SKILLEDTRADESBC

PROGRAM OUTLINE

Sheet Metal Worker

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SKILLED TRADES BC

SHEET METAL WORKER
HARMONIZED PROGRAM OUTLINE

APPROVED BY INDUSTRY

JANUARY 2018

BASED ON

RSOS 2017

Developed by
SkilledTradesBC
Province of British Columbia

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Section 1

INTRODUCTION

Sheet Metal Worker

Foreword

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

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

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

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

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

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

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

SAFETY ADVISORY

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

Acknowledgements

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- Bob Pascuzzi
- Doug Savory

SkilledTradesBC 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	Communicates 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
OAC	Communicates 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, measureable 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
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

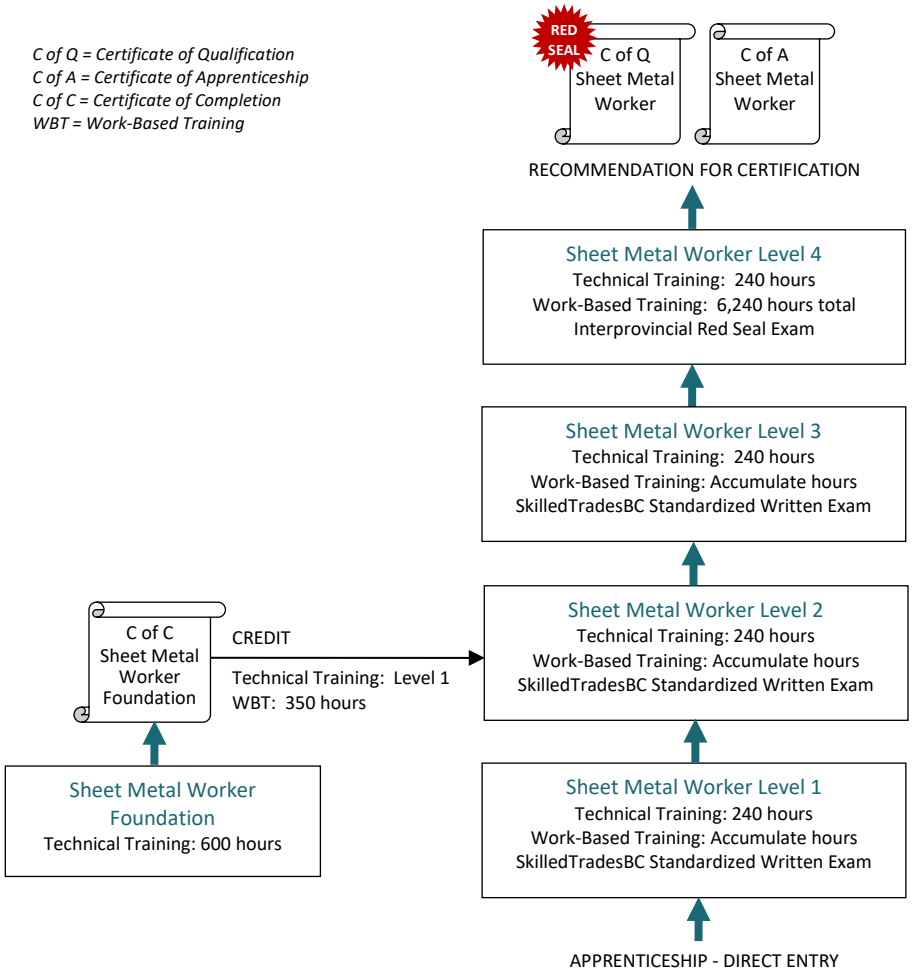
PROGRAM OVERVIEW

Sheet Metal Worker

Program Credentialing Model

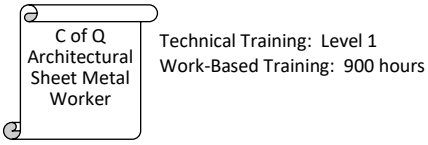
Apprenticeship Pathway

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



CROSS-PROGRAM CREDITS

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



Occupational Analysis Chart

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, metal roofing, restaurant, kitchen, marine installations and hospital equipment fields.

Block	Task	Code					
PERFORM SAFETY RELATED FUNCTIONS (A)	Use personal protective equipment (PPE) and safety equipment	A1	1				
	Maintain safe work environment	A2	1				
	Perform lock-out and tag-out procedures	A3	1				
	Use WHMIS	A4	1				
USE AND MAINTAIN TOOLS AND EQUIPMENT (B)	Use hand and portable power tools	B1	1				
	Use shop tools and equipment	B2	1	2	3		
	Use gas metal arc welding (GMAW) equipment	B3	1	2	3	4	
	Use gas tungsten arc welding (GTAW) equipment	B4			3		
	Use shielded metal arc welding (SMAW) equipment	B5	1	2			
	Use oxy-fuel and plasma arc cutting equipment	B6	1				
	Use soldering and brazing equipment	B7	1	2			
	Use measuring and layout equipment	B8	1				
	Use stationary and mobile work platforms	B9	1				
	Use hoisting, rigging and positioning equipment	B10	1			4	
ORGANIZE WORK (C)	Use trade related documentation	C1	1	2			
	Interpret drawings	C2	1	2			
	Organize materials and equipment for projects	C3	1				
	Perform basic design and field modifications	C4		2			
	Use mathematics	C5	1				
USE COMMUNICATION AND MENTORING TECHNIQUES (D)	Use communication techniques	D1	1				
	Use mentoring techniques	D2				4	

HARMONIZED PROGRAM OUTLINE
Program Overview

PERFORM PATTERN DEVELOPMENT **E**	Develop patterns using simple and straight line methods E1	1	2				Develop patterns using parallel line method E2	1	2	3			Develop patterns using radial line development E3	1	2	3			Develop patterns using triangulation method E4	1	2	3	4		Use computer technology for pattern development E5				4	
FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS F	Select materials for trade related products F1	1					Fabricate ductwork, fittings and components F2	1	2	3	4		Insulate ductwork, fittings and components F3	1					Fabricate material handling system components F4		2	3	4		Fabricate dampers F5				4		Fabricate hanger systems, supports and bases F6	1				
FABRICATE ARCHITECTURAL SHEET METAL PRODUCTS **G**	Select material for flashing, roofing, sheeting and cladding G1		2				Fabricate flashing, roofing, sheeting and cladding G2		2																						
FABRICATE PRODUCTS FROM SPECIALTY MATERIALS **H**	Select material for specialty products H1			3			Fabricate specialty products H2			3																				
PREPARE INSTALLATION SITE **I**	Perform on-site measurements I1		2				Perform demolition for renovations I2		2																						
INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLINCES AND MECHANICAL EQUIPMENT J	Install chimneys J1		2				Connect appliances or mechanical equipment to chimney and breeching J2		2				Install high efficiency appliances and mechanical equipment. J3		2																	

Line	Competency	Code	Levels
INSTALL AIR HANDLING SYSTEM COMPONENTS (K)	Install air handling equipment	K1	1, 2, 3, 4
	Install hangers, cables, braces and brackets	K2	2
	Install sheet metal ducts, fittings and dampers	K3	1
	Install penetrations and sleeves	K4	2
	Install registers, grilles, diffusers and louvers	K5	1
	Install terminal boxes and coils	K6	3
	Install system component accessories	K7	2, 3, 4
	Install residential systems	K8	1
	Install industrial, commercial and institutional systems	K9	3
INSTALL MATERIAL HANDLING SYSTEM COMPONENTS (L)	Install pneumatic material handling system components	L1	4
	Install gravity material handling system components	L2	4
	Install mechanized material handling system components	L3	4
APPLY THERMAL INSULATION, LAGGING, CLADDING AND FLASHING (M)	Apply lagging and cladding to components	M1	4
	Apply flashing to components	M2	4
PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING (N)	Perform leak tests	N1	3, 4
	Perform testing, adjusting and balancing (TAB)	N2	3, 4
	Participate in the commissioning of air and material handling systems	N3	3, 4
INSTALL METAL ROOFING AND CLADDING/ SIDING SYSTEMS (O)	Lay out roof and walls	O1	2
	Install insulation, isolation material and building envelope components	O2	2
	Install roofing, cladding/ siding system components	O3	2
	Seal exposed joints	O4	2
	Install decking	O5	2

INSTALL EXTERIOR COMPONENTS **P**	Prepare surface P1		2			Fasten exterior components P2		2		
INSTALL SPECIALTY PRODUCTS **Q**	Install stainless steel specialty products Q1			3		Install non-stainless steel specialty products Q2			3	
	Install marine products Q3			3						
PERFORM SCHEDULED MAINTENANCE **R**	Diagnose system faults R1			3		Repair worn or faulty components R2			3	

Training Topics and Suggested Time Allocation: Level 1

SHEET METAL WORKER – LEVEL 1

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line A	**PERFORM SAFETY RELATED FUNCTIONS**	**7%**	**100%**	**0%**	**100%**
A1	Use personal protective equipment (PPE) and safety equipment		✓		
A2	Maintain safe work environment		✓		
A3	Perform lock-out and tag-out procedures		✓		
A4	Use WHMIS		✓		
Line B	**USE AND MAINTAIN TOOLS AND EQUIPMENT**	**25%**	**30%**	**70%**	**100%**
B1	Use hand and portable power tools		✓	✓	
B2	Use shop tools and equipment		✓	✓	
B3	Use gas metal arc welding (GMAW) equipment		✓	✓	
B5	Use shielded metal arc welding (SMAW) equipment		✓	✓	
B6	Use oxy-fuel and plasma arc cutting equipment		✓	✓	
B7	Use soldering and brazing equipment		✓	✓	
B8	Use measuring and layout equipment		✓	✓	
B9	Use stationary and mobile work platforms		✓	✓	
B10	Use hoisting, rigging and positioning equipment		✓	✓	
Line C	**ORGANIZE WORK**	**13%**	**85%**	**15%**	**100%**
C1	Use trade-related documentation		✓	✓	
C2	Interpret drawings		✓	✓	
C3	Organize materials and equipment for projects		✓		
C5	Use mathematics		✓		
Line D	**USE COMMUNICATION AND MENTORING TECHNIQUES**	**2%**	**50%**	**50%**	**100%**
D1	Use communication techniques		✓	✓	
Line E	**PERFORM PATTERN DEVELOPMENT**	**23%**	**80%**	**20%**	**100%**
E1	Develop patterns using simple and straight line methods		✓	✓	
E2	Develop patterns using parallel line method		✓	✓	
E3	Develop patterns using radial line development		✓	✓	
E4	Develop patterns using triangulation method		✓	✓	
Line F	**FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS**	**17%**	**30%**	**70%**	**100%**
F1	Select materials for trade related products		✓		
F2	Fabricate ductwork, fittings and components		✓	✓	
F3	Insulate ductwork, fittings and components		✓	✓	
F6	Fabricate hanger systems, supports and bases		✓	✓	

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line K	**INSTALL AIR HANDLING SYSTEM COMPONENTS**	**13%**	**70%**	**30%**	**100%**
K1	Install air handling equipment		✓	✓	
K3	Install sheet metal ducts, fittings and dampers		✓	✓	
K5	Install registers, grilles, diffusers and louvers		✓	✓	
K8	Install residential systems		✓	✓	
	Total Percentage for Sheet Metal Worker Level 1	**100%**			

Training Topics and Suggested Time Allocation: Level 2

SHEET METAL WORKER – LEVEL 2

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line B	**USE AND MAINTAIN TOOLS AND EQUIPMENT**	**17%**	**30%**	**70%**	**100%**
B2	Use shop tools and equipment		✓	✓	
B3	Use gas metal arc welding (GMAW) equipment		✓	✓	
B5	Use shielded metal arc welding (SMAW) equipment		✓	✓	
B7	Use soldering and brazing equipment		✓	✓	
Line C	**ORGANIZE WORK**	**10%**	**70%**	**30%**	**100%**
C1	Use trade-related documentation		✓	✓	
C2	Interpret drawings		✓	✓	
C4	Perform basic design and field modifications		✓	✓	
Line E	**PERFORM PATTERN DEVELOPMENT**	**20%**	**75%**	**25%**	**100%**
E1	Develop patterns using simple and straight line methods		✓	✓	
E2	Develop patterns using parallel line method		✓	✓	
E3	Develop patterns using radial line development		✓	✓	
E4	Develop patterns using triangulation method		✓	✓	
Line F	**FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS**	**17%**	**30%**	**70%**	**100%**
F2	Fabricate ductwork, fitting and components		✓	✓	
F4	Fabricate material handling system components		✓	✓	
Line G	**FABRICATE ARCHITECTURAL SHEET METAL PRODUCTS**	**10%**	**50%**	**50%**	**100%**
G1	Select material for flashing, roofing, sheeting and cladding		✓	✓	
G2	Fabricate flashing, roofing, sheeting and cladding		✓	✓	
Line I	**PREPARE INSTALLATION SITE**	**2%**	**90%**	**10%**	**100%**
I1	Perform on-site measurements		✓	✓	
I2	Perform demolition for renovations		✓		
Line J	**INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLIANCES AND MECHANICAL EQUIPMENT**	**5%**	**100%**	**0%**	**100%**
J1	Install chimneys		✓		
J2	Connect appliances or mechanical equipment to chimney and breeching		✓		
J3	Install high efficiency appliances and mechanical equipment		✓		
Line K	**INSTALL AIR HANDLING SYSTEM COMPONENTS**	**9%**	**80%**	**20%**	**100%**
K1	Install air handling equipment		✓		

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
K2	Install hangers, cables, braces and brackets			✓	
K4	Install penetrations and sleeves			✓	
K7	Install system component accessories			✓	
Line O	**INSTALL METAL ROOFING AND CLADDING/SIDING SYSTEMS**	**8%**	**75%**	**25%**	**100%**
O1	Lay out roof and walls		✓	✓	
O2	Install insulation, isolation material and building envelope components		✓	✓	
O3	Install roofing, cladding/siding system components		✓	✓	
O4	Seal exposed joints		✓	✓	
O5	Install decking		✓		
Line P	**INSTALL EXTERIOR COMPONENTS**	**2%**	**100%**	**0%**	**100%**
P1	Prepare surface		✓		
P2	Fasten exterior components		✓		
	Total Percentage for Sheet Metal Worker Level 2	**100%**			

Training Topics and Suggested Time Allocation: Level 3

SHEET METAL WORKER – LEVEL 3

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

Training Topics and Suggested Time Allocation: Level 4

SHEET METAL WORKER – LEVEL 4

			% of Time Allocated to:		
		% of Time	Theory	Practical	Total
Line B	**USE AND MAINTAIN TOOLS AND EQUIPMENT**	**12%**	**40%**	**60%**	**100%**
B3	Use gas metal arc welding (GMAW) equipment		✓	✓	
B10	Use hoisting, rigging and positioning equipment		✓	✓	
Line D	**USE COMMUNICATION AND MENTORING TECHNIQUES**	**2%**	**100%**	**0%**	**100%**
D2	Use mentoring techniques		✓	✓	
Line E	**PERFORM PATTERN DEVELOPMENT**	**23%**	**75%**	**25%**	**100%**
E4	Develop patterns using triangulation method		✓	✓	
E5	Use computer technology for pattern development		✓		
Line F	**FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS**	**20%**	**35%**	**65%**	**100%**
F2	Fabricate ductwork, fittings and components		✓	✓	
F4	Fabricate material handling system components		✓	✓	
F5	Fabricate dampers		✓		
Line K	**INSTALL AIR HANDLING SYSTEM COMPONENTS**	**15%**	**75%**	**25%**	**100%**
K1	Install air handling equipment		✓		
K7	Install system component accessories		✓	✓	
Line L	**INSTALL MATERIAL HANDLING SYSTEM COMPONENTS**	**10%**	**90%**	**10%**	**100%**
L1	Install pneumatic material handling system components		✓		
L2	Install gravity material handling system components		✓	✓	
L3	Install mechanized material handling system components		✓		
Line M	**APPLY THERMAL INSULATION, LAGGING, CLADDING AND FLASHING**	**9%**	**80%**	**20%**	**100%**
M1	Apply lagging and cladding to components		✓	✓	
M2	Apply flashing to components		✓	✓	
Line N	**PERFORM LEAK TESTING, AIR BALANCING AND COMMISSIONING**	**9%**	**80%**	**20%**	**100%**
N1	Perform leak tests		✓	✓	
N2	Perform testing, adjusting and balancing (TAB)		✓	✓	
N3	Participate in the commissioning of air and material handling systems		✓	✓	
	Total Percentage for Sheet Metal Worker Level 4	**100%**			

Section 3

PROGRAM CONTENT

Sheet Metal Worker

Level 1

Sheet Metal Worker

Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS

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

Objectives

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

- Select and use personal protective equipment.

LEARNING TASKS	CONTENT
1. Describe personal protective equipment requirements	• Safety footwear • Eye protection • Ear protection • Head protection • Respiratory protection • Clothing • Fall protection • CSA Standards • WorkSafeBC Standards
2. Use personal protective equipment	• Use • Inspection • Maintenance • Storage • Limitations of PPE • Fit test • Training requirements
3. Describe the conditions necessary to support a fire	• Air • Fuel • Heat
4. Describe the classes of fires according to the materials being burned	• Class A • Class B • Class C • Class D • Symbols and colours

LEARNING TASKS	CONTENT

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

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

7. Describe the procedure for using a fire extinguisher	• Extinguisher selection
	• P.A.S.S.
	  ○ Pull
	  ○ Aim
	  ○ Squeeze
	  ○ Sweep

Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS

Competency: A2 Maintain safe work environment

Objectives

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

- Identify and describe workplace hazards.
- Manage workplace hazards.
- Demonstrate emergency procedures.
- Describe non-emergency injury reporting procedures.
- Describe how worksite safety policies are established.
- Locate information in regulations and standards.

LEARNING TASKS	CONTENT

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

2. Describe long term hazards in the sheet metal industry	• Respiratory disease • Asbestos • Repetitive strain injuries • Management of hazards
3. Demonstrate safe attitude	• Respect for others' safety • Constant awareness of surroundings • Management of hazards
4. Describe safety precautions when working at elevations	• Wind • Floor openings • Guard rails • Safety lines • Weather • Stressed cables

LEARNING TASKS	CONTENT
5 Demonstrate emergency procedures	• Emergency shutoffs • Fire control systems • Eye wash facilities • Emergency exits • Emergency contact/phone numbers • Outside meeting place • Disaster meeting place
6. Describe non-emergency injury reporting procedures	• First aid facilities • Reports

7. Describe how a workplace safety policy is established	• 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
	  ○ Non-compliance procedures
	• Minimum standards
	  ○ Acts and Regulations

LEARNING TASKS	CONTENT

8. Locate information in the OHS regulation and WCB standards	• 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
	• Chemical and biological substances
	• Substance specific requirements
	• Noise, vibration, radiation and temperature
	• Personal protective clothing and equipment
	• Confined spaces
	• De-energization and lockout
	• Fall protection
	• Tools, machinery and equipment
	• Ladders, scaffolds and temporary work platforms
	• Cranes and hoists
	• Rigging
	• Mobile equipment
	• Transportation of workers
	• Traffic control
	• Electrical safety

Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS

Competency: A3 Perform lock-out and tag-out procedures

Objectives

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

- Identify workplace lock-out procedures and policies.
- Identify energy sources.
- Select correct lock-out device.
- Demonstrate competency in usage of selected devices.

LEARNING TASKS	CONTENT

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

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

3. Select and demonstrate competency in use of lock-out devices	• Devices
	  ○ Padlocks
	  ○ Scissor clamps
	  ○ Lock boxes
	  ○ Ball valve lock-outs
	  ○ Circuit breaker lock-outs
	• Plug in boxes

Line (GAC): A PERFORM SAFETY RELATED FUNCTIONS

Competency: A4 Use WHMIS

Objectives

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

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

LEARNING TASKS	CONTENT
1. State the legislation that requires suppliers of hazardous materials to provide SDSs and label products as a condition of sale and importation	• Hazardous Product Act • Controlled Products Regulations • Ingredient Disclosure List • Hazardous Materials Information Review Act • Hazardous Materials Information Review Regulations

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

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

4. Describe the responsibilities of suppliers under WHMIS	• Provision of
	  ○ SDSs
	  ○ Labels

5. Describe the responsibilities of employers under WHMIS	• Provision of
	  ○ SDSs
	  ○ Labels
	  ○ Work education programs in the workplace

LEARNING TASKS	CONTENT
6. Describe information to be disclosed on a SDS	• Hazardous ingredients • Preparation information • Product information • Physical data • Fire or explosion • Reactivity data • Toxicological properties • Preventive measures • First-aid measures

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

8. Apply WHMIS regulations as they apply to hazardous materials used in the shop	• Use • Storage • Disposal

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B1 Use hand and portable power tools

Objectives

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

- Select hand and portable power tools appropriate to sheet metal processes.
- Use hand and portable power tools.
- Inspect and maintain tools.

LEARNING TASKS	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 and portable power tools	• Types • Parts • Purpose/uses • Procedures/operations • Safety • Adjustment • Inspection • Maintenance • Tool manual • Storage
3. Use shop layout tools	• Trammel points • Scratch awl • Scribers • Verification of layout and measuring tools accuracy

LEARNING TASKS	CONTENT
4. Describe portable power tools	• Drills • Grinders • Nibblers • Shears • Saws • Electric seamers • Gas powered tools • Battery tools

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B2 Use shop tools and equipment

Objectives

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

- Select shop equipment appropriate to sheet metal processes.
- Use shop equipment.
- Inspect and maintain shop equipment.

LEARNING TASKS	CONTENT
1. Describe shop equipment	• Squaring shears • Power shears • Bar folders • Rolls • Notcher • Hand brakes • Roll forming equipment • Punches • Rotary hand machines • Band saws • Bench grinders • Drill presses • Cleat benders • Forming stakes • Beverly shear
2. Use shop equipment	• Types • Parts • Purpose/uses • Procedures/operations • Capacities • Safety • Adjustment • Inspection • Minor maintenance • Equipment manual • Storage

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

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

Objectives

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

- Weld using GMAW.

LEARNING TASKS	CONTENT
1. Describe types of GMAW equipment	• Push-pull guns • Spool guns • Foot pedals / remote controls • Portable machines • Stationary machines • Gas powered welding machine
2. Describe welding safety	• Licensing and training requirements • Government regulations • Ventilation requirements • Flammable material recognition • Personal protective equipment • Compressed gas safety • Shock hazards
3. Describe gas metal arc welding (GMAW)	• Terminology • Weld defects • Purpose/uses • Equipment • Materials to be welded • Consumables • Safety • Basic procedures/operations • Set-up • Adjustment • Take down • Inspection • Maintenance • Storage
4. Use welding tools	• GMAW

Achievement Criteria

Performance	The learner will weld 16 gauge and 12 gauge mild steel coupons in flat position using GMAW.
Conditions	The learner will be given: • Welding equipment • Materials • Coupons
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Continuous • Heat setting

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B5 Use shielded metal arc welding (SMAW) equipment

Objectives

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

- Weld using SMAW.

LEARNING TASKS	CONTENT
1. Describe types of welding equipment	• Shielded metal arc welding (SMAW) • Equipment/hand tools
2. Describe welding safety	• Licensing and training requirements • Government regulations • Ventilation requirements • Flammable material recognition • Personal protective equipment
3. Describe shielded metal arc welding (SMAW)	• Terminology • Weld defects • Basic procedures/operations • Purpose/uses • Equipment • Materials to be welded • Electrode designation • Electrode storage • Safety • Set-up • Adjustment • Take down • Inspection • Maintenance
4. Use welding tools	• SMAW

Achievement Criteria

Performance	The learner will weld 12 gauge mild steel coupon lap weld in flat position using SMAW.
Conditions	The learner will be given: • Welding equipment • Materials • Coupons
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Continuous • Heat setting

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B6 Use oxy-fuel and plasma arc cutting equipment

Objectives

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

- Cut using plasma and oxy-acetylene tools.

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

LEARNING TASKS	CONTENT
	• Materials to be cut • Consumables • Safety • Procedures/operations • Set-up • Adjustment • Take down • Inspection • Maintenance • Storage
5. Use cutting tools	• Plasma • Oxy-acetylene

Achievement Criteria 1

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

Conditions — The learner will be given:

- Steel
- Plasma cutter
- Pattern

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

- Safety
- Clean cut
- Accuracy

And/ or

Achievement Criteria 2

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

Conditions — The learner will be given:

- Steel
- Oxy-acetylene cutting equipment
- Pattern

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

- Safety
- Clean cut
- Accuracy

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B7 Use soldering and brazing equipment

Objectives

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

- Describe soldering and brazing equipment and techniques.
- Use soldering techniques.

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

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

3. Use soldering techniques	• Selection • Procedure • Inspection

Achievement Criteria

Performance	The learner will solder a project with various seams.
Conditions	The learner will be given: • Soldering tools • Materials • Project plan
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Setup • Material • Surface • Irons • Watertight • Appearance • Sweat versus skim

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B8 Use measuring and layout equipment

Objectives

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

- Select hand tools appropriate to sheet metal processes.
- Use hand tools.
- Inspect and maintain tools.

LEARNING TASKS	CONTENT
1. Describe sheet metal hand tools	• Squares • Rules • Dividers • Marking devices • Hammers
2. Use shop layout tools	• Trammel points • Scratch awl • Scribers • Verification of layout and measuring tools accuracy

Achievement Criteria

Performance: The learner will calculate the required system adjustments and generate a testing report.

Conditions: The learner will be given:

- Test data
- System design data
- Tools and equipment
- Testing forms

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

- Process
- Calculated adjustments
- Completed report

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B9 Use stationary and mobile work platforms

Objectives

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

- Describe ladders, and stationary and mobile scaffolds.
- Use ladders and mobile and stationary scaffolds.

LEARNING TASKS	CONTENT

1. Describe ladders	• Types
	  ○ Extension
	  ○ Step
	• Uses
	• Safety
	• Hazard recognition
	• Government regulations

2. Describe elevated work platforms	• Types
	  ○ Boom lift
	  ○ Scissor lift
	  ○ Articulated boom lift
	  ○ Mobile and stationary scaffold
	• Uses
	• Certification
	• Safety
	• Hazard recognition
	• Government regulations

3. Use ladders	• Selection • Operating procedures • Limitations • Securing • Inspection • Maintenance • Storage
4. Use mobile and stationary scaffold	• Selection • Operating procedures • Limitations • Securing • Inspection • Maintenance • Storage

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B10 Use hoisting, rigging and positioning equipment

Objectives

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

- Identify hoisting, lifting and rigging equipment.
- Tie knots, bends and hitches.
- Select and use hoisting, lifting and rigging equipment.

LEARNING TASKS	CONTENT

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

2. Tie knots bends and hitches	• Rope types • Terms • General rules • Knot, bend and hitch types • Rope inspection • Maintenance • Storage
3. Identify hoisting, lifting and rigging equipment	• Safety • Operating procedures • Communication and hand signals • Overhead crane • Duct lift • Come-alongs • Cable puller • Plate clamp • Inspection • Maintenance • Storage • Hand signals • 2-way radios • Centre of gravity

LEARNING TASKS	CONTENT
4. Use basic hoisting, lifting and rigging equipment	• Duct lift • Come-alongs • Cable puller • Plate clamp

Line (GAC): C ORGANIZE WORK

Competency: C1 Use trade related documentation

Objectives

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

- Describe pictorial drawing types.
- Develop pictorial and orthographic drawings.

LEARNING TASKS	CONTENT

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

2. Describe pictorial drawings	• Isometric • Perspective • Oblique • Dimensioning • Lettering • Scaling • Line types • Free hand sketches

Line (GAC): C ORGANIZE WORK

Competency: C2 Interpret drawings

Objectives

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

- Interpret the information on an orthographic projection drawing.

LEARNING TASKS

1. Describe orthographic projection

CONTENT

- 3rd angle projection
- Views
  - Plan
  - Front
  - Bottom
  - Side
- 1st angle projection
- Auxiliary
- Profile
- Section
- Lines
  - Centre
  - Extension
  - Hidden
  - Dimension
  - Object

Line (GAC): C ORGANIZE WORK

Competency: C3 Organize materials and equipment for projects

Objectives

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

- Describe considerations when handling materials.
- Select the proper procedure for handling materials.

LEARNING TASKS	CONTENT

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

2. Select procedures for handling materials	• Safety
	• Procedures
	• Securing
	• Packaging/shipping
	  ○ Required views
	• Mathematical formulas
	• Applications
	  ○ Transition
	  ○ Ogee offset
	  ○ Duct elbows
	• Seam and joint allowances
	• Pattern labelling and forming instructions

Line (GAC): C ORGANIZE WORK

Competency: C5 Use mathematics

Objectives

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

- Use mathematical formulas to solve problems relating to sheet metal work.

LEARNING TASKS	CONTENT
1. Describe geometric shapes	• Types

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

3. Solve problems using formulas	• Transposition to solve for different unknowns • Word problems • Sheet metal applications
4. Describe formulas used for triangles	• Pythagorean Theorem • Trigonometric functions
5. Solve problems involving triangles	• Word problems • Sheet metal applications

Line (GAC): D USE COMMUNICATION AND MENTORING TECHNIQUES

Competency: D1 Use communication techniques

Objectives

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

- Describe methods of communication.
- Communicate with others.

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

2. Communicate with people	• Interpersonal skills
	• Ethics
	  ○ Time management
	  ○ LEAN principles
	  ○ Punctuality
	  ○ Respect for authority
	  ○ Stewardship of materials
	• Accepting constructive feedback
	• Respect for customer property
	• Respect for other trades
	• Customers (layperson terms)
	• Employer representation
	• First impression

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E1 Develop patterns using simple and straight line method

Objectives

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

- Develop patterns for duct fittings and sheet metal components.

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

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

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

LEARNING TASKS	CONTENT

4. Develop patterns for sheet metal components and duct fittings	• Applications
	  ○ Two way transition
	  ○ Ogee offset
	  ○ Square throat elbow
	  ○ Radius throat elbow
	  ○ Straight duct
	  ○ Side take off
	  ○ Drain pans
	  ○ Boxes
	  ○ End caps
	• Seam and joint allowances
	• Pattern labelling and forming instructions

5. Describe seams, locks and edges	• Types
	• Patented duct connections (TDC, TDF)
	  ○ Single and double seams
	  ○ Standing seams
	  ○ Riveted seam
	  ○ Groove seams
	  ○ Pocket lock
	  ○ S-lock
	  ○ Button lock
	  ○ Pittsburgh lock
	  ○ Lap and fasten
	  ○ Hems
	  ○ Flange connections
	  ○ Slip and drive
	  ○ Wired edge

Achievement Criteria 1

Performance — The learner will develop patterns for:

- Transitions
- Ogee offsets *and/or*
- Duct elbows

Conditions — The learner will be given:

- Project specifications
- Drafting equipment
- Paper
- Calculator

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

- Tools selection
- Procedure
- Patterns are complete and accurate to within +/- 1/32" of drawing specifications.

Achievement Criteria 2

Performance — The learner will develop patterns for:

- Straight duct
- Pan
- Ogee offset
- Duct elbows
- Transition
- End caps, *and/or*
- Boxes

Conditions — The learner will be given:

- Project specifications
- Patterns developed to seams and connections specified
- Drafting or layout tools

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

- Tools selection
- Procedure
- Patterns are complete and accurate to within +/- 1/16" of drawing specifications

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E2 Develop patterns using parallel line method

Objectives

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

- Develop patterns using parallel line development.

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

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

3. Develop patterns using parallel line development	• 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, *and/or*
- Elbows

Conditions — The learner will be given:

- Drawing specifications
- Drafting equipment
- Paper
- Calculator

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

- Tool selection
- Procedures
- Patterns complete and accurate to within +/- 1/32” of drawing specifications

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E3 Develop patterns using radial line development

Objectives

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

- Develop patterns using radial line development.

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

2. Describe drafting techniques for radial line development	• Line development
	  ○ Construction
	  ○ Radial line
	• Geometric construction
	  ○ Front view
	  ○ Plan view
	  ○ Visualization in three dimensions
	  ○ Required views
	• Mathematical formulas
	• Right cones (chimney cap)
	  ○ Frustum (storm collar)
	  ○ Truncated (roof jack on a slope)
	  ○ Round reducer on centre

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

Achievement Criteria

Performance	The learner will use radial line development to develop patterns for: • Right cones • Frustum • Truncated, *and/or* • Round reducer on centre
Conditions	The learner will be given: • Drawing specifications • Drafting and lay out tools
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Tools selection • Procedure • Patterns are complete and accurate to within +/- 1/32” of drawing specifications.

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E4 Develop patterns using triangulation method

Objectives

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

- Develop patterns using triangulation from the plan view.

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

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

3. Develop patterns using triangulation from the plan view	• 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, *and/or* • Round reducer off centre
Conditions	The learner will be given: • Project specifications • Drafting and lay out tools.
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Tools selection • Procedure • Patterns are complete and accurate to within +/- 1/16” of drawing specifications

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F1 Select materials for trade related products

Objectives

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

- Describe materials used in the sheet metal trade.

LEARNING TASKS

1. Describe type of materials and their properties

CONTENT

- Metal types
    - Ferrous
        - Galvanized
        - Hot and cold rolled mild steel
        - Satin coat (Wipe coat, Paint lock)
        - Stainless steel
        - Pre-painted
        - Terne plate
    - Non ferrous
- Aluminum
- Copper
- Zinc
- Brass
- Titanium
- Monel
- Bronze
- Expanded
- Perforated
- Screen
- Mesh
- Checker plate
- Profile shapes
- Plastic
- Composites
- Fibreglass
- Rubber
- Polyvinylchloride (PVC)
- Coatings
- Material finishes
- Properties
    - Ductility

LEARNING TASKS	CONTENT
	○ Malleability ○ Hardness ○ Strength ○ Elasticity • Gauges • Appearance • Special design • Extrusions

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F2 Fabricate ductwork, fittings and components

Objectives

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

- Produce a cutting list and fabricate components.

LEARNING TASKS	CONTENT
1. Describe sheet metal components	• End caps • Spin-in collars • Flexible connections • Insulation stops • Volume dampers
2. Select tools	• Layout tools • Hand tools • Shop equipment • Power tools
3. Select materials	• Types • Gauges
4. Make a cutting list	• Fitting requirements • Mathematics • Allowances • Material thickness allowance • Recording

5. Describe seams, locks and edges	• Types
	  ○ Single and double seams
	  ○ Standing seams
	  ○ Riveted seam
	  ○ Groove seams
	  ○ Pocket lock
	  ○ S-lock
	  ○ Button lock
	  ○ Pittsburgh lock
	  ○ Lap and spot weld
	  ○ Hems

LEARNING TASKS	CONTENT

6. Fabricate seams, locks and edges	• Types
	  ○ Double seam
	  ○ Pittsburgh lock
	  ○ Lap and spot weld
	  ○ Standing seams
	  ○ Groove seam
	• Seam allowances

7. Fabricate components	• Use of cutting list
	• Notching
	• Equipment selection
	• Waste minimization
	• Forming techniques
	  ○ Bending and bend sequence
	  ○ Cross-braking
	  ○ Rolling
	  ○ Rotary machine

8. Select shop tools and equipment to fabricate ductwork and assemble fittings with components	• Layout tools • Hand tools • Shop equipment • Power tools
9. Describe shop layout techniques for duct fittings	• Line development • Geometric construction • Mathematical formulas • Cut list • Seam and joint allowances

10. Fabricate duct fittings	• Applications
	  ○ Straight duct
	  ○ Transition
	  ○ Ogee offset
	  ○ Duct elbows
	• Labelling

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

Achievement Criteria 1

Performance — The learner will fabricate seams and locks:

- Double seam
- Pittsburgh lock
- Lap and spot weld
- Standing seams, *and/or*
- Groove seam

Conditions — The learner will be given:

- Project specifications
- Tools and equipment

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

- Tools selection
- Procedure
- Seams and locks have no visible marks from hand tools
- Projects are complete and accurate to within specified standards.

Achievement Criteria 2

Performance — The learner will fabricate components:

- End caps
- Spin-in collars
- Flexible connections *and/or*
- Insulation stops

Conditions — The learner will be given:

- Project specifications
- Tools and equipment

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

- Tools selection
- Procedure
- Seams and locks have no visible marks from hand tools
- Seams and locks are accurate to specified standards.

Achievement Criteria 3

Performance — The learner will fabricate and assemble duct fittings with components.

- Straight duct
- Transition
- Ogee offset, *and/or*
- Duct elbows

Conditions — The learner will be given:

- Project specifications
- Tools and equipment

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

- Safety
- Tools selection
- Procedure
- Project has no visible marks from hand tools
- Project is accurate to specified standards.

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F3 Insulate ductwork, fittings and components

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe insulation	• Safety
	• Requirements
	• Types
	  ○ Rigid/flexible
	  ○ Acoustic/thermal
	  ○ Fibreglass
	  ○ Neoprene
	  ○ Coatings
	• Densities
	• Thicknesses
	• Applications
	• Layout
	• Cutting

2. Describe fastening methods	• Adhesives
	  ○ Types
	  ○ Uses
	• Pins
	  ○ Placement
	• Lagging materials
	  ○ Mastics
	  ○ Perforated metal
	• Insulation stops

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F6 Fabricate hanger systems, supports and bases

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe hanger systems	• Purpose
	• Types
	  ○ Strap hangers
	  – Mathematics
	  ○ Brackets
	  ○ Saddles
	  ○ Trapeze

2. Describe hanging considerations	• Weight • Structure • Vibration • Fasteners/anchors • Environment • Manufacturers' shop drawings • Seismic requirements
3. Describe the fabrication of knee bracket hanger systems	• Safety • Tools • Cutting • Forming • Welding • Specifications • Materials • Layout • Mathematics • Assembly • Fastening
4. Describe equipment bases and supports	• Purpose • Types • Size • Weights

LEARNING TASKS	CONTENT
5. Describe the fabrication of equipment bases and supports	• Design • Specifications • Materials • Lay out • Cutting • Forming • Welding • Assembly • Fastening • Insulation • Priming and painting

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K1 Install air handling equipment

Objectives

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

- Describe air handlers.
- Describe the installation of air handlers.

LEARNING TASKS	CONTENT

1. Describe air handlers	• Purpose
	• Types
	  ○ Furnaces
	  ○ Fans
	  – Supply
	  – Exhaust
	  – Make up air
	• Operation

2. Describe the installation of air handlers	• Manufacturers' specifications • Effect of weather on installation • Maintenance considerations • Curbs • Sleepers • Stands • Housekeeping pads • Flex connections

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K3 Install sheet metal ducts, fittings and dampers

Objectives

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

- Describe installation procedure for duct work.
- Install damper in duct work.

LEARNING TASKS

1. Describe installation procedure for duct work

CONTENT

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

LEARNING TASKS	CONTENT

2. Install damper in duct work	• Location determination
	• Ensure access
	• Size determination
	• Securing
	• Cycle and set
	• Directional orientation
	• Types
	  ○ Control
	  ○ Motorized
	  ○ Shut-off
	  ○ Iris
	  ○ Balancing
	  ○ Explosion proof

Achievement Criteria

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

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

Criteria — The learner will score 70% or better on a rating sheet that reflects the following criteria:
- As per project specifications

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K5 Install registers, grilles, diffusers and louvers

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe inlet and outlet covers	• Types
	  ○ Registers
	  ○ Diffusers
	  ○ Louvers
	  ○ Troffers
	  ○ Grilles
	  ○ Linear slot
	  ○ Egg crate
	  ○ Transfer air

2. Describe the installation of inlet and outlet covers	• Purpose • Directional consideration • Alignment • Reflected ceiling plan • Length of flex • Hard pipe • Cushion heads • Radiant fire dampers • Seismic • Cleanliness • Seal • Install access doors

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K8 Install residential systems

Objectives

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

- Describe residential heating, ventilation and air conditioning systems.
- Install residential heating, ventilation and air conditioning systems.

LEARNING TASKS	CONTENT
1. Describe residential heating, ventilation and air conditioning	• Furnace types • Equipment • Locations

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

3. Describe the installation of residential furnaces	• Manufacturer's requirements • Location of supply and return air outlets • Sealing methods
4. Describe residential slab duct	• Contract drawings • Outlet locations • Inlet locations • Bracing / chairs • Length connections • Elbows 45 ° and 90 ° • Sealing • Dryer vent • Run locations • Insulation wrap • Under slab duct

Level 2

Sheet Metal Worker

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B2 Use shop tools and equipment

Objectives

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

- Select shop equipment appropriate to architectural sheet metal processes.
- Use shop equipment.
- Inspect and maintain shop equipment.

LEARNING TASKS	CONTENT
1. Describe advanced use of shop equipment	• Power shears • Gap shears • Power rolls • Power notchers • Hand brakes • Roll forming equipment • Turret punches • Iron worker • Power rotary machines • Clinch lock machine • Dimpler • Cold cut saw • Horizontal band saws • Spot welders • Stud welders • Drill presses
2. Describe shop equipment used for architectural purposes	• Roll forming machines • XYZ machines • Hand brake S-lock former • Slitter
3. Use shop equipment	• Types • Parts • Purpose/uses • Procedures/operations • Capacities • Safety • Adjustment • Inspection • Minor maintenance • Storage

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

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

Objectives

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

- Weld using GMAW.

LEARNING TASKS	CONTENT
1. Review types of welding equipment	• Gas metal arc welding (GMAW) • Equipment/hand tools
2. Review welding safety	• Licensing and training requirements • Government regulations • Ventilation requirements • Flammable material recognition • Personal protective equipment • Compressed gas safety • Shock hazard

3. Describe gas metal arc welding (GMAW)	• Advanced procedures/operations
	• Purpose/Uses
	• Limitations
	• Equipment
	• Materials to be welded
	• Consumables
	• Safety
	• Set-up
	• Adjustment
	• Take down
	• Inspection
	• Leak Test
	  ○ Light Test
	  ○ Dye Test
	  ○ Water Test
	  ○ Smoke Test
	• Maintenance
	• Storage

LEARNING TASKS	CONTENT
4. Interpret welding symbols	• Fillet • Spot • Flange • Bevel • Field • Weld all around • Length and pitch • Plug • Arrow side / other side
5. Use welding tools	• GMAW • Weld inspection

Achievement Criteria 1

Performance	The learner will weld 16 gauge and 12 gauge mild steel coupons in flange, corner and fillet using GMAW.
Conditions	The learner will be given: • Welding equipment • Materials • Coupons
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Continuous • Heat setting • Penetration • Consistency • Porosity

Achievement Criteria 2

Performance	The learner will plug weld an 18 gauge coupon to a 12 gauge mild steel coupon.
Conditions	The learner will be given: • Welding equipment • Materials • Coupons
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Solid puddle • Specified diameter

Achievement Criteria 3

Performance	The learner will fabricate and weld a project from a shop drawing.
Conditions	The learner will be given: • Shop fabrication drawing complete with welding symbols and specifications • Tools and equipment • Materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Continuous • Heat setting • Penetration • Consistency • Porosity • Welding symbols followed • Specifications followed

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B5 Use shielded metal arc welding (SMAW) equipment

Objectives

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

- Weld using SMAW.

LEARNING TASKS	CONTENT
1. Describe types of welding equipment	• Shielded metal arc welding (SMAW) • Equipment/hand tools • Gas powered welding machine
2. Describe welding safety	• Licensing and training requirements • Government regulations • Ventilation requirements • Flammable material recognition • Personal protective equipment

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

4. Use welding tools	• SMAW

Achievement Criteria

Performance	The learner will weld mild steel in all positions using SMAW.
Conditions	The learner will be given: • Welding equipment • Materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Continuous • Heat setting

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B7 Use soldering and brazing equipment

Objectives

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

- Describe soldering and brazing equipment and techniques.
- Use soldering techniques.

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

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

3. Use soldering techniques	• Selection • Procedure • Inspection

LEARNING TASKS	CONTENT

4. Describe brazing techniques	• Alloy selection
	• Equipment selection
	• Fluxes
	  ○ Types
	  ○ Applications
	• Techniques
	  ○ Safety
	  ○ Cleaning
	• Limitations

Line (GAC): C ORGANIZE WORK

Competency: C1 Use trade related documentation

Objectives

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

- Develop a shop drawing using manufacturer's drawings and technical reference material.

LEARNING TASKS	CONTENT
1. Identify bodies responsible for codes, regulations and standards related to the sheet metal industry	• SMACNA (Sheet Metal and Air Conditioning Contractors National Association) • ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) • NFPA (National Fire Protection Association) • NBC and BCBC (National Building Code and British Columbia Building Code) • Municipal Bylaws • RCABC (Roofing Contractors Association of British Columbia) • TABB (Testing Adjusting and Balancing Bureau) • CWB (Canadian Welding Bureau) • CSA (Canadian Standards Association) • ULC (Underwriters Laboratories of Canada)
2. Describe how codes, regulations and standards affect sheet metal fabrication and installations	• Material selection • Construction and installation methods • Design characteristics • Site specific documentation, permits and signage
3. Describe documentation encountered in the sheet metal trade	• Tool and equipment documentation • System component documentation • Proprietary product documentation • Certification agencies
4. Describe information contained in manufacturer and supplier documentation	• Installation instructions and requirements • Operation and maintenance manuals • Product specifications • Warranty information

Achievement Criteria

Performance	The learner will develop a shop drawing using shop standards, technical reference and manufacturer's drawings.
Conditions	The learner will be given: • Drawing specifications • Manufacturer's drawing • Technical reference material • Drafting equipment
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Selection of appropriate tools • Proper construction techniques applied • Drawings are accurate to a tolerance of +/- 1/16"

Line (GAC): C ORGANIZE WORK

Competency: C2 Interpret drawings

Objectives

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

- Describe drawings and specifications.
- Extract information from drawings and specifications.

LEARNING TASKS	CONTENT

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

2. Describe line types, symbols and abbreviations used in drawings	• Lines • Symbols • Abbreviations
3. Describe the scales used in drawings	• Architect's scale • Metric scale

LEARNING TASKS	CONTENT

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

5. Describe contract documents	• Types • Purpose
6. Describe construction specifications	• Master format • Purpose • Addendums
7. Use contract documents and construction specifications	• Responsibilities and obligations • Extracting information • Penetrations for components • Quality control • Commissioning

Line (GAC): C ORGANIZE WORK

Competency: C4 Perform basic design and field modifications

Objectives

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

- Perform field measurements.
- Alter duct design to accommodate site conditions.
- Order duct fittings to accommodate changes.

LEARNING TASKS	CONTENT
1. Compare site to contract drawings	• Obstacles • Other trades • Changes to contract drawings • Structural members • Change notices
2. Perform field measurements for the purpose of modifications	• Reference points • Benchmark elevations • Other trade drawings • Penetration size • Penetration location • Clearances • Connection and seam allowances • Insulation allowances • Equipment clearances
3. Solve problems using formulas	• Transposition to solve for different unknowns • Word problems • Sheet metal applications
4. Review formulas used for triangles	• Pythagorean Theorem • Trigonometric functions
5. Apply mathematics for field modifications	• Ogee offsets • Elbow formulas • Transition to equal area • Two given elbow offset • Two elbow 90˚ • Roof pitch • Mitre duct

LEARNING TASKS	CONTENT
6. Order fittings	• Sketching • Work orders • Templates • E-mails • Pictures

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E1 Develop patterns using simple and straight line method

Objectives

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

- Develop patterns for advanced sheet metal components and duct fittings.

LEARNING TASKS	CONTENT

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

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

LEARNING TASKS	CONTENT

3. Review seams, locks and edges	• Types
	• Patented duct connections (TDC, TDF)
	  ○ Single and double seams
	  ○ Standing seams
	  ○ Riveted seam
	  ○ Groove seams
	  ○ Pocket lock
	  ○ S-lock
	  ○ Button lock
	  ○ Pittsburgh lock
	  ○ Lap and spot weld
	  ○ Lap and fasten
	  ○ Hems
	  ○ Flange connections
	  ○ Slip and drive
	  ○ Wired edge

Achievement Criteria

Performance — The learner will develop patterns for:

- Change cheek ogee offset
- Drop cheek elbows
- Transitional ogee offset
- Two way transition, *and/or*
- Drop cheek transitional elbow

Conditions — The learner will be given:

- Project specifications
- Patterns developed to seams and connections specified
- Drafting or layout tools

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

- Tools selection
- Procedure
- Patterns are complete and accurate to within +/- 1/16” of drawing specifications

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E2 Develop patterns using parallel line method

Objectives

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

- Develop patterns using parallel line development.

LEARNING TASKS	CONTENT

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

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

Achievement Criteria

Performance	The learner will use parallel line development to develop patterns for: • Gutter mitres • Tee branches off centre, *and/or* • Elbows by the rise method
Conditions	The learner will be given: • Drawing specifications • Drafting equipment • Paper • Calculator
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Tool selection • Procedures • Patterns complete and accurate to within +/- 1/32” of drawing specifications

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E3 Develop patterns using radial line development

Objectives

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

- Develop patterns for oblique cones using radial line development.

LEARNING TASKS	CONTENT
1. Review the selection of drafting equipment for radial line development	• Tee squares • Dividers • Compasses • Rulers • Scales • Set squares • Protractors • Pencils • Calculators

2. Describe drafting techniques for oblique cones using radial line development	• Line development
	  ○ Construction
	  ○ Radial line
	• Geometric construction
	  ○ Front view
	  ○ Plan view
	  ○ Visualization in three dimensions
	  ○ Required views
	• Mathematical formulas
	• Seam allowances
	• Pattern labelling and forming instructions
	• Applications
	  ○ Oblique cones
	  ○ Off centre reducer
	  ○ Off centre roof jack
	  ○ Flat back funnel

Achievement Criteria

Performance	The learner will use radial line development to develop patterns for Oblique cone.
Conditions	The learner will be given: • Drawing specifications • Drafting and lay out tools
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Tools selection • Procedure • Patterns are complete and accurate to within +/- 1/16” of drawing specifications

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E4 Develop patterns using triangulation method

Objectives

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

- Develop patterns using triangulation from elevation view.

LEARNING TASKS	CONTENT

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

2. Develop patterns using triangulation from elevation view	• Applications
	  ○ Square to round on a pitch (Roof jack)
	  ○ Round reducer on a pitch (Roof jack)
	  ○ Drop cheek elbows
	  ○ Two way transition
	• Seam allowances
	• Pattern labelling and forming instructions

Achievement Criteria

Performance — The learner will use triangulation to develop patterns for:

- Square to round on a pitch (Roof jack) *and/or*
- Round reducer on a pitch (Roof jack)

Conditions — The learner will be given:

- Project specifications
- Drafting and lay out tools

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

- Tools selection
- Procedure
- Patterns are complete and accurate to within +/- 1/32” of drawing specifications

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F2 Fabricate ductwork, fittings and 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	• Tools and equipment • Line development • Geometric construction • Mathematical formulas • Cut list • Seam and joint allowances

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

3. Install components	• Turning vanes • Louver • Volume dampers

Achievement Criteria 1

Performance — The learner will fabricate and assemble duct fittings.

- Two way transition
- Change cheek ogee offset
- Drop cheek elbows
- Transitional ogee offset, *and/or*
- Square throat square heel elbow

Conditions — The learner will be given:

- Project specifications
- Tools and equipment

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

- Safety
- Tools selection
- Procedure
- Project has no visible marks from hand tools
- Project is accurate to specified standards

Achievement Criteria 2

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

Conditions — The learner will be given:

- Project specifications
- Tools and equipment

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

- Safety
- Tools selection
- Procedure
- Project has no visible marks from hand tools
- Project is accurate to specified standards

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F4 Fabricate material handling system components

Objectives

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

- Describe material handling system components and their fabrication.
- Fabricate material handling system components.

LEARNING TASKS	CONTENT
1. Describe material handling system components	• Companion flanges • Welded duct • Small end big end • Welded round elbow • Clean outs • Belt guards • Hoppers • Chutes
2. Fabricate material handling system components	• Safety • Tools and equipment • Mathematics • Procedure • Specifications

Achievement Criteria

Performance: The learner will fabricate a 16 gauge mild steel welded belt guard.

Conditions: The learner will be given:

- Project specifications
- Tools and equipment
- Materials

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

- Safety
- Tools selection
- Procedure
- Project is accurate to specified standards

Line (GAC): G FABRICATE ARCHITECTURAL SHEET METAL PRODUCTS

Competency: G1 Select materials for flashing, roofing, sheeting and cladding

Objective

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

- Describe materials and applications of these materials used in architectural sheet metal.

LEARNING TASKS	CONTENT
1. Describe considerations necessary when selecting metal for architectural applications	• Corrosion resistance • Malleability • Ductility • Elasticity • Expansion and contraction • Cost • Durability • Appearance • Gauges • Galvanic scale • Weight • Material finishes
2. Describe other materials used in architectural applications	• Plastic • Composites • Fibreglass • Rubber • Polyvinylchloride (PVC) • Ethylene Propylene Diene Monomer (EPDM) • Expanded Polystyrene (EPS)
3. Describe material applications	• Roof drainage systems • Roofing/flashings • Cladding • Composite metal panels • Decking • Speed wall • Cornice/gutters

Line (GAC): G FABRICATE ARCHITECTURAL SHEET METAL PRODUCTS

Competency: G2 Fabricate flashing, roofing, sheeting and cladding

Objectives

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

- Describe roofing, decking and cladding and its purpose.
- Describe wall panel systems.
- Fabricate roofing, decking and cladding flashings.
- Fabricate architectural sheet metal components.

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

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

LEARNING TASKS	CONTENT

3. Describe roof layout	• Roof structures
	  ○ Pitched
	  ○ Tapered
	  ○ Domes
	  ○ Spires
	• Roof construction features
	  ○ Hips
	  ○ Ridges
	  ○ Valleys
	• Roof hatches
	• Materials
	• Procedures
	• Tools
	  ○ Transit
	  ○ Level
	  ○ Chalk line

4. Describe wall panel systems	• Wall panel systems
	  ○ Composite panels
	  ○ Sandwich panels
	  ○ Related flashings
	  ○ Sub-girts

5. Describe power tools used for architectural purposes	• Cut-off saw
	• Blades
	  ○ Abrasive
	  ○ Carbide tipped metal cutting blades
	• Types
	  ○ Gas powered
	  ○ Mitre
	  ○ Chop
	• Roof seamers
	• Screw gun
	• Impact guns
	• Powder actuated tools
	• Power shears
	• Routers
	• Portable band saw
	• Nibblers
	• Double-cutting sheers
	• Electric seamers

LEARNING TASKS	CONTENT
6. Cut material for roofing, sheeting, cladding and flashing	• Safety/ hazards • Materials • Types • Seam allowances • Cutting equipment • Girth determination (Stretch-out) • Waste minimization
7. Form flashing and roofing	• Materials • Types • Joints • “S” • Lap • Standing • Seam allowances • Joint forming • Soldering • Sealing
8. Describe architectural components	• Louvers • Scuppers • Roof jack • Roofing • Decking • Cladding • Gutter mitre
9. Fabricate architectural components	• Gutter mitre • Coping • Scupper • Roof jack • Flashing • Safety • Tools and equipment • Materials • Procedures

Achievement Criteria

Performance	The learner will fabricate the following architectural components: • Gutter mitre • Coping • Scupper • Roof jack, *and/or* • Flashing
Conditions	The learner will be given: • Project specifications • Tools and equipment • Materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: Safety • Tools selection • Procedure • Project is accurate to specified standards

Line (GAC): I PREPARE INSTALLATION SITE

Competency: I1 Perform on-site measurements

Objectives

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

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

LEARNING TASKS	CONTENT
1. Select and use measuring tools and equipment	• Levels • Laser levels • Tape measures • Scale rulers • Plumb bob • Chalk line
2. Use trade mathematics	• Pythagoras • Trigonometry • Linear • Area • Volume • Pitch/slope

3. Use construction drawings, specifications and codes to measure and position components	• Identification of hazards
	• Verification of duct design
	  ○ Headroom
	  ○ Size
	  ○ Off sets
	• Identification of structural obstructions
	• Establishing elevations
	• Identification of other trades interference
	• Alignment
	• Orientation

Line (GAC): I PREPARE INSTALLATION SITE

Competency: I2 Perform demolition for renovations

Objectives

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

- Describe preparing removal plan.
- Describe dismantling and removing materials.

LEARNING TASKS	CONTENT

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

2. Describe dismantling and removing materials	• Safety barricades • Sectioning • Recycling • Disposal

Line (GAC): J INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLIANCES AND MECHANICAL EQUIPMENT

Competency: J1 Install chimneys

Objectives

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

- Describe venting and its purpose.

LEARNING TASKS

1. Describe venting and its purpose

CONTENT

- Types
  - A vent
  - B vent
  - BW vent
  - Multi-storey
  - Manifold
  - Stacks
- Purpose
  - Combustion and emissions
  - Types of appliances
  - Chimney
  - Venting
- Designs
  - Manifold
  - Multi-storey
- Components
  - Bracing
  - Hangers
  - Supports
  - Flashing
  - Clean outs
  - Liners
- Materials
- Draft control equipment
- Combustion air

LEARNING TASKS	CONTENT

2. Describe the installation of bracing, hangers and supports	• Requirements
	  ○ Clearances
	  ○ Weight
	  ○ Spacing
	  ○ Seismic
	• Materials
	• Fasteners
	• Flashing

3. Describe the installation of flashing	• Materials • Selection • Weatherproofing materials • Fastening • Sealants

Line (GAC): J INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLIANCES AND MECHANICAL EQUIPMENT

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

Objectives

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

- Describe the connection of venting and breeching to appliances.

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

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

3. Describe the connection of venting and breeching to appliances	• Types of appliances
	• Manufacturers' specifications and codes
	  ○ Location
	  ○ Sealants
	  ○ Assembly
	  ○ Fastening
	  ○ Materials

Line (GAC): J INSTALL AND CONNECT CHIMNEYS, BREECHING AND VENTING TO EXHAUST APPLIANCES AND MECHANICAL EQUIPMENT INSTALL AIR HANDLING SYSTEMS

Competency: J3 Install high efficiency appliances and mechanical equipment

Objectives

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

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

LEARNING TASKS	CONTENT

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

2. Describe the installation of high efficiency appliances and mechanical equipment	• Safety and hazards • Manufacturer's specifications • Codes • Materials • Clearances • Slope • Sealants • Penetrations • Weatherproofing
3. Describe venting requirements for high efficiency appliances and mechanical equipment	• Underwriters' Labs of Canada Standards (ULCS) 636 • Planning location of venting • Selection of venting size and material • Z vent • Direct vent • Concentric vent • Termination

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K1 Install air handling equipment

Objectives

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

- Describe built-up units and roof-top units.
- Describe the installation of an exhaust fan.

LEARNING TASKS	CONTENT

1. Review air handling equipment	• Purpose
	• Types
	  ○ Furnaces
	  ○ Fans
	  – Supply
	  – Exhaust
	  – Make up air
	• Operation

2. Describe built-up units and roof-top units	• Purpose
	• Types
	• Built-up systems
	  ○ Individual components
	  ○ Mechanical room
	  ○ Plenum construction
	  ○ Plenum housings
	• Rooftop units
	  ○ Packaged
	  ○ Pre-assembled
	  ○ Set on curb
	• Operation

3. Describe the installation of an exhaust fan	• Manufacturers' specifications • Effect of weather on installation • Maintenance considerations • Curbs • Penetration size • Penetration obstructions • Sleepers • Stands • Gasket isolator and seal • In line • Wall mounted

Achievement Criteria

Performance	The learner will calculate the fabrication and installation requirements of an exhaust fan curb.
Conditions	The learner will be given: • Project specifications • Manufacturer's drawings • Codes and regulations
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Procedure • Project is accurate to specified standards

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K2 Install hangers, cables, braces and brackets

Objectives

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

- Describe the installation of hangers, cables, braces and brackets.

LEARNING TASKS

1. Describe the installation of hangers

CONTENT

- Obstacles
- Elevations
- Mechanical drawings
- Reflected ceiling plans
- Plum level
- Specification requirements
- Trade Standards
- Codes and regulations
- Fasteners
    - Structure anchors
- Considerations
    - Weight
    - Structure
    - Vibration
    - Environment
    - Seismic
    - Manufacturer's shop drawings
- Types
    - Strap
    - Wrap
    - Trapeze
    - Saddle
    - Rod wire
    - Threaded rod
- Total stations
- Stiffeners and cross braces

LEARNING TASKS	CONTENT

2. Describe the installation of cables	• Obstacles
	• Elevations
	• Mechanical drawings
	• Reflected ceiling plans
	• Plum level
	• Specification requirements
	• Trade Standards
	• Codes and regulations
	• Fasteners
	• Considerations
	  ○ Weight
	  ○ Structure
	  ○ Vibration
	  ○ Environment
	  ○ Manufacturer's shop drawings
	• Manufactured cable grips
	• Cable clamps
	• Structure anchors
	• Crimp ferrule
	• Seismic
	• Stiffeners and cross braces

3. Describe the installation of braces and brackets.	• Obstacles
	• Elevations
	• Mechanical drawings
	• Reflected ceiling plans
	• Plum level
	• Specification requirements
	• Trade Standards
	• Codes and regulations
	• Fasteners
	  ○ Structure anchors
	• Considerations
	  ○ Weight
	  ○ Structure
	  ○ Vibration
	  ○ Environment
	  ○ Seismic
	  ○ Manufacturer's shop drawings
	• Field fabricated to site conditions
	• Stiffeners and cross braces

LEARNING TASKS	CONTENT

4. Calculate the hanger requirements	• Mathematics
	  ○ Pythagoras
	  ○ Trigonometry
	  ○ Linear
	  ○ Perimeter circumference
	• Allowances
	• Contract drawings
	• Specifications
	• Trade standards
	• Anchor specifications

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K4 Install penetrations and sleeves

Objective

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

- Describe fire dampers and the installation of fire dampers.

LEARNING TASKS	CONTENT
1. Describe fire dampers	• Purpose • Style A • Style B • Style C • Fire / smoke dampers • Static and dynamic • Hourly rating • Horizontal (springs) • Vertical (gravity) • Fusible link • Operating temperatures
2. Describe the installation of fire dampers	• Manufacturer's specifications • Trade standards • Hole clearance • Damper sizing • Order sleeve • Retaining angle • Access door • Sleeve gauge • Maximum length • Breakaway connections • Blueprint symbols • Fire caulking • Fastener size / pitch / method • Testing

LEARNING TASKS	CONTENT
3. Identify penetration location	• Manufacturer's specifications • Trade standards • Measure from gridlines • Contract drawings • Structural Interference • Hidden hazards • Other trade interference • Verification of penetration size • Coordination • Safety • Mathematics

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K7 Install system component accessories

Objectives

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

- Describe system component accessories and their installation.

LEARNING TASKS	CONTENT

1. Describe system component accessories	• Burglar bars
	  ○ Material selection
	• Access doors
	  ○ Fire rated
	  ○ Dry wall access doors
	• Drain pans
	• Fire dampers
	• Splitter vanes
	• Turning vanes
	• Build outs / Hat sections
	• Insulation stops / nosing

2. Describe the installation of system component accessories	• Location • Fasteners • Fire rated • Sealant • Finish • Manufacturer's specifications • Contract specifications • Safety hazards

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

Competency: O1 Lay out roof and walls

Objectives

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

- Describe roofing, decking and cladding and their purposes.
- Describe the layout of roofing, decking and cladding.

LEARNING TASKS	CONTENT

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

2. Describe 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

3. Describe wall systems	• Wall systems
	  ○ Composite panels
	  ○ Sandwich panels
	  ○ Related flashings

LEARNING TASKS	CONTENT

4. Describe roof layout	• Roof structures
	  ○ Pitched
	  ○ Tapered
	  ○ Domes
	  ○ Spires
	• Roof construction features
	  ○ Hips
	  ○ Ridges
	  ○ Valleys
	• Roof hatches
	• Materials
	• Procedures
	• Mathematics
	• Tools
	  ○ Transit
	  ○ Level
	  ○ Chalk line

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

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

Objectives

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

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

LEARNING TASKS	CONTENT

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

2. Describe the installation of wall subsurface systems	• Systems
	  ○ Liner
	  ○ Vapour barrier
	  ○ Waterproof membrane
	  ○ Slip sheet
	  ○ Insulation types
	  ○ Isolation material
	• Building envelope
	• Sub-girt
	• Fastener types
	• Manufacturers' recommended installation
	• Methods
	• Cutting
	• Fitting
	• Securing
	• Sealing

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

Competency: O3 Install roofing and cladding/siding system components

Objectives

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

- Describe the installation of roofing, cladding/siding and components.
- Install roofing, cladding/siding and components.

LEARNING TASKS	CONTENT
1. Cut roofing and cladding/siding	• Materials • Types • Seam allowances • Cutting equipment • Waste minimization

2. Prepare roofing and cladding/siding	• Materials
	• Types
	• Joints
	  ○ "S"
	  ○ Lap
	  ○ Standing
	• Seam allowances
	• Joint forming
	• Roll forming machines

3. Install roofing, cladding/siding systems and components	• Seam Types
	• Fasteners
	• Sheet preparation
	• Thermal expansion and contraction
	• Expansion joints
	• Effects of weather conditions on material and installation
	• Components
	  ○ Joints
	  ○ Flashings
	  ○ Gutters
	  ○ Cornice
	• Cutting
	• Fitting
	• Field cut and mitre
	• Securing
	• Sealing

LEARNING TASKS	CONTENT
	○ Sealants • Use of reference lines • Sequence of installation
4. Describe the installation of wall system components	• Seam Types • Fasteners • Sheet preparation • Thermal expansion and contraction • Effects of weather conditions on material and installation • Components • Cutting • Fitting • Securing • Sealing ○ Sealants • Use of reference lines • Wall systems ○ Sandwich panels ○ Engineered panels ○ Composite panels

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

Competency: O4 Seal exposed joints

Objectives

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

- Describe sealants.
- Use sealants.

LEARNING TASKS	CONTENT
1. Describe different types of sealants	• Butyl • Latex • Mastic • Solder • Silicone • Fire rated • Gasket • Caulking tape • Closure strips • Two-part epoxy
2. Use sealants	• Surface prep • Backer rod • Tooling • Caulking gun • Masking • Environmental • Clean up • Storage • Packing • Thermal limitations • Manufacturer's specifications

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

Competency: O5 Install decking

Objectives

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

- Describe the installation of decking.

LEARNING TASKS	CONTENT

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

2. Install flashings	• Materials
	• Types
	• Joints
	  ○ "S"
	  ○ Lap
	  ○ Standing
	• Seam allowances
	• Joint forming
	• Field modifications
	• Soldering
	• Sealing

Line (GAC): P INSTALL EXTERIOR COMPONENTS

Competency: P1 Prepare surface

Objectives

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

- Describe the preparation of a site for installation of external components.

LEARNING TASKS	CONTENT

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

Line (GAC): P INSTALL EXTERIOR COMPONENTS

Competency: P2 Fasten exterior components

Objectives

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

- Describe the preparation of a site for installation of external components.
- Describe the installation of exterior components.

LEARNING TASKS

1. Describe the installation of exterior components

CONTENT

- Types
  - 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): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B2 Use shop tools and equipment

Objectives

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

- Select shop equipment appropriate to sheet metal processes.
- Use shop equipment.
- Inspect and maintain shop equipment.

LEARNING TASKS	CONTENT
1. Describe shop equipment used for specialty purposes	• CNC press brake • Iron worker • Spot welders • Power rolls • Angle iron rolls • Overhead crane • Drill presses • Hand brakes • Ring and circle shear • Stationary belt sander • Hydraulic knock-out tool • Hand plasma • Rod and tube bender
2. Use shop equipment	• Types • CNC • Parts • Purpose/uses • Procedures/operations • Capacities • Safety • Adjustment • Inspection • Minor maintenance • Storage

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

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

Objectives

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

- Weld using GMAW.

LEARNING TASKS	CONTENT
1. Review types of welding equipment	• Gas metal arc welding (GMAW) • Equipment/ hand tools
2. Review welding safety	• Licensing and training requirements • Government regulations • Ventilation requirements • Flammable material recognition • Personal protective equipment • Compressed gas safety • Shock hazard
3. Describe gas metal arc welding (GMAW) in all positions	• Advanced procedures/operations • Purpose/uses • Limitations • Equipment • Materials to be welded • Safety • Set-up • Adjustment
4. Use welding tools	• GMAW • Weld inspection, clean-up and testing

Achievement Criteria 1

Performance	The learner will weld 16 gauge coupons in all positions using GMAW.
Conditions	The learner will be given: • Welding equipment • Materials • Coupons
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Continuous • Heat setting • Penetration • Consistency • Porosity

Achievement Criteria 2

Performance	The learner will fabricate and weld in position a project from a shop drawing.
Conditions	The learner will be given: • Shop fabrication drawing complete with welding symbols and specifications • Tools and equipment • Materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Continuous • Heat setting • Penetration • Consistency • Porosity • Welding symbols followed • Specifications followed

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B4 Use gas tungsten arc welding (GTAW) equipment

Objectives

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

- Weld using GTAW.

LEARNING TASKS	CONTENT
1. Review welding safety	• Licensing and training requirements • Government regulations • Ventilation requirements • Flammable material recognition • Personal protective equipment • Compressed gas safety
2. Describe gas tungsten arc welding (GTAW)	• Terminology • Weld defects • Purpose/uses • Equipment limitations • Materials to be welded • Consumables • Safety • Procedures/operations • Set-up • Adjustment • Take down • Inspection • Maintenance • Storage
3. Use welding tools	• GTAW • Weld inspection, clean-up and testing

Achievement Criteria

Performance	The learner will fabricate and GTAW a project from a shop drawing.
Conditions	The learner will be given: • Shop fabrication drawing complete with welding symbols and specifications • Tools and equipment • Materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Continuous • Heat setting • Penetration • Consistency • Porosity • Welding symbols followed • Specifications followed

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E2 Develop patterns using parallel line method

Objectives

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

- Develop advanced patterns using parallel line development.

LEARNING TASKS	CONTENT

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

2. Develop advanced patterns using parallel line development	• Applications • Tee on a taper • Clean out on round elbow throat • Flat back elbow • Tee on an offset • Finial • Seam allowances • Pattern labelling and forming instructions

Achievement Criteria

Performance	The learner will use parallel line development to develop patterns for: • Tee on a taper • Clean out on round elbow throat • Flat back elbow • Tee on an offset, *and/or* • Finial
Conditions	The learner will be given: • Drawing specifications • Drafting and lay out tools
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Tool selection • Procedures • Patterns complete and accurate to within +/- 1/32” of drawing specifications

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E3 Develop patterns using radial line development

Objectives

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

- Develop patterns for advanced fittings using radial line development.

LEARNING TASKS	CONTENT
1. Review the selection of drafting equipment for radial line development	• Tee squares • Dividers • Compasses • Rulers • Scales • Set squares • Protractors • Pencils • Calculators

2. Describe drafting techniques for advanced industrial fittings using radial line development	• Line development
	  ○ Construction
	  ○ Radial line
	• Geometric construction
	  ○ Front view
	  ○ Plan view
	  ○ Visualization in three dimensions
	  ○ Required views
	• Mathematical formulas
	• Seam allowances
	• Pattern labelling and forming instructions
	• Applications
	  ○ Cone on a pipe
	  ○ Cone intersecting a cone
	  ○ Pipe intersecting a cone
	  ○ Rectangle intersecting a cone

Achievement Criteria

Performance	The learner will use radial line development to develop patterns for advanced industrial fittings using radial line development.
Conditions	The learner will be given: • Drawing specifications • Drafting and lay out tools
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Tools selection • Procedure • Patterns are complete and accurate to within +/- 1/16” of drawing specifications

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E4 Develop patterns using triangulation method

Objective

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

- Develop complex patterns using triangulation.

LEARNING TASKS	CONTENT

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

2. Develop complex patterns using triangulation	• Applications
	  ○ "Y" branch
	  ○ Transitional duct "Y"
	  ○ Drop cheek transitional elbow
	  ○ Twisted fittings
	• Pattern development using a combination of techniques
	• Seam allowances
	• Pattern labelling and forming instructions

Achievement Criteria

Performance — The learner will use triangulation to develop patterns for:

- "Y" branch

Conditions — The learner will be given:

- Project specifications
- Drafting and lay out

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

- Tools selection
- Procedure
- Patterns are complete and accurate to within +/- 1/32" of drawing specifications

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F2 Fabricate ductwork, fittings and components

Objectives

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

- Fabricate ductwork and fittings.

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

2. Fabricate duct fittings	• Applications
	  ○ Duct "Y" branch fittings
	  ○ Drop cheek change elbow
	• Labelling

Achievement Criteria

Performance The learner will fabricate and assemble duct fittings.

- Duct "Y" branch fittings *and/or*
- Drop cheek change elbow

Conditions The learner will be given:

- Project specifications
- Tools and equipment

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

- Safety
- Tools selection
- Procedure
- Project has no visible marks from hand tools
- Project is accurate to specified standards

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F4 Fabricate material handling system components

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe gravity material handling systems	• Components
	  ○ Chutes
	  ○ Hoppers
	  ○ Twists
	  ○ Roller conveyors
	  ○ Spouting
	• Purpose/applications
	• Materials

2. Fabricate gravity material handling system components	• Safety • Material selection • Tools and equipment • Layout • Mathematics • Cut • Form • Welding • Fastening • Specifications • Bend allowances • Assemble • Finish • Product protection • Wear and abrasion

Achievement Criteria

Performance	The learner will fabricate a material handling system component, such as: • Chute, • Hopper, or • Twist
Conditions	The learner will be given: • Project specifications • Tools and equipment • Materials
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Tools selection • Procedure • Final appearance • Project is accurate to specified standards

Line (GAC): H FABRICATE PRODUCTS FROM SPECIALTY MATERIALS

Competency: H1 Select material for specialty products

Objectives

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

- Select materials and fastenings for specialty products.

LEARNING TASKS	CONTENT

1. Describe considerations necessary when selecting materials for specialty applications	• Types and properties of
	  ○ Stainless steel
	  ○ Aluminum
	  ○ Hardened steel
	  ○ Non-metals
	  ○ Copper
	  ○ Brass
	  ○ Composites
	  ○ PVC-coated
	  ○ Black iron
	• Profile Shapes
	  ○ Round bar
	  ○ Square bar
	  ○ Tubing
	  ○ Angle iron
	  ○ Flat
	  ○ Extrusion

2. Describe material applications	• Food service industry
	• Industrial
	• Laboratories
	• Medical
	• Signage
	• Institutional
	• Commercial
	• Miscellaneous components
	  ○ Column covers
	  ○ Hand rails
	  ○ Fireplace faces
	• Marine

LEARNING TASKS	CONTENT

3. Describe fastening for specialty products	• Types
	  ○ Blind rivets
	  ○ Solid rivets
	  ○ Machine screws
	  ○ Sheet metal screws
	  ○ Bolts and nuts
	  ○ Rivet nuts
	  ○ Solder
	  ○ Welding
	  ○ Caulking
	• Considerations
	  ○ Specifications and codes
	  ○ Cost
	  ○ Galvanic scale
	  ○ Exposed
	  ○ Tamper-proofing
	  ○ Tensile strength
	  ○ Shear strength
	  ○ Sanitation
	  ○ Corrosiveness

Line (GAC): H FABRICATE PRODUCTS FROM SPECIALTY MATERIALS

Competency: H2 Fabricate specialty products

Objectives

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

- Select shop equipment for specialty products.
- Fabricate specialty products.

LEARNING TASKS	CONTENT

1. Describe specialty applications and products	• Types
	  ○ Food processing and service
	  ○ Medical
	  ○ Pharmaceutical
	  ○ Laboratories
	  ○ Institutional
	  – Prison systems (tamper proof)
	  – Security systems
	  – Architectural features
	  – Commercial displays
	  – Baggage carousels
	  – People movers (escalators, elevators)
	  ○ Industrial
	  – Corrosive
	  – Abrasive
	  ○ Decorative
	  ○ Marine
	  – Waterproof louver
	  – Water tight joints
	  – Fully welded seams
	  – Marine terminology
	  – Safety considerations
	  – Metal properties
	  ○ Awnings
	  ○ Signage
	• Purpose/applications
	• Materials
	• Considerations for specialty applications

LEARNING TASKS	CONTENT
2. Describe shop equipment used for specialty products	• Press brake • Power notchers • Iron worker • Power rolls • Ring and circle shear • Hand brakes • Drill presses • Shears • Spot welders
3. Use shop equipment for specialty products	• Types • CNC • Parts • Purpose/uses • Procedures/operations • Capacities • Safety • Adjustment • Inspection • Minor maintenance • Storage

4. Use power tools for specialty products	• Types
	  ○ Pneumatic
	  ○ Weld-finishing tools
	  ○ Hydraulic
	  ○ Electric
	• Safety and hazards
	• Purposes and uses
	• Procedures and operations
	• Adjustments
	• Maintenance
	• Storage

LEARNING TASKS

5. Fabricate stainless steel products

CONTENT

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

Achievement Criteria

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

Conditions — The learner will be given:

- Project specifications
- Tools and equipment
- Materials

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

- Safety
- Tools selection
- Procedure
- Final appearance
- Project is accurate to specified standards

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K1 Install air handling equipment

Objectives

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

- Describe air handling systems and their purposes.
- Describe the installation of air handling systems.

LEARNING TASKS	CONTENT

1. Describe air handlers	• Purpose
	• Types
	  ○ Furnaces
	  ○ Booster
	  ○ Fans
	  – Axial
	  – Centrifugal
	  – Forward inclined
	  – Backward inclined
	  – Paddle
	  – Vane axial
	  ○ Fan laws
	  ○ Rooftop units
	  ○ Built-up systems
	• Operation

2. Describe the installation of air handlers	• Manufacturers' specifications
	• Effect of weather on installation
	• Maintenance considerations
	• Housekeeping pads
	• Seismic restraints
	• Isolators
	  ○ Inertia bases
	  ○ Isolation springs
	  ○ Isolation pads

3. Describe heat and energy recovery ventilators	• Purpose • Types • Operation • Applications
4. Describe the installation of heat and energy recovery ventilators	• Codes and Regulations • Manufacturer's specifications • Filter types • Hanging hardware • Stands

LEARNING TASKS	CONTENT
5. Describe residential heating, ventilation and air conditioning	• Heat transfer • Furnace types • Controls • Equipment • Locations
6. Describe the installation of residential furnaces	• Manufacturer's requirements • Location of supply and return air outlets • Sealing methods

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K6 Install terminal boxes and coils

Objectives

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

- Describe terminal boxes and their installation.
- Describe coils and their installation.

LEARNING TASKS	CONTENT

1. Describe terminal boxes	• Types
	  ○ VAV
	  ○ Mixing boxes
	  ○ By-passes
	  ○ Attenuating boxes
	• Controls
	  ○ Digital controls
	  ○ Motorized dampers
	  ○ Sensors
	• Applications
	  ○ Single duct
	  ○ Dual duct
	  ○ Zone control
	  ○ Economy
	  ○ Noise control
	  ○ Reduced size duct

2. Describe the installation of terminal boxes	• Manufacturer's specifications • Inlet length • Access door • Air flow directional • Seal • Support • Seismic • Trade standards

3. Describe coils	• Types
	  ○ Heating
	  ○ Refrigerated coil
	  ○ Electric
	  ○ Hydronic
	  ○ Reheat
	  ○ Pre-heat

LEARNING TASKS	CONTENT

4. Describe the installation of coils	• Location verification
	• Size determination
	  ○ BTU calculations
	  ○ Heating loads
	  ○ Cooling loads
	• Drain pans
	• Access doors
	• Blanking
	• Safing
	• Refrigeration principles
	• Codes and Regulations
	• Trade standards
	• Manufacturer's specifications
	• Securing
	• Sealing
	• Access doors
	• Seismic
	• Supports

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K7 Install system component accessories

Objectives

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

- Describe system components and their installation.

LEARNING TASKS	CONTENT

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

2. Describe the installation of system component accessories	• Identify hazards • Lock out • Maintenance • Location • Blanking • Hat sections • Filter rack • Access • Drainage • Order fittings • Trade standards • Seismic • Sealing • Support • Stiffeners • Blueprint symbols

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K9 Install commercial, industrial and institutional systems

Objectives

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

- Describe commercial, industrial and institutional plenums and their installation.

LEARNING TASKS	CONTENT

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

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

LEARNING TASKS	CONTENT

3. Install commercial, industrial and institutional plenums	• Methods
	  ○ Fasten sections
	  ○ Stiffeners
	  ○ Damper blade brackets
	  ○ Linkage connections
	  ○ Motor installation
	• Filter racks
	• Sealing
	• Floor and ceiling tracks
	• Flex connections
	• Trade standards
	• Contract drawings
	• Other trade coordination
	• Safety hazards

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

Competency: N1 Perform leak tests

Objectives

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

- Describe the purpose and application of leak testing.

LEARNING TASKS	CONTENT

1. Describe leak testing	• Types
	  ○ Smoke
	  ○ Dye
	  ○ Pressure
	  ○ Fluid
	  ○ Visual
	  ○ Audible

2. Prepare for leak testing	• System preparation for testing
	  ○ Temporary caps
	  ○ Access doors
	  ○ Dampers in appropriate position and location
	  ○ Sections, sealed and complete
	• Test ports
	• Techniques
	• System knowledge and understanding

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

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

Objectives

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

- Describe the purpose and application of air balancing.
- Calculate air flow system variables.

LEARNING TASKS	CONTENT
1. Describe indoor air quality	• Contaminates • Irritants • Odours • Noise • Filtration • Relative humidity
2. Describe air flow in ducts	• Air flow • Duct design • Fitting design

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

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

Achievement Criteria

Performance	The learner will calculate the air flow system variables.
Conditions	The learner will be given: • Test data • System design data • Tools and equipment
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Process • Calculated adjustments

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

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

Objectives

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

- Describe knowledge of commissioning and its purpose.

LEARNING TASKS	CONTENT
1. Describe knowledge of commissioning and its purpose	• Shop drawings • As builts • Job specifications • Manufacturer's specifications
2. Describe knowledge of the procedures used to commission air and material handling systems and components	• Shop drawings • As builts • Job specifications • Manufacturer's specifications

Line (GAC): Q INSTALL SPECIALTY PRODUCTS

Competency: Q1 Install stainless steel specialty products

Objectives

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

- Describe the installation of stainless steel specialty products.

LEARNING TASKS	CONTENT

1. Describe the different considerations between stainless steel and general construction	• Safety
	  ○ Fire considerations
	  ○ Health considerations
	• Material contamination
	• Work place contamination
	• Specialty tools
	• Surface protection
	• Codes and regulations
	  ○ Health Canada
	  ○ CSA-ULCA
	  ○ NFPA
	• Job site management
	• Food grade caulking, solders and welding materials
	• Sanitary requirements
	• Manufacturer's installation instructions
	• Finishing
	• Galvanic action

2. Describe the installation of stainless steel specialty products	• Kitchen preparation products • Pharmaceutical laboratory products • Food processing products • Medical facility products • Institutional installation

Line (GAC): Q INSTALL SPECIALTY PRODUCTS

Competency: Q2 Install non-stainless steel specialty products

Objectives

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

- Describe the installation of specialty products.

LEARNING TASKS	CONTENT

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

2. Describe the installation of non-stainless steel specialty products	• Kitchen preparation products • Pharmaceutical laboratory products • Food processing products • Medical facility products • Institutional installation

Line (GAC): Q INSTALL SPECIALTY PRODUCTS

Competency: Q3 Install marine products

Objectives

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

- Install marine products.

LEARNING TASKS	CONTENT

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

2. Describe marine installations and applications	• Waterproof louver
	• Water tight joints
	• Metal properties
	• Typical installations
	  ○ Lockers
	  ○ Furniture
	  ○ Galleys
	  ○ Ceilings

Line (GAC): R PERFORM SCHEDULED MAINTENANCE

Competency: R1 Diagnose system faults

Objectives

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

- Describe the normal operation of systems.
- Identify signs of abnormality.

LEARNING TASKS	CONTENT
1. Describe normal operation of a system	• Sounds • Vibrations • Smells • Heat build-ups • Fan laws
2. Identify signs of abnormality	• Sounds • Vibrations • Odours • Mould • Corrosion • Decreased air flow • Heat build-ups • Signs of wear and fatigue • Amperage/voltage/resistance • Air pressure readings • Temperature

Line (GAC): R PERFORM SCHEDULED MAINTENANCE

Competency: R2 Repair worn or faulty components

Objectives

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

- Describe the servicing and repair of components.

LEARNING TASKS

1. Describe the servicing and repair of components

CONTENT

- Safety/lock out
- Frequency of scheduled servicing
- Warranty
- Devices
  - Belts
  - Pulleys
  - Bearings
  - Fan blades
  - Filters
  - Motors
  - Shafts
  - Gears/chains
- Inspection
- Cleaning
- Adjustment
- Lubrication
- Filters
  - Types
  - Construction
  - Applications
  - Locations
  - Changing
  - Cleaning
- Repair sequence
  - Removal
  - Replacement
  - Verification
- Patching methods
- Verification of compatibility of new components
- Modifying replacement components
- Coordinating replacement components
- Verifying repairs
- Service reports

Level 4

Sheet Metal Worker

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

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

Objectives

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

- Describe specialized welding processes.

LEARNING TASKS	CONTENT
1. Review types of welding equipment and processes	• Gas metal arc welding (GMAW) • Equipment/hand tools
2. Review welding safety	• Licensing and training requirements • Government regulations • Ventilation requirements • Flammable material recognition • Personal protective equipment • Compressed gas safety
3. Describe specialized welding processes and consumables	• Flux core arc welding (FCAW) • Silicone bronze • Aluminium • Spool gun • Push-pull gun • Stainless GMAW • Types of gasses • Pulse
4. Perform specialized GMAW processes	• Flux core arc welding (FCAW) • Silicone bronze • Aluminium • Stainless

Achievement Criteria

Performance	The learner will weld a fabricated material handling system component project using GMAW process:
Conditions	The learner will be given: • Welding equipment • Shop fabrication/assembly drawing • Fabricated project
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Continuous • Heat setting • Penetration • Consistency • Porosity • Weld symbols followed • Specifications followed

Line (GAC): B USE AND MAINTAIN TOOLS AND EQUIPMENT

Competency: B10 Use hoisting, rigging and positioning equipment

Objectives

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

- Describe hoisting, lifting and rigging equipment.
- Tie knots, bends and hitches.
- Select and use hoisting, lifting and rigging equipment.
- Calculate working load limits.

LEARNING TASKS	CONTENT

1. Review hoisting, lifting and rigging equipment	• Types
	  ○ Lifting equipment
	  ○ Rigging equipment
	  ○ Rolling equipment
	• Uses
	• Limitations and capacities
	• Government regulations
	• Safety
	• Lift and landing barriers

2. Review knots, bends and hitches	• Rope types • Working load limits • Terms • General rules • Knot, bend and hitch types • Inspection • Maintenance • Storage
3. Use hoisting, lifting and rigging equipment	• Selection of equipment • Selection of lifting location or point • Operating procedures • Crane and /or lifting equipment selection • Communication and hand signals • Securing of loads • Landing of loads • Site hazards • Inspection • Maintenance • Storage

LEARNING TASKS	CONTENT
4. Calculate working load limit	• Sling angles • Sling types • Hitch types • Hardware • Spreader bars

Line (GAC): D USE COMMUNICATION AND MENTORING TECHNIQUES

Competency: D2 Use mentoring techniques

Objectives

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

- Describe mentoring.
- Mentoring others.

LEARNING TASKS	CONTENT
1. Review methods of communication	• Listening skills • Questioning skills • Following verbal directions • Body language • Written directions • Drawings • Trade terminology

2. Mentoring others	• Interpersonal skills
	  ○ Encouragement
	  ○ Explaining
	  ○ Following up
	  ○ Showing
	  ○ Leading by example
	  ○ Respect for others
	• Ethics
	  ○ Time management
	  ○ LEAN principles
	  ○ Punctuality
	  ○ Respect for authority
	  ○ Stewardship of materials
	• Deliver constructive feedback respectfully
	• Customers (layperson terms)
	• Employer representation
	• First impression
	• Identify learning needs
	• Teaching techniques
	  ○ Patience
	  ○ Clear explanations
	  ○ Linking lessons
	  ○ Allow practice
	  ○ Expect mistakes
	  ○ Assessment

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E4 Develop patterns using triangulation method

Objectives

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

- Develop complex patterns using triangulation.

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

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

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

Achievement Criteria

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

- Round reducer elbow *and/or*
- Square to round elbow

Conditions — The learner will be given:

- Project specifications
- Drafting and tool lay out equipment
- Paper
- Calculator

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

- Tools selection
- Procedure
- Patterns are complete and accurate to within +/- 1/16” of drawing specifications

Line (GAC): E PERFORM PATTERN DEVELOPMENT

Competency: E5 Use computer technology for pattern development

Objectives

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

- Develop patterns using computer technology.

LEARNING TASKS	CONTENT

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

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

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

4. Use software to develop patterns	• Enter fittings from shop fabrication drawings

5. Describe software programs that provide more than just pattern development	• Package software which includes
	  ○ Estimation
	  ○ Design
	  ○ Fabrication
	  ○ Project management

Achievement Criteria

Performance	The learner will enter information from a shop fabrication drawing using computer aided sheet metal software program.
Conditions	The learner will be given: • Project specifications • Computer and software application
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Gauge • Labelling • Dimensioning • Seams • Joints • Fittings entered according to information

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F2 Fabricate ductwork, fittings and components

Objectives

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

- Fabricate complex ductwork and fittings.

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

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

Achievement Criteria

Performance — The learner will fabricate and assemble advanced duct fittings.

- Square to round elbow, *and/or*
- Round reducing elbow

Conditions — The learner will be given:

- Project specifications
- Tools and equipment

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

- Safety
- Tools selection
- Procedure
- Project has no visible marks from hand tools
- Project is accurate to specified standards

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F4 Fabricate material handling system components

Objectives

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

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

LEARNING TASKS	CONTENT

1. Describe pneumatic material handling systems	• Components
	  ○ Cyclone
	  ○ Feeder valves
	  ○ Air locks
	  ○ Positive/negative systems
	  ○ Bag house
	  ○ Heat recovery
	  ○ Wet scrubbers
	  ○ Hoppers
	  ○ Air moving devices (AMD)
	  ○ Abort gates
	  ○ Vacuum doors
	  ○ Explosion curtains
	  ○ Collection hoods
	  ○ Fittings
	  ○ Liners
	• Purpose/applications
	  ○ Classifications
	• Materials

2. Fabricate pneumatic material handling system components	• Components • Cyclone • Feeder valves • Air locks • Positive/negative systems • Bag house • Heat recovery • Wet scrubbers • Hoppers • Air moving devices (AMD) • Abort gates • Vacuum doors • Explosion curtains

LEARNING TASKS

CONTENT

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

Achievement Criteria

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

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

Conditions — The learner will be given:

- Project specifications
- Tools and equipment
- Materials

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

- Safety
- Tools selection
- Procedure
- Final appearance
- Project is accurate to specified standards

Line (GAC): F FABRICATE SHEET METAL COMPONENTS FOR AIR AND MATERIAL HANDLING SYSTEMS

Competency: F5 Fabricate dampers

Objectives

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

- Describe types of dampers.
- Fabricate dampers to specifications.

LEARNING TASKS	CONTENT
1. Describe single blade dampers	• Volume damper • Flow control • Splitter • Round • Rectangular • Butterfly • Back draft • Balancing
2. Describe multi-blade dampers	• Volume damper • Air flow characteristics • Motorized • Back draft • Opposed blade • Parallel blade • Dynamic / static • Balancing
3. Describe blast gate dampers	• Material flow control • Balancing • Shut off • Wear and erosion
4. Describe damper hardware	• Quadrant arms • Linkages • Ball joints • Bearings • Frames

Achievement Criteria 1

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

Achievement Criteria 2

Performance	The learner will fabricate saddle and trapeze hangers.
Conditions	The learner will be given: • Project specifications • Tools and equipment
Criteria	The learner will score 70% or better on a rating sheet that reflects the following criteria: • Safety • Tools selection • Procedure • Project has no visible marks from hand tools • Project is accurate to specified standards

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K1 Install air handling equipment

Objectives

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

- Describe air handling systems and their purposes.
- Describe the installation of air handling systems.

LEARNING TASKS	CONTENT

1. Describe air moving devices	• Centrifugal fans
	  ○ Forward curved
	  ○ Backward inclined
	  ○ Straight blade
	  ○ Rotation
	  ○ Orientation
	  ○ Inlet straight
	  ○ Outlet straight
	• Axial fans
	  ○ Vain axial
	  ○ Tube axial
	  ○ Disc blade
	  ○ Propeller blade
	  ○ Variable pitch
	• Fan wall technology

2. Describe the installation of centrifugal and axial fans	• Manufacturer's specifications
	• Effect of weather on installation
	• Maintenance considerations
	• Penetration size
	• Penetration obstructions
	• Sleepers
	• Stands
	• Housekeeping pads
	• Seismic restraints
	• Isolators
	  ○ Inertia bases
	  ○ Isolation springs
	  ○ Isolation pads

LEARNING TASKS	CONTENT

3. Review the installation of air handling ductwork and fittings	• Components
	• Installation drawings
	  ○ Elevation
	  ○ Plan
	  ○ Specifications
	• Tools and equipment
	• Safety
	• Hangers
	• Fasteners
	• Plumbing and levelling
	• Connection
	• Sealing
	• Field cutting
	• Field modification
	• Seismic

Line (GAC): K INSTALL AIR HANDLING SYSTEM COMPONENTS

Competency: K7 Install system component accessories

Objectives

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

- Describe system component accessories and their installation.

LEARNING TASKS	CONTENT

1. Describe system component accessories	• Air flow sensors
	  ○ Proves air flow
	• Temperature sensors
	• Controls
	  ○ Damper controls
	• Spark arrestors
	• Smoke detectors
	• Air balancing test ports
	• High limit switches
	• Magnehelic gauge

2. Describe the installation of system component accessories	• Identify hazards • Lock out • Maintenance • Location • Trade standards • Sealing • Blueprint symbols

Line (GAC): L INSTALL MATERIAL HANDLING SYSTEM COMPONENTS

Competency: L1 Install pneumatic material-handling systems

Objectives

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

- Describe pneumatic material and dust handling systems and their purpose.
- Describe the installation of pneumatic material and dust handling systems.

LEARNING TASKS	CONTENT

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

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

LEARNING TASKS	CONTENT

3. Describe the installation of air moving devices	• Purpose
	• Types
	  ○ Axial
	  ○ Centrifugal
	  ○ Forward inclined
	  ○ Backward inclined
	  ○ Paddle
	• Codes and Regulations
	• Manufacturer's specifications
	• Fastening

4. Describe the installation of collection devices	• Purpose
	• Types
	  ○ Hoppers
	  ○ Hoods
	  ○ Bins
	• Codes and Regulations
	• Manufacturer's specifications
	• Positioning
	• Fastening
	• Effects of weather on installation

5. Describe the installation of separating devices	• Purpose
	• Types
	  ○ Cyclones
	  ○ Bag houses
	  ○ Conveyor skirting
	• Parts
	  ○ Air locks/feeders
	• Operation
	• Codes and Regulations
	• Manufacturer's specifications
	• Effects of weather on installation
	• Positioning
	• Fastening

Line (GAC): L INSTALL MATERIAL HANDLING SYSTEM COMPONENTS

Competency: L2 Install gravity material handling system components

Objectives

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

- Describe gravity material handling systems and their purpose.
- Describe the installation of gravity material handling systems.

LEARNING TASKS

1. Describe gravity material handling systems

CONTENT

- Purpose
  - Product movement
    - Baggage handling
    - Garbage
    - Product
    - Packaging
    - Manufacturing/ Production lines
    - Waste removal
- Types
  - Roller conveyors
  - Chutes and spouts
- Components
  - Hoppers
  - Liners
  - Fittings
    - Fitting design
  - Rollers
  - System service access
- Operation

LEARNING TASKS	CONTENT

2. Describe the installation of mechanized systems	• Supports and Bases
	  ○ Dimensions and weights of components
	  ○ Orientation and location of units
	  ○ Securing of equipment
	• Separating devices
	  ○ Types
	  – Hoppers
	  – Bins
	• Purpose
	• Types
	• Parts
	• Operation
	• Codes and Regulations
	• Manufacturer's specifications
	• Positioning
	• Fastening
	• Effects of weather on installation

Line (GAC): L INSTALL MATERIAL HANDLING SYSTEM COMPONENTS

Competency: L3 Install mechanized material handling system components

Objectives

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

- Describe mechanized material handling systems and their purpose.
- Describe the installation of mechanized material handling systems.

LEARNING TASKS

1. Describe mechanized material handling systems

CONTENT

- Purpose
  - Product movement
    - Waste removal
    - Baggage handling
    - Garbage
    - Product
    - Packaging
    - Manufacturing/ Production lines
- Types
  - Screw/auger
  - Bucket elevators
  - Conveyors
- Components
  - Liners
  - Fittings
    - Fitting design
  - Chutes
  - Belts
  - System service access
- Operation

LEARNING TASKS	CONTENT

2. Describe the installation of mechanized systems	• Supports and bases
	  ○ Dimensions and weights of components
	  ○ Orientation and location of units
	  ○ Securing of equipment
	  ○ Purpose
	• Collection Devices
	  ○ Hoppers
	  ○ Bins
	• Separating devices
	  ○ Purpose
	  ○ Types
	• Parts
	• Operation
	• Codes and Regulations
	• Manufacturer's specifications
	• Effects of weather on installation
	• Positioning
	• Fastening

Line (GAC): M APPLY THERMAL INSULATION, LAGGING, CLADDING AND FLASHING

Competency: M1 Apply lagging and cladding to components

Objectives

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

- Describe the purpose of cladding and lagging.
- Describe the installation of cladding and lagging.

LEARNING TASKS	CONTENT
1. Describe the purpose of cladding and lagging	• Purpose • Types

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

LEARNING TASKS	CONTENT
	○ Securing techniques ○ Installation techniques ○ Sealants ○ Safe work practices and procedures

Line (GAC): M APPLY THERMAL INSULATION, LAGGING, CLADDING AND FLASHING

Competency: M2 Apply flashing to components

Objectives

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

- Describe the purpose of lagging flashings.
- Describe the installation of lagging flashings.

LEARNING TASKS	CONTENT

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

2. Describe the installation of flashing for lagging	• Materials
	  ○ Thermal expansion and contraction
	  ○ Stainless steel
	  ○ Aluminum
	  ○ Coated steel
	  ○ Membrane
	  ○ Plastic
	  ○ Galvanic reaction
	• Mechanical equipment
	  ○ Boilers
	  ○ Piping
	  ○ Pressure vessels
	  ○ Cladding requirements
	• Process
	  ○ Mathematics
	  ○ Layout
	  ○ Forming
	  ○ Securing techniques
	  ○ Seams and joints
	  ○ Sealants
	  ○ Water shedding
	  ○ Capillary actions
	  ○ Field measuring and modifications

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

Competency: N1 Perform leak tests

Objectives

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

- Describe leak testing.
- Perform and calculate leak testing.

LEARNING TASKS	CONTENT

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

2. Calculate leakage amount	• Testing report • Mathematics • Identify deficiencies • Recommended solutions to problems

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

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

Objectives

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

- Apply air balancing techniques.
- Calculate required system adjustments.

LEARNING TASKS	CONTENT
1. Describe air flow in ducts	• Air flow • Duct design • Fitting design • Dynamic loss • System effect • Fan inlet and outlet effective lengths • Relative humidity
2. Use testing and balancing procedures	• Purpose • Pressures • Mathematics

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

LEARNING TASKS	CONTENT
	○ Sheaves • Test port installation • Amperage check • Velocity readings • Test running the system
4. Balance an air system	• Comparison to design specifications • Adjust components • Retest • Documentation

Achievement Criteria

Performance — The learner will perform air balancing.

Conditions — The learner will be given:

- Test data
- System design data
- Tools and equipment

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

- Process
- Calculated adjustments

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

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

Objectives

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

- Complete commissioning report.

LEARNING TASKS	CONTENT
1. Use documentation to compile reports	• Shop drawings • As builts • Job specifications • Manufacturer's specifications
2. Use calculations to complete reports	• Rotation testing • BTU verification • Mechanical service connections • Air flow verifications • Temperature rise • Voltage and amps check • BHP • Indoor air quality
3. Address deficiencies in commissioning report	• Identifying and labelling • Component check • Future maintenance • System operation education

Section 4

ASSESSEMENT GUIDELINES

Assessment Guidelines – Level 1

Level 1 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	SHEET METAL WORKER LEVEL 1		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
A	Perform Safety Related Functions	5%	0%
B	Use and Maintain Tools and Equipment	23%	35%
C	Organize Work	17%	0%
D	Use Communication and Mentoring Techniques	0%	0%
E	Perform Pattern Development	25%	20%
F	Fabricate Sheet Metal Components for Air and Material Handling Systems	20%	40%
K	Install Air Handling System Components	10%	5%
	Total	100%	100%
In-school theory / practical subject competency weighting		62%	38%
Final in-school mark Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Sheet Metal Worker Standardized Level exam.		IN-SCHOOL %	

In-school Mark Combined theory and practical subject competency multiplied by	80%
Standardized Level Exam Mark The exam score is multiplied by	20%
Final Level Mark	Final%

Assessment Guidelines – Level 2

Level 2 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	SHEET METAL WORKER LEVEL 2		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
B	Use and Maintain Tools and Equipment	10%	25%
C	Organize Work	20%	10%
E	Perform Pattern Development	20%	20%
F	Fabricate Sheet Metal Components for Air and Material Handling Systems	10%	25%
G	Fabricate Flashing, Roofing, Sheeting and Cladding	8%	15%
I	Prepare Installation Site	0%	0%
J	Install and Connect Chimneys, Breeching, and Venting to Exhaust Appliances and Mechanical Equipment	8%	0%
K	Install Air Handling System Components	8%	5%
O	Install Metal Roofing and Cladding/Siding Systems	8%	0%
P	Install Exterior Components	8%	0%
	Total	100%	100%
In-school theory / practical subject competency weighting		62%	38%
Final in-school mark Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Sheet Metal Worker Standardized Level exam.		IN-SCHOOL %	

In-school Mark Combined theory and practical subject competency multiplied by	80%
Standardized Level Exam Mark The exam score is multiplied by	20%
Final Level Mark	Final%

Assessment Guidelines – Level 3

Level 3 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	SHEET METAL WORKER LEVEL 3		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
B	Use and Maintain Tools and Equipment	15%	23%
E	Perform Pattern Development	20%	15%
F	Fabricate Sheet Metal Components for Air and Material Handling Systems	13%	25%
H	Fabricate Specialty Products	8%	25%
K	Install Air Handling System Components	16%	0%
N	Perform Leak Testing, Air Balancing and Commissioning	15%	12%
Q	Install Specialty Products	8%	0%
R	Perform Scheduled Maintenance	5%	0%
	Total	100%	100%
In-school theory / practical subject competency weighting		62%	38%
Final in-school mark Apprentices must achieve a minimum 70% for the final in-school mark to be eligible to write the Sheet Metal Worker Standardized Level exam.		IN-SCHOOL %	

In-school Mark Combined theory and practical subject competency multiplied by	80%
Standardized Level Exam Mark The exam score is multiplied by	20%
Final Level Mark	Final%

Assessment Guidelines – Level 4

Level 4 Grading Sheet: Subject Competency and Weightings

PROGRAM: IN-SCHOOL TRAINING:	SHEET METAL WORKER LEVEL 4		
LINE	**SUBJECT COMPETENCIES**	**THEORY WEIGHTING**	**PRACTICAL WEIGHTING**
B	Use and Maintain Tools and Equipment	8%	25%
D	Use Communication and Mentoring Techniques	0%	0%
E	Perform Pattern Development	20%	25%
F	Fabricate Sheet Metal Components for Air and Material Handling Systems	20%	30%
K	Install Air Handling System Components	15%	0%
L	Install Material Handling System Components	15%	0%
M	Apply Thermal Insulation, Lagging, Cladding and Flashing	12%	0%
N	Perform Leak Testing, Air Balancing and Commissioning	10%	20%
	Total	100%	100%
In-school theory / practical subject competency weighting		62%	38%
Final in-school mark		IN-SCHOOL %	

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.

SkilledTradesBC will enter the apprentices' Sheet Metal Worker Interprovincial Red Seal examination percentage score into SkilledTradesBC Portal.

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

Section 5

TRAINING PROVIDER STANDARDS

Facility Requirements

Classroom Area

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

Shop Area

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

Lab Requirements

Does not apply

Student Facilities

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

Instructor's Office Space

Does not apply

Other

- Desk and filing space
- Computer
- Phone

Tools and Equipment

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

HAND TOOLS: LEVELS 1 to 4

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
		2	Laser 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
	High visibility vests

LAYOUT AND DRAFTING EQUIPMENT: LEVELS 1 to 4

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

MEASURING TOOLS: LEVELS 1 to 4

2	Angle finders	16	Tape measures

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

3	Ladders	1	Material lift

PORTABLE POWER TOOLS: ALL LEVELS

4	Angle grinder	1	Hammer drill
1	Circular saw	1	Inline belt sander
1	Reciprocating saw	1	Drum sander
		1	Orbital sander
4	Cordless drill	1	Jigsaw
1	Die grinder	2	Portable plasma cutter
1	Double cutter	4	Uni-shear
4	Electric drill motor	1	Nibbler
1	Right angle drill	1	Pneumatic rivet gun
1	Cordless angle grinder	1	Impact driver

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	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	CNC Press Brake
1	Iron worker

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	1	Combination rotary machine

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	8	Software packages
1	Printer		

Reference Materials

Required Reference Materials

- Contact Training Facility for Required Reference Material

NOTE:

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

Instructor Requirements

Occupation Qualification

The instructor must possess:

- A BC Certificate of Qualification preferably with a Red Seal Endorsement.
- Certificate of Qualification from another Canadian jurisdiction complete with Red Seal Endorsement only.

Work Experience

A minimum of five years experience working in the industry as a journeyperson.

Instructional Experience and Education

It is preferred that the instructor also possesses one of the following:

- An Instructor's Diploma or equivalent
- A Bachelor's Degree in Education
- A Master's Degree in Education