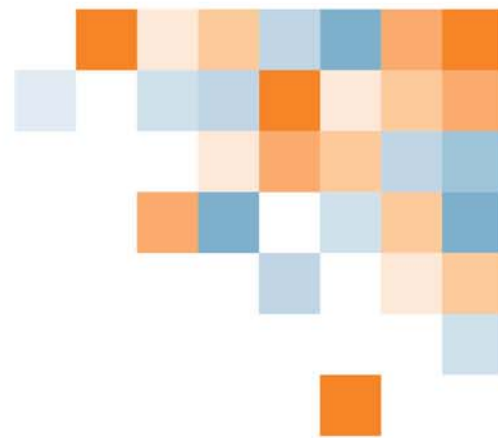


ita
YOUR TICKET.



PROGRAM OUTLINE

Sheet Metal Worker



The latest version of this document is available in PDF format on the ITA website
www.itabc.ca

To order printed copies of Program Outlines
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SHEET METAL WORKER PROGRAM OUTLINE

APPROVED BY INDUSTRY

SEPTEMBER 2011

BASED ON

NOA 2010

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



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Section 1

INTRODUCTION

Sheet Metal Worker



Foreword

This revised Sheet Metal Worker Program Outline is intended as a guide for instructors, apprentices, and employers of apprentices as well as for the use of industry organizations, regulatory bodies, and provincial and federal governments. It reflects updated standards based on the new Sheet Metal Worker 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 measurable and that they reflect the skills spelled out in the competency as those required of a competent journey person. 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.



How to Use this Document

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

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



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



Section 2

PROGRAM OVERVIEW

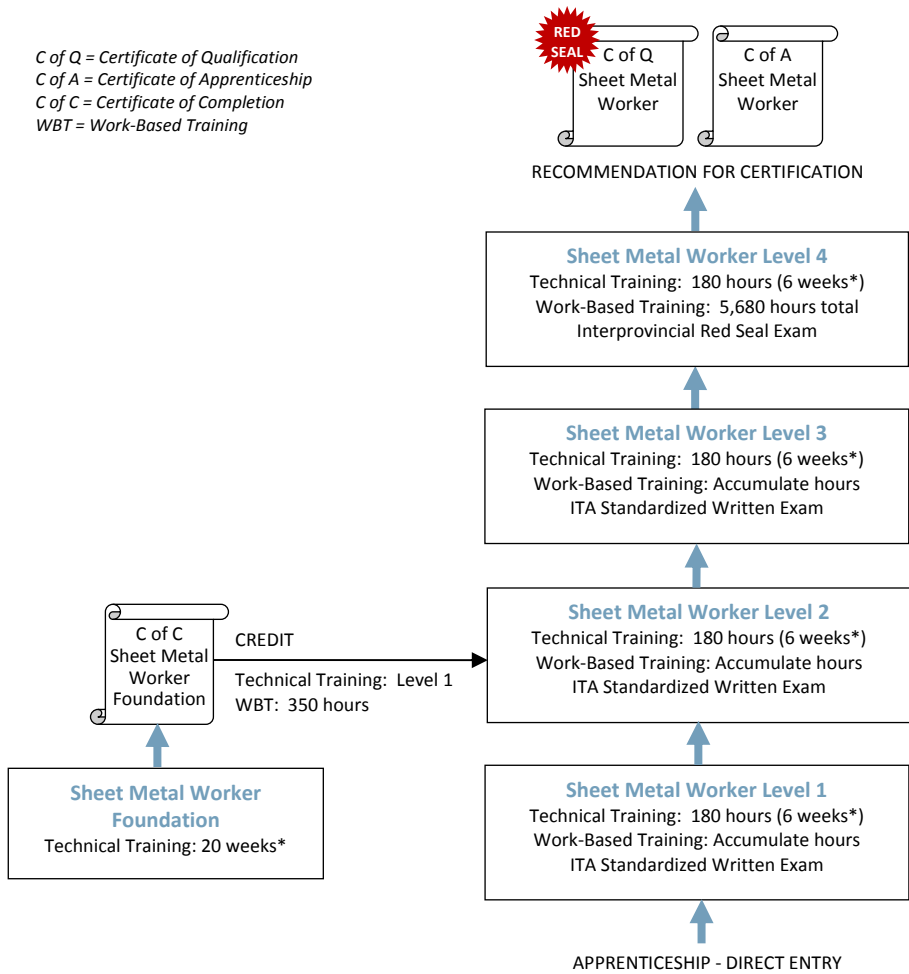
Sheet Metal Worker



Program Credentialing Model

Apprenticeship Pathway

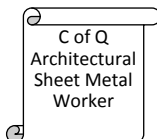
This graphic provides an overview of the Sheet Metal Worker apprenticeship pathway.



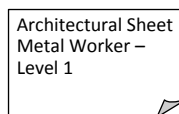
*Suggested duration based on 30-hour week

CROSS-PROGRAM CREDITS

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



C of Q Architectural Sheet Metal Worker
Technical Training: Level 1
Work-Based Training: 900 hours



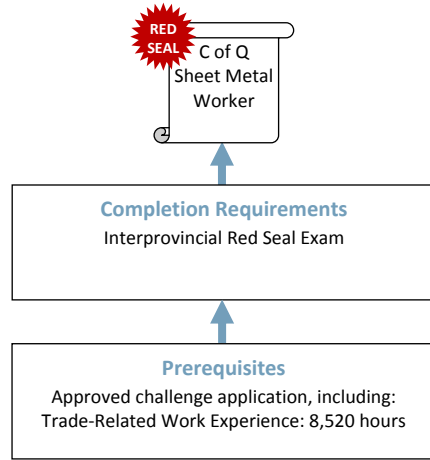
Architectural Sheet Metal Worker – Level 1
Technical Training: Level 1
Work-Based Training: None



Challenge Pathway

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

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.

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



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 A	Control workplace hazards A1	Locate information in the OHS Regulation and WCB Standards A2	Use WHMIS A3	Use personal protective equipment A4	Select fire extinguishers A5		
	1 2 3 4	1	1 2 3 4	1	1		
USE TOOLS AND EQUIPMENT B	Use hand tools B1	Use portable power tools B2	Use shop equipment B3	Use welding equipment B4	Use soldering and brazing equipment B5	Use fasteners B6	
	1 2	1 2 3	1 2 3 4	1 2 3 4	1	1 2 4	
	Use ladders and platforms B7	Use hoisting, lifting and rigging equipment B8					
	1	1					
	ORGANIZE WORK C	Use mathematics C1	Read drawings and specifications C2	Use codes, regulations, and standards C3	Use manufacturer and supplier documentation C4	Analyze project requirements C5	Handle materials C6
		1 2 3 4	1 2 3 4	2 3 4	2 3 4	2 3 4	1 2 3 4
		Communicate with others C7					



1			4	
---	--	--	---	--

LAYOUT AND DEVELOP PATTERNS
D

Use drafting equipment to develop geometric constructions
D1

1				
---	--	--	--	--

Develop pictorial drawings and orthographic projections
D2

1	2			
---	---	--	--	--

Develop patterns using parallel line development
D3

1	2	3	4	
---	---	---	---	--

Develop patterns using radial line development
D4

1			4	
---	--	--	---	--

Develop patterns using triangulation
D5

1	2	3	4	
---	---	---	---	--

Develop patterns for duct fittings
D6

1	2	3	4	
---	---	---	---	--

Develop patterns using computer technology
D7

	2	3	4	
--	---	---	---	--

FABRICATE TRADE RELATED PRODUCTS
E

Select materials for trade related products
E1

1	2	3	4	
---	---	---	---	--

Fabricate components
E2

1	2		4	
---	---	--	---	--

Fabricate ductwork and assemble fittings with components
E3

1	2	3	4	
---	---	---	---	--

Insulate ductwork, fittings and components
E4

1				
---	--	--	--	--

Fabricate hanger systems
E5

1	2	3	4	
---	---	---	---	--

Fabricate equipment supports and bases
E6

			4	
--	--	--	---	--

Fabricate specialty and stainless steel products
E7

		3		
--	--	---	--	--

Fabricate architectural components
E8

	2			
--	---	--	--	--

Fabricate industrial components
E9

	2	3	4	
--	---	---	---	--

INSTALL AIR HANDLING SYSTEMS
F

Install air handling system equipment
F1

			4	
--	--	--	---	--

Install air handling ductwork and components
F2

1	2	3	4	
---	---	---	---	--

Install residential heating, ventilating and air conditioning
F3

		3		
--	--	---	--	--

INSTALL INDUSTRIAL SYSTEMS
G

Install chimneys, breeching and venting
G1

		3	4	
--	--	---	---	--

Install gravity/conveyor material handling systems
G2

			4	
--	--	--	---	--

Install pneumatic material and dust handling systems
G3

			4	
--	--	--	---	--

Install lagging
G4

			4	
--	--	--	---	--

Program Overview



INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS H	Install roofing, decking and cladding H1	Install panel systems H2	Install exterior components H3	Install specialty and stainless steel products H4																			
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	2																						
	2																						
	2																						
		3																					
SERVICE SYSTEMS I	Test and adjust systems I1	Perform maintenance inspections and service I2																					
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		3	4																				
			4																				



Training Topics and Suggested Time Allocation

Sheet Metal Worker - Level 1

		Theory %	Practical %	Page
Line A	USE SAFE WORK PRACTICES	5		22
A1	Control workplace hazards	34		24
A2	Locate information in the OHS Regulation and WCB Standard	23		26
A3	Use WHMIS	11		28
A4	Use personal protective equipment	21	✓	29
A5	Select fire extinguishers	11		
Line B	USE TOOLS AND EQUIPMENT	15	32	30
B1	Use hand tools	7		31
B2	Use portable power tools	7		32
B3	Use shop equipment	7		33
B4	Use welding equipment	31	✓	36
B5	Use soldering and brazing equipment	14	✓	38
B6	Use fasteners	7		39
B7	Use ladders and platforms	13		39
B8	Use hoisting, lifting and rigging equipment	14		40
Line C	ORGANIZE WORK	14		
C1	Use mathematics	57		41
C2	Read drawings and specifications	20	✓	42
C6	Handle materials	15		43
C7	Communicate with others	8		44
Line D	LAYOUT AND DEVELOP PATTERNS	42	15	
D1	Use drafting equipment to develop geometric constructions	7	✓	45
D2	Develop pictorial drawings and orthographic projections	22	✓	46
D3	Develop patterns using parallel line development	24	✓	47
D4	Develop patterns using radial line development	8	✓	49
D5	Develop patterns using triangulation	15	✓	50
D6	Develop patterns for duct fittings	24	✓	51
Line E	FABRICATE TRADE RELATED PRODUCTS	18	53	
E1	Select materials for trade related products	29		52
E2	Fabricate components	29	✓	53
E3	Fabricate ductwork and assemble fittings with components	26	✓	55
E4	Insulate ductwork, fittings and components	7		56
E5	Fabricate hanger systems	9	✓	57
Line F	INSTALL AIR HANDLING SYSTEMS	6		
F2	Install air handling ductwork and components	100	✓	58
Total Percentage for Sheet Metal Worker - Level 1		100%	100%	



Training Topics and Suggested Time Allocation

Sheet Metal Worker – Level 2

		Theory %	Practical %	Page
Line A	USE SAFE WORK PRACTICES	3		61
A1	Control workplace hazards	100		
Line B	USE TOOLS AND EQUIPMENT	12	17	
B1	Use hand tools	17		62
B2	Use portable power tools	4		63
B3	Use shop equipment	17		64
B4	Use welding equipment	57	✓	65
B6	Use fasteners	5		67
Line C	ORGANIZE WORK	14	4	
C1	Use mathematics	30		68
C2	Read drawings and specifications	17	✓	69
C3	Use codes, regulations, and standards	6		71
C4	Use manufacturer and supplier documentation	12		72
C5	Analyse project requirements	12		73
C6	Handle materials	23		74
Line D	LAYOUT AND DEVELOP PATTERNS	44	18	
D2	Develop pictorial drawings and orthographic projections	10	✓	75
D3	Develop patterns using parallel line development	28	✓	76
D5	Develop patterns using triangulation	31	✓	77
D6	Develop patterns for duct fittings	28	✓	78
D7	Develop patterns using computer technology	3		79
Line E	FABRICATE TRADE RELATED PRODUCTS	19	43	
E1	Select materials for trade related products	23		80
E2	Fabricate components	18	✓	81
E3	Fabricate ductwork and assemble fittings with components	18	✓	82
E5	Fabricate hanger systems		✓	84
E8	Fabricate architectural components	35	✓	85
E9	Fabricate industrial components	6	✓	86
Line F	INSTALL AIR HANDLING SYSTEMS	1	5	
F2	Install air handling ductwork and components	100	✓	87
Line H	INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS	7	13	
H1	Install roofing, decking and cladding	33	✓	88
H2	Install panel systems	33		91
H3	Install exterior components	34		93
Total Percentage for Sheet Metal Worker - Level 2		100%	100%	



Training Topics and Suggested Time Allocation

Sheet Metal Worker – Level 3

		Theory %	Practical %	Page
Line A	USE SAFE WORK PRACTICES	3		
A1	Control workplace hazards	100		95
Line B	USE TOOLS AND EQUIPMENT	15	14	
B2	Use portable power tools	40		96
B3	Use shop equipment	41		97
B4	Use welding equipment	19	✓	98
Line C	ORGANIZE WORK	8	6	
C1	Use mathematics	37		100
C2	Read drawings and specifications	17	✓	101
C3	Use codes, regulations, and standards	5		103
C4	Use manufacturer and supplier documentation	11		104
C5	Analyse project requirements	9		105
C6	Handle materials	21		106
Line D	LAYOUT AND DEVELOP PATTERNS	22	17	
D3	Develop patterns using parallel line development	29		107
D5	Develop patterns using triangulation	29	✓	108
D6	Develop patterns for duct fittings	29	✓	109
D7	Develop patterns using computer technology	13	✓	110
Line E	FABRICATE TRADE RELATED PRODUCTS	13	54	
E1	Select materials for trade related products	44		111
E3	Fabricate ductwork and assemble fittings with components	7	✓	112
E5	Fabricate hanger systems	7	✓	113
E7	Fabricate specialty and stainless steel products	21	✓	114
E9	Fabricate industrial components	21	✓	116
Line F	INSTALL AIR HANDLING SYSTEMS	16	9	
F2	Install air handling ductwork and components	12	✓	117
F3	Install residential heating, ventilating and air conditioning	88		118
Line G	INSTALL INDUSTRIAL SYSTEMS	3		
G1	Install chimneys, breeching and venting	100		119
Line H	INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS	3		
H4	Install specialty and stainless steel products	100		120
Line I	SERVICE SYSTEMS	17		
I1	Test and adjust systems	100	✓	121
Total Percentage for Sheet Metal Worker - Level 3		100%	100%	



Training Topics and Suggested Time Allocation

Sheet Metal Worker – Level 4

		Theory %	Practical %	Page
Line A	USE SAFE WORK PRACTICES	1		
A1	Control workplace hazards	100		124
Line B	USE TOOLS AND EQUIPMENT	12		
B3	Use shop equipment	30		125
B4	Use welding equipment	30		126
B6	Use fasteners	10		127
B8	Use hoisting, lifting and rigging equipment	30		128
Line C	ORGANIZE WORK	21	15	
C1	Use mathematics	58		129
C2	Read drawings and specifications	14	✓	130
C3	Use codes, regulations, and standards	3		132
C4	Use manufacturer and supplier documentation	14		133
C5	Analyse project requirements	5		134
C6	Handle materials	3		135
C7	Communicate with others	3		136
Line D	LAYOUT AND DEVELOP PATTERNS	17	30	
D3	Develop patterns using parallel line development	29		137
D4	Develop patterns using radial line development	8	✓	138
D5	Develop patterns using triangulation	29	✓	139
D6	Develop patterns for duct fittings	26	✓	140
D7	Develop patterns using computer technology	8	✓	141
Line E	FABRICATE TRADE RELATED PRODUCTS	15	55	
E1	Select materials for trade related products	11		142
E2	Fabricate components	19		143
E3	Fabricate ductwork and assemble fittings with components	10	✓	144
E5	Fabricate hanger systems	6		145
E6	Fabricate equipment supports and bases	10		146
E9	Fabricate industrial components	44	✓	147
Line F	INSTALL AIR HANDLING SYSTEMS	14		
F1	Install air handling system equipment	50		148
F2	Install air handling ductwork and components	50		149
Line G	INSTALL INDUSTRIAL SYSTEMS	10		
G1	Install chimneys, breeching and venting	25		152
G2	Install gravity/conveyor material handling systems	25		153
G3	Install pneumatic material and dust handling systems	25		155
G4	Install lagging	25		157 158
Line I	SERVICE SYSTEMS	10		
I1	Test and adjust systems	70	✓	158
I2	Perform maintenance inspections and service	30		160
Total Percentage for Sheet Metal Worker - Level 4		100%	100%	



Section 3

PROGRAM CONTENT

Sheet Metal Worker



Level 1

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:

- 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

CONTENT

- | | |
|---|--|
| <p>1. Describe short term hazards in the sheet metal industry</p> | <ul style="list-style-type: none"> • Sharp objects • Ladders • Work platforms • Electrical • Lockout procedures • Compressed gas • Explosive material (dust) • Lifting • Personal apparel <ul style="list-style-type: none"> ○ Clothing ○ Hair and beards ○ Jewellery • Housekeeping • Clear head • Horseplay • Respect for others safety • Constant awareness of surroundings • Safe attitude • Management of hazards |
| <p>2. Describe long term hazards in the sheet metal industry</p> | <ul style="list-style-type: none"> • Respiratory disease • Asbestos • Repetitive strain injuries • Management of hazards |
| <p>3. Describe safety precautions when working at elevations</p> | <ul style="list-style-type: none"> • Wind • Floor openings • Guard rails • Safety lines • Weather • Stressed cables |



LEARNING TASKS

4. Demonstrate emergency procedures

5. Describe non-emergency injury reporting procedures

6. Describe how a workplace safety policy is established

CONTENT

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

- 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



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
 - Health and safety programs
 - Investigations and reports
 - Workplace inspections
 - Right to refuse work
- General Conditions
 - Building and equipment safety
 - Emergency preparedness
 - Preventing violence
 - Working alone
 - Ergonomics
 - Illumination
 - Indoor air quality
 - 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

CONTENT

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. State the legislation that requires suppliers of hazardous materials to provide MSDSs and label products as a condition of sale and importation | <ul style="list-style-type: none"> • Hazardous Product Act • Controlled Products Regulations • Ingredient Disclosure List • Hazardous Materials Information Review Act • Hazardous Materials Information Review Regulations |
| <ol style="list-style-type: none"> 2. State the purpose of the Workplace Hazardous Materials Information System (WHMIS) | <ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> ○ Workers ○ Employers ○ Suppliers ○ Regulators |
| <ol style="list-style-type: none"> 3. Describe the key elements of WHMIS | <ul style="list-style-type: none"> • Material safety data sheets (MSDSs) • Labelling of containers of hazardous materials • Worker education programs |
| <ol style="list-style-type: none"> 4. Describe the responsibilities of suppliers under WHMIS | <ul style="list-style-type: none"> • Provide <ul style="list-style-type: none"> ○ MSDSs ○ Labels |
| <ol style="list-style-type: none"> 5. Describe the responsibilities of employers under WHMIS | <ul style="list-style-type: none"> • Provide <ul style="list-style-type: none"> ○ MSDSs ○ Labels ○ Work education programs in the workplace |
| <ol style="list-style-type: none"> 6. Describe information to be disclosed on a MSDS | <ul style="list-style-type: none"> • Hazardous ingredients • Preparation information • Product information • Physical data • Fire or explosion • Reactivity data • Toxicological properties • Preventive measures • First-aid measures |

**LEARNING TASKS**

7. Identify symbols found on WHMIS labels and their meaning

8. Apply WHMIS regulations as they apply to hazardous materials used in the shop

CONTENT

- Compressed gases
- Flammable and combustible materials
- Oxidizing materials
- Poisonous and infectious materials
 - Materials causing immediate and serious toxic effects
 - Materials causing other toxic effects
 - Biohazardous infectious materials
- Corrosive materials
- Dangerously reactive materials

- Use, storage and disposal



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

CONTENT

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Describe the conditions necessary to support a fire 2. Describe the classes of fires according to the materials being burned 3. Apply preventative fire safety precautions when working near, handling or storing flammable liquids or gases, combustible materials and electrical apparatus 4. Describe the considerations and steps to be taken prior to fighting a fire 5. Describe the procedure for using a fire extinguisher | <ul style="list-style-type: none"> • Air • Fuel • Heat
 • Class A • Class B • Class C • Class D • Symbols and colours
 • Fuels <ul style="list-style-type: none"> ○ Diesel ○ Gasoline ○ Propane ○ Natural Gas • Ventilation • Purging • Lubricants • Oily rags • Combustible metals • Aerosols
 • Warning others and fire department • Evacuation of others • Fire contained and not spreading • Personal method of egress • Training
 • Extinguisher selection • P.A.S.S. <ul style="list-style-type: none"> ○ 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

CONTENT

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

1. Describe portable power tools

2. Use portable power tools

3. Use battery powered tools

CONTENT

- Drills
- Grinders
- Nibblers
- Shears
- Saws
- Electric seamers
- Gas powered tools

- Types
- Parts
- Purpose/uses
- Procedures/operations
- Safety
- Adjustment
- Inspection
- Maintenance
- Equipment manual
- Storage

- 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

CONTENT

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

2. Use shop equipment

- Types
- Parts
- Purpose/uses
- Procedures/operations
- Capacities
- Safety
- Adjustment
- Inspection
- Minor maintenance
- Equipment Manual
- Storage



Line (GAC): B USE 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

1. Describe types of cutting and welding equipment

2. Describe cutting and welding safety

3. Describe plasma cutting

CONTENT

- Plasma cutting
- Oxy-acetylene cutting
- Shielded metal arc welding (SMAW)
- Gas metal arc welding (GMAW)
- Equipment/hand tools

- Licensing and training requirements
- Government regulations
- Ventilation requirements
- Flammable material recognition
- Personal protective equipment
- Compressed gas safety

- Purpose/uses
- Limitations
- Equipment
- Materials to be cut
- Consumables
- Safety
- Procedures/operations
- Set-up
- Adjustment
- Take down
- Inspection
- Maintenance
- Storage



LEARNING TASKS

CONTENT

- | | |
|---|--|
| 4. Describe oxy-acetylene cutting | <ul style="list-style-type: none"> • Purpose/uses • Limitations • Equipment • Materials to be cut • Consumables • Safety • Procedures/operations • Set-up • Adjustment • Take down • Inspection • Maintenance • Storage |
| 5. Use cutting tools | <ul style="list-style-type: none"> • Plasma • Oxy-acetylene |
| 6. Describe gas metal arc welding (GMAW) | <ul style="list-style-type: none"> • 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) | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • Setup • Basic procedures/operations • Maintenance • Safety • Limitations |
| 9. Use welding tools | <ul style="list-style-type: none"> • 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



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

CONTENT

- | | |
|--|--|
| <p>1. Describe soldering and brazing equipment</p> | <ul style="list-style-type: none"> • Types • Purpose • Materials to be soldered/brazed • Safety • Gases • Transportation of Dangerous Goods Regulations • Ventilation requirements • Flammable material recognition • Inspection • Maintenance • Storage |
| <p>2. Describe soldering techniques</p> | <ul style="list-style-type: none"> • Solder selection • Equipment selection • Fluxes <ul style="list-style-type: none"> ○ Types ○ Applications • Techniques <ul style="list-style-type: none"> ○ Safety ○ Cleaning ○ Forging ○ Tinning ○ Soldering • Limitations |
| <p>3. Use soldering techniques</p> | <ul style="list-style-type: none"> • Selection • Procedure • Inspection |
| <p>4. Describe brazing techniques</p> | <ul style="list-style-type: none"> • Alloy selection • Equipment selection • Fluxes <ul style="list-style-type: none"> ○ Types ○ Applications • Techniques <ul style="list-style-type: none"> ○ 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

2. Describe fastening tools

3. Use fasteners

CONTENT

- Types
- Purpose
- Limitations

- Types
- Procedures for use
- Safety considerations
- Inspection
- Maintenance
- Storage

- 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

2. Use ladders and elevated platforms

CONTENT

- Types
- Uses
- Safety
- Hazard recognition
- Government regulations

- Selection
- Operating procedures
- Limitations
- Securing
- Inspection
- Maintenance
- Storage



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

CONTENT

- | | |
|--|--|
| <p>1. Describe hoisting, lifting and rigging equipment</p> | <ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> ○ Lifting equipment ○ Rigging equipment ○ Rolling equipment • Uses • Limitations and capacities • Government regulations • Safety |
| <p>2. Tie knots bends and hitches</p> | <ul style="list-style-type: none"> • Rope types • Working load limits • Terms • General rules • Knot, bend and hitch types • Inspection • Maintenance • Storage |
| <p>3. Use hoisting, lifting and rigging equipment</p> | <ul style="list-style-type: none"> • 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

CONTENT

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Describe geometric shapes 2. Describe mathematical formulas

 3. Solve problems using formulas

 4. Describe formulas used for triangles

 5. Solve problems involving triangles | <ul style="list-style-type: none"> • Types • Linear measurement <ul style="list-style-type: none"> ○ 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:

- Interpret the information on a shop drawing.
- Construct a project from a shop drawing.

LEARNING TASKS

1. Describe shop drawings

2. Use a shop drawing

CONTENT

- Purpose
- Information contained
- Generation process

- 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



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

CONTENT

- Listening
- Verbal
- Written
- Drawings
- Trade terminology
- Hoisting signals
- Use of
 - Two-way radios
 - Cell phones
 - Fax machines
 - Computers
- Interpersonal skills
- Ethics

- Other trades
- Industry people
- Apprentices mentoring
- Customers (layperson terms)

2. Communicate with people



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

CONTENT

- | | |
|---|--|
| 1. Describe drafting equipment | <ul style="list-style-type: none"> • Tee squares • Dividers • Compasses • Scale rulers • Set squares • Protractors • Pencils |
| 2. Describe geometric shapes in pattern development | <ul style="list-style-type: none"> • Circles • Squares • Rectangles • Triangles • Angles • Ellipses • Polygons |
| 3. Develop geometric constructions | <ul style="list-style-type: none"> • Develop and layout <ul style="list-style-type: none"> ○ Scales ○ Lines ○ Arcs ○ Angles ○ Shapes ○ 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: **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. Select drafting equipment for parallel line development

2. Describe drafting techniques for parallel line development

3. Develop patterns using parallel line development

CONTENT

- Tee squares
- Dividers
- Compasses
- Rulers
- Scales
- Set squares
- Protractor
- Pencils
- Calculators

- Views
 - Front
 - Plan
 - End
 - Which are required
 - Visualization in three dimensions
- Line development
 - Construction
 - Projection
- Geometric construction
- Mathematical formulas

- Applications
 - Architectural mitres
 - Elbows
 - Tee branches on centre complete with main pipe hole patterns
 - Round pipes on slope complete with hole layout
- Seam allowances
- Pattern labelling and forming instructions

**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



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
2. Describe drafting techniques for triangulation
3. Develop patterns using triangulation

CONTENT

- Tee squares
- Dividers
- Compasses
- Rulers
- Scales
- Set squares
- Protractors
- Pencils
- Calculators
- Line development
 - Construction
 - Triangulation
- Geometric construction
 - Front view
 - Plan view
 - Visualization in three dimensions
 - Required views
- Mathematical formulas
- Applications
 - Square to round on centre
 - Square to round off centre
 - 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

2. Describe drafting techniques for duct fittings

3. Develop patterns using for duct fittings

CONTENT

- Tee squares
- Dividers
- Compasses
- Rulers
- Scales
- Set squares
- Protractors
- Pencils
- Calculators

- Line development
 - Construction
- Geometric construction
 - Front view
 - Plan view
 - Visualization in three dimensions
 - Required views
- Mathematical formulas

- 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: **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

1. Describe sheet metal components

2. Select tools

3. Select materials

4. Make a cutting list

5. Describe seams, locks and edges

6. Fabricate seams, locks and edges

CONTENT

- End caps
- Spin-in collars
- Flexible connections
- Insulation stops

- Layout tools
- Hand tools
- Shop equipment
- Power tools

- Types
- Gauges

- Fitting requirements
- Mathematics
- Allowances
- Material thickness allowance
- Recording

- Types
 - Single and double seams
 - Standing seams
 - Riveted seam
 - Groove seams
 - Pocket lock
 - S-lock
 - Button lock
 - Pittsburgh lock
 - Lap and spot weld
 - Hems

- Types
 - Double seam
 - Pittsburgh lock
 - Lap and spot weld
 - Standing seams
 - Groove seam
- Seam allowances



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

CONTENT

<ol style="list-style-type: none"> 1. Select shop tools and equipment to fabricate ductwork and assemble fittings with components 2. Describe shop layout techniques for duct fittings 3. Fabricate duct fittings 4. Install components 	<ul style="list-style-type: none"> • Layout tools • Hand tools • Shop equipment • Power tools • Line development • Geometric construction • Mathematical formulas • Cut list • Seam and joint allowances • Applications <ul style="list-style-type: none"> ○ Straight duct ○ Transition ○ Ogee offset ○ Duct elbows • Labelling • 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: **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

2. Fabricate strap hanger systems

CONTENT

- Purpose
- Types
 - Strap hangers
 - Brackets
 - Saddles
 - Trapeze

- Safety
- Tools
- Hanger strap machine
 - Cutting
 - 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

CONTENT

- | | |
|---|---|
| <p>1. Describe installation of air handling ductwork and components</p> | <ul style="list-style-type: none"> • Obstacles • Duct • Slab duct • Components <ul style="list-style-type: none"> ○ Access doors ○ Volume dampers ○ Back draft dampers |
| <p>2. Install air handling ductwork and components</p> | <ul style="list-style-type: none"> • Components • Installation drawings <ul style="list-style-type: none"> ○ Elevation ○ Plan ○ Specifications • Tools and equipment • Safety • Hangers • Fasteners • Plumbing and levelling • Connection • Sealing • Field cutting |

Achievement Criteria

- | | |
|-----------------------|---|
| <p>1. Performance</p> | <p>The learner will install ductwork to specifications.</p> |
| <p>Conditions</p> | <p>The learner will be given:
 Project specifications
 Ductwork
 Tools and equipment</p> |
| <p>Criteria</p> | <p>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</p> |



- | | | |
|----|---------------------------|---|
| 2. | Performance
Conditions | The learner will install components to specifications.
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



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

CONTENT

- | | |
|---|--|
| <p>1. Review sheet metal hand tools</p> | <ul style="list-style-type: none"> • Squares • Rules • Dividers • Marking devices • Hammers • Punches • Chisels • Hack saws • Snips • Files • Pliers • Screw drivers • Fold-up tools • Pop riveter • Bubble level |
| <p>2. Describe sheet metal hand tools used in architectural and decking processes</p> | <ul style="list-style-type: none"> • Bavarian snips • Chalk line • Hand seamers • Deck crimpers • Laser level • Folding tools • Specialty hammers |
| <p>3. Use hand tools</p> | <ul style="list-style-type: none"> • 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 architectural sheet metal processes.
- Use shop equipment.
- Inspect and maintain shop equipment.

LEARNING TASKS

CONTENT

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Review shop equipment | <ul style="list-style-type: none"> • 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 |
| <ol style="list-style-type: none"> 2. Describe shop equipment used for architectural purposes | <ul style="list-style-type: none"> • Roll forming machines • XYZ machines • Hand brake S-lock former • Slitter |
| <ol style="list-style-type: none"> 3. Use shop equipment | <ul style="list-style-type: none"> • 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

2. Review welding safety

3. Describe gas metal arc welding (GMAW)

4. Describe shielded metal arc welding (SMAW)

CONTENT

- Shielded metal arc welding (SMAW)
- Gas metal arc welding (GMAW)
- Equipment/hand tools

- Licensing and training requirements
- Government regulations
- Ventilation requirements
- Flammable material recognition
- Personal protective equipment
- Compressed gas safety

- Purpose/Uses
- Limitations
- Equipment
- Materials to be welded
- Consumables
- Safety
- Advanced procedures/operations
- Set-up
- Adjustment
- Take down
- Inspection
- Maintenance
- Storage

- 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 |



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

CONTENT

- | | |
|--|---|
| <p>1. Review fasteners and their uses</p> | <ul style="list-style-type: none"> • Types • Purpose • Limitations |
| <p>2. Review fastening tools</p> | <ul style="list-style-type: none"> • Types • Procedures for use • Safety considerations • Inspection • Maintenance • Storage |
| <p>3. Describe architectural and decking fastening systems</p> | <ul style="list-style-type: none"> • Panel clips • Cleats • Expansion and contraction joints • Shims • Powder actuated fasteners • Exposed fasteners • Compatibility of materials <ul style="list-style-type: none"> o Isolation |
| <p>4. Use fasteners</p> | <ul style="list-style-type: none"> • 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

3. Solve problems using formulas

4. Review formulas used for triangles

5. Apply mathematics to sheet metal related problems

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
- 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

- | | |
|---|--|
| <p>1. Describe the different types and uses of drawings</p> | <ul style="list-style-type: none"> • Views <ul style="list-style-type: none"> ○ Orthographic ○ Isometric ○ Oblique ○ Perspective • Types of drawings <ul style="list-style-type: none"> ○ Civil ○ Architectural ○ Structural ○ Mechanical ○ Electrical ○ Shop ○ As-built ○ Landscape |
| <p>2. Describe line types, symbols and abbreviations used in drawings</p> | <ul style="list-style-type: none"> • Lines • Symbols • Abbreviations |
| <p>3. Interpret welding symbols</p> | <ul style="list-style-type: none"> • Location • Process • Type • Pitch and length |
| <p>4. Describe the scales used in drawings</p> | <ul style="list-style-type: none"> • Architect's scale • Metric scale |



LEARNING TASKS

5. Describe the purpose of drawings and their parts

6. Describe contract documents

7. Describe construction specifications

8. Use contract documents and construction specifications

9. Describe shop fabrication drawings

10. Create a shop fabrication drawing

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

- Types
- Purpose

- Master format
- Purpose
- Addendums

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

- Purpose
- Information contained
- Generation process

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

Achievement Criteria

Performance	The learner will create a shop fabrication drawing from field measurements.
Conditions	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: **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
 - 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



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

CONTENT

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Describe considerations when handling architectural materials | <ul style="list-style-type: none"> • Safety • Storage • Timing • Transportation • Hoisting and rigging • Work platforms • Labelling • Moving • Product protection • Disposal • Recycling |
| <ol style="list-style-type: none"> 2. Select procedures for handling architectural materials | <ul style="list-style-type: none"> • Safety • Procedures • Securing • Packaging/shipping |



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. Review pictorial drawings

2. Review orthographic projection

3. Develop pictorial and orthographic drawings

CONTENT

- Isometric
- Perspective
- Oblique
- Dimensioning
- Lettering
- Scaling
- Line types
- Free hand sketches
- Tools

- 3rd angle projection

- 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: **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

CONTENT

- | | |
|---|---|
| <p>1. Describe drafting techniques for triangulation</p> | <ul style="list-style-type: none"> • Tools • Line development <ul style="list-style-type: none"> ○ Construction ○ Triangulation • Geometric construction <ul style="list-style-type: none"> ○ Front view ○ Plan view ○ Visualization in three dimensions ○ Required views • Mathematical formulas |
| <p>2. Develop patterns using triangulation for architectural applications</p> | <ul style="list-style-type: none"> • Applications <ul style="list-style-type: none"> ○ Square to round on a pitch (Roof jack) ○ 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: **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

CONTENT

- | | |
|--|--|
| <p>1. Describe software programs applicable to the sheet metal industry</p> | <ul style="list-style-type: none"> • CAD (Computer Aided Design) programs • SDS (Shop Data Systems) programs • Office software <ul style="list-style-type: none"> ○ Word processing ○ Data base ○ Spreadsheets ○ E-mail ○ Presentation ○ Project management ○ Estimating |
| <p>2. Describe employment opportunities through enhanced computer skills</p> | <ul style="list-style-type: none"> • Estimator • Detailer • Project manager • Construction manager |
| <p>3. Describe the advantages and disadvantages of using computers to generate patterns and control cutting machines</p> | <ul style="list-style-type: none"> • Advantages <ul style="list-style-type: none"> ○ Easy to make revisions ○ Storing patterns ○ Less waste in the nesting ○ Accuracy ○ Speed ○ Automatic labelling • Disadvantages <ul style="list-style-type: none"> ○ Initial cost ○ Training requirements ○ Cutting machine consumables |



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

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Describe considerations necessary when selecting metal for architectural applications
 2. Describe other materials used in architectural applications
 3. Describe building envelope requirements
 4. Describe material applications | <ul style="list-style-type: none"> • Corrosion resistance • Malleability • Ductility • Elasticity • Expansion and contraction • Cost • Durability • Appearance • Gauges • Galvanic scale • Weight • Material finishes
 • Plastic • Composites • Fibreglass • Rubber • Polyvinylchloride (PVC) • Ethylene Propylene Diene Monomer (EPDM) • Expanded Polystyrene (EPS)
 • Rain screen • Flashings • Air/vapour barrier • Waterproofing membrane • Slip sheets • Sub-girt • Insulation
 • 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
2. Select materials
3. Fabricate fittings and components

CONTENT

- Style A
- Style B
- Types
- Gauges
- Cutting list
- Components
 - Turning vanes
 - Fire damper sleeves
 - 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

CONTENT

1. Describe shop layout techniques for duct fittings

2. Fabricate duct fittings

3. Install components

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

- Applications
 - Two way transition
 - Change cheek ogee offset
 - Drop cheek elbows
 - Transitional ogee offset
 - Square throat square heel elbow
- Cross-braking
- Labelling

- 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



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 | <ul style="list-style-type: none"> • Purpose • Types <ul style="list-style-type: none"> ○ Strap hangers ○ Brackets ○ Saddles ○ Trapeze |
| 2. Fabricate saddle and trapeze hanger systems | <ul style="list-style-type: none"> • 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



Line (GAC): E **FABRICATE TRADE RELATED PRODUCTS**
Competency: E8 **Fabricate architectural components**

Objective

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

- Fabricate architectural components.

LEARNING TASKS

CONTENT

- | | |
|---------------------------------------|--|
| 1. Describe architectural components | <ul style="list-style-type: none"> • Louvers • Scuppers • Roof jack • Roofing • Decking • Cladding • Gutter mitre |
| 2. Fabricate architectural components | <ul style="list-style-type: none"> • 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 The learner will fabricate a 16 gauge mild steel welded belt guard.

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

Criteria The learner will score 70% or better on a rating sheet that reflects the following criteria:
 Safety
 Tools selection
 Procedure
 Project is accurate to specified standards



Line (GAC): **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

- | | |
|--|---|
| <p>1. Install air handling ductwork and components</p> | <ul style="list-style-type: none"> • Components • Installation drawings <ul style="list-style-type: none"> ○ Elevation ○ Plan ○ Specifications • Tools and equipment • Safety • Hangers • Fasteners • Plumbing and levelling • Connection • Sealing • Field cutting • Field modification |
|--|---|

Achievement Criteria

- | | |
|--------------------------------------|---|
| <p>1. Performance
Conditions</p> | <p>The learner will install ductwork to specifications using trapeze hangers.
The learner will be given:
Project specifications
Ductwork
Tools and equipment</p> |
| <p>Criteria</p> | <p>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</p> |
| <p>2. Performance
Conditions</p> | <p>The learner will install spiral pipe to specifications using saddle hangers.
The learner will be given:
Project specifications
Spiral pipe
Tools and equipment</p> |
| <p>Criteria</p> | <p>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</p> |



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

CONTENT

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

5. Describe the installation of subsurface systems

6. Install roofing and cladding system components

CONTENT

- Roof structures
 - Pitched
 - Tapered
 - Domes
 - Spires
- Roof construction features
 - Hips
 - Ridges
 - Valleys
- Roof hatches
- Materials
- Procedures
- Tools
 - Transit
 - Level
 - Chalk line
- Systems
 - Vapour barrier
 - Waterproof membrane
 - Slip sheet
 - Insulation
 - Isolation material
- Building envelop
- Sub girts
- Fastener types
- Manufacturers' recommended installation methods
- Cutting
- Fitting
- Securing
- Sealing
- 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



Line (GAC): H **INSTALL ARCHITECTURAL AND SPECIALTY COMPONENTS**
Competency: H2 **Install panel systems**

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

2. Describe the installation of subsurface systems

3. Describe the cutting of panels

CONTENT

- Wall systems
 - Composite panels
 - Sandwich panels
 - Related flashings

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

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



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.

LEARNING TASKS

1. Describe site preparation

2. Describe the installation of exterior components

CONTENT

- 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
- 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

2. Describe power tools used for specialty applications

3. Use portable power tools

CONTENT

- Drills
- Grinders
- Nibblers
- Shears
- Saws
- Electric seamers
- Gas powered tools

- Pneumatic tools
- Stainless steel weld finishing tools
- Hydraulic 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

2. Describe shop equipment used for specialty purposes

3. Use 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

- 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.
- Weld using SMAW, GTAW and GMAW.

LEARNING TASKS

CONTENT

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

CONTENT

- | | |
|---|---|
| 5. Describe gas tungsten arc welding (GTAW) | <ul style="list-style-type: none"> • Purpose/uses • Limitations • Equipment • Materials to be welded • Consumables • Safety • Procedures/operations • Set-up • Adjustment • Take down • Inspection • Maintenance • Storage |
| 6. Use welding tools | <ul style="list-style-type: none"> • 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
2. Review mathematical formulas

3. Solve problems using formulas

4. Review formulas used for triangles

5. Apply mathematics to sheet metal related problems

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
- Review
 - 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
- New applications
 - Air volumes and velocity
 - Heavy gauge bend allowances
 - Air changes per hour



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

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

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Review the different types and uses of drawings | <ul style="list-style-type: none"> • Views <ul style="list-style-type: none"> ○ Orthographic ○ Isometric ○ Oblique ○ Perspective • Types of drawings <ul style="list-style-type: none"> ○ Civil ○ Architectural ○ Structural ○ Mechanical ○ Electrical ○ Shop ○ As-built ○ Landscape |
| <ol style="list-style-type: none"> 2. Review line types, symbols and abbreviations used in drawings | <ul style="list-style-type: none"> • Lines • Symbols • Abbreviations |
| <ol style="list-style-type: none"> 3. Review welding symbols | <ul style="list-style-type: none"> • Location • Process • Type • Pitch and length |
| <ol style="list-style-type: none"> 4. Review the scales used in drawings | <ul style="list-style-type: none"> • Architect's scale • Metric scale |



LEARNING TASKS

5. Review the purpose of drawings and their parts

6. Review contract documents and construction specifications

7. Review shop fabrication drawings

8. Create a shop fabrication drawing

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

- Types
- Purpose
- Master format
- Purpose
- Addendums
- Responsibilities and obligations
- Extracting information
- Quality control
- Commissioning

- Purpose
- Information contained
- Generation process

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

Achievement Criteria

Performance	The learner will create a shop fabrication drawing from plans and specifications.
Conditions	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



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

CONTENT

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Review documentation encountered in the sheet metal trade
 2. Review information contained in manufacturer and supplier documentation | <ul style="list-style-type: none"> • 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 requirements for a sheet metal project.
- Extract information from plans and specifications to organize a project.

LEARNING TASKS

1. Describe organization of a project

CONTENT

- 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):	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
2. Review the development of patterns using parallel line development

CONTENT

- Tools
- Views
 - Front
 - Plan
 - End
 - Which are required
 - Visualization in three dimensions
- Line development
 - Construction
 - Projection
- Geometric construction
- Mathematical formulas
- Applications
- Seam allowances
- Pattern labelling and forming instructions



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

CONTENT

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Describe software programs for pattern development 2. Use software to develop patterns | <ul style="list-style-type: none"> • 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



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

2. Describe material applications

CONTENT

- Types and properties of
 - Stainless steel
 - Aluminum
 - Hardened steel
 - Non-metals

- Food service industry
- Industrial
- Laboratories
- Signage
- Institutional
- Commercial
- Lagging
- Ornamental



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

CONTENT

- | | |
|---|---|
| <p>1. Review shop layout techniques for duct fittings</p> <p>2. Fabricate duct fittings</p> | <ul style="list-style-type: none"> • Tools and equipment • Line development • Geometric construction • Mathematical formulas • Cut list • Seam and joint allowances • Applications <ul style="list-style-type: none"> ○ Duct “Y” branch fittings ○ Drop cheek change elbow • Labelling |
|---|---|

Achievement Criteria

<p>Performance</p> <p>Conditions</p> <p>Criteria</p>	<p>The learner will fabricate and assemble duct fittings. Duct “Y” branch fittings Drop cheek change elbow</p> <p>The learner will be given: Project specifications Tools and equipment</p> <p>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</p>
--	---



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

CONTENT

- | | |
|--|---|
| 1. Review hanger systems | <ul style="list-style-type: none"> • Purpose • Types <ul style="list-style-type: none"> ○ Strap hangers ○ Brackets ○ Saddles ○ Trapeze |
| 2. Describe hanging considerations | <ul style="list-style-type: none"> • Weight • Structure • Vibration • Fasteners/anchors • Environment • Manufacturers' shop drawings • Seismic requirements |
| 3. Fabricate knee bracket hanger systems | <ul style="list-style-type: none"> • 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



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
2. Describe marine applications
3. Fabricate stainless steel products

CONTENT

- Types
- Purpose/applications
- Materials
- Waterproof louver
- Water tight joints
- Fully welded seams
- Marine terminology
- Safety considerations
- Metal properties
- Safety
- Material selection
- Tools and equipment
- Layout
- Mathematics
- Cut
- Form
- Welding
- Fastening
- Specifications
- Bend allowances
- Assemble
- Finish
 - Grinding and polishing
 - Plating
 - Passivation
 - Chemical Etching
 - Polishing compound
- Product protection



Achievement Criteria

Performance	The learner will fabricate a welded and finished stainless steel project.
Conditions	The learner will be given: Project specifications Tools and equipment Materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Safety Tools selection Procedure Final appearance Project is accurate to specified standards



Line (GAC): **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

CONTENT

- | | |
|---|--|
| <p>1. Describe basic industrial components</p> | <ul style="list-style-type: none"> • Components <ul style="list-style-type: none"> ○ Chutes ○ Hoppers ○ Conveyors • Purpose/applications • Materials |
| <p>2. Fabricate basic industrial components</p> | <ul style="list-style-type: none"> • Safety • Material selection • Tools and equipment • Layout • Mathematics • Cut • Form • Welding • Fastening • Specifications • Bend allowances • Assemble • Finish • Product protection |

Achievement Criteria

<p>Performance</p>	The learner will fabricate a field measured, welded twist fitting.
<p>Conditions</p>	The learner will be given: Project specifications Tools and equipment Materials
<p>Criteria</p>	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
 - Elevation
 - Plan
 - 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

CONTENT

- | | |
|--|---|
| <p>1. Describe residential heating, ventilation and air conditioning</p> | <ul style="list-style-type: none"> • Heat transfer • Furnace types • Controls • Equipment • Locations |
| <p>2. Describe residential duct systems</p> | <ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> ○ Loop ○ Extended plenum ○ Graduated plenum ○ Radial • Advantages/disadvantages • Selection • Application • Limitations |
| <p>3. Describe the installation of residential furnaces</p> | <ul style="list-style-type: none"> • 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

1. Describe venting

2. Describe the installation of bracing, hangers and supports

3. Describe the installation of flashing

4. Describe the connection of venting to appliances

CONTENT

- Types
- Purpose
 - Combustion and emissions
 - Types of appliances
 - Chimney
 - Venting
- Designs
 - Manifold
 - Multi-storey
- Components
 - Bracing
 - Hangers
 - Supports
 - Flashing
- Materials
- Draft control equipment
- Requirements
 - Clearances
 - Weight
 - Spacing
 - Seismic
- Materials
- Fasteners
- Flashing
- Materials
- Selection
- Weatherproofing materials
- Fastening
- Types of appliances
- Manufacturers' specifications
- Sealants
- Materials
- Fastening



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

CONTENT

1. Describe the installation of stainless steel specialty products

2. Describe the installation of non-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

- 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

CONTENT

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Describe indoor air quality 2. Describe air flow in ducts 3. Describe testing and balancing procedures 4. Describe leak testing 5. Describe air balancing instruments and techniques | <ul style="list-style-type: none"> • Contaminates • Irritants • Odours • Noise • Filtration • Air flow • Duct design • Fitting design • Purpose • Pressures • Mathematics • Types <ul style="list-style-type: none"> ○ Smoke ○ Dye ○ Pressure ○ Fluid ○ Visual ○ Audible • Charts • Test selection • Specifications • System preparation for testing <ul style="list-style-type: none"> ○ Temporary caps ○ Access doors ○ Test ports • Balancing instruments <ul style="list-style-type: none"> ○ 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 |
|---|--|



LEARNING TASKS

- 6. Describe relative humidity
- 7. 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

2. Describe shop equipment used for specialty purposes

3. Use 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
- Cut to length line
- Duct line
- Transverse joint machine
- Spiral machine
- 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

CONTENT

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Review types of welding and cutting equipment and processes
 2. Review welding and cutting safety | <ul style="list-style-type: none"> • Shielded metal arc welding (SMAW) • Gas metal arc welding (GMAW) • Gas tungsten arc welding (GTAW) • Oxy-acetylene • Plasma • Equipment/hand tools
 • 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

2. Review fastening tools

CONTENT

- Types
- Purpose
- Limitations

- Types
- Procedures for use
- Safety considerations
- Inspection
- Maintenance
- Storage



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

CONTENT

- | | |
|---|---|
| <p>1. Review hoisting, lifting and rigging equipment</p> | <ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> ○ Lifting equipment ○ Rigging equipment ○ Rolling equipment • Uses • Limitations and capacities • Government regulations • Safety |
| <p>2. Review knots bends and hitches</p> | <ul style="list-style-type: none"> • Rope types • Working load limits • Terms • General rules • Knot, bend and hitch types • Inspection • Maintenance • Storage |
| <p>3. Review the use of hoisting, lifting and rigging equipment</p> | <ul style="list-style-type: none"> • Selection of equipment • Selection of lifting location or point • Safety • Operating procedures • Communication and hand signals • Securing of loads • Inspection • Maintenance • Storage |



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

3. Review formulas used for triangles

4. Apply mathematics to sheet metal related problems

CONTENT

- Types
- Linear measurement
 - Metric
 - Imperial
- Stretch outs
- Areas
- Volumes
- Capacities
- Metric conversions
- Squares
- Square roots

- Pythagorean Theorem
- Trigonometric functions

- Word problems
- Transposition to solve for different unknowns
- Review
 - 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
 - Air volumes and velocity
 - Heavy gauge bend allowances
 - Air changes per hour
- New applications
 - Fan laws
 - Pulley ratios
 - Heat loss
 - British Thermal Units (BTUs)



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

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Review the different types and uses of drawings | <ul style="list-style-type: none"> • Views <ul style="list-style-type: none"> ○ Orthographic ○ Isometric ○ Oblique ○ Perspective • Types of drawings <ul style="list-style-type: none"> ○ Civil ○ Architectural ○ Structural ○ Mechanical ○ Electrical ○ Shop ○ As-built ○ Landscape |
| <ol style="list-style-type: none"> 2. Review line types, symbols and abbreviations used in drawings | <ul style="list-style-type: none"> • Lines • Symbols • Abbreviations |
| <ol style="list-style-type: none"> 3. Review welding symbols | <ul style="list-style-type: none"> • Location • Process • Type • Pitch and length |
| <ol style="list-style-type: none"> 4. Review the scales used in drawings | <ul style="list-style-type: none"> • Architect's scale • Metric scale |
| <ol style="list-style-type: none"> 5. Review the purpose of drawings and their parts | <ul style="list-style-type: none"> • Plot plan • Foundation plan • Floor plan • Reflected ceiling plan • Roof plan • Elevation • Sections • Details • Title block • Revisions <ul style="list-style-type: none"> ○ Requests for information ○ Change orders ○ Addendums |



LEARNING TASKS

CONTENT

6. Review contract documents and construction specifications

- Schedules
- Legends
- Schematics
- 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

- | | | |
|----|-------------|--|
| 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: **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

CONTENT

- | | |
|--|---|
| <ol style="list-style-type: none"> 1. Review documentation encountered in the sheet metal trade
 2. Review information contained in manufacturer and supplier documentation | <ul style="list-style-type: none"> • 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 requirements for a sheet metal project.
- Extract information from plans and specifications to organize a project.

LEARNING TASKS

1. Describe organization of a project

CONTENT

- Project specifications
- Safety
- Sequence of operation
- Scheduling
 - Critical path
- 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
- Contract documents
- Manufacturers information
- Mathematics
- Tools



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
2. Review the development of patterns using parallel line development

CONTENT

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

CONTENT

- | | |
|--|---|
| <p>1. Review the selection of drafting equipment for radial line development</p> | <ul style="list-style-type: none"> • Tee squares • Dividers • Compasses • Rulers • Scales • Set squares • Protractors • Pencils • Calculators |
| <p>2. Review drafting techniques for radial line development</p> | <ul style="list-style-type: none"> • Line development <ul style="list-style-type: none"> ○ Construction ○ Radial line • Geometric construction <ul style="list-style-type: none"> ○ Front view ○ Plan view ○ Visualization in three dimensions ○ Required views • Mathematical formulas • Right cones (chimney cap) <ul style="list-style-type: none"> ○ Frustum (storm collar) ○ Truncated (roof jack on a slope) ○ Round reducer on centre. |
| <p>3. Review the development of patterns using radial line development</p> | <ul style="list-style-type: none"> • 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

CONTENT

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. Review drafting techniques for triangulation
 2. Review the development of patterns using triangulation
 3. Describe difference in profile triangulation | <ul style="list-style-type: none"> • Tools • Line development <ul style="list-style-type: none"> ○ Construction ○ Triangulation • Geometric construction <ul style="list-style-type: none"> ○ Front view ○ Plan view ○ Visualization in three dimensions ○ Required views • Mathematical formulas
 • Applications <ul style="list-style-type: none"> ○ Square to round on a pitch (Roof jack) ○ Round reducer on a pitch (Roof jack) • Seam allowances • Pattern labelling
 • Method • Applications <ul style="list-style-type: none"> ○ 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

CONTENT

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Review drafting techniques for duct fittings
 2. Review the development of patterns for duct fittings
 3. Develop advanced patterns for duct fittings | <ul style="list-style-type: none"> • Tools • Line development <ul style="list-style-type: none"> ○ Construction • Geometric construction <ul style="list-style-type: none"> ○ Front view ○ Plan view ○ Visualization in three dimensions ○ Required views • Mathematical formulas
 • Applications <ul style="list-style-type: none"> ○ Duct “Y” branch fittings ○ Drop cheek change elbow • Seam and joint allowances • Pattern labelling
 • Applications • Seam and joint allowances • Pattern labelling and forming instructions |
|--|--|

Achievement Criteria

<p>Performance</p> <p>Conditions</p> <p>Criteria</p>	<p>The learner will develop patterns for: Duct “Y” branch fittings Drop cheek change elbow</p> <p>The learner will be given: Project specifications Drafting equipment Paper Calculator</p> <p>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</p>
--	---



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

CONTENT

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Review software programs for pattern development 2. Describe software programs that provide more than just pattern development 3. Review the use of software to develop patterns | <ul style="list-style-type: none"> • Proprietary software • Package software which includes <ul style="list-style-type: none"> ○ Estimation ○ Design ○ Fabrication ○ Project management • Enter fittings from shop fabrication drawings |
|---|---|

Achievement Criteria

<p>Performance</p> <p>Conditions</p> <p>Criteria</p>	<p>The learner will enter information from a shop fabrication drawing using computer aided sheet metal software program.</p> <p>The learner will be given: Project specifications Computer and software application</p> <p>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</p>
--	---



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

CONTENT

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Review types and properties of materials used in the sheet metal trade | <ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> ○ Metals ○ Non-metals • Properties • Applications |
|---|---|



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

CONTENT

- | | |
|---|---|
| <p>1. Review shop layout techniques for duct fittings</p> | <ul style="list-style-type: none"> • Tools and equipment • Line development • Geometric construction • Mathematical formulas • Cut list • Seam and joint allowances |
| <p>2. Fabricate advanced duct fittings</p> | <ul style="list-style-type: none"> • Applications <ul style="list-style-type: none"> ○ Duct “Y” branch fittings ○ Drop cheek change elbow • Labelling |

Achievement Criteria

<p>Performance</p>	<p>The learner will fabricate and assemble advanced duct fittings. Duct “Y” branch fittings Drop cheek change elbow</p>
<p>Conditions</p>	<p>The learner will be given: Project specifications Tools and equipment</p>
<p>Criteria</p>	<p>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</p>



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

CONTENT

- | | |
|--|---|
| <p>1. Describe equipment bases and supports</p> | <ul style="list-style-type: none"> • Purpose • Types • Size • Weights |
| <p>2. Describe the fabrication of equipment bases and supports</p> | <ul style="list-style-type: none"> • 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

CONTENT

- | | |
|--|--|
| <p>1. Describe advanced industrial components</p> | <ul style="list-style-type: none"> • Components <ul style="list-style-type: none"> ○ Blow pipe elbow ○ Tapers ○ Transitions ○ Fans ○ Wheel ○ Blow boxes ○ Hoods • Purpose/applications • Materials |
| <p>2. Fabricate advanced industrial components</p> | <ul style="list-style-type: none"> • Safety • Material selection • Tools and equipment • Layout • Mathematics • Cut • Form • Welding • Fastening • Specifications • Bend allowances • Assemble • Finish • Product protection |

Achievement Criteria

<p>Performance</p>	<p>The learner will fabricate a welded blow pipe elbow.</p>
<p>Conditions</p>	<p>The learner will be given: Project specifications Tools and equipment Materials</p>
<p>Criteria</p>	<p>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</p>



Line (GAC): **F** **INSTALL AIR HANDLING SYSTEMS**
Competency: **F1** **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

CONTENT

- | | |
|---|---|
| <p>1. Describe air handlers</p> | <ul style="list-style-type: none"> • Purpose • Types <ul style="list-style-type: none"> ○ Furnaces ○ Fans ○ Rooftop units ○ Built-up systems ○ Air conditioners ○ Heat pumps ○ Fan powered mixing boxes ○ Dual duct • Operation |
| <p>2. Describe the installation of air handlers</p> | <ul style="list-style-type: none"> • Manufacturers' specifications • Effect of weather on installation • Maintenance considerations • Hoisting • Curbs • Penetration size • Penetration obstructions • Sleepers • Stands • Housekeeping pads • Seismic restraints • Isolators <ul style="list-style-type: none"> ○ Inertia bases ○ Isolation springs ○ Isolation pads |
| <p>3. Describe heat and energy recovery ventilators</p> | <ul style="list-style-type: none"> • Purpose • Types • Operation • Applications |
| <p>4. Describe the installation of heat and energy recovery ventilators</p> | <ul style="list-style-type: none"> • Codes and Regulations • Manufacturers' specifications • Filter types • Hanging hardware • Stands |



LEARNING TASKS

CONTENT

- | | |
|---|---|
| <p>4. Describe the installation of outlet covers</p> | <ul style="list-style-type: none"> • Purpose • Types <ul style="list-style-type: none"> ○ Registers ○ Grilles ○ Diffusers ○ Louvers • Operation • Manufacturers' specifications • Fastening • Sealing |
| <p>5. Describe the installation of coils</p> | <ul style="list-style-type: none"> • Purpose • Types <ul style="list-style-type: none"> ○ Electric ○ Hydronic ○ Direct expansion • Refrigeration principles • Codes and Regulations • Manufacturers' specifications • Securing • Sealing • Access doors • Drain pans |
| <p>6. Describe the installation of system component accessories</p> | <ul style="list-style-type: none"> • Types <ul style="list-style-type: none"> ○ Humidifiers ○ Silencers ○ Air valves ○ Variable air volume boxes ○ Mixing boxes ○ Filter banks ○ Drain pans ○ Burglar bars ○ Access doors ○ Flexible duct ○ Acoustic plenums ○ Unit heaters • Purpose • Codes and Regulations • Manufacturers' specifications • Location • Sealing |

**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



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

- | | |
|---|--|
| <p>1. Describe material handling systems</p> | <ul style="list-style-type: none"> • Purpose <ul style="list-style-type: none"> ○ Product movement ○ Waste removal ○ Pollution control • Types <ul style="list-style-type: none"> ○ Air moving devices ○ Collection devices ○ Separating devices ○ Filtering devices ○ Heat recovery devices ○ Dampers • Components <ul style="list-style-type: none"> ○ Blast gates ○ Cleanouts ○ Slips ○ Cyclones ○ Ball joints ○ Abort gate ○ Systems service access ○ Fitting design • Operation • Air flow |
| <p>2. Describe the installation of supports and bases</p> | <ul style="list-style-type: none"> • Dimensions and weights of components • Orientation and location of units • Securing of equipment |
| <p>3. Describe the installation of air moving devices</p> | <ul style="list-style-type: none"> • Purpose • Types <ul style="list-style-type: none"> ○ Axial ○ Centrifugal ○ Forward inclined ○ Backward inclined ○ Paddle • Codes and Regulations • Manufacturers' specifications • Fastening |



LEARNING TASKS

CONTENT

- | | |
|---|--|
| <p>4. Describe the installation of collection devices</p> | <ul style="list-style-type: none"> • Purpose • Types <ul style="list-style-type: none"> ○ Hoppers ○ Hoods ○ Bins • Codes and Regulations • Manufacturers' specifications • Positioning • Fastening • Effects of weather on installation |
| <p>5. Describe the installation of separating devices</p> | <ul style="list-style-type: none"> • Purpose • Types <ul style="list-style-type: none"> ○ Cyclones ○ Bag houses ○ Conveyor skirting • Parts <ul style="list-style-type: none"> ○ 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
 - Thermal expansion and contraction
 - Stainless steel
 - Aluminum
 - Coated steel
 - Membrane
 - Plastic
- Insulation
 - Types
 - Application
- Cladding components
 - End caps
 - Buttstraps
 - Preformed elbows
 - Stand offs
 - Flashing
- Mechanical equipment
 - Boilers
 - Piping
 - Pressure vessels
 - Cladding requirements
- Process
 - Mathematics
 - Layout
 - Banding machines
 - Securing techniques
 - Installation techniques
 - Sealants



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 the required system adjustments and generate a report.

LEARNING TASKS

CONTENT

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Review indoor air quality 2. Review air flow in ducts 3. Review testing and balancing procedures 4. Review leak testing | <ul style="list-style-type: none"> • Contaminates • Irritants • Odours • Noise • Filtration • Air flow • Duct design • Fitting design • Purpose • Pressures • Mathematics • Types <ul style="list-style-type: none"> ○ Smoke ○ Dye ○ Pressure ○ Fluid ○ Visual ○ Audible • Charts • Test selection • Specifications • System preparation for testing <ul style="list-style-type: none"> ○ Temporary caps ○ Access doors ○ Test ports |
|---|---|



LEARNING TASKS

5. Review air balancing instruments and techniques

6. Review relative humidity

7. Describe the commissioning process

8. Calculate required system adjustments for reports

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

- Psychrometric chart

- Trade coordination
- System operation verification

- Inspection report
- Recommended solutions to problems

Achievement Criteria

Performance	The learner will calculate the required system adjustments and generate a testing report.
Conditions	The learner will be given: Test data System design data Tools and equipment Testing forms
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Process Calculated adjustments Completed report



Line (GAC):	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.

LEARNING TASKS

CONTENT

<p>1. Describe normal operation of a system</p>	<ul style="list-style-type: none"> • Sounds • Vibrations • Smells • Heat build-ups • Fan laws
<p>2. Identify signs of abnormality</p>	<ul style="list-style-type: none"> • Sounds • Vibrations • Smells • Heat build-ups • Signs of wear and fatigue
<p>3. Describe the servicing and repair of components</p>	<ul style="list-style-type: none"> • Safety/lock out • Frequency of scheduled servicing • Warranty • Devices <ul style="list-style-type: none"> ○ Belts ○ Pulleys ○ Bearings ○ Fan blades ○ Filters ○ Motors ○ Shafts ○ Gears/chains • Inspection • Cleaning • Adjustment • Lubrication • Filters <ul style="list-style-type: none"> ○ Types ○ Construction ○ Applications ○ Locations ○ Changing ○ Cleaning • Repair sequence <ul style="list-style-type: none"> ○ Removal ○ Replacement • Patching methods



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

HAND TOOLS TO BE SUPPLIED BY STUDENTS: None

PERSONAL PROTECTIVE EQUIPMENT AND SAFETY EQUIPMENT: LEVELS 1 to 4

Eye protection	Hard hat
Eye wash station	Hearing protection
Face shield	Respiratory protection
Fire extinguisher	Welding curtain
First aid kit	Welding jacket
Gloves	Welding helmet

LAYOUT AND DRAFTING EQUIPMENT: LEVELS 1 to 4

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

MEASURING TOOLS: LEVELS 1 to 4

2	Angle finders	16	Tape measures
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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	



COMPUTER ASSISTED TOOLS: LEVELS 2, 3 and 4

8 Computer hardware
1 Printer

8 Software packages



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.



Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:		SHEET METAL WORKER LEVEL 1 0018SM01	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	Use of Safe Work Practices	7%	0%
B	Use of Tools and Equipment	18%	32%
C	Organize Work	16%	0%
D	Layout and Develop Patterns	30%	15%
E	Fabricate Trade Related Products	23%	53%
F	Install Air Handling Systems	6%	0%
	Total	100%	100%
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%	



PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:		SHEET METAL WORKER LEVEL 2 0018SM02	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	Use Safe Work Practices	7%	0%
B	Use Tools and Equipment	18%	17%
C	Organize Work	16%	4%
D	Layout and develop Patterns	23%	18%
E	Fabricate Trade Related Products	19%	43%
F	Install Air Handling Systems	5%	5%
H	Install Architectural and Specialty Components	12%	13%
	Total	100%	100%
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%	



PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:		SHEET METAL WORKER LEVEL 3 0018SM03	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	Use Safe Work Practices	3%	0%
B	Use Tools and Equipment	12%	18%
C	Organize Work	8%	6%
D	Layout and Develop Patterns	22%	17%
E	Fabricate Trade Related Products	13%	50%
F	Install Air Handling Systems	16%	9%
G	Install Industrial Systems	7%	0%
H	Install Architectural and Specialty Components	5%	0%
I	Service Systems	14%	0%
	Total	100%	100%
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%



PROGRAM: IN-SCHOOL TRAINING: ITA DIRECT ACCESS CODE:		SHEET METAL WORKER LEVEL 4 0018SM04	
LINE	SUBJECT COMPETENCIES	THEORY WEIGHTING	PRACTICAL WEIGHTING
A	Use Safe Work Practices	4%	0%
B	Use Tools and Equipment	12%	0%
C	Organize Work	18%	15%
D	Layout and Develop Patterns	17%	30%
E	Fabricate Trade Related Products	15%	55%
F	Install Air Handling Systems	14%	0%
G	Install Industrial Systems	10%	0%
I	Service Systems	10%	0%
	Total	100%	100%

Calculated by the Training Provider:		
SHEET METAL WORKER in-school theory & practical subject competency weighting	62%	38%
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	FINAL %	

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.