
To be competent in this area, the individual must be able to:
- Describe fasteners and fastening tools and their uses within the sheet metal trade.
- Select and use fasteners and fastening tools.

LEARNING TASKS
1. Review fasteners and their uses
   - Types
   - Purpose
   - Limitations

2. Review fastening tools
   - Types
   - Procedures for use
   - Safety considerations
   - Inspection
   - Maintenance
   - Storage
Program Content
Level 4

Line (GAC): B USE TOOLS AND EQUIPMENT
Competency: B8 Use hoisting, lifting and rigging 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.

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

2. Review knots bends and hitches
   • Rope types
   • Working load limits
   • Terms
   • General rules
   • Knot, bend and hitch types
   • Inspection
   • Maintenance
   • Storage

3. Review the use of hoisting, lifting and rigging equipment
   • Selection of equipment
   • Selection of lifting location or point
   • Safety
   • Operating procedures
   • Communication and hand signals
   • Securing of loads
   • Inspection
   • Maintenance
   • Storage
**Program Content**
**Level 4**

**Line (GAC):** C ORGANIZE WORK  
**Competency:** C1 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**

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types</td>
</tr>
<tr>
<td>Linear measurement</td>
</tr>
<tr>
<td>- Metric</td>
</tr>
<tr>
<td>- Imperial</td>
</tr>
<tr>
<td>Stretch outs</td>
</tr>
<tr>
<td>Areas</td>
</tr>
<tr>
<td>Volumes</td>
</tr>
<tr>
<td>Capacities</td>
</tr>
<tr>
<td>Metric conversions</td>
</tr>
<tr>
<td>Squares</td>
</tr>
<tr>
<td>Square roots</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pythagorean Theorem</td>
</tr>
<tr>
<td>Trigonometric functions</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Word problems</td>
</tr>
<tr>
<td>Transposition to solve for different unknowns</td>
</tr>
<tr>
<td>Review</td>
</tr>
<tr>
<td>- Ogee offsets</td>
</tr>
<tr>
<td>- Elbow formulas</td>
</tr>
<tr>
<td>- Cone formulas</td>
</tr>
<tr>
<td>- Stretch out of an arc formulas</td>
</tr>
<tr>
<td>- Companion flange hole space formulas</td>
</tr>
<tr>
<td>- Two given elbow offset</td>
</tr>
<tr>
<td>- Two elbow 90°</td>
</tr>
<tr>
<td>- Roof pitch</td>
</tr>
<tr>
<td>- Air volumes and velocity</td>
</tr>
<tr>
<td>- Heavy gauge bend allowances</td>
</tr>
<tr>
<td>- Air changes per hour</td>
</tr>
<tr>
<td>New applications</td>
</tr>
<tr>
<td>- Fan laws</td>
</tr>
<tr>
<td>- Pulley ratios</td>
</tr>
<tr>
<td>- Heat loss</td>
</tr>
<tr>
<td>- British Thermal Units (BTUs)</td>
</tr>
</tbody>
</table>
Program Content
Level 4

Line (GAC): C ORGANIZE WORK
Competency: C2 Read drawings and specifications

Objectives
To be competent in this area, the individual must be able to:
- Describe drawings and specifications.
- Extract information from drawings and specifications.
- Generate a shop fabrication drawing.
- Interpret welding symbols.

LEARNING TASKS

1. Review 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. Review line types, symbols and abbreviations used in drawings

   - Lines
   - Symbols
   - Abbreviations

3. Review welding symbols

   - Location
   - Process
   - Type
   - Pitch and length

4. Review the scales used in drawings

   - Architect’s scale
   - Metric scale

5. Review the purpose of drawings and their parts

   - Plot plan
   - Foundation plan
   - Floor plan
   - Reflected ceiling plan
   - Roof plan
   - Elevation
   - Sections
   - Details
   - Title block
   - Revisions
     - Requests for information
     - Change orders
     - Addendums
LEARNING TASKS

6. Review contract documents and construction specifications

CONTENT
- Schedules
- Legends
- Schematics
- Types
- Purpose
- Master format
- Purpose
- Addendums
- Responsibilities and obligations
- Extracting information
- Quality control
- Commissioning

7. Review shop fabrication drawings

CONTENT
- Purpose
- Information contained
- Generation process
- Field measurements
- Complete information contained for fabrication
- Accuracy of information
- Proper drawing conventions used

Achievement Criteria

1. Performance
   The learner will answer a set of questions based on information to be extracted from a set of drawings and specifications.
   Conditions
   The learner will be given:
   - Plans and specifications
   - Set of questions
   Criteria
   The learner will score 70% or better on the set of questions

2. Performance
   The learner will create a shop fabrication drawing from field measurements.
   Conditions
   The learner will be given:
   - Existing duct work
   - Tools and equipment
   - Project specifications
   Criteria
   The learner will score 70% or better on a rating sheet that reflects the following criteria:
   - Proper drawing conventions
   - Completeness
   - Neatness
   - Legibility
   - Accurate information
Line (GAC): C  ORGANIZE WORK
Competency: C3  Use codes, regulations and standards

Objectives
To be competent in this area, the individual must be able to:
- Identify bodies responsible for codes, regulations and standards related to the sheet metal industry.
- Describe how codes, regulations and standards affect sheet metal fabrication and installations.

LEARNING TASKS
1. Review 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. Review how codes, regulations and standards affect sheet metal fabrication and installations
   - Material selection
   - Construction and installation methods
   - Design characteristics
Line (GAC): C ORGANIZE WORK
Competency: C4 Use manufacturer and supplier documentation

Objectives
To be competent in this area, the individual must be able to:
• Describe documentation encountered in the sheet metal trade.
• Describe information contained in manufacturer and supplier documentation.

LEARNING TASKS
1. Review documentation encountered in the sheet metal trade
   • Tool and equipment documentation
   • Material Safety and Data Sheets
   • System component documentation
   • Proprietary product documentation
   • Certification agencies

2. Review information contained in manufacturer and supplier documentation
   • Installation instructions and requirements
   • Operation and maintenance manuals
   • Product specifications
   • Warranty information
Line (GAC): C  ORGANIZE WORK
Competency: C5  Analyze project requirements

Objectives
To be competent in this area, the individual must be able to:
• Describe requirements for a sheet metal project.
• Extract information from plans and specifications to organize a project.

LEARNING TASKS
1. Describe organization of a project

   • Project specifications
   • Safety
   • Sequence of operation
   • Scheduling
     o Critical path
   • Coordination with other trades
   • Estimate
     o Time
     o Material
     o Workforce
   • Security
   • Tools and equipment
   • Inventory requirements
     o Secure storage
     o Time delivery
     o Labelling materials
     o Stock maintenance
     o Consumables
       - Fasteners
       - Sheets
       - Sealants
   • Cost efficiency
   • Post job efficiency analysis

2. Extract information from plans and specifications to organize projects

   • Plans
   • Specifications
   • Contract documents
   • Manufacturers information
   • Mathematics
   • Tools
Program Content
Level 4

Line (GAC): C ORGANIZE WORK
Competency: C6 Handle materials

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

LEARNING TASKS
1. Review considerations when handling materials
   • Safety
   • Storage
   • Timing
   • Transportation
   • LEED (Leadership in Energy and Environmental Design)
   • Hoisting and rigging
   • Work platforms
   • Labelling
   • Moving
   • Product protection
   • Disposal
   • Recycling

2. Select procedures for handling materials
   • Safety
   • Procedures
   • Securing
   • Packaging/shipping
Line (GAC): C ORGANIZE WORK
Competency: C7 Communicate with others

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

LEARNING TASKS CONTENT
1. Review methods of communication
   - Listening
   - Verbal
   - Written
   - Drawings
   - Trade terminology
   - Hoisting signals
   - Use of
     - Two-way radios
     - Cell phones
     - Fax machines
     - Computers
   - Interpersonal skills
   - Ethics

2. Communicate with people
   - Other trades
   - Industry people
   - Apprentices mentoring
   - Customers (layperson terms)
Program Content
Level 4

Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D3  Develop patterns using parallel line development

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. Review the development of patterns using parallel line development
   - Applications
   - Seam allowances
   - Pattern labelling and forming instructions
### Line (GAC): D  
#### LAYOUT AND DEVELOP PATTERNS

**Competency:** D4  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.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Review the selection of drafting equipment for radial line development    | • Tee squares  
  • Dividers  
  • Compasses  
  • Rulers  
  • Scales  
  • Set squares  
  • Protractors  
  • Pencils  
  • Calculators                                                                  |
| 2. Review drafting techniques for radial line development                     | • 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  
  • Right cones (chimney cap)  
  o Frustum (storm collar)  
  o Truncated (roof jack on a slope)  
  o Round reducer on centre.                                                   |
| 3. Review the development of patterns using radial line development           | • Applications  
  • Seam allowances  
  • Pattern labelling and forming instructions                                  |

### Achievement Criteria

**Performance**  
The learner will use radial line development to develop patterns for:  
Cone intersecting cone

**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:  
Tools selection  
Procedure  
Patterns are complete and accurate to within +/- 1/32" of drawing specifications
Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D5  Develop patterns using triangulation

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

LEARNING TASKS
1. Review drafting techniques for triangulation
2. Review the development of patterns using triangulation
3. Describe difference in profile triangulation

CONTENT
• Tools
• Line development
  ○ Construction
  ○ Triangulation
• Geometric construction
  ○ Front view
  ○ Plan view
  ○ Visualization in three dimensions
  ○ Required views
• Mathematical formulas
• Applications
  ○ Square to round on a pitch (Roof jack)
  ○ Round reducer on a pitch (Roof jack)
• Seam allowances
• Pattern labelling
• Method
• Applications
  ○ Reducing elbow
• Seam allowances
• Pattern labelling and forming instructions

Achievement Criteria
Performance  The learner will use triangulation and parallel line development to develop patterns for:
Reducing elbow
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
Line (GAC): D LAYOUT AND DEVELOP PATTERNS
Competency: D6 Develop patterns for duct fittings

Objectives
To be competent in this area, the individual must be able to:
- Develop patterns for duct fittings.

LEARNING TASKS

1. Review drafting techniques for duct fittings
   - Tools
   - Line development
     - Construction
   - Geometric construction
     - Front view
     - Plan view
     - Visualization in three dimensions
     - Required views
   - Mathematical formulas

2. Review the development of patterns for duct fittings
   - Applications
     - Duct “Y” branch fittings
     - Drop cheek change elbow
   - Seam and joint allowances
   - Pattern labelling

3. Develop advanced patterns for duct fittings
   - Applications
   - Seam and joint allowances
   - Pattern labelling and forming instructions

Achievement Criteria

Performance
The learner will develop patterns for:
- Duct “Y” branch fittings
- Drop cheek change elbow

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
Line (GAC): D  LAYOUT AND DEVELOP PATTERNS
Competency: D7  Develop patterns using computer technology

Objectives
To be competent in this area, the individual must be able to:
- Describe the application of computer aided sheet metal software.
- Create a pattern using computer aided sheet metal software.
- Describe the application of computer aided sheet metal software.
- Create a pattern using computer aided sheet metal software.

LEARNING TASKS
1. Review software programs for pattern development
   - Proprietary software
2. Describe software programs that provide more than just pattern development
   - Package software which includes
     o Estimation
     o Design
     o Fabrication
     o Project management
3. Review the use of software to develop patterns
   - Enter fittings from shop fabrication drawings

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): E  FABRICATE TRADE RELATED PRODUCTS
Competency: E1  Select materials for trade related products

Objectives
To be competent in this area, the individual must be able to:
• Describe materials and their applications within the sheet metal industry.

LEARNING TASKS
1. Review types and properties of materials used in the sheet metal trade

CONTENT
• Types
  o Metals
  o Non-metals
• Properties
• Applications
Program Content
Level 4

Line (GAC): E FABRICATE TRADE RELATED PRODUCTS
Competency: E2 Fabricate components

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

LEARNING TASKS
1. Review the selection of materials for component fabrication
2. Review the fabrication of fittings and components

CONTENT
• Types
• Gauges
• Cutting list
• Components
• Cutting
• Forming and bend sequence
Line (GAC): E  FABRICATE TRADE RELATED PRODUCTS
Competency: E3  Fabricate ductwork and assemble fittings with 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 advanced duct fittings
   • Applications
     o Duct “Y” branch fittings
     o Drop cheek change elbow
   • Labelling

Achievement Criteria
Performance  The learner will fabricate and assemble advanced duct fittings.
Duct “Y” branch fittings
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
Objective
To be competent in this area, the individual must be able to:
• Describe types of hanger systems and their purpose.

LEARNING TASKS
1. Review hanger systems
   • Purpose
   • Types
     o Strap hangers
     o Brackets
     o Saddles
     o Trapeze

2. Describe hanging considerations
   • Weight
   • Structure
   • Vibration
   • Fasteners/anchors
   • Environment
   • Manufacturers’ shop drawings
   • Seismic requirements
Line (GAC): E   FABRICATE TRADE RELATED PRODUCTS
Competency: E6   Fabricate equipment supports and bases

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

• Describe types of equipment bases and supports and their purpose.
• Describe the fabrication of equipment bases and supports.

LEARNING TASKS

1. Describe equipment bases and supports
   • Purpose
   • Types
   • Size
   • Weights

2. Describe the fabrication of equipment bases and supports
   • Design
   • Specifications
   • Materials
   • Layout
   • Cutting
   • Forming
   • Welding
   • Assembly
   • Fastening
   • Insulation
   • Priming and painting
Line (GAC): E  FABRICATE TRADE RELATED PRODUCTS

Competency: E9  Fabricate industrial components

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

- Describe types of advanced industrial components and their purpose.
- Fabricate advanced industrial components to specifications.

LEARNING TASKS

1. Describe advanced industrial components
   - Components
     o Blow pipe elbow
     o Tapers
     o Transitions
     o Fans
     o Wheel
     o Blow boxes
     o Hoods
   - Purpose/applications
   - Materials

2. Fabricate advanced industrial components
   - Safety
   - Material selection
   - Tools and equipment
   - Layout
   - Mathematics
   - Cut
   - Form
   - Welding
   - Fastening
   - Specifications
   - Bend allowances
   - Assemble
   - Finish
   - Product protection

Achievement Criteria
Performance
- The learner will fabricate a welded blow pipe elbow.

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
Competency: F1

INSTALL AIR HANDLING SYSTEMS

Install air handling system 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 handlers
   - Purpose
   - Types
     - Furnaces
     - Fans
     - Rooftop units
     - Built-up systems
     - Air conditioners
     - Heat pumps
     - Fan powered mixing boxes
     - Dual duct
   - Operation

2. Describe the installation of air handlers
   - Manufacturers’ specifications
   - Effect of weather on installation
   - Maintenance considerations
   - Hoisting
   - Curbs
   - Penetration size
   - Penetration obstructions
   - Sleepers
   - Stands
   - Housekeeping pads
   - Seismic restraints
   - Isolators
     - Inertia bases
     - Isolation springs
     - 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
   - Manufacturers’ specifications
   - Filter types
   - Handling hardware
   - Stands
Line (GAC): F  INSTALL AIR HANDLING SYSTEMS
Competency: F2 Install air handling ductwork and components

Objectives
To be competent in this area, the individual must be able to:
• Describe demolitions for renovations.
• Install air handling ductwork and components.

LEARNING TASKS
1. Describe demolitions for renovations
   • Barricades
   • Tools and equipment
   • Demolition plans
   • Dismantling
   • Material recycling/disposal

2. Describe air handling system components
   • Purpose
   • Types
     o Terminal units
     o Mixing units
     o Induction units
     o Dampers
     o Outlet covers
       - Registers
       - Diffusers
       - Louvers
       - Troffers
     o Filters
     o Coils
     o Control system
   • Operation
   • Accessories

3. Describe the installation of dampers
   • Purpose
   • Types
     o Volume
     o Smoke
     o Motorized
     o Back-draft
     o Fire
   • Operation
   • Codes and Regulations
   • Manufacturers’ specifications
   • Penetration size
   • Penetration obstructions
   • Fastening
   • Checks
     o Fit
     o Operation
   • Sealing
### LEARNING TASKS

#### 4. Describe the installation of outlet covers

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
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<tbody>
<tr>
<td>• Purpose</td>
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<td>• Types</td>
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<td>o Registers</td>
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<td>o Grilles</td>
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<td>• Operation</td>
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<td>• Manufacturers’ specifications</td>
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<td>• Fastening</td>
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<td>• Sealing</td>
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</tbody>
</table>

#### 5. Describe the installation of coils

<table>
<thead>
<tr>
<th>CONTENT</th>
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<tbody>
<tr>
<td>• Purpose</td>
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<td>o Hydronic</td>
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<td>o Direct expansion</td>
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<td>• Refrigeration principles</td>
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<td>• Codes and Regulations</td>
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<td>• Manufacturers’ specifications</td>
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<tr>
<td>• Securing</td>
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<tr>
<td>• Sealing</td>
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<tr>
<td>• Access doors</td>
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<tr>
<td>• Drain pans</td>
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</tbody>
</table>

#### 6. Describe the installation of system component accessories

<table>
<thead>
<tr>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>• Types</td>
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<tr>
<td>o Humidifiers</td>
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<tr>
<td>o Silencers</td>
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<tr>
<td>o Air valves</td>
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<tr>
<td>o Variable air volume boxes</td>
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<tr>
<td>o Mixing boxes</td>
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<tr>
<td>o Filter banks</td>
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<tr>
<td>o Drain pans</td>
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<tr>
<td>o Burglar bars</td>
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<tr>
<td>o Access doors</td>
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<tr>
<td>o Flexible duct</td>
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<tr>
<td>o Acoustic plenums</td>
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<tr>
<td>o Unit heaters</td>
</tr>
<tr>
<td>• Purpose</td>
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<tr>
<td>• Codes and Regulations</td>
</tr>
<tr>
<td>• Manufacturers’ specifications</td>
</tr>
<tr>
<td>• Location</td>
</tr>
<tr>
<td>• Sealing</td>
</tr>
</tbody>
</table>
LEARNING TASKS

7. 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
Program Content
Level 4

Line (GAC): G

Competency: G1 Install chimneys, breeching and venting

Objectives
To be competent in this area, the individual must be able to:
- Describe chimneys and breeching and their purpose.
- Describe the installation of chimneys and breeching.

Learning Tasks
1. Describe chimneys and breeching

   Content
   - Purpose
     o Combustion and emissions
     o Types of appliances
     o Chimney
     o Breeching
   - Designs
     o Manifold
     o Multi-storey
     o Breeching
   - Components
     o Bracing
     o Hangers
     o Supports
     o Flashing
     o Cladding
     o Lagging
     o Expansion joints
     o Clean outs
     o Field joints
   - Materials
   - Draft control equipment

2. Describe the installation of bracing, hangers and supports

   Content
   - Code requirements
     o Clearances
     o Weight
     o Spacing
     o Seismic
   - Materials
   - Fasteners
   - Sealants
   - Flashing
   - Cladding
   - Lagging
     o Insulation types

3. Describe the installation of flashing

   Content
   - Materials
   - Selection
   - Weatherproofing materials
   - Fastening
Line (GAC): G INSTALL INDUSTRIAL SYSTEMS
Competency: G2 Install gravity/conveyor material handling systems

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

LEARNING TASKS
1. Describe material handling systems
   • Purpose
     o Product movement
     o Waste removal
   • Types
     o Collection devices
     o Separating devices
     o Dampers
     o Bulk loading
     o Grain elevators
     o Baggage handling
     o Manufacturing production lines
   • Components
     o Liners
     o Fittings
     o Fitting design
     o Screw/auger
     o Bucket elevators
     o Chutes
     o System service access
   • Operation

2. Describe the installation of supports and bases
   • Dimensions and weights of components
   • Orientation and location of units
   • Securing of equipment

3. Describe the installation of collection devices
   • Purpose
   • Types
     o Hoppers
     o Hoods
     o Bins
   • Codes and Regulations
   • Manufacturers’ specifications
   • Positioning
   • Fastening
   • Effects of weather on installation
### LEARNING TASKS
4. Describe the installation of separating devices

### CONTENT
- Purpose
- Types
  - Cleaners
  - De-stoners
- Parts
- Operation
- Codes and Regulations
- Manufacturers’ specifications
- Effects of weather on installation
- Positioning
- Fastening
Line (GAC): G INSTALL INDUSTRIAL SYSTEMS
Competency: G3 Install pneumatic material and dust 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 CONTENT

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
     - Ball joints
     - Abort gate
     - Systems service access
     - Fitting design
   - Operation
   - Air flow

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

3. Describe the installation of air moving devices
   - Purpose
   - Types
     - Axial
     - Centrifugal
     - Forward inclined
     - Backward inclined
     - Paddle
   - Codes and Regulations
   - Manufacturers’ specifications
   - Fastening
LEARNING TASKS

4. Describe the installation of collection devices

CONTENT
- Purpose
- Types
  - Hoppers
  - Hoods
  - Bins
- Codes and Regulations
- Manufacturers’ specifications
- Positioning
- Fastening
- Effects of weather on installation

5. Describe the installation of separating devices

CONTENT
- Purpose
- Types
  - Cyclones
  - Bag houses
  - Conveyor skirt ing
- Parts
  - Air locks/feeders
- Operation
- Codes and Regulations
- Manufacturers’ specifications
- Effects of weather on installation
- Positioning
- Fastening
Line (GAC): G INSTALL INDUSTRIAL SYSTEMS
Competency: G4 Install lagging

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

2. Describe the installation of cladding and lagging

CONTENT
• Purpose
• Types
• Materials
  o Thermal expansion and contraction
  o Stainless steel
  o Aluminum
  o Coated steel
  o Membrane
  o Plastic
• Insulation
  o Types
  o Application
• Cladding components
  o End caps
  o Buttstraps
  o Preformed elbows
  o Stand offs
  o Flashing
• Mechanical equipment
  o Boilers
  o Piping
  o Pressure vessels
  o Cladding requirements
• Process
  o Mathematics
  o Layout
  o Banding machines
  o Securing techniques
  o Installation techniques
  o Sealants
Objectives
To be competent in this area, the individual must be able to:
- Describe the purpose and application of leak testing and air balancing.
- Calculate the required system adjustments and generate a report.

LEARNING TASKS
1. Review indoor air quality
   - Contaminates
   - Irritants
   - Odours
   - Noise
   - Filtration

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

3. Review testing and balancing procedures
   - Purpose
   - Pressures
   - Mathematics

4. Review leak testing
   - Types
     - Smoke
     - Dye
     - Pressure
     - Fluid
     - Visual
     - Audible
   - Charts
   - Test selection
   - Specifications
   - System preparation for testing
     - Temporary caps
     - Access doors
     - Test ports
LEARNING TASKS

5. Review air balancing instruments and techniques

CONTENT

- Balancing instruments
  - Manometers
  - Psychrometer
  - Velometer
  - Pitot tube
  - Anemometer
  - Magnehelic gauge
  - Flow hood
- Techniques
- System knowledge and understanding
- Damper locations
- Thermal overload
- Damper checking and adjusting
- RPM testing
- Rotation testing
- Adjustment
  - Belts
  - Belt length calculation
  - Pulleys
  - Sheaves
- Test port installation
- Amperage check
- Velocity readings
- Test running the system

6. Review relative humidity

7. Describe the commissioning process

8. Calculate required system adjustments for reports

Achievement Criteria

Performance Conditions
The learner will calculate the required system adjustments and generate a testing report.
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
Program Content  
Level 4

Line (GAC): I  SERVICE SYSTEMS  
Competency: I2  Perform maintenance inspections and service

Objectives

To be competent in this area, the individual must be able to:
- Describe the normal operation of systems.
- Describe how to detect abnormal operation of the systems.
- Describe the performance of maintenance inspections and service on systems.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>1. Describe normal operation of a system</td>
<td>Sounds</td>
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<td>Vibrations</td>
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<td>Smells</td>
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<td>Heat build-ups</td>
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<td>Fan laws</td>
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<tr>
<td>2. Identify signs of abnormality</td>
<td>Sounds</td>
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<td>Vibrations</td>
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<td>Smells</td>
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<td>Heat build-ups</td>
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<td>Signs of wear and fatigue</td>
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<tr>
<td>3. Describe the servicing and repair of components</td>
<td>Safety/lock out</td>
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<td></td>
<td>Frequency of scheduled servicing</td>
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<td>Warranty</td>
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<td>Devices</td>
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<td>o Types</td>
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<td>o Replacement</td>
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<td>Patching methods</td>
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</tbody>
</table>
LEARNING TASKS

CONTENT

- Verification of compatibility of new components
- Modifying replacement components
- Coordinating replacement components
- Verifying repairs
- Service reports
Section 4

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

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

HAND TOOLS TO BE SUPPLIED BY STUDENTS: None

PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT: LEVELS 1 to 4

Eye protection
Eye wash station
Face shield
Fire extinguisher
First aid kit
Gloves

Hard hat
Hearing protection
Respiratory protection
Welding curtain
Welding jacket
Welding helmet

LAYOUT AND DRAFTING EQUIPMENT: LEVELS 1 to 4

16  Combination squares
16  Drafting tables

16  Framing squares
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 Hammer drill
1 Circular saw                                                      1 Inline belt sander
4 Cordless drill                                                    1 Jigsaw
1 Die grinder                                                       1 Portable plasma cutter
1 Double cutter                                                     4 Uni-shear
4 Electric drill motor

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                                  4 Soldering furnaces or post
1 Spot welder

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
1 Abrasive cut-off saw                                                1 Foot shear
3 Bar folder                                                        3 Hand brake
1 Bench grinder                                                     1 Lever bench shear
1 Bench vice                                                        1 Notcher
1 Box and pan brake                                                 2 Pittsburgh machine
1 Compressor                                                        1 Power forming rolls
1 Drill index                                                       1 Power shear
1 Drill press

SHOP TOOLS AND EQUIPMENT: LEVELS 3 and 4
1 Press Brake

ROTARY MACHINES: LEVELS 1 to 4
1 Beading machine                                                    1 Elbow seaming
1 Burring machine                                                    2 Slip roll former
1 Crimping machine                                                  1 Turning machine
2 Easy edger

METAL FORMING STAKES: LEVELS 1 to 4
1 Beak horn                                                          1 Double seaming
1 Bench plate                                                        1 Double seaming with heads
1 Blow horn                                                          1 Hatchet
1 Candle mould                                                       1 Hollow mandrel
1 Common square                                                      1 Solid mandrel
1 Copper smith                                                       1 Square
1 Creasing stake


<table>
<thead>
<tr>
<th>Item</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

Recommended Resources
N/A

Suggested Texts
N/A

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 Instructors Diploma or equivalent
- A Bachelors Degree in Education
- A Masters Degree in Education
Appendices
Appendix A –
Assessment Guidelines
Program: Sheet Metal Worker

Training providers delivering Sheet Metal Worker apprenticeship in-school technical training are required to enter the following information in ITA Direct Access for each apprentice:

- An in-school mark in the form of a percentage

The in-school mark for each level is the result of a combination of theory and practical assessments. This mark is then combined with the ITA Standard Level Examination to determine a final mark for the level.

Training Provider Component: In-School Technical Training

Calculation tables showing the subject competencies, level percentage weightings and level examination weightings are shown in the Grading Sheet: “Subject Competencies and Weightings” section of this document.

Sheet Metal Worker Level 1, 2, 3 & 4 in-school marks are calculated by:

- totaling the level theory competency results as noted in the competencies and weightings tables and multiplying the total by 62% to produce a weighted theory result;
- totaling the level practical competency results as noted in the competencies and weightings tables and multiplying the total by 38% to produce a weighted practical result; and
- adding the theory and practical competency results together to determine the final in-school result.

This final percentage score is entered into ITA Direct Access.

ITA Component: ITA Standardized Level Examinations - Level 1, 2 & 3

Once the in-school training and standard level exam percentage scores are entered into ITA Direct Access, the system automatically calculates the final percentage score. The percentage score is calculated by blending the standardized exam percentage score and the in-school technical training percentage score to determine the final percentage score for the level.

In-school technical training (combined theory & practical) is weighted at 80% and the ITA standardized exam is weighted at 20%. These two scores are combined to determine the final level percentage score. This result is the final percentage score that is recorded in ITA Direct Access.

A percentage score of 70% or greater is required to pass the level when combining the final in-school percentage score and the final ITA standardized level exam percentage score.
Sheet Metal Worker Level 4 - Proprietary Examinations

Until further notice, Training Providers delivering the Sheet Metal Worker program will continue using their institution’s proprietary examination in the calculation of the apprentices’ achievement for Level 4. The percentage weighting of this exam is 20% of the final in-school technical training mark.

Refer to the Grading Sheet Subject Competencies and Weightings Level 4 Table to determine the calculation process for completing a final Level 4 percentage. The final blended mark for Level 4 is to be reported to ITA and must be 70% or greater to pass the level.

Interprovincial Red Seal Exam

In order to achieve certification with the Red Seal Endorsement, Sheet Metal Worker apprentices are required to write the Sheet Metal Worker Interprovincial Red Seal exam after completing all levels of in-school technical training. Apprentices must have passed all levels of in-school technical training or be approved challengers to sit the exam. A score of 70% or greater is required for a pass.

Training providers should request interprovincial Red Seal or exams via the usual ITA procedure.

The ITA will administer and invigilate Interprovincial Red Seal exams and score and record exam results in ITA Direct Access.
Assessment Guidelines

Grading Sheet: Subject Competency and Weightings

<table>
<thead>
<tr>
<th>PROGRAM:</th>
<th>SHEET METAL WORKER</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN-SCHOOL TRAINING:</td>
<td>LEVEL 1</td>
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<tr>
<td>ITA DIRECT ACCESS CODE:</td>
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<tr>
<th>LINE</th>
<th>SUBJECT COMPETENCIES</th>
<th>THEORY WEIGHTING</th>
<th>PRACTICAL WEIGHTING</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Use of Safe Work Practices</td>
<td>7%</td>
<td>0%</td>
</tr>
<tr>
<td>B</td>
<td>Use of Tools and Equipment</td>
<td>18%</td>
<td>32%</td>
</tr>
<tr>
<td>C</td>
<td>Organize Work</td>
<td>16%</td>
<td>0%</td>
</tr>
<tr>
<td>D</td>
<td>Layout and Develop Patterns</td>
<td>30%</td>
<td>15%</td>
</tr>
<tr>
<td>E</td>
<td>Fabricate Trade Related Products</td>
<td>23%</td>
<td>53%</td>
</tr>
<tr>
<td>F</td>
<td>Install Air Handling Systems</td>
<td>6%</td>
<td>0%</td>
</tr>
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</table>

Total 100% 100%

Calculated by the Training Provider
SHEET METAL WORKER in-school theory & practical subject competency weighting

Training Provider enters final in-school percentage score into ITA Direct Access

IN-SCHOOL%

Calculated by ITA:

<table>
<thead>
<tr>
<th>In-school Percentage Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>ITA Direct Access calculates the percentage weighting once the in-school mark is entered. Combined theory and practical subject competency multiplied by 80%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standard Level Exam Percentage Score</th>
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<tr>
<td>ITA Direct Access will calculate the percentage weighting once the standard level exam marks have been entered. The exam score is multiplied by 20%</td>
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<table>
<thead>
<tr>
<th>Final Percentage Score</th>
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</thead>
<tbody>
<tr>
<td>The final score for determining credit is calculated by ITA Direct Access</td>
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FINAL%
## Assessment Guidelines

**PROGRAM:** SHEET METAL WORKER  
**LEVEL 2**  
**ITA DIRECT ACCESS CODE:** 0018SM02

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<tr>
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<td>Use Safe Work Practices</td>
<td>7%</td>
<td>0%</td>
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<td>B</td>
<td>Use Tools and Equipment</td>
<td>18%</td>
<td>17%</td>
</tr>
<tr>
<td>C</td>
<td>Organize Work</td>
<td>16%</td>
<td>4%</td>
</tr>
<tr>
<td>D</td>
<td>Layout and develop Patterns</td>
<td>23%</td>
<td>18%</td>
</tr>
<tr>
<td>E</td>
<td>Fabricate Trade Related Products</td>
<td>19%</td>
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</tr>
<tr>
<td>F</td>
<td>Install Air Handling Systems</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>H</td>
<td>Install Architectural and Specialty Components</td>
<td>12%</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Calculated by the Training Provider

**SHEET METAL WORKER** in-school theory & practical subject competency weighting  
62% 38%

Training Provider enters final in-school percentage score into ITA Direct Access

IN-SCHOOL%

Calculated by ITA: In-school Percentage Score

ITA Direct Access calculates the percentage weighting once the in-school mark is entered. Combined theory and practical subject competency multiplied by 80%

Calculated by ITA: Standard Level Exam Percentage Score

ITA Direct Access will calculate the percentage weighting once the standard level exam marks have been entered. The exam score is multiplied by 20%

Calculated by ITA: Final Percentage Score

The final score for determining credit is calculated by ITA Direct Access. FINAL%
## Assessment Guidelines

**PROGRAM:**

**IN-SCHOOL TRAINING:**

**ITA DIRECT ACCESS CODE:**

### SHEET METAL WORKER

**LEVEL 3**

0018SM03

<table>
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<tr>
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<td>B</td>
<td>Use Tools and Equipment</td>
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<td>18%</td>
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<td>C</td>
<td>Organize Work</td>
<td>8%</td>
<td>6%</td>
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<tr>
<td>D</td>
<td>Layout and Develop Patterns</td>
<td>22%</td>
<td>17%</td>
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<tr>
<td>E</td>
<td>Fabricate Trade Related Products</td>
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<td>50%</td>
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<tr>
<td>F</td>
<td>Install Air Handling Systems</td>
<td>16%</td>
<td>9%</td>
</tr>
<tr>
<td>G</td>
<td>Install Industrial Systems</td>
<td>7%</td>
<td>0%</td>
</tr>
<tr>
<td>H</td>
<td>Install Architectural and Specialty Components</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>I</td>
<td>Service Systems</td>
<td>14%</td>
<td>0%</td>
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</table>

**Total**

100% 100%

Calculated by the Training Provider

SHEET METAL WORKER in-school theory & practical subject competency weighting

Total 100% 100%

Training Provider enters final in-school percentage score into ITA Direct Access

**IN-SCHOOL%**

Calculated by ITA:

- **In-school Percentage Score**
  
  ITA Direct Access calculates the percentage weighting once the in-school mark is entered. Combined theory and practical subject competency multiplied by

  80%

- **Standard Level Exam Percentage Score**
  
  ITA Direct Access will calculate the percentage weighting once the standard level exam marks have been entered. The exam score is multiplied by

  20%

Calculated by ITA:

- **Final Percentage Score**
  
  The final score for determining credit is calculated by ITA Direct Access.  
  
  **FINAL%**
### Assessment Guidelines

**PROGRAM:**
IN-SCHOOL TRAINING:
ITA DIRECT ACCESS CODE:

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Use Safe Work Practices</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>B</td>
<td>Use Tools and Equipment</td>
<td>12%</td>
<td>0%</td>
</tr>
<tr>
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<td>Organize Work</td>
<td>18%</td>
<td>15%</td>
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<tr>
<td>E</td>
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<td>55%</td>
</tr>
<tr>
<td>F</td>
<td>Install Air Handling Systems</td>
<td>14%</td>
<td>0%</td>
</tr>
<tr>
<td>G</td>
<td>Install Industrial Systems</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>I</td>
<td>Service Systems</td>
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<td>0%</td>
</tr>
</tbody>
</table>

**Total** 100% 100%

Calculated by the Training Provider:

**SHEET METAL WORKER** in-school theory & practical subject competency weighting

<table>
<thead>
<tr>
<th>SHEET METAL WORKER</th>
<th>THEORY</th>
<th>PRACTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>in-school theory &amp; practical subject competency weighting</td>
<td>62%</td>
<td>38%</td>
</tr>
</tbody>
</table>

**In-school Percentage Score**
Combined theory and practical subject competency score is multiplied by 80%

**Proprietary Exam Percentage Score**
The exam score is multiplied by 20%

**Training Provider enters final in-school percentage score into ITA Direct Access**

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 Red Seal Interprovincial examination mark in ITA Direct Access. A minimum percentage score of 70% on the examination is required for a pass.