PROGRAM PROGRAMME
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RED SEAL OCCUPATIONAL STANDARD

Sheet Metal Worker

INTERPROVINCIAL STANDARD
CANADA
NORME INTERPROVINCIALE

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Employment and Social Development Canada
Emploi et Développement social Canada

Canada

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FOREWORD

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Red Seal Occupational Standard (RSOS) as the Red Seal standard for the Sheet Metal Worker trade.

Background

The first National Conference on Apprenticeship in Trades and Industries, held in Ottawa in 1952, recommended that the federal government be requested to cooperate with provincial and territorial apprenticeship committees and officials in preparing analyses of a number of skilled occupations. Employment and Social Development Canada (ESDC) sponsors the Red Seal Program, which, under the guidance of the CCDA, develops a national occupational standard for each of the Red Seal trades.

Standards have the following objectives:

- to describe and group the tasks performed by skilled workers;
- to identify which tasks are performed in every province and territory;
- to develop instruments for use in the preparation of Interprovincial Red Seal Examinations and assessment tools for apprenticeship and certification authorities;
- to develop common tools for apprenticeship on-the-job and technical training in Canada;
- to facilitate the mobility of apprentices and skilled workers in Canada;
- to supply employers, employees, associations, industries, training institutions and governments with analyses of occupations.

Any questions, comments, or suggestions for changes, corrections, or revisions to this standard or any of its related products may be forwarded to:

Trades and Apprenticeship Division
Apprenticeship and Regulated Occupations Directorate
Employment and Social Development Canada
140 Promenade du Portage, Phase IV, 6th Floor
Gatineau, Quebec K1A 0J9
Email: redseal-sceaurouge@hrsdc-rhdcc.gc.ca

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This standard was prepared by the Apprenticeship and Regulated Occupations Directorate of ESDC. The coordinating, facilitating and processing of this standard was undertaken by employees of the standards development team of the Trades and Apprenticeship Division and of Ontario, the host jurisdiction for this trade.

STRUCTURE OF THE OCCUPATIONAL STANDARD

To facilitate understanding of the occupation, this standard contains the following sections:

Description of the Sheet Metal Worker trade: An overview of the trade's duties, work environment, job requirements, similar occupations and career progression

Trends in the Sheet Metal Worker trade: Some of the trends identified by industry as being the most important for workers in this trade

Essential Skills Summary: An overview of how each of the 9 essential skills is applied in this trade

Roles and Opportunities for Skilled Trades in a Sustainable Future: an overarching description of how in the context of climate change, skilled trades play a large role in implementing solutions and adjusting to changes in the world. In addition to highlighting the importance of this awareness, the standard may also contain more details on activities, skills and knowledge elements that are specific to the trade

Industry Expected Performance: description of the expectations regarding the level of performance of the tasks, including information related to specific codes, regulations and standards that must be observed

Language Requirements: description of the language requirements for working and studying in this trade in Canada

Pie Chart: a graph which depicts the national percentages of exam questions assigned to the major work activities

Task Matrix and Examination Weightings: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard and their respective exam weightings

Major Work Activity (MWA): the largest division within the standard that is comprised of a distinct set of trade activities

Task: distinct actions that describe the activities within a major work activity

Task Descriptor: a general description of the task

Sub-task: distinct actions that describe the activities within a task

Essential Skills: The most relevant essential skills for this sub-task

Skills:

Performance Criteria: description of the activities that are done as the sub-task is performed

Evidence of Attainment: proof that the activities of the sub-task meet the expected performance of a tradesperson who has reached journeyperson level

Knowledge:

Learning Outcomes: describes what should be learned relating to a sub-task while participating in technical or in-school training

Learning Objectives: topics to be covered during technical or in-school training in order to meet the learning outcomes for the sub-task

Range Variables: elements that provide a more in-depth description of a term used in the performance criteria, evidence of attainment, learning outcomes, or learning objectives

Appendix A—Acronyms: a list of acronyms used in the standard with their full name

Appendix B—Tools and Equipment: a non-exhaustive list of tools and equipment used in this trade

Appendix C—Glossary: definitions or explanations of selected technical terms used in the standard

DESCRIPTION OF THE SHEET METAL WORKER TRADE

"Sheet Metal Worker" is this trade's official Red Seal occupational title approved by the CCDA. This standard covers tasks performed by sheet metal workers whose occupational title has been identified by some provinces and territories of Canada under the following names:

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
Sheet Metal Worker	■	■	■	■		■	■	■	■	■	■	■	■
Tinsmith					■								

Sheet metal workers design, fabricate, assemble, install and repair sheet metal products and systems. In fabrication work, sheet metal workers lay out and measure pieces to specifications. They use tools such as hand tools, portable power tools and shop equipment to cut and shape material. They assemble and join the pieces with various techniques such as welding and using mechanical fasteners.

They work with black iron, galvanized steel, satin-coated steel, stainless steel, aluminum, copper, brass, nickel, tin plate and other alloys. Some may also work with composites, fibreglass, ceramics and plastics.

Pieces may be laid out and cut in the shop and assembled on construction or industrial sites. Sheet metal workers may specialize in on-site installation, heating, ventilation and air conditioning (HVAC) and material handling system design, shop manufacture, and servicing and maintenance of installed equipment and systems. Those who work in installation may specialize in HVAC, boiler lagging/vessel cladding, roofing products, architectural sheet metal, custom metal products, food service products, secondary systems for environmental projects, pneumatic conveyance or signage.

Employers in this trade include sheet metal fabrication shops, manufacturing companies of sheet metal, installation contractors, HVAC contractors, and architectural sheet metal contractors. Sheet metal workers may be involved in residential, industrial, commercial, institutional and construction sectors.

Key attributes for people entering this trade are mechanical and mathematical aptitude, hand-eye coordination, spatial perception and manual dexterity. The work often requires considerable standing, climbing, kneeling, lifting and carrying.

Hazards of the trade include working with sharp metal pieces, at heights, around excessive noise and vibration, as well as exposure to heat and fumes. Sheet metal workers often have to work in adverse weather and environmental conditions.

This standard recognizes some transferable skills between the sheet metal worker trade and other trades such as ironworkers, boilermakers, refrigeration and air conditioning mechanics, plumbers, insulators (heat and frost), gasfitters, oil heat system technicians, electricians, roofers, carpenters and welders.

With experience, sheet metal workers act as mentors and trainers to apprentices in the trade. They may also become specialists in design and layout, and move into other positions such as estimators, supervisors or business owners.

TRENDS IN THE SHEET METAL WORKER TRADE

TECHNOLOGY

Much of the equipment used by sheet metal workers has remained the same. However, some equipment has become computer-controlled and motorized to improve efficiency. Sheet metal workers are using more computerized software and equipment to design and lay out and fabricate sheet metal products.

SAFETY

Workplaces have become safer because of an increase in training and legislated safety practices and procedures. There is a greater awareness of the importance of job safety. For example, practices such as documentation, safety committees and weekly safety meetings are well-established.

ENVIRONMENT

Clients are more inclined to promote the use of environmentally friendly products and processes in their buildings. Environmental considerations are modifying building methods to reduce energy use, implementing integrated building management systems, improving indoor air quality and taking advantage of alternate energy sources. For instance, “green roofs” are becoming more common. Plastic and new alloys are being used for venting and will continue to become more prevalent with the continued effort to increase fuel efficiency in all gas burning appliances.

Leadership in Energy and Environmental Design (LEED) projects are becoming more prevalent in this trade which have led to the use of different products such as solar panels/walls and reflective surfaces, and different building processes. For instance, these standards impact the removal and recycling of construction materials, collection and control of dust, and limiting of solvents and other chemicals. Also, environmental upgrading and maintenance of existing systems is a developing trend in the trade.

New versions of building codes are being revised with the “net zero” principle in mind. This means that there is a need for more complex systems that conserve, reuse and generate energy.

ESSENTIAL SKILLS SUMMARY

Essential skills are needed for work, learning and life. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Through extensive research, the Government of Canada and other national and international agencies have identified and validated nine essential skills. These skills are used in nearly every occupation and throughout daily life in different ways.

A series of CCDA-endorsed tools have been developed to support apprentices in their training and to be better prepared for a career in the trades. The tools can be used independently or with the assistance of a tradesperson, trainer, employer, teacher or mentor to:

- understand how essential skills are used in the trades;
- learn about individual essential skills strengths and areas for improvement; and
- improve essential skills and increase success in an apprenticeship program.

Tools are available online or for order at: https://www.canada.ca/en/employment-social-development/programs/essential-skills/tools.html.

The application of these skills may be described throughout this document within the competency statements which support each subtask of the trade. The following are summaries of the requirements in each of the essential skills, taken from the essential skills profile. A link to the complete essential skills profile can be found at: www.red-seal.ca.

READING

Sheet metal workers require reading skills to gather information from forms and labels. They also need to read to understand more complex texts such as equipment and policy and procedure manuals, specifications, codes and standards. They also refer to project specifications and work orders when planning a job.

DOCUMENT USE

Document use is a significant essential skill for this trade. Sheet metal workers need to be able to locate and interpret information in several types of documents such as labels, signs, forms, lists, tables, technical drawings and schematics. They also need to create documents such as orthographic projections, sketches and work forms.

WRITING

Writing skills are used by sheet metal workers to write short texts, usually less than one paragraph. Some examples of written work include safety documentation, logbook entries, invoices, inventory lists, takeoffs, bids, forms and summaries of work projects.

ORAL COMMUNICATION

Some tasks performed by sheet metal workers require oral communication skills, including discussing project requirements with suppliers, discussing specifications and plans with co-workers, supervisors and general contractors, and supervising and directing the work of apprentices. Sheet metal workers may explain the fabrication, construction, installation and repair procedures to customers as well.

NUMERACY

Numeracy skills are extremely important in the everyday work of sheet metal workers. Substantial mathematical skills are used in taking measurements, doing material layout, using formulas and performing trade calculations such as heat loss/gain, air flows, capacities and air pressures. Numeracy is used significantly in system design. Sheet metal workers may create project timelines, calculating time requirements for tasks in the project. They may also calculate amounts for supplies, estimates and overall costs.

THINKING

Sheet metal workers solve problems in situations where work may be delayed due to equipment breakdowns, shortages in materials and work of other trades. They may perform modifications to project designs to correct flaws. They need the ability to think spatially and visualize in three dimensions. Problem-solving and thinking sequentially are important skills in fabrication and installation activities. Sheet metal workers need to be able to plan their work and organize tasks and materials.

WORKING WITH OTHERS

Sheet metal workers coordinate job tasks and share workspace and equipment with groups of co-workers and colleagues. Those working in fabrication shops may work alone on small projects, and also work as members of a team on larger projects. During installation work, tasks must be coordinated with other tradespersons such as crane operators, carpenters, drywall finishers, plasterers, bricklayers, plumbers and electricians.

DIGITAL TECHNOLOGY

Sheet metal workers may use computers and computer-aided design (CAD) and building information modelling (BIM) software in their work. They may also use computers to perform word processing and electronic communication devices to communicate with others, record job changes and daily activities, track job progress, order materials and perform Internet research. Increasingly sheet metal workers are required to have digital skills when performing daily tasks which may require the use of numerically controlled equipment and electronic devices.

CONTINUOUS LEARNING

Sheet metal workers are required to stay current with new technology, trends and product developments as well as changes in fabrication, installation and production processes. They also need to stay updated on codes and trade standards.

Roles and Opportunities for Skilled Trades in a Sustainable Future

Climate change affects all of us. Trades play a large role in implementing solutions and adjusting to changes in the world.

Throughout this standard, there may be specific references to tasks, skills and knowledge that clearly show this trade's role in a more sustainable future. Each trade has different roles to play and contributions to make in their own way.

For example:

- Construction tradespeople need to consider the materials they are using, building methods, and improvements to mechanical and electrical installations. There are important changes to codes and standards to help meet the climate change goals and commitments set for 2030 and 2050. Retrofits and new construction of low-energy buildings provide enormous opportunities for workers in this sector. Concepts, such as energy efficiency and regarding buildings as systems are foundational.

- Automotive and mechanical trades are seeing a shift towards the electrification of vehicles and equipment. As a result, new skills and knowledge will be required for tradespeople working in this sector. There are mandates for sales of new light-duty zero-emission vehicles (ZEV) in Canada, with the goal of achieving 100% ZEV sales by 2035. Due to this mandate, the demand for these vehicles is growing quickly among consumers and fleets. With this escalating demand, the need for skilled workers to maintain and repair these vehicles is also increasing.

- In industrial and resource sectors, there is pressure to move towards increased electrification of industrial processes. Many industrial and commercial facilities are also being upgraded to improve energy efficiency in areas such as lighting systems, and new production processes and technologies. There are also opportunities in carbon capture, utilization and storage (CCUS), as well as the production and export of low-carbon hydrogen.

- Trades in the service sector may also need to be aware of responsible sourcing, as well as efficient use of products and materials. New ways of working better are always a part of the job.

There are fast-moving changes in guidelines, codes, regulations and specifications. Many are being implemented for the purpose of energy efficiency and climate change. Those that affect specific trades may be mentioned within the standard. Examples of these guidelines and legislation include:

- The National Energy Code of Canada for Buildings (NECB).

- The Canadian Net-Zero Emissions Accountability Act (CNZEAA).

- programs that encourage sustainable building design and construction such as Leadership in Energy and Environmental Design (LEED) and the Zero Carbon Building (ZCB) standards.

- the Montreal Protocol for phasing out R22 refrigerants.

- energy efficiency programs such as ENERGY STAR.

- principles of the United Nations Declaration for the Rights of Indigenous Peoples pertaining to energy sector development.

Apprentices and tradespeople need to increase their climate literacy and reinforce their own understanding of energy issues and environmental practices. It is important for them to understand why these changes are happening and their effect on trades' work. While individual tradespeople and apprentices may not be able to choose certain elements like; the architectural design of buildings, building material selection, regulatory requirements, use of electric vehicles and technologies, they must understand the impact of using these elements in their work. Impacts include using environmentally friendly products and following requirements related to the disposal and recycling of materials.

In apprenticeship, as well as in ongoing professional development, employers and instructors should encourage learning about these concepts, why they are important, how they are implemented, and the overarching targets they are aiming to achieve.

All in all, it's about doing the work better and building a better world.

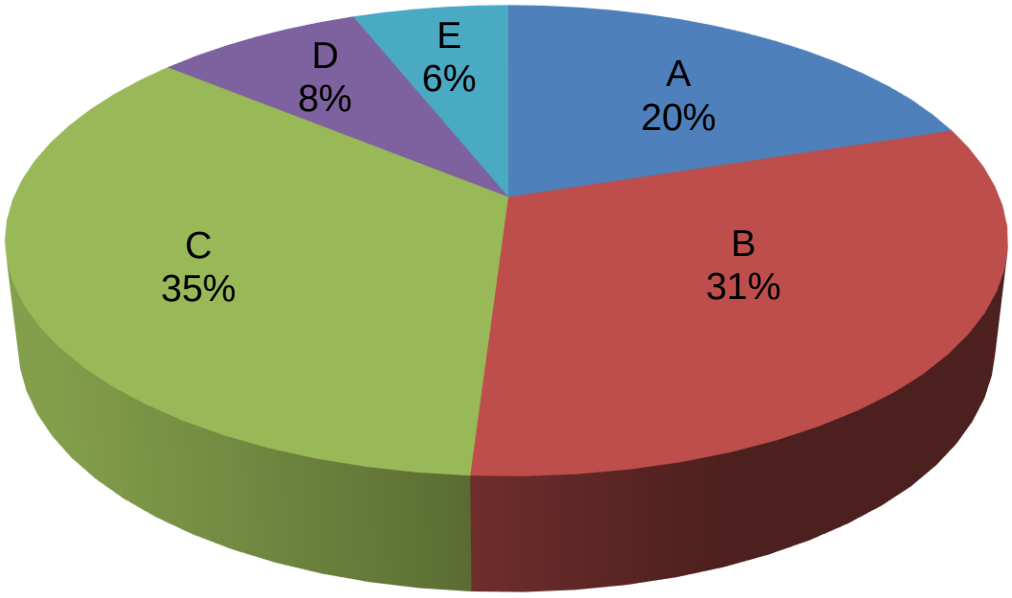
INDUSTRY EXPECTED PERFORMANCE

All tasks must be performed according to the applicable jurisdictional codes and standards. All health and safety practices, procedures and standards must be respected and observed. Work should be done efficiently and at a high quality with minimal material waste or environmental damage. All requirements of the manufacturer, client job specifications, the National Building Code (NBC), Authority having jurisdiction (AHJ) and trade standards (such as Sheet Metal and Air Conditioning National Association [SMACNA], American Society of Heating, Refrigeration and Air Conditioning Engineers [ASHRAE], American National Standards Institute [ANSI], Canadian Standards Association [CSA] and National Fire Protection Association [NFPA]) must be met. At a journeyperson level of performance, all tasks must be done with minimal direction and supervision. As a journeyperson progresses in their career there is an expectation they continue to upgrade their skills and knowledge to keep pace with industry and promote continuous learning in their trade through mentoring of apprentices.

LANGUAGE REQUIREMENTS

It is expected that journeypersons are able to understand and communicate in either English or French, which are Canada's official languages. English or French are the common languages of business as well as languages of instruction in apprenticeship programs.

PIE CHART
OF RED SEAL EXAMINATION WEIGHTINGS



MWA A	Performs common occupational skills	20%
MWA B	Performs fabrication	31%
MWA C	Installs air and material handling systems	35%
MWA D	Installs roofing and specialty products	8%
MWA E	Performs maintenance and repair	6%

This pie chart represents a breakdown of the interprovincial Red Seal examination. Percentages are based on the collective input from workers from the trade from across Canada. The Task Matrix on the next pages indicates the breakdown of tasks and sub-tasks within each Major Work Activity and the breakdown of questions assigned to the Tasks. Interprovincial examinations for this trade have 120 questions.

SHEET METAL WORKER
TASK MATRIX

A – Performs common occupational skills — 20%

Task A-1 **Performs safety-related functions** **22%**	**A-1.01 Uses personal protective equipment (PPE) and safety equipment**	**A-1.02 Maintains safe work environment**	**A-1.03 Performs lock-out and tag-out procedures**
Task A-2 **Uses and maintains tools and equipment** **39%**	**A-2.01 Uses hand and portable power tools**	**A-2.02 Uses shop tools and equipment**	**A-2.03 Uses gas metal arc welding (GMAW) equipment**
	A-2.04 Uses resistance spot welding equipment	**A-2.05 Uses gas tungsten arc welding (GTAW) equipment**	**A-2.06 Uses shielded metal arc welding (SMAW) equipment**
	A-2.07 Uses oxy-fuel and plasma arc cutting equipment	**A-2.08 Uses soldering and brazing equipment**	**A-2.09 Uses measuring and layout equipment**
	A-2.10 Uses testing and inspection devices	**A-2.11 Uses stationary and mobile work platforms**	**A-2.12 Uses hoisting, rigging and positioning equipment**
Task A-3 **Organizes work** **26%**	**A-3.01 Uses trade-related documentation**	**A-3.02 Interprets drawings**	**A-3.03 Organizes materials and equipment for project**
	A-3.04 Performs basic design and field modifications		
Task A-4 **Uses communication and mentoring techniques** **13%**	**A-4.01 Uses communication techniques**	**A-4.02 Uses mentoring techniques**	

B – Performs fabrication 31%

Task B-5 **Performs pattern development** **33%**	**B-5.01 Develops patterns using simple and straight line layout**	**B-5.02 Develops patterns using parallel line method**	**B-5.03 Develops patterns using radial line method**
	B-5.04 Develops patterns using triangulation method	**B-5.05 Uses computer technology for pattern development**	
Task B-6 **Fabricates sheet metal components for air and material handling systems** **42%**	**B-6.01 Cuts ductwork, fittings and components**	**B-6.02 Forms ductwork, fittings and components**	**B-6.03 Insulates ductwork, fittings and components**
	B-6.04 Assembles ductwork, fittings and components	**B-6.05 Fabricates dampers**	**B-6.06 Fabricates hanger systems, supports and bases**
Task B-7 **Fabricates flashing, roofing, sheeting and cladding** **9%**	**B-7.01 Cuts metal for flashing, roofing, sheeting and cladding**	**B-7.02 Forms flashing, roofing, sheeting and cladding**	
Task B-8 **Fabricates specialty products** **16%**	**B-8.01 Cuts material for specialty products**	**B-8.02 Forms specialty products**	**B-8.03 Assembles specialty products**
	B-8.04 Finishes specialty products		

C – Installs air and material handling systems — 35%

Task C-9 **Prepares installation site** **17%**	**C-9.01 Performs on-site measurements**	**C-9.02 Performs demolitions for renovations**	**C-9.03 Installs penetrations and sleeves**
	C-9.04 Installs supports and bases	**C-9.05 Installs hangers, cables, braces and brackets**	
Task C-10 **Installs and connects chimneys, breeching and venting to exhaust appliances and mechanical equipment** **15%**	**C-10.01 Installs chimney**	**C-10.02 Connects appliances or mechanical equipment to chimney and breeching**	**C-10.03 Installs high efficiency appliances and mechanical equipment**
Task C-11 **Installs air handling system components** **39%**	**C-11.01 Installs air handling equipment**	**C-11.02 Installs sheet metal ducts and fittings**	**C-11.03 Installs dampers**
	C-11.04 Installs fire and fire/smoke dampers	**C-11.05 Installs registers, grilles, diffusers and louvers**	**C-11.06 Installs terminal boxes**
	C-11.07 Installs coils	**C-11.08 Installs system component accessories**	**C-11.09 Installs plenums**
Task C-12 **Installs material handling system components** **12%**	**C-12.01 Installs pneumatic and gravity material handling system components**	**C-12.02 Installs mechanized material handling system components**	
Task C-13 **Applies thermal insulation, lagging, cladding and flashing** **8%**	**C-13.01 Applies thermal insulation to components**	**C-13.02 Applies lagging and cladding to components**	**C-13.03 Applies flashing to components**
Task C-14 **Performs leak testing, air balancing and commissioning** **9%**	**C-14.01 Performs leak tests**	**C-14.02 Performs testing, adjusting and balancing (TAB)**	**C-14.03 Participates in the commissioning of air and material handling systems**

D – Installs roofing and specialty products 8%

Task D-15 **Installs metal roofing and cladding/siding systems** **27%**	**D-15.01 Lays out roof and walls**	**D-15.02 Installs insulation, isolation material and building envelope components**	**D-15.03 Installs roofing and cladding/siding system components**
	D-15.04 Seals exposed joints	**D-15.05 Installs decking**	
Task D-16 **Installs exterior components** **21%**	**D-16.01 Prepares surface**	**D-16.02 Fastens exterior components**	
Task D-17 **Installs specialty products** **52%**	**D-17.01 Installs stainless steel specialty products**	**D-17.02 Installs non-stainless steel specialty products**	**D-17.03 Installs marine products (Not Common Core)**

E – Performs maintenance and repair 6%

Task E-18 **Performs scheduled maintenance** **38%**	**E-18.01 Performs maintenance inspections**	**E-18.02 Services components**
Task E-19 **Repairs faulty systems and components** **62%**	**E-19.01 Diagnoses system faults**	**E-19.02 Repairs worn or faulty components**

Harmonization of Apprenticeship Training

Provincial and territorial apprenticeship authorities are each responsible for their respective apprenticeship programs. In the spirit of continual improvement, and to facilitate mobility among apprentices in Canada, participating authorities have agreed to work towards harmonizing certain aspects of their programs where possible. After consulting with their stakeholders in the trade, they have reached consensus on the following elements. Note that implementation of these elements may vary from jurisdiction to jurisdiction, depending on their own circumstances. For more information on the implementation in any province and territory, please contact that jurisdiction's apprenticeship authority.

1. Trade name

The official Red Seal name for this trade is Sheet Metal Worker.

2. Number of Levels of Apprenticeship

The number of levels of technical training recommended for this trade is 4 (four).

3. Total Training Hours During Apprenticeship Training

The total hours of training, including both on-the-job and in-school training for this trade is 7200.

4. Sequencing Topics and Related Sub-tasks

The topic titles in the table below are placed in a column for each apprenticeship level for technical training. Each topic is accompanied by the sub-tasks and their reference number. The topics in the grey shaded cells represent those that are covered "in context" with other training in the subsequent years.

Level 1	Level 2	Level 3	Level 4
	Safety-Related Functions	Safety-Related Functions	Safety-Related Functions
		Installation Site (prepares)	Installation Site (prepares)
		Organizes Work	Organizes Work
	Communication	Communication	Communication
			Specialty Products (fabricates)
			Specialty Products (installs)
		Chimney, Breeching, Venting (installs, connects)	Chimney, Breeching, Venting (installs, connects)
			Scheduled Maintenance
			Repair

Level 1	Level 2	Level 3	Level 4
Safety-Related Functions 1.01 Uses personal protective equipment (PPE) and safety equipment 1.02 Maintains safe work environment 1.03 Performs lock-out and tag-out procedures			
Tools and Equipment 2.01 Uses hand and portable power tools 2.02 Uses shop tools and equipment 2.03 Uses gas metal arc welding (GMAW) equipment 2.04 Uses resistance spot welding equipment 2.07 Uses oxy-fuel and plasma arc cutting equipment 2.08 Uses soldering and brazing equipment 2.09 Uses measuring and layout equipment 2.11 Uses stationary and mobile work platforms 2.12 Uses hoisting, rigging and positioning equipment	**Tools and Equipment** 2.02 Uses shop tools and equipment 2.03 Uses gas metal arc welding (GMAW) equipment 2.06 Uses shielded metal arc welding (SMAW) equipment 2.08 Uses soldering and brazing equipment 2.10 Uses testing and inspection devices	**Tools and Equipment** 2.02 Uses shop tools and equipment 2.03 Uses gas metal arc welding (GMAW) equipment 2.05 Uses gas tungsten arc welding (GTAW) equipment 2.10 Uses testing and inspection devices	**Tools and Equipment** 2.03 Uses gas metal arc welding (GMAW) equipment 2.10 Uses testing and inspection devices
Organizes Work 3.01 Uses trade-related documentation 3.02 Interprets drawings 3.03 Organizes materials and equipment for project	**Organizes Work** 3.01 Uses trade-related documentation 3.02 Interprets drawings 3.04 Performs basic design and field modifications		
Communication 4.01 Uses communication techniques			**Mentoring** 4.02 Uses mentoring techniques
Pattern Development◆ 5.01 Develops patterns using simple and straight line layout (Identification of other types of pattern development methods)	**Pattern Development**◆ 5.02 Develops patterns using parallel line method 5.03 Develops patterns using radial line method 5.04 Develops patterns using triangulation method	**Pattern Development**◆ 5.02 Develops patterns using parallel line method 5.03 Develops patterns using radial line method 5.04 Develops patterns using triangulation method	**Pattern Development**◆ 5.05 Uses computer technology for pattern development

Level 1	Level 2	Level 3	Level 4
Air/Material handling components (fabricates) 6.01 Cuts ductwork, fittings and components 6.02 Forms ductwork, fittings and flexible connectors 6.03 Insulates ductwork and fittings 6.04 Assembles ductwork, fittings and flexible connectors 6.06 Fabricates hanger systems, supports and bases	**Air/Material handling components (fabricates)** 6.02 Forms ductwork, fittings and flexible connectors 6.04 Assembles ductwork, fittings and flexible connectors	**Air/Material handling components (fabricates)** 6.02 Forms ductwork, fittings and flexible connectors 6.04 Assembles ductwork, fittings and flexible connectors	**Air/Material handling components (fabricates)** 6.02 Forms ductwork, fittings and flexible connectors 6.04 Assembles ductwork, fittings and flexible connectors 6.05 Fabricates dampers
	Flashing, roofing, sheeting, and cladding (fabricates) 7.01 Cuts metal for flashing, roofing, sheeting and cladding 7.02 Forms flashing, roofing, sheeting and cladding		
		Specialty Products (fabricates) 8.01 Cuts material for specialty products 8.02 Forms specialty products 8.03 Assembles specialty products 8.04 Finishes specialty products	
		Specialty Products (installs) 17.01 Installs stainless steel specialty products 17.02 Installs non-stainless steel specialty products 17.03 Installs marine products	
	Installation Site (prepares) 9.01 Performs on-site measurements 9.02 Performs demolitions for renovations 9.03 Installs penetrations and sleeves 9.04 Installs supports and bases 9.05 Installs hangers, cables, braces and brackets		

Level 1	Level 2	Level 3	Level 4
	Chimney, Breeching, Venting (Installs, connects) 10.01 Installs chimney 10.02 Connects appliances or mechanical equipment to chimney and breeching 10.03 Installs high efficiency appliances and mechanical equipment		
Air Handling System Components (Installs) 11.01 Installs air handling equipment 11.02 Installs sheet metal ducts and fittings 11.03 Installs dampers 11.05 Installs registers, grilles, diffusers and louvers 11.09 Installs plenums	**Air Handling System Components (Installs)** 11.01 Installs air handling equipment 11.04 Installs fire and fire/smoke dampers 11.08 Installs system component accessories	**Air Handling System Components (Installs)** 11.01 Installs air handling equipment 11.06 Installs terminal boxes 11.07 Installs coils 11.08 Installs system component accessories 11.09 Installs plenums	**Air Handling System Components (Installs)** 11.01 Installs air handling equipment 11.08 Installs system component accessories
			Material Handling System Components (Installs) 12.01 Installs pneumatic and gravity material handling system components 12.02 Installs mechanized material handling system components
			Thermal Insulation, Lagging, Cladding and Flashing 13.01 Applies thermal insulation to components 13.02 Applies lagging and cladding to components 13.03 Applies flashing to components
		Leak Testing, Air Balancing, Commissioning 14.01 Performs leak tests 14.02 Performs testing, adjusting and balancing (TAB) 14.03 Participates in the commissioning of air and material handling systems	**Leak Testing, Air Balancing, Commissioning** 14.01 Performs leak tests 14.02 Performs testing, adjusting and balancing (TAB) 14.03 Participates in the commissioning of air and material handling systems

Level 1	Level 2	Level 3	Level 4
	Metal Roofing and Cladding Systems 15.01 Lays out roof and walls 15.02 Installs insulation, isolation material and building envelope components 15.03 Installs roofing and cladding system components 15.04 Seals exposed joints 15.05 Installs decking		
	Exterior Components (Installs) 16.01 Prepares surface 16.02 Fastens exterior components		
		Scheduled Maintenance* 18.01 Performs maintenance inspections 18.02 Services components	
		Repair* 19.01 Diagnoses system faults 19.02 Repairs worn or faulty components	

MAJOR WORK ACTIVITY A

Performs common occupational skills

TASK A-1 Performs safety-related functions

TASK DESCRIPTOR

Sheet metal workers are responsible for ensuring the safety of themselves and others in the work environment. Therefore, they must comply with company and jurisdictional regulations. It is critical that they be constantly aware of their surroundings and the hazards they may encounter.

A-1.01 Uses personal protective equipment (PPE) and safety equipment

Essential Skills Thinking, Document Use, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-1.01.01P	select PPE and safety equipment	PPE and safety equipment are selected according to ***regulations*** and site requirements
A-1.01.02P	inspect PPE and safety equipment	PPE and safety equipment are inspected before each use to verify operating condition and that they are free from damage
A-1.01.03P	verify that PPE fits properly	PPE is verified to ensure a proper fit according to safety standards
A-1.01.04P	identify site hazards and ***regulations*** requiring the use of PPE and safety equipment	site hazards and ***regulations*** requiring the use of PPE and safety equipment are identified according to ***inspections***, toolbox talks and job specifications
A-1.01.05P	store PPE and safety equipment	PPE and safety equipment are stored to keep them free from contaminants and deterioration, and for longevity
A-1.01.06P	identify and remove from service worn, damaged and defective PPE and safety equipment	worn, damaged and defective PPE and safety equipment are identified and removed from service according to manufacturers' specifications and ***regulations***

RANGE OF VARIABLES

regulations include: Workplace Hazardous Material Information System (WHMIS), Occupational Health & Safety (OH&S), Workers Compensation Board (WCB), site-specific regulations

inspections include: pre-safety inspection (PSI), hazard assessments

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-1.01.01L	demonstrate knowledge of PPE and safety equipment, their applications, maintenance, storage and procedures for use	identify ***types of PPE*** and ***safety equipment***
		describe applications and limitations of PPE and safety equipment
		describe PPE and safety equipment operations
		describe the procedures used to inspect, maintain and store PPE and safety equipment
		identify training requirements for PPE and safety equipment
A-1.01.02L	demonstrate knowledge of regulatory requirements pertaining to PPE and safety equipment	identify and interpret the safety and health ***regulations*** and responsibilities with respect to the use of PPE and safety equipment
		describe the roles and responsibilities of employers and employees with respect to the selection and use of PPE and safety equipment
		describe workplace safety and health ***regulations*** related to the use of PPE and safety equipment

RANGE OF VARIABLES

types of PPE include: respirators, fall arrest harnesses, fall restraint equipment, welding face shields, hearing, eye, foot and hand protection, high visibility safety vests

types of safety equipment include: fire extinguishers, welding screens, barricades

regulations include: Workplace Hazardous Material Information System (WHMIS), Occupational Health & Safety (OH&S), Workers Compensation Board (WCB), site-specific regulations

A-1.02 Maintains safe work environment

Essential Skills	Thinking, Oral Communication, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-1.02.01P	perform preliminary site inspection	preliminary site inspection is performed according to site-specific practices to identify ***workplace hazards***
A-1.02.02P	report ***workplace hazards***	***workplace hazards*** are reported
A-1.02.03P	install temporary ***safety protection***	temporary ***safety protection*** is installed according to regulations or site-specific practices
A-1.02.04P	participate in daily or weekly toolbox meetings	toolbox meetings are held daily or weekly according to site-specific practices
A-1.02.05P	perform ***housekeeping*** tasks	***housekeeping*** tasks are performed to prevent tripping hazards, falling objects and slips
A-1.02.06P	follow safety practices for using tools and equipment	safety practices for using tools and equipment are followed according to manufacturers' specifications and site-specific practices

RANGE OF VARIABLES

workplace hazards include: fire, asbestos, hazardous openings, overhead hazards
safety protection includes: barriers to cover hazardous openings, guard rails, signage
housekeeping includes: sweeping, removing debris, storing materials and tools and equipment

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-1.02.01L	demonstrate knowledge of safe work practices and procedures	describe company safety policies and procedures
		describe ***safe work practices, procedures and equipment***
		describe good ***housekeeping*** practices
		identify ***workplace hazards***
A-1.02.02L	demonstrate knowledge of regulatory requirements pertaining to safety	identify and interpret workplace safety and health ***regulations***

		identify site-specific lock-out and tag-out procedures
A-1.02.03L	demonstrate knowledge of inspection procedures	describe the procedures used to inspect site

RANGE OF VARIABLES

safe work practices, procedures and equipment include: lock-out/tag-out, fall arrest, awareness of hoisting practices

housekeeping includes: sweeping, removing debris, storing materials and tools and equipment

workplace hazards include: fire, asbestos, hazardous openings, overhead hazards

regulations include: WHMIS, OH&S, WCB, site-specific regulations

A-1.03 Performs lock-out and tag-out procedures

Essential Skills Thinking, Working with Others, Oral Communication

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-1.03.01P	coordinate lock-out and tag-out requirements	lock-out and tag-out requirements are coordinated with appropriate authorities and other trades according to regulations and job requirements
A-1.03.02P	locate all circuits and equipment that require lock-out and tag-out	circuits and equipment that require lock-out and tag-out are located according to job requirements
A-1.03.03P	select devices for lock-out and tag-out	devices are selected to ensure lock-out and tag-out according to job requirements and site policies
A-1.03.04P	isolate ***hazardous energies*** and de-energize ***lock-out equipment***	***hazardous energies*** are isolated and ***lock-out equipment*** is de-energized according to regulations
A-1.03.05P	verify lock-out and tag-out to be in a zero energy state	lock-out and tag-out is verified to be in a zero energy state by performing a post-operational test
A-1.03.06P	remove lock-out and tag-out devices	lock-out and tag-out devices are removed after equipment has been repaired or replaced

RANGE OF VARIABLES

hazardous energies include: electricity, steam, fuel sources, hydraulic systems, pneumatic systems, magnetic systems, gravitational systems

lock-out equipment includes: lock and key, chains and tags, lock-out scissor clamps, lock-box

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-1.03.01L	demonstrate knowledge of regulations, applications and procedures for locking out and tagging out	identify situations, circuits and equipment that require lock-out and tag-out
		identify ***lock-out*** and tag-out ***equipment***
		describe procedures for locking out and tagging out equipment and for removing lock-out and tag-out devices
		identify safety regulations pertaining to locking out and tagging out ***hazardous energies*** equipment

RANGE OF VARIABLES

lock-out equipment includes: lock and key, chains and tags, lock-out scissor clamps, lock-box

hazardous energies include: electricity, steam, fuel sources, hydraulic systems, pneumatic systems, magnetic systems, gravitational systems

TASK A-2 Uses and maintains tools and equipment

TASK DESCRIPTOR

This task describes the use and maintenance of tools and equipment that sheet metal workers use to perform tasks in their trade. It also describes the use and maintenance of hoisting, rigging and positioning equipment, and stationary and mobile work platforms.

A-2.01 Uses hand and portable power tools

Essential Skills	Thinking, Continuous Learning, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
A-2.01.01P	select and use ***hand and portable power tools***	***hand and portable power tools*** are selected according to job requirements and used according to manufacturers' specifications
A-2.01.02P	organize and store ***hand and portable power tools***	***hand and portable power tools*** are organized and stored in a clean and dry environment to avoid damage
A-2.01.03P	clean and maintain ***hand and portable power tools***	***hand and portable power tools*** are cleaned and maintained to prevent corrosion and to promote ease of operation and longevity
A-2.01.04P	identify and replace worn, damaged and defective ***hand and portable power tools***	worn, damaged and defective ***hand and portable power tools*** are tagged and removed from service
A-2.01.05P	charge batteries	batteries are charged according to manufacturers' specifications

RANGE OF VARIABLES

hand and portable power tools include: See Appendix B

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.01.01L	demonstrate knowledge of ***hand and portable power tools***, their applications, maintenance and procedures for use	identify hazards and describe safe work practices and procedures pertaining to the use of ***hand and portable power tools***
		identify types of hand tools and describe their applications and procedures for use
		identify types of portable power tools and describe their applications and procedures for use
		describe the procedures used to maintain ***hand and portable power tools***
		identify criteria for replacement or repair of ***hand and portable power tools***
		describe the procedures used to inspect ***hand and portable power tools***
		describe specifications and regulations for the use of powder-actuated tools

RANGE OF VARIABLES

hand and portable power tools include: See Appendix B

A-2.02 Uses shop tools and equipment

Essential Skills Thinking, Digital Technology, Oral Communication

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
A-2.02.01P	select and use ***shop tools and equipment***	***shop tools and equipment*** are selected according to job requirements and used according to manufacturers' specifications
A-2.02.02P	clean and maintain ***shop tools and equipment***	***shop tools and equipment*** are cleaned and maintained to prevent corrosion and for ease of operation and longevity according to manufacturers' specifications
A-2.02.03P	identify and tag worn, damaged and defective ***shop tools and equipment***	worn, damaged and defective ***shop tools and equipment*** are identified and tagged according to company policies and removed from service

A-2.02.04P	identify ***shop tools and equipment*** capacities, limitations and operational parameters	***shop tools and equipment*** capacities, limitations and operational parameters are identified according to manufacturers' specifications
A-2.02.05P	change damaged, worn or dull ***components***	damaged, worn or dull ***components*** are changed according to manufacturers' specifications
A-2.02.06P	monitor and top up fluids for ***shop equipment***	***shop equipment*** is monitored for fluid levels according to manufacturers' specifications and performance

RANGE OF VARIABLES

shop tools and equipment include: See Appendix B
components include: blades, dies, grinding wheels, grinding stones, safety guards, plasma/welding tips
shop equipment includes: See Appendix B

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.02.01L	demonstrate knowledge of ***shop tools and equipment***, their applications, maintenance and procedures for use	identify hazards of using ***shop tools and equipment*** by interpreting warning and caution labels and manufacturers' specifications
		identify types of ***shop tools and equipment*** and describe their applications and procedures for use
		identify types of ***Computer Numerical Control (CNC) equipment*** and describe their applications for use
		describe the procedures used to maintain ***shop tools and equipment***
A-2.02.02L	demonstrate knowledge of inspection procedures and criteria	describe the procedures used to inspect ***shop tools and equipment***
		identify criteria for replacement or repair of ***shop tools and equipment***

RANGE OF VARIABLES

shop tools and equipment include: See Appendix B
Computer Numerical Control (CNC) equipment includes: plasma tables, brake presses

A-2.03 Uses gas metal arc welding (GMAW) equipment

Essential Skills Thinking, Document Use, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-2.03.01P	select and use equipment	equipment is selected according to job requirements and used according to manufacturers' specifications
A-2.03.02P	ensure work area is ventilated and ***PPE*** is used	work area is ventilated and ***PPE*** is used according to job requirements
A-2.03.03P	follow hot work procedures	hot work procedures are followed according to job requirements
A-2.03.04P	prepare material to be welded	material to be welded is prepared according to job requirements, material compatibility and engineered drawings
A-2.03.05P	select type of gas used for welding	type of gas used for welding is selected according to job requirements, material compatibility and manufacturers' specifications
A-2.03.06P	select and use welding wire	welding wire is selected and used according to job requirements, material compatibility and manufacturers' specifications
A-2.03.07P	perform welding process	welding process is performed according to job requirements, material compatibility and manufacturers' specifications
A-2.03.08P	inspect visual characteristics of weld	characteristics of weld are visually inspected for quality and deficiencies are identified

RANGE OF VARIABLES

PPE include: respirators, welding face shields, welding helmets, jackets/aprons, gloves

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.03.01L	demonstrate knowledge of GMAW equipment, its applications, maintenance and procedures for use	define terminology associated with GMAW
		describe the GMAW process and its applications

		identify types of GMAW equipment, consumables and ***accessories*** used to weld mild steel, aluminum and stainless steel, and describe their characteristics and applications
		describe the procedures used to set up, adjust and shut down GMAW equipment
		describe the procedures used to maintain and troubleshoot GMAW equipment
		identify the ***types of welds performed*** using the GMAW process
		interpret symbols and information pertaining to GMAW welding found on drawings and specifications
		identify weld characteristics and deficiencies
		describe ***weld defects***, their causes and the procedures used to prevent and correct them
A-2.03.02L	demonstrate knowledge of ***safe work practices and procedures*** pertaining to the use of GMAW equipment	identify ***hazards*** and describe ***safe work practices and procedures*** pertaining to the use of GMAW equipment
		describe hot work procedures

RANGE OF VARIABLES

accessories include: chill plates, strongbacks

types of welds performed include: plug, fillet (continuous), stitch, tack, edge, corner

weld defects include: porosity, cracks, warping, undercut

safe work practices and procedures include: use of PPE, following confined space procedures, obtaining required permits, fire watch, positioning welding screens

hazards include: fumes and particulate inhalation, arc flash, electrical shock, burns, damage to property

A-2.04 Uses resistance spot welding equipment

Essential Skills Thinking, Document Use, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-2.04.01P	select and use equipment	equipment is selected according to job requirements and used according to manufacturers' specifications
A-2.04.02P	inspect and maintain resistance spot welding equipment	resistance spot welding equipment is maintained according to manufacturers' specifications
A-2.04.03P	ensure work area is ventilated and ***PPE*** is used	work area is ventilated according to regulations and ***PPE*** is used according to job requirements
A-2.04.04P	prepare material to be welded	material to be welded is prepared according to job requirements, material compatibility and manufacturers' specifications
A-2.04.05P	perform spot welding process	spot welding process is performed according to job requirements, material compatibility and manufacturers' specifications
A-2.04.06P	verify welds	welds are verified to confirm fusion meets job requirements and deficiencies are identified

RANGE OF VARIABLES

PPE include: safety glasses, safety shields, gloves

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.04.01L	demonstrate knowledge of resistance spot welding equipment, consumables, accessories and procedures for use	identify ***considerations when determining resistance spot welding equipment setup***
		describe the ***procedures used to set up and adjust resistance spot welding equipment***
		describe the procedures used to inspect and maintain resistance spot welding equipment

A-2.04.02L	demonstrate knowledge of the procedures used to weld using resistance spot welding equipment	describe the procedures used to weld using the resistance spot welding process
		define terminology associated with resistance spot welding
		interpret symbols and information pertaining to resistance spot welding found on drawings and specifications
A-2.04.03L	demonstrate knowledge of ***safe work practices and procedures*** pertaining to the use of resistance spot welding equipment	identify ***hazards*** and describe ***safe work practices and procedures*** pertaining to resistance spot welding

RANGE OF VARIABLES

considerations when determining resistance spot welding equipment setup include: specification requirements, base metal, properties, thickness

procedures used to set up and adjust resistance spot welding equipment include: set time, determine amperage, adjust pressure

safe work practices and procedures include: using PPE, following confined space procedures, obtaining required permits

hazards include: pinch points, burns, electrical shock, fire

A-2.05 Uses gas tungsten arc welding (GTAW) equipment

Essential Skills Thinking, Document Use, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-2.05.01P	select and use equipment	equipment is selected according to job requirements and used according to manufacturers' specifications
A-2.05.02P	ensure work area is ventilated and ***PPE*** is used	work area is ventilated according to job specifications and ***PPE*** is used according to job requirements
A-2.05.03P	follow hot work procedures	hot work procedures are followed according to job requirements
A-2.05.04P	prepare material to be welded	material to be welded is prepared according to job requirements and material compatibility

A-2.05.05P	select type of gases used for welding	type of gases used for welding are selected according to job requirements, material compatibility and manufacturers' specifications
A-2.05.06P	select tungsten electrode	tungsten electrode is selected according to job requirements, material compatibility and manufacturers' specifications
A-2.05.07P	select and use filler material	filler material is selected and used according to job requirements, material compatibility and manufacturers' specifications
A-2.05.08P	perform GTAW processes	GTAW processes are performed according to job requirements, material compatibility and manufacturers' specifications
A-2.05.09P	visually inspect welds	welds are visually inspected for quality and deficiencies are identified

RANGE OF VARIABLES

PPE include: respirators, welding face shields, welding helmets, jackets/aprons, gloves

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.05.01L	demonstrate knowledge of GTAW equipment, its applications, maintenance and procedures for use	define terminology associated with GTAW
		describe the procedures used to maintain and troubleshoot GTAW equipment
		identify GTAW equipment, consumables and ***accessories*** used to weld, and describe their characteristics and applications
		interpret symbols and information, pertaining to the use of GTAW equipment found on drawings and specifications
		describe the procedures used to set up, adjust and shut down GTAW equipment
A-2.05.02L	demonstrate knowledge of the procedures used to weld using the GTAW process	identify the ***types of welds performed*** using the GTAW process
		describe the procedures used to weld mild steel, aluminum and stainless steel using the GTAW process
		describe ***weld defects***, their causes and the procedures used to prevent and correct them
A-2.05.03L	demonstrate knowledge of ***safe work practices and procedures*** pertaining to the use of GTAW equipment	identify ***hazards*** and describe ***safe work practices and procedures*** pertaining to the use of GTAW equipment

RANGE OF VARIABLES

accessories include: chill plates, strongbacks

types of welds performed include: plug, fillet (continuous), stitch, tack, edge, corner

weld defects include: porosity, cracks, warping, undercut

safe work practices and procedures include: use of PPE, following confined space procedures, obtaining required permits, fire watch, positioning welding screens

hazards include: fumes and particulate inhalation, arc flash, burns, damage to property, fire, electrical shock

A-2.06 Uses shielded metal arc welding (SMAW) equipment

Essential Skills Thinking, Document Use, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-2.06.01P	select and use equipment	equipment is selected according to job requirements and used according to manufacturers' specifications
A-2.06.02P	ensure work area is ventilated and ***PPE*** is used	work area is ventilated according to job specifications and ***PPE*** is used according to job requirements
A-2.06.03P	follow hot work procedures	hot work procedures are followed according to job requirements
A-2.06.04P	prepare material to be welded	material to be welded is prepared according to job requirements and material compatibility
A-2.06.05P	select electrode	electrode is selected according to job requirements, material compatibility and manufacturers' specifications
A-2.06.06P	perform SMAW processes	welding processes are performed according to job requirements, material compatibility and manufacturers' specifications
A-2.06.07P	inspect visually characteristics of weld	characteristics of weld are visually inspected for quality and deficiencies are identified

RANGE OF VARIABLES

PPE include: respirators, welding face shields, welding helmets, jackets/aprons, gloves

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.06.01L	demonstrate knowledge of SMAW equipment, its applications, maintenance and procedures for use	define terminology associated with SMAW
		describe the procedures used to maintain and troubleshoot SMAW equipment
		identify SMAW equipment and ***accessories***, and describe their applications, limitations and procedures for use

		interpret electrode numbering system for the application
		interpret symbols and information pertaining to the SMAW process found on drawings and specifications
		describe the procedures to set up, adjust and shut down SMAW equipment
A-2.06.02L	demonstrate knowledge of the procedures used to weld using the SMAW process	identify the ***types of welds performed*** using SMAW equipment
		describe the procedures used to weld mild steel, aluminum and stainless steel using the SMAW process
		describe ***weld defects***, their causes and the procedures used to prevent and correct them
A-2.06.03L	demonstrate knowledge of ***safe work practices and procedures*** pertaining to the use of SMAW equipment	identify ***hazards*** and describe ***safe work practices and procedures*** pertaining to the use of SMAW equipment

RANGE OF VARIABLES

accessories include: chill plates, strongbacks

types of welds performed include: plug, fillet (continuous), stitch, tack, edge, corner

weld defects include: porosity, cracks, warping, undercut

safe work practices and procedures include: using PPE, following confined space procedures, obtaining required permits, fire watch, positioning welding screens

hazards include: fumes and particulate inhalation, arc flash, burns, damage to property, fire, electrical shock

A-2.07 Uses oxy-fuel and plasma arc cutting equipment

Essential Skills	Thinking, Document Use, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-2.07.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements, manufacturers' specifications and engineered drawings
A-2.07.02P	ensure work area is ventilated and ***PPE*** is used	work area is ventilated according to job specifications and ***PPE*** is used according to job requirements

A-2.07.03P	follow hot work procedures	hot work procedures are followed according to job requirements
A-2.07.04P	identify and prepare material to be cut	material to be cut is identified and prepared according to job specifications and manufacturers' specifications
A-2.07.05P	select ***gases*** for cutting	***gases*** for cutting are selected according to job requirements and manufacturers' specifications
A-2.07.06P	perform oxy-fuel cutting procedures	oxy-fuel cutting procedures are performed according to type of materials to be cut, site conditions and jurisdictional regulations
A-2.07.07P	perform plasma arc cutting procedures	plasma arc cutting procedures are performed according to type of materials to be cut, site conditions and jurisdictional regulations
A-2.07.08P	select and maintain torch tips on oxy-fuel cutting equipment and plasma arc cutting equipment	torch tips on oxy-fuel cutting equipment and plasma arc cutting equipment are selected and maintained according to manufacturers' specifications
A-2.07.09P	inspect oxy-fuel ***cutting defects***	cuts are visually inspected for quality and deficiencies are identified
A-2.07.10P	inspect plasma arc ***cutting defects***	cuts are visually inspected for quality and deficiencies are identified

RANGE OF VARIABLES

tools and equipment include: oxy-fuel torches, plasma arc torches, compressed air/gas
PPE include: respirators, eye protection, jackets/aprons, gloves
gases include: butane, propane, acetylene, oxygen, other assorted compressed gases
cutting defects include: slag, kerf, speed, angle

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.07.01L	demonstrate knowledge of oxy-fuel and plasma arc cutting equipment and accessories	define terminology associated with oxy-fuel cutting and plasma arc cutting
		identify types of oxy-fuel cutting equipment and plasma arc cutting equipment and accessories and describe their applications
		interpret jurisdictional regulations pertaining to oxy-fuel and plasma arc cutting
		interpret symbols and information pertaining to oxy-fuel and plasma arc cutting found on drawings and specifications
A-2.07.02L	demonstrate knowledge of oxy-fuel and	describe the procedures used to prepare

	plasma arc cutting procedures	materials using oxy-fuel equipment and plasma arc equipment
		describe the procedures used to cut materials using oxy-fuel equipment and plasma arc equipment
A-2.07.03L	demonstrate knowledge of safety practices and procedures related to oxy-fuel and plasma arc cutting	identify ***hazards*** and describe ***safe work practices and procedures*** pertaining to oxy-fuel and plasma arc cutting

RANGE OF VARIABLES

hazards include: fumes and particulates inhalation, burns, damage to property, fire, electrical shock

safe work practices and procedures include: using PPE, following confined space procedures, obtaining required permits, fire watch

A-2.08 Uses soldering and brazing equipment

Essential Skills Thinking, Document Use, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-2.08.01P	select and use soldering and brazing equipment	soldering and brazing equipment is selected according to job requirements and used according to manufacturers' specifications
A-2.08.02P	store soldering and brazing equipment and supplies	soldering and brazing equipment and supplies are stored to avoid damage or injury and according to regulations
A-2.08.03P	ensure work area is ventilated and ***PPE*** is used	work area is ventilated according to job specifications and ***PPE*** is used according to job requirements
A-2.08.04P	clean and replace torch tips on brazing equipment	torch tips on brazing equipment are cleaned and replaced according to manufacturers' specifications
A-2.08.05P	clean and tin irons for soldering	irons are cleaned and tinned according to manufacturers' specifications
A-2.08.06P	perform soldering and brazing procedures	soldering and brazing procedures are performed according to type of materials to be cut, site conditions and jurisdictional regulations
A-2.08.07P	follow hot work procedures	hot work procedures are followed according to job requirements

RANGE OF VARIABLES

PPE include: respirators, eye protection, jackets/aprons, gloves

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.08.01L	demonstrate knowledge of soldering and brazing equipment, its maintenance and procedures for use	define terminology associated with soldering and brazing
		describe the procedures used to maintain and troubleshoot soldering and brazing equipment
		describe the procedures used to set up, adjust, and shut down soldering and brazing equipment

		identify ***types of soldering and brazing equipment*** and accessories, and describe their applications and procedures for use
A-2.08.02L	demonstrate knowledge of ***safe work practices and procedures*** pertaining to the use of soldering and brazing equipment	identify ***hazards*** and describe ***safe work practices and procedures*** pertaining to the use of soldering and brazing equipment
A-2.08.03L	demonstrate knowledge of procedures used to solder and braze materials	identify ***materials used to solder and braze***, and describe their applications
		identify differences between hard soldering and soft soldering
		describe the procedures used to solder and braze materials

RANGE OF VARIABLES

types of soldering and brazing equipment include: compressed gas, air acetylene torch, oxyacetylene torch, irons, coppers

safe work practices and procedures include: using PPE, following WHMIS, following confined space procedures, obtaining required permits, fire watch

hazards include: burns, fumes and particulates inhalation, caustic substances, damage to property

materials used to solder and braze include: fluxes, solders, fillers

A-2.09 Uses measuring and layout equipment

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-2.09.01P	select and use measuring and layout equipment	measuring and layout equipment is selected according to job requirements and used according to manufacturers' specifications, and drawings and dimensions
A-2.09.02P	clean and maintain measuring and layout equipment	measuring and layout equipment is cleaned and maintained
A-2.09.03P	sharpen layout equipment	layout equipment is sharpened
A-2.09.04P	verify accuracy of measuring equipment	accuracy of measuring equipment is verified according to manufacturers' specifications

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.09.01L	demonstrate knowledge of measuring and layout equipment, their applications, maintenance and procedures for use	identify ***types of measuring*** and ***layout equipment***, and describe their applications and procedures for use
		describe the procedures used to inspect and maintain measuring and layout equipment
		describe drafting tools and their application

RANGE OF VARIABLES

types of measuring equipment includes: squares, scribers, measuring tape, drafting compass, architectural rule, T-square, set squares, drafting board

types of layout equipment includes: trammel points, scratch awls, dividers

A-2.10 Uses testing and inspection devices

Essential Skills Document Use, Thinking, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
A-2.10.01P	select and use testing and inspection devices	testing and inspection devices are selected according to job specifications and used according to manufacturers' specifications
A-2.10.02P	store testing and inspection devices	testing and inspection devices are stored according to manufacturers' specifications
A-2.10.03P	identify, tag and remove from service defective testing and inspection devices	defective testing and inspection devices are identified, tagged and removed from service according to manufacturers' specifications
A-2.10.04P	follow manufacturers' recommendations for regular calibration of testing and inspection devices	manufacturers' recommendations for regular calibration of testing and inspection devices are followed
A-2.10.05P	check service records of testing and inspection devices	service records of testing and inspection devices are checked prior to use to ensure effective operation

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.10.01L	demonstrate knowledge of testing and inspection devices, their applications, maintenance and procedures for use	identify hazards and describe safe work practices and procedures pertaining to the use of testing and inspection devices
		identify ***types of testing and inspection devices*** and describe their applications and procedures for use
		describe the procedures used to inspect, maintain and store testing and inspection devices
		describe the procedures for the use of testing and inspection devices

RANGE OF VARIABLES

types of testing and inspection devices include: manometers, anemometers, cameras, gas detection equipment, velometers, pitot tubes, refrigeration gauges

A-2.11 Uses stationary and mobile work platforms

Essential Skills Document Use, Working with Others, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
A-2.11.01P	select and use stationary and mobile work platforms	stationary and mobile work platforms are selected and used according to size, site condition, job requirements and jurisdictional regulations
A-2.11.02P	inspect, identify, tag and remove from service worn, damaged and defective stationary and mobile work platforms	stationary and mobile work platforms are inspected for damage and missing components, are tagged and removed from service if required according to regulations
A-2.11.03P	identify ***hazards*** when erecting stationary and mobile work platforms	***hazards*** are identified according to site conditions
A-2.11.04P	secure stationary and mobile work platforms	stationary and mobile work platforms are secured according to safety regulations and manufacturers' specifications
A-2.11.05P	erect, level and remove stationary and mobile work platforms	stationary and mobile work platforms are erected, levelled and removed according to site requirements and regulations

A-2.11.06P	operate stationary and mobile work platforms within limitations	stationary and mobile work platforms are operated within limitations according to manufacturers' specifications and regulations
A-2.11.07P	document safe work procedures and maintenance	safe work procedures and maintenance are documented according to regulations and manufacturers' specifications

RANGE OF VARIABLES

hazards include: power lines, excess loads, uneven surfaces, pinch points, crush injuries

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.11.01L	demonstrate knowledge of stationary and mobile work platforms, their applications, limitations and procedures for use	describe terminology associated with stationary and mobile work platforms
		identify ***types of stationary and mobile work platforms***, and describe their characteristics, limitations and applications
		describe the procedures used to erect and remove stationary and mobile work platforms
		describe the procedures used to inspect, maintain and store stationary and mobile work platforms
A-2.11.02L	demonstrate knowledge of safe work practices and procedures pertaining to stationary and mobile work platforms	identify ***hazards*** and describe safe work practices and procedures pertaining to stationary and mobile work platforms
A-2.11.03L	demonstrate knowledge of regulatory requirements pertaining to stationary and mobile work platforms	identify codes and regulations pertaining to stationary and mobile work platforms

RANGE OF VARIABLES

types of stationary and mobile work platforms include: ladders, scaffolds, elevated platforms
hazards include: power lines, excess loads, uneven surfaces, pinch points, crush injuries

A-2.12 Uses hoisting, rigging and positioning equipment

Essential Skills	Oral Communication, Thinking, Working with Others

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-2.12.01P	select and use hoisting, rigging and positioning equipment	hoisting, rigging and positioning equipment is selected and used according to job requirements, load size and capacities
A-2.12.02P	inspect hoisting, rigging and positioning equipment before and after use	hoisting, rigging and positioning equipment is inspected before and after use according to manufacturers' specifications and regulations
A-2.12.03P	store hoisting, rigging and positioning equipment	hoisting, rigging and positioning equipment is stored according to regulations and manufacturers' specifications
A-2.12.04P	identify worn, damaged or defective hoisting, rigging and positioning equipment, and tag and remove from service	defective hoisting, rigging and positioning equipment is identified, tagged and removed from service according to manufacturers' specifications and regulations
A-2.12.05P	maintain hoisting, rigging and positioning equipment	hoisting, rigging and positioning equipment is maintained according to manufacturers' specifications and regulations
A-2.12.06P	identify centre of gravity of load	centre of gravity of load is identified according to drawings and pre-lift checks
A-2.12.07P	secure load to rigging	load is secured to rigging using rigging equipment according to manufacturers' specifications and regulations
A-2.12.08P	communicate with personnel involved in lift	personnel involved in lift use ***procedures used to communicate***
A-2.12.09P	restrict access to lift area	access to lift area is restricted using ***barriers***

RANGE OF VARIABLES

procedures used to communicate include: hand signals, electronic communications, audible/visual
barriers include: signs, barricades, danger/caution tape

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.12.01L	demonstrate knowledge of hoisting, rigging and positioning equipment***,*** their applications, limitations and procedures for use	define terminology associated with hoisting, rigging and positioning equipment
		identify ***types of hoisting, rigging and positioning equipment*** and accessories, and describe their characteristics, limitations and procedures for use
		identify the ***factors to consider when selecting hoisting, rigging and positioning equipment***
A-2.12.02L	demonstrate knowledge of basic hoisting, rigging and positioning techniques	identify ***types of knots, hitches, splices and bends***, and describe the procedures used to tie them
		identify types of slings
		explain sling angle when preparing for hoisting and positioning operations
		describe the procedures used for attaching rigging equipment to the load
		describe the ***procedures used to perform a lift***
A-2.12.03L	demonstrate knowledge of safe work practices and procedures pertaining to hoisting, rigging and positioning	identify ***hazards*** and describe safe work practices and procedures pertaining to the use of hoisting, rigging and positioning equipment
		describe the ***procedures used to communicate*** during hoisting, rigging and positioning operations
		describe the ***procedures used to ensure the work area is safe*** for hoisting, rigging and positioning operations
A-2.12.04L	demonstrate knowledge of regulatory requirements pertaining to hoisting, rigging and positioning	identify codes and regulations pertaining to hoisting, rigging and positioning
A-2.12.05L	demonstrate knowledge of inspection, maintenance and storage procedures for hoisting, rigging and positioning equipment	describe the procedures used to inspect, maintain and store hoisting, rigging and positioning equipment

RANGE OF VARIABLES

types of hoisting, rigging and positioning equipment includes: duct lift, overhead cranes, come-alongs, grip hoists, chainfalls, ropes, slings, chains, hooks, spreader bars, shackles, winches

factors to consider when selecting hoisting, rigging and positioning equipment include: load characteristics, environment, safety factors, anchor points, sling angles

types of knots, hitches, splices and bends include: bowline, running bowline, square/reef, half-hitch, barrel hitch

procedures used to perform a lift include: load determination, communication methods, pre-lift checks, placement of load, post-lift inspection

hazards include: power lines, excess loads, ground conditions, overhead hazards, environmental hazards

procedures used to communicate include: hand signals, electronic communications, audible/visual

procedures used to ensure the work area is safe include: supervision of lift, securing work area, communication

TASK A-3 Organizes work

TASK DESCRIPTOR

In order to organize their work, sheet metal workers must be able to use documents and drawings, plan their project tasks, and obtain and organize required materials. A well-organized job reduces costs, minimizes mistakes and ensures a productive and safe workplace.

A-3.01 Uses trade-related documentation

Essential Skills Document Use, Thinking, Writing

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
A-3.01.01P	fill out ***trade-related documentation***	***trade-related documentation*** is filled out according to shop standards
A-3.01.02P	complete ***safety-related documentation***	***safety-related documentation*** is completed according to regulations and company policies
A-3.01.03P	record maintenance, repairs and recommendations for follow-up action	maintenance, repairs and recommendations are recorded for follow-up action according to company policies
A-3.01.04P	sketch and dimension components to be fabricated and assembled	components to be fabricated and assembled are sketched and dimensioned according to shop standards
A-3.01.05P	complete material take-off lists (tear sheets)	material take-off lists (tear sheets) are completed with ***information*** according to drawings and specifications
A-3.01.06P	review maintenance records ***and safety-related documentation***	maintenance records and ***safety-related documentation*** are reviewed to identify potential hazards

A-3.01.07P	locate ***information*** in ***reference materials***	***information*** in ***reference materials*** is located for job planning and to ensure job specifications are met
A-3.01.08P	complete deficiency reports for quality control	deficiency reports are completed for quality control according to manufacturers' specifications and ***reference materials***

RANGE OF VARIABLES

trade-related documentation includes: time cards, as-builts, work orders, change orders, change directives, invoices, requests for information (RFI), manufacturers' specifications, drawings and specifications, codes and standards

safety-related documentation includes: accident/incident reports, near-miss reports, safety inspection reports, WHMIS labels, Safety Data Sheets (SDS), job hazard assessments

information includes: material and equipment needed, number of components to be fabricated

reference materials include: SMACNA, local and national construction codes, drawings and specifications

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.01.01L	demonstrate knowledge of ***trade-related documentation*** and their application	define terminology associated with ***trade-related documentation***
		identify types of ***trade-related documentation*** and describe their applications
A-3.01.02L	demonstrate knowledge of procedures used to prepare ***trade-related documentation***	explain responsibilities associated with completing and signing ***trade-related documentation***
		describe the procedures used to complete ***trade-related documentation***
		develop and interpret sketches
A-3.01.03L	demonstrate knowledge of the procedures used to produce ***material take-off lists***	identify the types of ***material take-off lists***, and describe their applications and the procedures used to produce them
A-3.01.04L	demonstrate knowledge of procedures used to prepare ***safety-related documentation***	explain responsibilities associated with completing and signing ***safety-related documentation***
		describe the procedures used to complete ***safety-related documentation***

RANGE OF VARIABLES

trade-related documentation includes: time cards, as-builts, work orders, change orders, change directives, invoices, requests for information (RFI), manufacturers' specifications, drawings and specifications, codes and standards

material take-off lists include: material estimation, material installation

safety-related documentation includes: accident/incident reports, near-miss reports, safety inspection reports, WHMIS labels, Safety Data Sheets (SDS), job hazard assessments

A-3.02 Interprets drawings

Essential Skills	Thinking, Document Use, Working with Others

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-3.02.01P	locate information on drawings	information on drawings is located
A-3.02.02P	interpret sizing of actual dimensions	sizing of actual dimensions is interpreted according to scale readings
A-3.02.03P	check drawings	drawings are checked for dimensioning and locations
A-3.02.04P	identify obstructions and the needs for coordinating work with others	obstructions are identified by visualizing the finished product and work is coordinated with others to facilitate installation
A-3.02.05P	cross-reference information on drawings	information on drawings is cross-referenced with specifications and ***reference materials***

RANGE OF VARIABLES

reference materials include: SMACNA, local and national construction codes, drawings and specifications

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.02.01L	demonstrate knowledge of drawings and specifications, and their applications	define terminology associated with drawings and specifications
		identify the ***types of drawings*** and describe their applications
		identify the ***views used on drawings***
		identify the ***parts of a drawing***, and describe their purpose and applications
		identify and interpret common symbols and abbreviations found on drawings
		describe how to use scale rulers
		describe metric and imperial systems of measurement

A-3.02.02L	demonstrate knowledge of the procedures used to interpret and extract information from drawings	interpret and extract information from drawings
		explain the purpose of drawings

RANGE OF VARIABLES

types of drawings include: pictorial, orthographic, architectural, mechanical, structural, electrical, interference, shop, sketches, as-builts, legends, schedules, details, prints

views used on drawings include: elevation, plan, section, detail, auxiliary

parts of a drawing include: lines, legend, symbols, abbreviations, title block, notes, specifications

A-3.03 Organizes materials and equipment for project

Essential Skills	Working with Others, Thinking, Oral Communication

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-3.03.01P	use materials and equipment	materials and equipment are used according to job requirements
A-3.03.02P	label materials and equipment	materials and equipment are labelled by transferring information from drawings to fittings to ensure correct fabrication, assembly, shipping and installation
A-3.03.03P	manage inventory of materials and equipment	inventory of materials and equipment is managed according to shop standards
A-3.03.04P	estimate time, and materials and equipment requirements	time and materials and equipment requirements are estimated for time management and work coordination purposes
A-3.03.05P	manage and store job site materials and equipment	job site materials and equipment are managed and stored according to environmental conditions, construction schedule and to coordinate work with other trades
A-3.03.06P	load and unload materials and equipment	materials and equipment are loaded and unloaded considering ***hazards of loading/unloading***

RANGE OF VARIABLES

hazards of loading/unloading include: uneven weight distribution, capacity of hoisting equipment, over-sized loads, pinch points

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-3.03.01L	demonstrate knowledge of types, properties and handling requirements of materials and equipment	identify ***types of materials and equipment***
		describe ***considerations*** for determining material and supply requirements
		describe procedures to organize, store and maintain inventory
A-3.03.02L	demonstrate knowledge of safe handling practices for materials and equipment	describe safety requirements for handling materials and equipment
A-3.03.03L	demonstrate knowledge of the procedures used to plan and organize jobs	identify ***sources of information relevant to job planning***
		identify ***considerations for determining job requirements***
		describe the ***procedures used to plan job tasks***

RANGE OF VARIABLES

types of materials and equipment include: consumables, fasteners, sheets, sealants, ductwork, hoisting, air handling components, hazardous materials, material lifts

considerations include: plans, specifications, drawings, environment

sources of information relevant to job planning include: documentation, drawings, specifications, professionals in related trades, clients, LEED requirements

considerations for determining job requirements include: personnel, tools and equipment, materials, permits, specifications, LEED requirements

procedures used to plan job tasks include: scheduling, estimating

A-3.04 Performs basic design and field modifications

Essential Skills Thinking, Numeracy, Oral Communication

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
A-3.04.01P	perform preliminary site inspection	preliminary site inspection is performed to identify potential conflicts or design modifications by comparing drawings and specifications to site conditions
A-3.04.02P	modify design for installation	design for installation is modified using site measurements

A-3.04.03P	design and modify sheet metal systems, materials and routing	sheet metal systems, materials and routing are designed and modified according to job site conditions and interference drawings
A-3.04.04P	sketch modifications	modifications to accommodate changes in construction and installation requirements are sketched according to job specifications
A-3.04.05P	determine design conflicts and implement field modifications	design conflicts are determined and field modifications are implemented according to job specifications and approvals

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.04.01L	demonstrate knowledge of inspection procedures	describe the procedures used to inspect site
A-3.04.02L	demonstrate knowledge of the procedures used to take field measurements	describe the procedures used to take field measurements
A-3.04.03L	demonstrate knowledge of performing field modifications	identify conflicts and implement field modifications
		identify hazards and describe safe work practices and procedures pertaining to applying field modifications
A-3.04.04L	demonstrate knowledge of basic pattern development and layout	define terminology associated with pattern development and layout
		identify layout tools and describe their applications and procedures for use
		identify ***layout methods*** and describe their applications
		describe the procedures used to develop ***basic drawings and sketches***
A-3.04.05L	demonstrate knowledge of duct systems and their associated design principles	define terminology associated with duct system design
		identify the ***types of basic duct systems*** and describe their associated design principles
		describe the procedures used to perform heat gain/loss calculations and their applications
		identify air patterns and describe their impact on the operation of duct systems
		explain air pressure and its impact on the operation of duct systems
		identify ***formulas used in duct system design*** and describe their applications

	identify codes and regulations pertaining to basic design and field modifications
	identify ***considerations and requirements used to determine duct system design***

RANGE OF VARIABLES

layout methods include: simple/straight line, parallel line, radial line, triangulation, computerized, combination

basic drawings and sketches include: pictorial, orthographic

types of basic duct systems include: air handling systems (single path, variable air volume [VAV]), material handling systems (positive, negative)

formulas used in duct system design include: fan laws, velocity, quantity, pressure

considerations and requirements used to determine duct system design include: equal friction, air duct calculations, static regain, constant velocity

TASK A-4 Uses communication and mentoring techniques

TASK DESCRIPTOR

Learning in the trades is done primarily in the workplace with tradespeople passing on their skills and knowledge to apprentices, as well as sharing knowledge among themselves. Apprenticeship is, and always has been about mentoring—learning workplace skills and passing them on. Because of the importance of this to the trade, this task covers activities related to communication in the workplace and mentoring skills.

A-4.01 Uses communication techniques

Essential Skills	Oral Communication, Working with Others, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	no	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
A-4.01.01P	demonstrate ***communication practices*** with individuals or in a group	instructions and messages are understood by all parties involved in communication
A-4.01.02P	listen using ***active listening*** practices	steps of ***active listening*** are utilized
A-4.01.03P	receive and respond to feedback on work	response to feedback indicates understanding and corrective measures are taken

A-4.01.04P	explain and provide feedback	explanation and feedback is provided and task is carried out as directed
A-4.01.05P	use questioning to improve communication	questions enhance understanding, on-the-job training and goal setting
A-4.01.06P	participate in safety and information meetings	meetings are attended, and information is relayed to the workforce, and is understood and applied
A-4.01.07P	establish effective lines of communication with crew before starting hazardous work	effective communication is established so that work proceeds smoothly and is completed without incident

RANGE OF VARIABLES

communication practices include: oral, written and body language

active listening includes: hearing, interpreting, reflecting, responding, paraphrasing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-4.01.01L	demonstrate knowledge of trade terminology	define terminology used in the trade
A-4.01.02L	demonstrate knowledge of effective ***communication practices***	describe the importance of using effective verbal and non-verbal communication with ***people in the workplace***
		identify ***sources of information*** to effectively communicate
		identify communication and ***learning styles***
		describe effective listening and speaking skills
		identify ***personal responsibilities and attitudes*** that contribute to on-the-job success
		identify the value of diversity in the workplace
		identify communication that constitutes ***harassment*** and ***discrimination***

RANGE OF VARIABLES

communication practices include: oral, written and body language

people in the workplace include: other tradespeople, colleagues, apprentices, supervisors, clients, public, Authority having jurisdiction (AHJ), manufacturers

sources of information include: regulations, codes, occupational health and safety requirements, requirements of AHJ, prints, drawings, specifications, company and client documentation

learning styles include: seeing it, hearing it, trying it

personal responsibilities and attitudes include: asking questions, working safely, accepting constructive feedback, time management and punctuality, respect for authority, good stewardship of materials, tools and property, efficient work practice

harassment includes: objectionable conduct, comment or display made either on a one-time or continuous basis that demeans, belittles, or causes personal humiliation or embarrassment to the recipient

discrimination is prohibited based on: race, national or ethnic origin, colour, religion, age, sex, sexual orientation, marital status, family status, disability or conviction for which a pardon has been granted

A-4.02 Uses mentoring techniques

Essential Skills	Working with Others, Oral Communication, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	no	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
A-4.02.01P	identify and communicate learning objective and point of lesson	apprentice or learner can explain the objective and point of the lesson
A-4.02.02P	link lesson to other lessons and the job	lesson order and unplanned learning opportunities are defined
A-4.02.03P	demonstrates performance of a skill to an apprentice or learner	***steps required to demonstrate a skill*** are performed
A-4.02.04P	set up conditions required for an apprentice to practice a skill	***practice conditions*** are set up so that the skill can be practiced safely by the apprentice
A-4.02.05P	assess apprentice or learner's ability to perform tasks with increasing independence	performance of apprentice improves with practice to a point where skill can be done with little supervision
A-4.02.06P	give supportive and corrective feedback	apprentice adopts best practice after having been given supportive or corrective feedback
A-4.02.07P	support apprentices in pursuing technical training opportunities	technical training is completed within timeframe prescribed by apprenticeship authority
A-4.02.08P	support equity group apprentices	workplace is harassment and discrimination-free
A-4.02.09P	implement probationary period to assess suitability to the trade	commitment is demonstrated and more suitable career options are suggested if required

RANGE OF VARIABLES

steps required to demonstrate a skill include: understanding the who, what, where, when, why, and how, explaining, showing, giving encouragement, following up to ensure skill is performed correctly

practice conditions means: guided, limited independence, full independence

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-4.02.01L	demonstrate knowledge of strategies for learning skills in the workplace	describe the importance of individual experience
		describe the shared responsibilities for workplace learning
		determine one's own learning preferences and explain how these relate to learning new skills
		describe the importance of different types of skills in the workplace
		describe the importance of ***essential skills*** in the workplace
		identify different ***learning styles***
		identify different ***learning needs*** and strategies to meet ***learning needs***
		identify ***strategies to assist in learning a skill***
A-4.02.02L	demonstrate knowledge of strategies for teaching workplace skills	identify different roles played by a workplace mentor
		describe ***teaching skills***
		explain the importance of identifying the point of a lesson
		identify how to choose a good time to present a lesson
		explain the importance of linking the lessons
		identify the components of the skill (the context)
		describe considerations in setting up opportunities for skill practice
		explain the importance of providing feedback
		identify techniques for giving effective feedback
		describe a skills assessment
		identify methods of assessing progress
		explain how to adjust a lesson to different situations

RANGE OF VARIABLES

essential skills are: reading, writing, document use, oral communication, numeracy, thinking, working with others, digital technology, continuous learning

learning styles include: seeing it, hearing it, trying it

learning needs include: learning disabilities, learning preferences, language proficiency

strategies to assist in learning a skill include: understanding the basic principles of instruction, developing coaching skills, being mature and patient, providing feedback

teaching skills include: identifying the point of the lesson, linking the lesson, demonstrating the skill, providing practice, giving feedback, assessing skills and progress

MAJOR WORK ACTIVITY B
Performs fabrication

TASK B-5 Performs pattern development

TASK DESCRIPTOR

Pattern development is the starting point of fabrication and one of the most important steps. Sheet metal workers develop a pattern by hand or computer using one or more of the four methods of layout to build a finished product. They need to be able to identify which method to use.

B-5.01 Develops patterns using simple and straight line layout

Essential Skills Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-5.01.01P	visualize finished product in three dimensions	finished product is visualized in three dimensions
B-5.01.02P	determine cut size of blank piece	cut size of blank piece is determined while allowing for seams and edges and to minimize waste
B-5.01.03P	mark material	material is marked to identify seams and bend marks
B-5.01.04P	mark braking lines and braking diagrams on pattern	braking lines and braking diagrams on pattern are marked for future forming according to order of operation

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-5.01.01L	demonstrate knowledge of simple and straight line layout, its applications and associated calculations	define terminology associated with simple and straight line layout
		identify the types of basic patterns and fittings that require simple and straight line layout
		identify calculations used in simple and straight line layout

		describe the ***procedures used*** to perform calculations used in simple and straight line layout
B-5.01.02L	demonstrate knowledge of basic pattern development using simple layout	describe the ***procedures used*** to develop basic patterns using simple and straight line layout

RANGE OF VARIABLES

procedures used include: determining views, labelling lines and points, preparing patterns, determining true length of lines, determining types of seams, joints and edges, calculating allowances, determining stretch-outs, checking pattern accuracy, cutting pattern, labelling pieces

B-5.02 Develops patterns using parallel line method

Essential Skills Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-5.02.01P	visualize finished product in three dimensions	finished product is visualized in three dimensions
B-5.02.02P	develop plan and elevation views	plan and elevation views required for fitting are developed according to drawings and dimensions
B-5.02.03P	divide plan and elevation into equal parts	plan and elevation is divided into equal parts to achieve required accuracy
B-5.02.04P	calculate stretch-out	stretch-out is calculated according to required dimensions
B-5.02.05P	divide stretch-out lengths into equal parts	stretch-out lengths are divided into equal parts, and spaced according to developed plan and elevation views
B-5.02.06P	connect points to finish pattern	points to finish pattern are connected and allowances for seams and edges are added
B-5.02.07P	mark forming lines and forming diagrams on pattern	forming lines and forming diagrams are marked on pattern for future forming and according to order of operations

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-5.02.01L	demonstrate knowledge of parallel line development for round duct fittings, its applications and associated calculations	define terminology associated with parallel line development for round duct fittings
		describe the ***types of round duct fittings*** that require parallel line development
		identify calculations used in parallel line development for round duct fittings
		describe the ***procedures used*** to perform calculations used in parallel line development for round duct fittings
B-5.02.02L	demonstrate knowledge of the ***procedures used*** to develop and fabricate round duct fittings using parallel line development	describe the ***procedures used*** to develop and fabricate round duct fittings using parallel line development
B-5.02.03L	demonstrate knowledge of parallel line development for architectural applications and its associated calculations	define terminology associated with parallel line development for architectural applications
		identify the ***types of fittings and components for architectural applications*** that require parallel line development
		identify calculations used in parallel line development for architectural applications
		describe the ***procedures used*** to perform calculations used in parallel line development for architectural applications
B-5.02.04L	demonstrate knowledge of the ***procedures used*** to develop patterns for advanced or complex fittings for architectural applications using parallel line development	describe the ***procedures used*** to develop patterns for architectural applications using parallel line development

RANGE OF VARIABLES

types of round duct fittings include: tee, round elbow, round offsets

procedures used include: determining views, labelling lines and points, preparing patterns, determining true length of lines, determining types of seams, joints and edges, calculating allowances, determining stretch-outs, checking pattern accuracy, cutting pattern, labelling pieces

types of fittings and components for architectural applications include: copings, gutters, mitred flashings, skylights, finials

B-5.03 Develops patterns using radial line method

Essential Skills Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-5.03.01P	visualize finished product in three dimensions	finished product is visualized in three dimensions
B-5.03.02P	develop plan and elevation views	plan and elevation views required for fittings are developed according to drawings and dimensions
B-5.03.03P	find common apex	common apex is found using layout tools and mathematical formulas
B-5.03.04P	calculate circumference stretch-out	circumference stretch-out is calculated
B-5.03.05P	divide stretch-out lengths into equal parts	stretch-out lengths are divided into equal parts, spaced according to the dimension of the fitting, and plan and elevation views are developed
B-5.03.06P	transfer points from plan and elevation views to pattern	points from plan and elevation views are transferred to pattern, and allowances are added for seams and edges
B-5.03.07P	connect points to finish pattern	points to finish pattern are connected according to layout
B-5.03.08P	mark forming lines and forming diagrams on pattern	forming lines and forming diagrams are marked on pattern for future forming according to order of operations

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-5.03.01L	demonstrate knowledge of radial line development for right cones, its applications and associated calculations	define terminology associated with radial line development for right cones
		identify calculations used in radial line development for right cones
		describe the procedures used to perform calculations used in radial line development for right cones
B-5.03.02L	demonstrate knowledge of the ***procedures used to develop patterns*** for fittings based on right cones using radial line development	describe the ***procedures used to develop patterns*** for fittings based on right cones using radial line development
B-5.03.03L	demonstrate knowledge of radial line development for oblique fittings and components and its associated calculations	define terminology associated with radial line development for oblique fittings and components
		identify the types of oblique fittings and components that require radial line development
		identify calculations used in radial line development for oblique fittings and components
		describe the procedures used to perform calculations used in radial line development for oblique fittings and components
B-5.03.04L	demonstrate knowledge of the ***procedures used to develop patterns*** for oblique fittings and components using radial line development	describe the ***procedures used to develop patterns*** for oblique fittings and components using radial line development

RANGE OF VARIABLES

procedures used to develop patterns include: determining views, labelling lines and points, preparing patterns, determining true length of lines, determining types of seams, joints and edges, calculating allowances, determining stretch-outs, checking pattern accuracy, cutting pattern, labelling pieces

B-5.04 Develops patterns using triangulation method

Essential Skills Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-5.04.01P	visualize finished product in three dimensions	finished product is visualized in three dimensions
B-5.04.02P	develop plan and elevation views	plan and elevation views required for fittings are developed according to drawings and dimensions
B-5.04.03P	find true lengths	true lengths are found using the two known points and according to dimensions and drawings
B-5.04.04P	lay out flat pattern	flat pattern is laid out and transverse joint and longitudinal seam allowances are allowed for according to shop standards and specifications
B-5.04.05P	connect points to finish pattern	points to finish pattern are connected using layout tools and according to layout
B-5.04.06P	mark forming lines and forming diagrams on pattern	forming lines and forming diagrams are marked on pattern for future forming according to order of operation

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-5.04.01L	demonstrate knowledge of triangulation method from plan view, its applications and associated calculations	define terminology associated with the triangulation method from plan view
		describe the ***types of fittings that require triangulation method from plan view***
B-5.04.02L	demonstrate knowledge of the procedures used to develop patterns for fittings using triangulation method from plan view	identify calculations used in the triangulation method from plan view and describe the procedures used to perform them
		describe the ***procedures used to develop patterns for fittings*** using triangulation method from plan view
B-5.04.03L	demonstrate knowledge of triangulation method from elevation, its applications and associated calculations	define terminology associated with the triangulation method from elevation

		identify the types of fittings that require triangulation method from elevation
B-5.04.04L	demonstrate knowledge of the procedures used to develop patterns for advanced or complex fittings using triangulation method from elevation	identify calculations used in the triangulation method from elevation and describe the procedures used to perform them
		describe the ***procedures used to develop patterns for fittings*** and components using triangulation method from elevation

RANGE OF VARIABLES

types of fittings that require triangulation method from plan view include: transitions, tapers, square-to rounds

procedures used to develop patterns for fittings include: determining views, labelling lines and points, preparing patterns, determining true length of lines, determining types of seams, joints and edges, calculating allowances, determining stretch-outs, checking pattern accuracy, cutting pattern, labelling pattern

B-5.05 Uses computer technology for pattern development

Essential Skills Document Use, Digital Technology, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-5.05.01P	visualize finished product in three dimensions	finished product is viewed in three dimensions
B-5.05.02P	select required product to be developed from computer database	required product to be developed is selected from computer database
B-5.05.03P	input dimensions into computer	dimensions are input into computer based on type and size of finished product
B-5.05.04P	select joint and seam information from computer database	joint and seam information is selected from computer database according to finished product requirements
B-5.05.05P	label blank pieces with ***forming information***	blank pieces are labelled with ***forming information*** according to drawing and dimensions

RANGE OF VARIABLES

forming information includes: layout and assembly of pieces, braking lines, seams, allowances, joints, gauges

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-5.05.01L	demonstrate knowledge of computer technology used for pattern development and layout	describe the procedures used to perform pattern development using computer technology
B-5.05.02L	demonstrate knowledge of basic pattern development and layout	define terminology associated with pattern development and layout
		identify layout tools and describe their applications and procedures for use
		identify layout methods and describe their applications

TASK B-6 Fabricates sheet metal components for air and material handling systems

TASK DESCRIPTOR

Fabrication of air and material handling systems is the process of producing finished ductwork or fittings from a flat pattern (using simple, straight, radial, triangulation or parallel line pattern development techniques) or sheet using various tools.

B-6.01 Cuts ductwork, fittings and components

Essential Skills	Numeracy, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
B-6.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
B-6.01.02P	verify measurements	measurements are verified according to seam allowances and duct length
B-6.01.03P	create cut list	cut list is created according to drawing to minimize waste
B-6.01.04P	cut blanks	blanks are cut according to cut list

B-6.01.05P	scribe allowances	allowances are scribed for transverse, mitred and longitudinal seams
B-6.01.06P	notch material	material is notched according to seam allowances and pattern
B-6.01.07P	mark forming lines and forming diagrams on pieces	forming lines and forming diagrams are marked on pieces for future forming according to order of operation

RANGE OF VARIABLES

tools and equipment include: snips, shears, grinders, saws, marking tools, notchers

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-6.01.01L	demonstrate knowledge of the procedures used to fabricate ductwork and fittings	define terminology associated with fabrication
		interpret information pertaining to the fabrication of sheet metal components found on drawings and specifications
		identify ***tools and equipment*** used to fabricate sheet metal components and describe their applications and procedures for use
		identify types of materials used to fabricate sheet metal components and describe their characteristics and applications
		identify and describe ***sheet metal components associated with air and material handling systems***
		identify ***considerations and requirements*** when fabricating sheet metal components for air and material handling systems
B-6.01.02L	demonstrate knowledge of ***codes and regulations*** pertaining to the fabrication of sheet metal components	identify ***codes and regulations*** pertaining to the fabrication of sheet metal components
B-6.01.03L	demonstrate knowledge of the procedures used to cut ductwork, fittings and components	identify tools used to cut ductwork, fittings and components and describe their applications and procedures for use
B-6.01.04L	demonstrate knowledge of safe work practices and procedures pertaining to cutting ductwork, fittings and components	identify hazards and describe safe work practices and procedures associated with cutting ductwork, fittings and components
B-6.01.05L	demonstrate knowledge of calculations required to measure ductwork, fittings and components	calculate measurements required for seam allowances according to materials handling requirements

RANGE OF VARIABLES

tools and equipment include: snips, shears, grinders, saws, marking tools, notchers

sheet metal components associated with air and material handling systems include: ductwork, fittings, dampers, fire dampers, flexible connections, hangers, equipment supports/bases, louvers, attenuators (silencers), blast gates, clean-outs, access doors, plenums

considerations and requirements include: load bearing capacities, system specifications, environmental conditions, architectural conditions

codes and regulations include: SMACNA, American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), National Building Code (NBC), National Fire Protection Association (NFPA), AHJ

B-6.02 Forms ductwork, fittings and components

Essential Skills Numeracy, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-6.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
B-6.02.02P	examine forming diagrams	forming diagrams are examined to establish order of operations
B-6.02.03P	cross-brake or bead pieces	pieces are cross-broken or beaded to strengthen piece and eliminate vibration and noise
B-6.02.04P	form longitudinal seams	longitudinal seams are formed according to forming diagram and scribes
B-6.02.05P	form transverse seams	transverse seams are formed according to forming diagram and scribes
B-6.02.06P	identify types of duct reinforcement	type of duct reinforcement are identified according to SMACNA and job specifications

RANGE OF VARIABLES

tools and equipment include: brakes, roll formers, rolls, stakes

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-6.02.01L	demonstrate knowledge of the procedures used to form ductwork, fittings and ***components***	define terminology associated with forming ductwork, fittings and ***components***
		interpret information pertaining to the forming of ductwork, fittings and ***components*** found on drawings and specifications
		identify ***tools and equipment*** used to form ductwork, fittings and ***components***, and describe their applications, limitations and procedures for use
		identify ***considerations and requirements*** when forming ductwork, fittings and ***components*** for air and material handling systems
		identify ***types of seams and joints*** for forming ductwork, fittings and components and describe the procedures used to produce them
		identify types of edges for fabrication of ductwork and fittings, and describe the procedures used to produce them
		identify ***types of fastening methods*** used to fabricate ductwork, fittings and ***components*** and describe their associated procedures
		identify types of duct reinforcement
		describe the procedures used to fabricate ductwork, fittings and ***components***
B-6.02.02L	demonstrate knowledge of safe work practices pertaining to forming ductwork, fittings and ***components***	identify hazards and describe safe work practices associated with forming ductwork, fittings and ***components***
		identify codes and regulations pertaining to the fabrication of sheet metal ***components***
B-6.02.03L	demonstrate knowledge of metallurgic principles	identify ***types of metals*** and describe their applications
		identify ***types of surface finishes*** and describe their applications
		identify ***methods used to work with metals***

RANGE OF VARIABLES

components include: turning vanes, splitter vanes, flex connectors, access doors

tools and equipment include: brakes, roll formers, rolls, stakes

considerations and requirements include: load bearing capacities, system specifications, environmental conditions

types of seams and joints include: longitudinal, Pittsburgh Locks, groove seams, acme locks, snap/button locks, transverse, slip & drive, TDC/TDF, companion flanges

types of fastening methods include: mechanical, adhesives, welding

types of metals include: steel (hot rolled, cold rolled, coated), copper, brass, aluminum, stainless steel

types of surface finishes include: mill, brushed, mirrored, dull

methods used to work with metals include: forming, cutting/shearing, punching, drilling, joining

B-6.03 Insulates ductwork, fittings and components

Essential Skills	Numeracy, Document Use, Reading

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-6.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job specifications
B-6.03.02P	select insulation thicknesses, properties and types	insulation thicknesses, properties and types are selected according to job specifications
B-6.03.03P	measure and cut insulation	insulation is measured and cut according to type and thickness
B-6.03.04P	select ***fastening method***	***fastening method*** is selected according to job specifications
B-6.03.05P	seal cut edges of insulation	edges of cut insulation are sealed according to job specifications
B-6.03.06P	apply insulation	insulation is applied using selected ***fastening method*** and according to job specifications
B-6.03.07P	apply perforated metal	perforated metal is applied according to specifications using ***application methods***
B-6.03.08P	install internal supports	internal supports are installed according to job requirements
B-6.03.09P	apply nosing	nosing is applied according to specifications using ***application methods***
B-6.03.10P	ensure work area is ventilated and PPE is used	work area is ventilated according to regulations and PPE is used according to job requirements

RANGE OF VARIABLES

tools and equipment include: knives, tape measure, straight edge, pin spotter
fastening method includes: adhesives, pins, foil tape
application methods include: screws, rivets

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-6.03.01L	demonstrate knowledge of the procedures used to insulate ductwork, fittings and ***components***	identify types and properties of insulation used for insulating ductwork, fittings and ***components***
		identify ***tools and equipment*** used to insulate ductwork, fittings and ***components*** and describe their applications, limitations and procedures for use
		interpret information pertaining to the insulation of ductwork, fittings and ***components*** found on drawings and specifications
B-6.03.02L	demonstrate knowledge of safe work practices and procedures pertaining to insulating ductwork, fittings and ***components***	identify hazards and describe safe work practices and procedures associated with insulating ductwork, fittings and ***components***
B-6.03.03L	demonstrate knowledge of metals and their properties, characteristics and applications	identify ***types of metals*** and describe their applications
B-6.03.04L	demonstrate knowledge of standards pertaining to insulating ductwork, fittings and ***components***	identify standards pertaining to the use of insulation pertaining to ductwork, fittings and ***components***

RANGE OF VARIABLES

components include: turning vanes, splitter vanes, flex connectors, access/plenum doors, attenuators (silencers)

tools and equipment include: knives, tape measure, straight edge, pin spotter

types of metals include: steel (hot rolled, cold rolled, coated), copper, brass, aluminum, cast iron, stainless steel

B-6.04 Assembles ductwork, fittings and components

Essential Skills	Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-6.04.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
B-6.04.02P	use welding equipment for assembly	welding equipment is used for assembly according to job specifications and requirements
B-6.04.03P	select and use ***fasteners***	***fasteners*** are selected and used according to job specifications
B-6.04.04P	select and use sealants	sealants are selected and used according to job specifications
B-6.04.05P	refer to labels and diagrams	labels and diagrams are referred to for order of assembly and orientation of pieces
B-6.04.06P	align and fasten pieces	pieces are aligned and fastened according to locks and seams
B-6.04.07P	install or form transverse joints	transverse joints are installed or formed according to standards, job requirements and specifications
B-6.04.08P	assemble flexible connectors	flexible connectors are assembled using glue and/or staples according to manufacturers' recommendations
B-6.04.09P	install ***components***	***components*** are installed according to standards, job requirements and specifications

RANGE OF VARIABLES

tools and equipment include: hammers, setting tools, screwdrivers, welders, drills
fasteners include: rivets, spot welds, screws
components include: turning vanes, splitter vanes, flex connectors, access doors, burglar bars

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-6.04.01L	demonstrate knowledge of the procedures used to assemble ductwork, fittings and ***components***	identify ***tools and equipment*** used to assemble ductwork, fittings and ***components***, and describe their applications, limitations and procedures for use
		interpret information pertaining to the assembly of ductwork, fittings and ***components***, found on drawings and specifications
		identify types of materials used to assemble ductwork, fittings and ***components***, and describe their characteristics and applications
B-6.04.02L	demonstrate knowledge of welding equipment, its application, maintenance and procedures for use	identify types of welding equipment required for assembling ductwork, fittings and ***components***
B-6.04.03L	demonstrate knowledge of safe work practices and procedures pertaining to the assembly of ductwork, fittings and ***components***	identify hazards and describe safe work practices and procedures associated with assembling ductwork, fittings and ***components***
B-6.04.04L	demonstrate knowledge of industry standards pertaining to the assembly of ductwork, fittings and ***components***	identify industry standards pertaining to the assembly of ductwork, fittings and ***components***

RANGE OF VARIABLES

components include: turning vanes, splitter vanes, flex connectors, access doors, burglar bars
tools and equipment include: hammers, setting tools, screwdrivers, welders, drills

B-6.05 Fabricates dampers

Essential Skills	Numeracy, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
B-6.05.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
B-6.05.02P	determine ***type of damper*** required	***type of damper*** required is determined according to specifications

B-6.05.03P	measure and size damper	damper is measured and sized according to application
B-6.05.04P	select ***hardware*** required for damper	***hardware*** required for damper is selected according to specifications
B-6.05.05P	cut and form damper blades and body	damper blades and body are cut and formed according to regulations and job specifications
B-6.05.06P	assemble blades, ***hardware*** and body	blades, ***hardware*** and body are assembled according to damper type
B-6.05.07P	verify damper operation	damper operation is verified according to orientation and blade movement

RANGE OF VARIABLES

tools and equipment include: drills, snips, screwdrivers, punch, brakes, welder
types of dampers include: splitter, opposed blade damper (OBD), parallel blade, blast gate
hardware includes: quadrant arms, linkages, ball joints

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-6.05.01L	demonstrate knowledge of the procedures used to fabricate dampers	identify ***tools and equipment*** used to fabricate dampers, and describe their applications, limitations and procedures for use
		interpret information pertaining to the fabrication of dampers found on drawings and specifications
		identify types of materials used to fabricate dampers and describe their characteristics and applications
B-6.05.02L	demonstrate knowledge of safe work practices and procedures pertaining to the fabrication of dampers	identify hazards and describe safe work practices and procedures associated with fabricating dampers
B-6.05.03L	demonstrate knowledge of ***calculations related to dampers***	explain calculations related to damper fabrication

RANGE OF VARIABLES

tools and equipment include: drills, snips, screwdrivers, punch, brakes, welder
calculations related to dampers include: frame size, bend allowances, number of blades, material thickness

B-6.06 Fabricates hanger systems, supports and bases

Essential Skills Numeracy, Reading, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-6.06.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
B-6.06.02P	confirm size and weight of equipment and materials to be supported	size and weight of equipment and materials to be supported are confirmed according to manufacturers' specifications and ***trade standards***
B-6.06.03P	confirm materials and components	materials and components are confirmed based on isolation and seismic restraint requirements and according to job specifications
B-6.06.04P	select hangers and supports	hangers and supports are selected for size and load of air and material handling systems according to job specifications, industry standards and jurisdictional regulations
B-6.06.05P	confirm number of hangers	required number and spacing of hangers for specified length of air and material handling systems are confirmed according to ***trade standards*** and specifications
B-6.06.06P	confirm location for required installation	location is confirmed according to drawings and manufacturers' specifications
B-6.06.07P	perform layout for hanger systems, supports and bases	hanger systems, supports and bases are laid out
B-6.06.08P	pre-drill holes for mounting hanger systems, supports and bases	holes for mounting hanger systems, supports and bases are pre-drilled according to job specifications
B-6.06.09P	assemble components of hanger systems, supports and bases	components of hanger systems, supports and bases are assembled according to manufacturers' specifications and drawings

RANGE OF VARIABLES

tools and equipment include: tape measures, welding equipment, drills, snips, abrasive cut-off saws, hack saws, wire cutters, rod cutter

trade standards include: SMACNA, ASHRAE, NBC, Canadian Welding Bureau (CWB)

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-6.06.01L	demonstrate knowledge of the procedures used to fabricate hanger systems, supports and bases	identify ***tools and equipment*** used to fabricate hanger systems, supports and bases, and describe their applications, limitations and procedures for use
		interpret information pertaining to the fabrication of hanger systems, supports and bases found on drawings and specifications
		identify types of materials used to fabricate hanger systems, supports and bases, and describe their characteristics and applications
		identify size and weight of equipment and materials to be supported according to manufacturers' specifications
B-6.06.02L	demonstrate knowledge of safe work practices and procedures pertaining to the fabrication of hanger systems, supports and bases	identify hazards and describe safe work practices and procedures associated with fabricating hanger systems, supports and bases
B-6.06.03L	demonstrate knowledge of drawing interpretation	lay out and fabricate hanger systems, supports and bases from drawings
		determine location for installation from drawings
B-6.06.04L	demonstrate knowledge of ***trade standards*** pertaining to the fabrication of hanger systems, supports and bases	identify ***trade standards*** pertaining to the fabrication of hanger systems, supports and bases

RANGE OF VARIABLES

tools and equipment include: tape measures, welding equipment, drills, snips, abrasive cut-off saws, hack saws, wire cutters, rod cutter

trade standards include: SMACNA, ASHRAE, NBC, Canadian Welding Bureau (CWB)

TASK B-7 Fabricates flashing, roofing, sheeting and cladding

TASK DESCRIPTOR

Flashing, roofing, sheeting and cladding are fabricated to provide protection and aesthetics to structures. Fabrication of flashing, roofing (and roofing drainage systems), sheeting and cladding is the process of producing finished products from a flat pattern or sheet using a variety of tools.

B-7.01 Cuts metal for flashing, roofing, sheeting and cladding

Essential Skills	Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
B-7.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
B-7.01.02P	select seam type	seam type is selected according to strength, aesthetics, type of material being used and job specifications
B-7.01.03P	calculate and measure material	material is calculated and measured, according to ***factors***
B-7.01.04P	calculate size of area to be covered	size of area to be covered is calculated to determine material required and to minimize waste
B-7.01.05P	shear material to blank size	material is sheared to blank size according to job requirements
B-7.01.06P	notch material	material is notched according to selected seams, joints and edges

RANGE OF VARIABLES

tools and equipment include: tape measures, snips, shears

factors include: expansion, contraction, seams, joints, bend allowances

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-7.01.01L	demonstrate knowledge of the procedures used to cut metal for flashing, roofing, sheeting and cladding	identify ***tools and equipment*** used to cut metal for flashing, roofing, sheeting and cladding, and describe their applications and procedures for use
		identify types of seams used for flashing, roofing, sheeting and cladding installations
B-7.01.02L	demonstrate knowledge of safe work practices and procedures pertaining to cutting metal for flashing, roofing, sheeting and cladding	identify hazards and describe safe work practices and procedures associated with cutting metal for flashing, roofing, sheeting and cladding
B-7.01.03L	demonstrate knowledge of calculations required to measure material for cutting	calculate and measure area to be covered
		calculate and measure material to be cut

RANGE OF VARIABLES

tools and equipment include: tape measures, snips, shears

B-7.02 Forms flashing, roofing, sheeting and cladding

Essential Skills Numeracy, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
B-7.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
B-7.02.02P	mark forming lines and diagrams on pieces	forming lines and diagrams on pieces are marked
B-7.02.03P	bend or roll material	material is bent or rolled according to forming lines and diagrams
B-7.02.04P	confirm sealing and joining methods required	sealing and joining methods are confirmed according to job specifications

RANGE OF VARIABLES

tools and equipment include: brakes, rolls, stakes

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-7.02.01L	demonstrate knowledge of procedures used for forming flashing, roofing, sheeting and cladding	define terminology associated with flashing, roofing, sheeting and cladding
		identify types of materials used in forming flashing, roofing, sheeting and cladding
		identify ***tools and equipment*** used to form flashing, roofing, sheeting and cladding, and describe their applications, limitations and procedures for use
		describe the ***procedures used to form flashing, roofing, sheeting and cladding***, and their associated components
		identify ***types of sealing and joining methods***
B-7.02.02L	demonstrate knowledge of safe work practices and procedures pertaining to forming flashing, roofing, sheeting and cladding	identify hazards and describe safe work practices and procedures associated with forming flashing, roofing, sheeting and cladding

RANGE OF VARIABLES

tools and equipment include: brakes, rolls, stakes

procedures used to form flashing, roofing, sheeting and cladding include: layout, determine seam, cut, form

types of sealing and joining methods include: caulking, soldering

TASK B-8 Fabricates specialty products

TASK DESCRIPTOR

This is the process of producing finished specialty products from designs. Specialty products may include kitchen equipment, medical facility products, food processing equipment, pharmaceutical laboratory products, decorative accessories, plastic and marine products.

B-8.01 Cuts material for specialty products

Essential Skills Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
B-8.01.01P	select and use ***tools and equipment***	***tools and equipment*** for cutting ***material*** is selected and used according to job requirements
B-8.01.02P	select ***material***	***material*** is selected according to drawings and specifications
B-8.01.03P	select fabrication methods	fabrication methods are selected according to drawings and specifications
B-8.01.04P	calculate and measure ***material***	***material*** is calculated according to ***considerations***
B-8.01.05P	shear and cut ***material***	***material*** is sheared and cut according to industry standards
B-8.01.06P	notch ***material***	***material*** is notched according to allowances
B-8.01.07P	mark braking lines and diagrams	braking lines and diagrams are marked according to allowances

RANGE OF VARIABLES

tools and equipment include: tape measures, snips, shears, grinders, abrasive cut-off saws, CNC machine (plasma/router)

material includes: plastic, polyvinyl chloride (PVC)-coated, stainless steel, copper, brass, black iron, aluminum, composites

considerations include: expansion, contraction, seam allowances, bend allowances

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-8.01.01L	demonstrate knowledge of specialty products and their applications	define terminology associated with specialty products
		identify ***tools and equipment*** used to fabricate specialty products and describe their applications, limitations and procedures for use
		identify ***types of specialty products*** and describe their applications
B-8.01.02L	demonstrate knowledge of industry standards pertaining to specialty products	identify industry standards pertaining to the fabrication of specialty products
B-8.01.03L	demonstrate knowledge of the procedures used to cut ***material*** for specialty products	identify cutting tools and equipment and describe their applications and procedures for use
B-8.01.04L	demonstrate knowledge of safe work practices and procedures pertaining to cutting ***material*** for specialty products	identify hazards and describe safe work practices and procedures associated with cutting ***material*** for specialty products
B-8.01.05L	demonstrate knowledge of calculations required to measure ***material*** for cutting	calculate and measure ***material*** to be cut
B-8.01.06L	demonstrate knowledge of ***materials*** and their properties, characteristics and applications	define terminology associated with metallurgy and associated ***materials***
		describe the properties of ***materials***
		describe identification systems for ***material***
B-8.01.07L	demonstrate knowledge of metallurgic principles	describe the effects metal working has on metallurgic properties
		identify practices that can create problems when working with metals and describe the procedures used to prevent or correct these problems

RANGE OF VARIABLES

tools and equipment include: tape measures, snips, shears, grinders, abrasive cut-off saws, CNC machine (plasma/router)

types of specialty products include: kitchen, medical, food processing, pharmaceutical, laboratory, decorative, underground ductwork, marine

material includes: plastic, polyvinyl chloride (PVC)-coated, stainless steel, copper, brass, black iron, aluminum, composites

B-8.02 Forms specialty products

Essential Skills	Numeracy, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-8.02.01P	select and use ***tools and equipment***	***tools and equipment*** for forming ***specific material*** are selected and used according to job requirements
B-8.02.02P	use ***specialized procedures*** for forming specialty products	***specialized procedures*** for forming specialty products are used according to industry standards
B-8.02.03P	plan and follow order of operations for forming materials	order of operations for forming materials is planned and followed
B-8.02.04P	bend or roll material according to forming lines and diagrams	material is bent or rolled according to forming lines and diagrams

RANGE OF VARIABLES

tools and equipment include: brakes, rolls, stakes, hammers, welders

specific material includes: plastic, PVC-coated, stainless steel, copper, brass, aluminum, black iron (hot rolled/cold rolled), composite

specialized procedures include: pre-heating material for bending, annealing to relieve stress

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.02.01L	demonstrate knowledge of the procedures used to form specialty products	define terminology associated with specialty products
		identify ***tools and equipment*** used to form specialty products and describe their applications, limitations and procedures for use
		identify ***types of specialty products*** and describe their applications
		identify ***types of materials used in forming specialty products*** and components, and describe their applications
		describe the ***procedures used to fabricate specialty products and their associated components***

B-8.02.02L	demonstrate knowledge of safe work practices and procedures pertaining to forming specialty products	identify hazards and describe safe work practices and procedures associated with forming specialty products
B-8.02.03L	demonstrate knowledge of drawing interpretation	interpret information pertaining to the forming of specialty products found on drawings and specifications
B-8.02.04L	demonstrate knowledge of ***considerations*** pertaining to forming specialty products	identify ***considerations*** pertaining to the forming of specialty products

RANGE OF VARIABLES

tools and equipment include: brakes, rolls, stakes, hammers, welders

types of specialty products include: kitchen, medical, food processing, pharmaceutical laboratory, decorative, marine, awnings, signage

types of materials used in forming specialty products include: ferrous, non-ferrous, plastics/PVC, composites

procedures used to fabricate specialty products and their associated components include: handling, designing, cutting, forming, assembling, joining, finishing

considerations include: manufacturers' specifications, environmental regulations, sanitation, AHJ, SMACNA, ASHRAE, NFPA

B-8.03 Assembles specialty products

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-8.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
B-8.03.02P	select and use ***fasteners***	***fasteners*** are selected and used according to material and specifications
B-8.03.03P	assemble product components	product components are assembled according to drawings and specifications
B-8.03.04P	select and use ***welding processes*** and equipment	***welding processes*** and equipment are selected according to job requirements and specifications

RANGE OF VARIABLES

tools and equipment include: welding equipment, soldering irons, drills
fasteners include: rivets, screws, nuts and bolts
welding processes include: GMAW, SMAW, GTAW, oxy-fuel, brazing, solder, plastic welding

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-8.03.01L	demonstrate knowledge of the procedures used to assemble specialty products	identify ***tools and equipment*** used to assemble specialty products, and describe their applications, limitations and procedures for use
		identify types of materials used to assemble specialty products, and describe their characteristics and applications
		interpret information pertaining to the assembly of specialty products, found on drawings and specifications
B-8.03.02L	demonstrate knowledge of safe work practices and procedures pertaining to the assembly of specialty products	identify hazards and describe safe work practices and procedures associated with assembling specialty products
B-8.03.03L	demonstrate knowledge of ***considerations*** pertaining to the assembly of specialty products	identify ***considerations*** pertaining to the assembly of specialty products

RANGE OF VARIABLES

tools and equipment include: welding equipment, soldering irons, drills
considerations include: manufacturers' specifications, environmental regulations, sanitation, AHJ, SMACNA, ASHRAE, NFPA

B-8.04 Finishes specialty products

Essential Skills	Continuous Learning, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
B-8.04.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
B-8.04.02P	finish product using ***surface finishing methods***	product is finished using ***surface finishing methods*** to achieve surface finish according to specifications and job requirements
B-8.04.03P	identify and correct deficiencies in ***surface finishing methods***	deficiencies in ***surface finishing methods*** are identified and corrected

RANGE OF VARIABLES

tools and equipment include: buffers, grinders, files, chemical compounds
surface finishing methods include: grinding, filing, buffing, chemical compounds, sealants

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.04.01L	demonstrate knowledge of the procedures used to finish specialty products	identify ***tools and equipment*** used to finish specialty products and describe their applications, limitations and procedures for use
		identify ***types of materials*** used to finish specialty products, and describe their characteristics and applications
		identify types of surface finishing products and describe their characteristics and applications
B-8.04.02L	demonstrate knowledge of the procedures used to interpret and extract information from drawings	interpret and extract information from drawings and specifications
B-8.04.03L	demonstrate knowledge of safe work practices and procedures pertaining to finishing specialty products	identify hazards and describe safe work practices and procedures associated with forming specialty products

B-8.04.04L	demonstrate knowledge of inspection procedures	describe the procedures used to inspect finished specialty products and recognize deficiencies
B-8.04.05L	demonstrate knowledge of ***considerations*** pertaining to finishing specialty products	identify ***considerations*** pertaining to the finishing of specialty products

RANGE OF VARIABLES

tools and equipment include: buffers, grinders, files, chemical compounds

types of materials include: ferrous, non-ferrous, PVC, composites

considerations include: manufacturers' specifications, job specifications, environmental regulations, sanitation, AHJ

MAJOR WORK ACTIVITY C

Installs air and material handling systems

TASK C-9 Prepares installation site

TASK DESCRIPTOR

Sheet metal workers need to confirm field measurements and prepare the site prior to installation of air and material handling systems to ensure safe, smooth and efficient installation.

C-9.01 Performs on-site measurements

Essential Skills Numeracy, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
C-9.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements and manufacturers' specifications
C-9.01.02P	measure and verify work area dimensions	work area dimensions are measured, verified on-site and compared to drawings and specifications for discrepancies
C-9.01.03P	identify obstructions and problems	obstructions and problems to be resolved are identified
C-9.01.04P	identify penetrations and sleeve locations	penetrations and sleeve locations for duct fittings are identified according to drawings
C-9.01.05P	verify location and size of penetrations and sleeves	location and size of penetrations and sleeves are verified on-site according to drawings and job specifications
C-9.01.06P	mark penetrations	penetrations are marked according to drawings and specifications
C-9.01.07P	determine position of hangers, braces and brackets	position of hangers, braces and brackets are determined according to regulations and job specifications

RANGE OF VARIABLES

tools and equipment include: laser levels, tape measures, scale rulers, ductulators

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-9.01.01L	demonstrate knowledge of the procedure to perform on-site measurements and the associated ***tools and equipment***	identify, select and use measuring ***tools and equipment*** and describe their application, limitations and procedures for use
		identify types of obstructions that could prevent installation
C-9.01.02L	demonstrate knowledge of calculations required to measure a work area	calculate orientation, alignment and projections
C-9.01.03L	demonstrate knowledge of drawing interpretation	interpret drawings and identify specifications for positioning of air and material handling systems
		verify duct design to achieve airflow capacity
C-9.01.04L	demonstrate knowledge of ***trade standards*** and specifications pertaining to installation of hangers, braces and brackets	identify ***trade standards*** and specifications related to the installation of hangers, braces and brackets

RANGE OF VARIABLES

tools and equipment include: laser levels, tape measures, scale rulers, ductulators

trade standards include: SMACNA, ASHRAE, AHJ, NFPA, CSA, NBC, Underwriters Laboratories of Canada (ULC), Health Canada

C-9.02 Performs demolitions for renovations

Essential Skills	Oral Communication, Thinking, Working with Others

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	no	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
C-9.02.01P	prepare removal plan for material and equipment	removal plan for material and equipment is prepared considering ***factors*** and according to job requirements, site conditions and sequence
C-9.02.02P	identify materials and equipment to be removed	materials and equipment to be removed are identified according to plans and demolition drawings

C-9.02.03P	arrange for containment of demolition area	demolition area is contained according to site conditions, potential hazards and regulations
C-9.02.04P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to removal plan
C-9.02.05P	place barricades	barricades are placed to isolate demolition site according to job and safety requirements
C-9.02.06P	dismantle and remove materials and equipment	materials and equipment are dismantled and removed according to removal plan and regulations
C-9.02.07P	recycle or dispose of waste materials and equipment	waste materials and equipment are recycled or disposed of according to job and safety requirements, and jurisdictional regulations

RANGE OF VARIABLES

factors include: containment of particles, hazardous materials, noise levels, biohazards, radiation
tools and equipment include: grinders, hammers, saws, hoisting equipment, drills, specialized PPE

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-9.02.01L	demonstrate knowledge of dismantling materials and equipment and the associated ***tools and equipment***	describe the process to plan the removal of material
		describe demolition methods and procedures
		identify, select and use ***tools and equipment*** and describe their application, limitations and procedures for use
		describe process and factors for sorting material to be removed
		identify waste materials and equipment which can be reused or recycled
C-9.02.02L	demonstrate knowledge of safe work practices and procedures related to the dismantling and removal of materials and equipment	identify hazards and describe safe work practices and procedures when dismantling materials and equipment
		list factors to consider when analyzing the integrity of waste materials and equipment
C-9.02.03L	demonstrate knowledge of regulations and specifications pertaining to the disposal of waste materials	identify waste disposal regulations and specifications

RANGE OF VARIABLES

tools and equipment include: grinders, hammers, saws, hoisting equipment, drills, specialized PPE

C-9.03 Installs penetrations and sleeves

Essential Skills	Thinking, Working with Others, Oral Communication

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-9.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to material to be cut
C-9.03.02P	measure penetrations	penetrations are measured to ensure accuracy
C-9.03.03P	identify ***obstructions and hidden hazards*** in surrounding area	***obstructions and hidden hazards*** in surrounding area are identified for safety and architectural reasons
C-9.03.04P	isolate cutting area	cutting area is isolated before beginning to cut to prevent damage to equipment, property and injury to people
C-9.03.05P	coordinate installation with other trades	work is coordinated with other trades
C-9.03.06P	perform cut	cut is performed according to markings, drawings and job specifications
C-9.03.07P	install sleeves	sleeves are installed according to drawings and job specifications

RANGE OF VARIABLES

tools and equipment include: hole saws, snips, reciprocating saws, grinders, power tools

obstructions and hidden hazards include: electrical, structural members, plumbing, hazardous materials (asbestos)

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-9.03.01L	demonstrate knowledge of procedures used to cut penetrations and their associated ***tools and equipment***	identify ***tools and equipment*** and describe their application, limitations and procedures for use
		describe cutting methods using manual and mechanical processes
		describe the procedures of cutting material of various thicknesses
C-9.03.02L	demonstrate knowledge of procedures used to install sleeves	identify codes and regulations pertaining to sleeves
		describe installation procedures

RANGE OF VARIABLES

tools and equipment include: hole saws, snips, reciprocating saws, grinders, power tools

C-9.04 Installs supports and bases

Essential Skills Document Use, Thinking, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-9.04.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-9.04.02P	verify drawings and specifications of equipment	drawings and specifications of equipment to be installed are verified according to manufacturers' and job specifications
C-9.04.03P	determine anchor positions	anchor positions are determined according to drawings and manufacturers' and job specifications
C-9.04.04P	select and use anchors and ***fasteners***	anchors and ***fasteners*** to support load are selected and used according to manufacturers' and job specifications
C-9.04.05P	install isolators	isolators are installed to isolate system from vibration according to manufacturers' and job specifications
C-9.04.06P	install ***supports and bases***	***supports and bases*** are installed according to manufacturers' and job specifications
C-9.04.07P	install seismic restraints	seismic restraints are installed, as required, according to specifications and ***trade standards***

RANGE OF VARIABLES

tools and equipment include: hammer drills, drills, welding equipment, hand tools, hoisting, rigging and positioning equipment, powder-actuated

fasteners include: screws, inserts, rivets, glue, welds, anchors

supports and bases include: gussets, riser clamps, inertia bases, housekeeping pads, equipment rails

trade standards include: SMACNA, CWB, NBC, AHJ, NFPA

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-9.04.01L	demonstrate knowledge of procedures used to install supports and bases and associated ***tools and equipment***	identify and describe ***tools and equipment***, their application, limitations and procedures for use
		describe the procedures used to install supports and bases
C-9.04.02L	demonstrate knowledge of drawing interpretation	interpret drawing to determine the positioning of equipment and anchors
C-9.04.03L	demonstrate knowledge of ***trade standards*** and regulations pertaining to supports and bases	identify ***trade standards*** pertaining to supports and bases
		identify codes and standards related to seismic restraints

RANGE OF VARIABLES

tools and equipment include: hammer drills, drills, welding equipment, hand tools, hoisting, rigging and positioning equipment, powder-actuated

trade standards include: SMACNA, CWB, NBC, AHJ, NFPA

C-9.05 Installs hangers, cables, braces and brackets

Essential Skills Thinking, Reading, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
C-9.05.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-9.05.02P	verify drawings and specifications	drawings and specifications of equipment to be installed are verified
C-9.05.03P	determine anchor positions	anchor positions are determined according to drawings and job specifications
C-9.05.04P	select ***materials***	***materials*** to be used are selected according to job requirements and regulations
C-9.05.05P	measure and cut ***material***	***material*** to fabricate hangers, cables, braces and brackets is measured and cut according to job requirements

C-9.05.06P	secure anchors and fasteners	anchors and fasteners to support load are secured according to manufacturers' specifications
C-9.05.07P	install seismic restraints	seismic restraints are installed according to manufacturers' specifications and ***trade standards***

RANGE OF VARIABLES

tools and equipment include: hammer drills, chop saws, grinders, hand tools, measuring tools, welding equipment, hoisting, rigging and positioning equipment

materials include: anchors, braces, cables and locks, brackets, inserts, epoxy, structural shapes, threaded rod

trade standards include: SMACNA, CWB, NBC, AHJ, NFPA

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-9.05.01L	demonstrate knowledge of the procedures used to install ***materials*** and associated ***tools and equipment***	identify and describe ***tools and equipment***, their application, limitations and procedures for use
		describe the procedure used to install ***materials***
C-9.05.02L	demonstrate knowledge of drawing interpretation	interpret drawing to determine the positioning of equipment and anchors
C-9.05.03L	demonstrate knowledge of ***trade standards*** and specifications pertaining to hangers, cables, braces and brackets	identify ***trade standards*** related to hangers, cables, braces and brackets
		identify codes and standards related to seismic restraints

RANGE OF VARIABLES

materials include: anchors, braces, cables and locks, brackets, inserts, epoxy, structural shapes, threaded rod

tools and equipment include: hammer drills, chop saws, grinders, hand tools, measuring tools, welding equipment, hoisting, rigging and positioning equipment

trade standards include: SMACNA, CWB, NBC, AHJ, NFPA

TASK C-10 Installs and connects chimneys, breeching and venting to exhaust appliances and mechanical equipment

TASK DESCRIPTOR

Chimneys are the vertical section used to vent gases, smoke and other products of combustion to the atmosphere. Breeching is the section of venting that connects one or more appliances or mechanical equipment to the chimney. Proper installation methods are important to ensure indoor and outdoor air quality and safety. Additional certification may be required by some jurisdictions to install products.

C-10.01 Installs chimney

Essential Skills Document Use, Numeracy, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
C-10.01.01P	select and size chimney systems	chimney systems are selected and sized according to jurisdictional regulations, ***codes*** and manufacturers' specifications
C-10.01.02P	plan location of chimney	location of chimney is planned to minimize interference and conflicts while ensuring the most direct path according to jurisdictional regulations, ***codes***, drawings, and job and manufacturers' specifications
C-10.01.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-10.01.04P	assemble and fasten sections	sections are assembled and fastened according to manufacturers' specifications
C-10.01.05P	flash and seal roof penetration	roof penetration is flashed and sealed to weatherproof according to job specifications
C-10.01.06P	install clean-out	clean-out at base of chimney is installed for removal of debris
C-10.01.07P	seal chimney	chimney is sealed according to manufacturers' specifications

RANGE OF VARIABLES

codes include: B149, B139, NBC

tools and equipment include: drills, saws, levels, caulking guns, hand tools, measuring tools

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-10.01.01L	demonstrate knowledge of installation procedures for chimneys and the associated ***tools and equipment***	define terminology associated with chimneys
		identify ***tools and equipment*** relating to the installation of chimneys and describe their applications and procedures for use
		identify ***types of chimney systems and their components***, and describe their applications
		describe the procedures used to install chimneys
		identify flashing requirements pertaining to chimneys
		describe the procedures used to connect chimneys to the appliance
C-10.01.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to the installation of chimneys found on drawings, and job and manufacturers' specifications
C-10.01.03L	demonstrate knowledge of regulatory requirements pertaining to the installation of chimneys	identify ***codes*** and standards related to the installation of chimneys
		describe and perform ***calculations related to the installation and sizing***
C-10.01.04L	demonstrate knowledge of safe work practices and procedures related to the installation of chimneys	identify hazards and describe safe work practices and procedures pertaining to the installation of chimneys

RANGE OF VARIABLES

tools and equipment include: drills, saws, levels, caulking guns, hand tools, measuring tools
types of chimney systems include: B-vent, BW-vent, A-vent, special venting systems, combustion air
codes include: B149, B139, NBC
calculations related to the installation and sizing include: combustion air, vent calculations, run, rise, equivalent length, equipment requirements

C-10.02 Connects appliances or mechanical equipment to chimney and breeching

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-10.02.01P	select appliance and mechanical equipment	appliance and mechanical equipment to connect to chimney are selected according to manufacturers' specifications
C-10.02.02P	select venting materials	venting materials are selected according to manufacturers' specifications
C-10.02.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-10.02.04P	plan location of breeching for appliance or mechanical equipment	location of breeching for appliance or mechanical equipment is planned according to manufacturers' specifications, jurisdictional regulations and ***codes***
C-10.02.05P	select breeching components, size, thickness and material	breeching components, size, thickness and material are selected according to ***codes*** and jurisdictional regulations
C-10.02.06P	assemble and fasten breeching	breeching is assembled and fastened according to ***codes*** and jurisdictional regulations
C-10.02.07P	fasten breeching to appliance	breeching is fastened to appliance according to manufacturers' specifications
C-10.02.08P	fasten breeching to chimney	breeching is fastened to chimney according to manufacturers' specifications
C-10.02.09P	sequence appliance or mechanical equipment connection	appliance or mechanical equipment connection is sequenced to breeching according to ***codes*** and jurisdictional regulations
C-10.02.10P	seal breeching	breeching is sealed to appliances and mechanical equipment according to specifications, ***codes*** and local authorities

RANGE OF VARIABLES

tools and equipment include: snips, drills, levels, tape measures, caulking guns, hammers, hoisting, rigging and positioning equipment, welding equipment, access equipment
codes include: B149, B139

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-10.02.01L	demonstrate knowledge of installation procedures for connecting appliances and mechanical equipment to chimneys and breeching and the associated ***tools and equipment***	define terminology associated with appliances and mechanical equipment
		identify ***tools and equipment*** relating to connecting appliances and mechanical equipment and describe their applications and procedures for use
		identify types of appliances and mechanical equipment, and describe their applications
		describe the procedures used to connect appliances and mechanical equipment to chimneys and breeching
		identify types of breeching and describe their applications
		describe the procedures used to install breeching
C-10.02.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to connecting appliances and mechanical equipment to chimneys and breeching found on drawings and specifications
C-10.02.03L	demonstrate knowledge of regulatory requirements pertaining to connecting appliances and mechanical equipment to chimneys and breeching	identify ***codes*** and ***trade standards*** related to connecting appliances and mechanical equipment to chimneys and breeching
C-10.02.04L	demonstrate knowledge of safe work practices and procedures related to connecting appliance and mechanical equipment to chimneys and breeching	identify hazards and describe safe work practices and procedures pertaining to connecting appliance and mechanical equipment to chimneys and breeching

RANGE OF VARIABLES

tools and equipment include: snips, drills, levels, tape measures, caulking guns, hammers, hoisting, rigging and positioning equipment, welding equipment, access equipment

codes include: B149, B139

trade standards include: CWB, AHJ, Wood Energy Transfer Technology (WETT)

C-10.03 Installs high efficiency appliances and mechanical equipment

Essential Skills	Numeracy, Thinking, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-10.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-10.03.02P	plan location of venting	location of venting is planned to minimize offsets while maintaining grade according to manufacturers' specifications and jurisdictional regulations
C-10.03.03P	select venting size and material	venting size and material is selected according to current applicable ***codes***, jurisdictional regulations and manufacturers' specifications
C-10.03.04P	assemble and fasten ***sections***	***sections*** are assembled and fastened according to current applicable ***codes***, jurisdictional regulations and manufacturers' specifications
C-10.03.05P	connect high efficiency appliances and mechanical equipment	high efficiency appliances and mechanical equipment are connected to the venting according to current applicable ***codes***, jurisdictional regulations and manufacturers' specifications
C-10.03.06P	install exterior vent termination	exterior vent termination is installed according to current applicable ***codes***, jurisdictional regulations and manufacturers' specifications
C-10.03.07P	seal and weatherproof exterior vent termination	exterior vent termination is sealed and weatherproofed according to current applicable ***codes***, jurisdictional regulations and manufacturers' specifications

RANGE OF VARIABLES

tools and equipment include: drills, saws, levels, caulking guns, cutters
codes include: B149, B139
sections include: pipe, elbows (45°, 90°), fittings, termination kits, couplings

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-10.03.01L	demonstrate knowledge of installation procedures for high efficiency appliances and mechanical equipment and the associated ***tools and equipment***	define terminology associated with high efficiency appliances and mechanical equipment
		identify ***tools and equipment*** used for installing high efficiency appliances and mechanical equipment and describe their applications and procedures for use
		identify types of high efficiency appliances and mechanical equipment, and describe their applications
C-10.03.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing high efficiency appliances and mechanical equipment found on drawings and specifications
C-10.03.03L	demonstrate knowledge of regulatory requirements pertaining to installing high efficiency appliances and mechanical equipment	identify ***codes*** related to installing high efficiency appliances and mechanical equipment
C-10.03.04L	demonstrate knowledge of safe work practices and procedures related to connecting high efficiency appliances and mechanical equipment to breeching	identify hazards and describe safe work practices and procedures pertaining to connecting high efficiency appliances or mechanical equipment to breeching

RANGE OF VARIABLES

tools and equipment include: drills, saws, levels, caulking guns, cutters
codes include: B149, B139

TASK C-11 Installs air handling system components

TASK DESCRIPTOR

Sheet metal workers install air handling systems to ensure comfort, air quality and efficiency. There are many components manufactured to be installed in air handling systems. They can be used for climate control, humidity control, indoor air quality, security, noise attenuation and fire prevention.

C-11.01 Installs air handling equipment

Essential Skills	Working with Others, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
C-11.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-11.01.02P	assemble air handling equipment components	air handling equipment components are assembled according to manufacturers' specifications
C-11.01.03P	place and secure air handling equipment	air handling equipment is placed and secured to base/structure according to manufacturers' and job specifications, and drawings
C-11.01.04P	install flexible connections	flexible connections are installed according to job and manufacturers' specifications
C-11.01.05P	remove shipping brackets	shipping brackets are removed prior to unit start-up
C-11.01.06P	verify tightness and alignment of pulleys and belts, and direction of fan rotation	tightness and alignment of pulleys and belts, and direction of fan rotation are verified according to manufacturers' specifications
C-11.01.07P	attach condensate drain	condensate drain is attached according to manufacturers' specifications

RANGE OF VARIABLES

tools and equipment include: See Appendix B

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-11.01.01L	demonstrate knowledge of installation procedures for air handling equipment and the associated ***tools and equipment***	define terminology associated with air handling equipment
		identify ***tools and equipment*** used for installing air handling equipment and describe their application and procedures for use
		identify ***types of air handling equipment*** and describe their applications
		describe the ***procedures used to prepare for installation of air handling equipment***
		identify ***considerations and requirements for installing air handling equipment***
		describe the procedures used to install air handling equipment
C-11.01.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing air handling equipment found on drawings and specifications
C-11.01.03L	demonstrate knowledge of safe work practices and procedures related to installing air handling equipment	identify hazards and describe safe work practices and procedures pertaining to installing air handling equipment
		identify hazards and describe safe work practices pertaining to working on or around electrical equipment and sources
		identify hazards and describe safe work practices pertaining to air quality management
C-11.01.04L	demonstrate knowledge of the basic concepts of electricity	define terminology associated with electricity
		explain the basic principles of electricity
		identify ***electrical devices*** and describe their purpose
C-11.01.05L	demonstrate knowledge of air quality management	define terminology associated with air quality management
		identify ***considerations and requirements associated with air quality management***
		identify ***areas requiring special air quality ventilation***
		identify ***methods of improving or correcting problems with air quality***

		identify the methods used to determine air quality relating to humidity and temperature
		identify ***air quality problems*** and describe the procedures used to prevent or correct them
		describe the impact improper system or component installation can have on air quality
		explain the importance of indoor air quality
C-11.01.06L	demonstrate knowledge of regulatory requirements	identify codes and ***trade standards*** pertaining to air quality management
		identify codes and ***trade standards*** pertaining to air handling equipment

RANGE OF VARIABLES

tools and equipment include: See Appendix B

types of air handling equipment includes: heat recovery ventilator (HRV), ERV, air handlers, make-up air unit (MUA), roof top unit (RTU), unit heaters, air curtains, fans, furnaces, fan coils

procedures used to prepare for installation of air handling equipment include: determining equipment requirements, determining penetration locations, performing site measurements, demolishing and removing existing systems and components, performing on-site coordination, staging (storing material), planning, distributing (material to installation area), sectioning (pre-assembling on-site), erecting, performing final inspection (completing)

considerations and requirements for installing air handling equipment include: manufacturers' specifications, isolators, building materials, environmental conditions, field design modifications, LEED requirements, indoor air quality, seismic requirements

electrical devices include: circuit breakers, disconnects, overload heaters, ground fault interrupters (GFI), fuses, programmable logic controllers (PLC), motors, capacitors

considerations and requirements associated with air quality management include: environmental conditions, intake locations, exhaust locations

areas requiring special air quality ventilation include: clean/sterile rooms, industrial/commercial settings

methods of improving or correcting problems with air quality include: heating/cooling, ventilation, conditioning (filtration, sterilization, purification, humidification/dehumidification), noise attenuation

air quality problems include: contamination, humidity, temperature (hot/cold zones), air motion

trade standards include: SMACNA, ASHRAE, ANSI, NBC, NFPA, CSA, ULC, AHJ

C-11.02 Installs sheet metal ducts and fittings

Essential Skills Thinking, Document Use, Working with Others

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-11.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-11.02.02P	select and lay out fittings and components	fittings and components are selected and laid out according to drawings and sequence to be installed
C-11.02.03P	connect and seal joints	joints are connected and sealed to ensure integrity according to job specifications and ***trade standards***
C-11.02.04P	secure ducts	ducts are secured to support system according to job specifications and ***trade standards***
C-11.02.05P	align ductwork with building lines	ductwork is aligned with building lines to ensure uniformity and aesthetics, and according to job specifications

RANGE OF VARIABLES

tools and equipment include: see Appendix B
trade standards include: SMACNA, ASHRAE, ANSI, NBC, NFPA, CSA, ULC, AHJ

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.02.01L	demonstrate knowledge of installation procedures for sheet metal ducts and fittings and the associated ***tools and equipment***	define terminology associated with sheet metal ducts and fittings
		identify ***tools and equipment*** used for installing sheet metal ducts and fittings, and describe their application and procedures for use
		describe the procedures used to install sheet metal ducts and fittings
C-11.02.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing sheet metal ducts and fittings found on drawings and specifications

C-11.02.03L	demonstrate knowledge of safe work practices and procedures related to installing sheet metal ducts and fittings	identify hazards and describe safe work practices and procedures pertaining to installing sheet metal ducts and fittings
C-11.02.04L	demonstrate knowledge of regulatory requirements pertaining to the installation of sheet metal ducts and fittings	identify codes and ***trade standards*** related to the installation of sheet metal ducts and fittings

RANGE OF VARIABLES

tools and equipment include: see Appendix B
trade standards include: SMACNA, ASHRAE, ANSI, NBC, NFPA, CSA, ULC, AHJ

C-11.03 Installs dampers

Essential Skills Document Use, Thinking, Working with Others

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-11.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-11.03.02P	select ***dampers***	***dampers*** are selected according to size, use and job specifications
C-11.03.03P	determine ***damper*** positions and access	***damper*** positions and access are determined according to air direction, shaft access, duct orientation, environmental conditions and job specifications
C-11.03.04P	prepare ductwork	ductwork is prepared using ***processes*** to receive ***dampers***
C-11.03.05P	prepare sectional ***dampers***	sectional ***dampers*** are prepared using ***methods*** to allow blades to move in unison and according to manufacturers' specifications
C-11.03.06P	measure ***dampers***	***dampers*** are measured to verify that they are true
C-11.03.07P	secure ***dampers*** and control mechanisms	***dampers*** and control mechanisms are secured using ***fasteners*** according to manufacturers' specifications
C-11.03.08P	mark or slot shafts	shafts are marked or slotted to identify blade direction

C-11.03.09P	cycle ***dampers***	***dampers*** are cycled to ensure free movement of parts
C-11.03.10P	set ***dampers***	***dampers*** are set according to job specifications

RANGE OF VARIABLES

tools and equipment include: see Appendix B

dampers include: iris, balancing, control, motorized, shutoff, smoke, explosion-proof

processes include: installing retaining brackets, slotting ductwork, sleeving dampers

methods include: bolting sections together, adding stiffeners to damper frames, adding brackets to damper blades, connecting brackets to linkages, installing motors

fasteners include: screws, rivets, bolts, welds

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-11.03.01L	demonstrate knowledge of installation procedures for dampers and the associated ***tools and equipment***	define terminology associated with ***dampers***
		identify ***tools and equipment*** used for installing ***dampers*** and describe their application and procedures for use
		describe the procedures used to install ***dampers***
		describe purposes for installation of ***dampers***
C-11.03.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing ***dampers*** found on drawings and specifications
C-11.03.03L	demonstrate knowledge of safe work practices and procedures related to installing ***dampers***	identify hazards and describe safe work practices and procedures pertaining to installing ***dampers***
		identify hazards and describe safe work practices and procedures pertaining to working on or around electrical equipment and sources
C-11.03.04L	demonstrate knowledge of regulatory requirements pertaining to the installation of ***dampers***	identify codes and ***trade standards*** related to the installation of ***dampers***

RANGE OF VARIABLES

tools and equipment include: see Appendix B

dampers include: iris, balancing, control, motorized, shutoff, smoke, explosion-proof

trade standards include: SMACNA, ASHRAE, ANSI, NBC, NFPA, CSA, ULC, AHJ

C-11.04 Installs fire and fire/smoke dampers

Essential Skills Thinking, Working with Others, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-11.04.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-11.04.02P	select fire and fire/smoke dampers	fire and fire/smoke dampers with fusible links are selected according to size, duct orientation, application and job specifications
C-11.04.03P	select and prepare sleeves	sleeves are selected and prepared according to requirements for installation of fire and fire/smoke dampers, codes, jurisdictional regulations and manufacturers' specifications
C-11.04.04P	measure fire and fire/smoke dampers	fire and fire/smoke dampers are verified to be true
C-11.04.05P	prepare sectional fire and fire/smoke dampers	sectional fire and fire/smoke dampers are prepared by bolting sections together and adding stiffeners to the fire and fire/smoke damper frames, according to manufacturers' specifications
C-11.04.06P	secure fire and fire/smoke dampers	fire and fire/smoke dampers are secured using fasteners and retaining angles according to codes, jurisdictional regulations and manufacturers' specifications
C-11.04.07P	test fire and fire/smoke dampers	fire and fire/smoke dampers are tested to ensure free movement of parts according to job specifications
C-11.04.08P	install access door on ductwork	access door on ductwork is installed for easy access to perform tests and visual inspections and to reset fire and fire/smoke dampers
C-11.04.09P	install breakaway joints	breakaway joints are installed according to jurisdictional regulations, codes and manufacturers' specifications
C-11.04.10P	seal fire and fire/smoke dampers	fire and fire/smoke dampers are sealed at the retaining angles to maintain fire separation according to jurisdictional regulations and manufacturers' specifications

RANGE OF VARIABLES

tools and equipment include: See Appendix B

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-11.04.01L	demonstrate knowledge of installation procedures for fire and fire/smoke dampers and the associated ***tools and equipment***	define terminology associated with fire and fire/smoke dampers
		identify ***tools and equipment*** used for installing fire and fire/smoke dampers and describe their application and procedures for use
		describe the procedures used to install fire and fire/smoke dampers
C-11.04.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing fire and fire/smoke dampers found on drawings and specifications
C-11.04.03L	demonstrate knowledge of safe work practices and procedures related to installing fire and fire/smoke dampers	identify hazards and describe safe work practices and procedures pertaining to installing fire and fire/smoke dampers
		identify hazards and describe safe work practices and procedures pertaining to working on or around electrical equipment and sources
C-11.04.04L	demonstrate knowledge of regulatory requirements pertaining to the installation of fire and fire/smoke dampers	identify codes and ***trade standards*** related to the installation of fire and fire/smoke dampers

RANGE OF VARIABLES

tools and equipment include: See Appendix B

trade standards include: SMACNA, ASHRAE, ANSI, NBC, NFPA, CSA, ULC, AHJ

C-11.05 Installs registers, grilles, diffusers and louvers

Essential Skills Document Use, Thinking, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-11.05.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-11.05.02P	select registers, grilles, diffusers and louvers	registers, grilles, diffusers and louvers are selected according to drawings and job specifications
C-11.05.03P	connect registers, grilles, diffusers and louvers to ductwork	registers, grilles, diffusers and louvers are connected to ductwork using flex and rigid connections, placing in ceiling grid/wall/floor, and taking directional considerations into account
C-11.05.04P	align registers, grilles, diffusers and louvers	registers, grilles, diffusers and louvers are aligned for aesthetic reasons
C-11.05.05P	assemble registers, grilles, diffusers, louvers and their components	registers, grilles, diffusers, louvers and their components are assembled according to manufacturers' specifications
C-11.05.06P	install access doors	access doors are installed according to jurisdictional regulations and job specifications
C-11.05.07P	seal grilles, diffusers and louvers	grilles, diffusers and louvers are sealed according to job requirements

RANGE OF VARIABLES

tools and equipment include: see Appendix B

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.05.01L	demonstrate knowledge of installation procedures for registers, grilles, diffusers and louvers, and the associated ***tools and equipment***	define terminology associated with registers, grilles, diffusers and louvers
		identify ***tools and equipment*** used for installing registers, grilles, diffusers and louvers, and describe their application and procedures for use
		describe the procedures used to install registers, grilles, diffusers and louvers

C-11.05.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing registers, grilles, diffusers and louvers found on drawings and specifications
C-11.05.03L	demonstrate knowledge of safe work practices and procedures related to installing registers, grilles, diffusers and louvers	identify hazards and describe safe work practices and procedures pertaining to installing registers, grilles, diffusers and louvers
C-11.05.04L	demonstrate knowledge of regulatory requirements pertaining to the installation of registers, grilles, diffusers and louvers	identify codes and ***trade standards*** related to the installation of registers, grilles, diffusers and louvers

RANGE OF VARIABLES

tools and equipment include: see Appendix B
trade standards include: SMACNA, ASHRAE, ANSI, NBC, NFPA, CSA, ULC, AHJ

C-11.06 Installs terminal boxes

Essential Skills Document Use, Numeracy, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-11.06.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-11.06.02P	determine terminal box position	terminal box position is determined according to airflow direction marked on box, and access to connections and shafts
C-11.06.03P	install access doors on ductwork	access doors on ductwork are installed for testing and cleaning purposes according to drawings, and job and manufacturers' specifications
C-11.06.04P	secure and seal terminal boxes	terminal boxes are secured and sealed to ductwork, plenums or units using ***mechanical fasteners***
C-11.06.05P	determine duct inlet straight length requirements	duct inlet straight length requirements are determined prior to connection to main ductwork for optimal operation according to job and manufacturers' specifications

RANGE OF VARIABLES

tools and equipment include: hand tools, portable power tools
mechanical fasteners include: S-cleats, drive cleats, screws

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-11.06.01L	demonstrate knowledge of installation procedures for terminal boxes and the associated ***tools and equipment***	define terminology associated with terminal boxes
		identify ***tools and equipment*** used for installing terminal boxes, and describe their application and procedures for use
		describe the procedures used to install terminal boxes
C-11.06.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing terminal boxes found on drawings and specifications
C-11.06.03L	demonstrate knowledge of safe work practices and procedures related to installing terminal boxes	identify hazards and describe safe work practices and procedures pertaining to installing terminal boxes
C-11.06.04L	demonstrate knowledge of regulatory requirements pertaining to the installation of terminal boxes	identify codes and ***trade standards*** related to the installation of terminal boxes

RANGE OF VARIABLES

tools and equipment include: hand tools, portable power tools
trade standards include: SMACNA, ASHRAE, ANSI, NBC, CSA, ULC, AHJ

C-11.07 Installs coils

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
C-11.07.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-11.07.02P	verify coil sizing	sizing is verified according to load

C-11.07.03P	determine coil position	coil position is determined according to airflow direction marked on coil, access to connections and for easy removal and service, and drawings and job requirements
C-11.07.04P	install access doors on ductwork	access doors on ductwork are installed for testing and cleaning purposes according to drawings, and job and manufacturers' specifications
C-11.07.05P	place, secure and seal coils	coils are placed, secured and sealed to ductwork, plenums and units by installing channels, drain pans and blanking using ***mechanical fasteners***

RANGE OF VARIABLES

tools and equipment include: hand tools, portable power tools
mechanical fasteners include: S-cleats, drive cleats, screws, bolts

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-11.07.01L	demonstrate knowledge of installation procedures for coils and the associated ***tools and equipment***	define terminology associated with coils
		identify ***tools and equipment*** used for installing coils, and describe their applications and procedures for use
		describe the procedures used to install coils
C-11.07.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing coils found on drawings and specifications
C-11.07.03L	demonstrate knowledge of safe work practices and procedures related to installing coils	identify hazards and describe safe work practices and procedures pertaining to installing coils
		identify hazards and describe safe work practices and procedures pertaining to air quality management

RANGE OF VARIABLES

tools and equipment include: hand tools, portable power tools

C-11.08 Installs system component accessories

Essential Skills	Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-11.08.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-11.08.02P	determine installation requirements for ***component accessories***	installation requirements for ***component accessories*** are determined according to drawings and job and manufacturers' specifications
C-11.08.03P	determine location of ***component accessories***	location of ***component accessories*** is determined according to accessibility, and job and manufacturers' specifications
C-11.08.04P	secure ***component accessories***	***component accessories*** are secured using mechanical fasteners according to job requirements and manufacturers' specifications

RANGE OF VARIABLES

tools and equipment include: hand tools, portable power tools

component accessories include: air balancing test ports, burglar bars, humidifiers, dehumidifiers, spark arrestors, air, noise and odour filtration systems, access doors, airflow sensors, temperature sensors, controls

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.08.01L	demonstrate knowledge of installation procedures for system ***component accessories***, and the associated ***tools and equipment***	define terminology associated with system ***component accessories***
		identify ***tools and equipment*** used for installing system ***component accessories***, and describe their applications and procedures for use
		describe the procedures used to install system ***component accessories***
C-11.08.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing system ***component accessories*** found on drawings and specifications

C-11.08.03L	demonstrate knowledge of safe work practices and procedures related to installing system ***component accessories***	identify hazards and describe safe work practices and procedures pertaining to installing system ***component accessories***
		identify hazards and describe safe work practices and procedures pertaining to air quality management
		identify hazards and describe safe work practices and procedures pertaining to working on or around electrical equipment and sources

RANGE OF VARIABLES

component accessories include: air balancing test ports, burglar bars, humidifiers, dehumidifiers, spark arrestors, air, noise and odour filtration systems, access doors, airflow sensors, temperature sensors, controls

tools and equipment include: hand tools, portable power tools

C-11.09 Installs plenums

Essential Skills Thinking, Document Use, Working with Others

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-11.09.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-11.09.02P	select and lay out plenums and ***components***	plenums and ***components*** are selected and laid out according to drawings and installation sequence
C-11.09.03P	assemble plenums and ***components***	plenums and ***components*** are assembled according to labelling, tagging and drawings
C-11.09.04P	connect and seal joints	joints are connected and sealed to ensure integrity according to job specifications and ***trade standards***
C-11.09.05P	place and secure plenums	plenums are placed and secured to support system according to job specifications and ***trade standards***

RANGE OF VARIABLES

tools and equipment include: see Appendix B

components include: coils, fans, humidifiers, dehumidifiers, flexible connections, filters, louvers, dampers, drains, drain pans, doors

trade standards include: SMACNA, ASHRAE, ANSI, NBC, CWB, NFPA, AHJ

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-11.09.01L	demonstrate knowledge of installation procedures for plenums and the associated ***tools and equipment***	define terminology associated with plenums
		identify ***tools and equipment*** used for installing plenums, and describe their applications and procedures for use
		describe the procedures used to install plenums
C-11.09.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to installing plenums found on drawings and specifications
C-11.09.03L	demonstrate knowledge of safe work practices and procedures related to installing plenums	identify hazards and describe safe work practices and procedures pertaining to installing plenums
C-11.09.04L	demonstrate knowledge of regulatory requirements pertaining to the installation of plenums	identify codes and ***trade standards*** related to the installation of plenums

RANGE OF VARIABLES

tools and equipment include: see Appendix B

trade standards include: SMACNA, ASHRAE, ANSI, NBC, CWB, NFPA, AHJ

TASK C-12 Installs material handling system components

TASK DESCRIPTOR

Material handling system components have specific applications such as dust collection, product separation and conveyance, and handling materials. These components may be installed for convenience, safety, cleanliness and cost-saving.

C-12.01 Installs pneumatic and gravity material handling system components

Essential Skills Document Use, Numeracy, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
no	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-12.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-12.01.02P	determine location of ***components***	location of ***components*** is determined according to specifications and job requirements
C-12.01.03P	assemble ductwork, fittings and ***components***	ductwork, fittings and ***components*** are assembled according to tagging, drawings and job requirements
C-12.01.04P	complete transverse connections	transverse connections are completed by welding or fastening to limit protrusions according to job requirements
C-12.01.05P	secure ducts and fittings	ducts and fittings are secured to support systems according to job specifications and ***trade standards***
C-12.01.06P	select and install ***components***	***components*** are selected and installed to ensure a smooth passage of materials through system by minimizing angle and direction changes
C-12.01.07P	select and install ***material handling lining***	***material handling lining*** is selected and installed

RANGE OF VARIABLES

tools and equipment include: see Appendix B

components include: chutes, explosion ducts, blast gates, relief vents, explosion dampers, blowers, separating devices (bag houses, cyclones), air locks, isolators, hoppers, bins

trade standards include: SMACNA, ASHRAE, NBC, ANSI, CSA, NFPA, CWB

material handling lining includes: ceramic, UHMW, polyurethane, composite

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-12.01.01L	demonstrate knowledge of installation procedures for pneumatic and gravity material handling system components, and the associated ***tools and equipment***	define terminology associated with pneumatic and gravity material handling system components
		identify ***tools and equipment*** used for installing pneumatic and gravity material handling system components and procedures for use
		identify types of pneumatic and gravity material handling system components, and describe their applications
		describe the ***procedures used to prepare for installation of pneumatic and gravity material handling system components***
		identify ***considerations when installing pneumatic and gravity material handling system components***
		describe the procedures used to install pneumatic and gravity material handling system components
C-12.01.02L	demonstrate knowledge of drawings and job specifications	interpret information pertaining to installing pneumatic and gravity material handling system ***components*** found on drawings and job specifications
C-12.01.03L	demonstrate knowledge of safe work practices and procedures related to installing pneumatic and gravity material handling system components	identify hazards and describe safe work practices and procedures pertaining to installing pneumatic and gravity material handling system components
C-12.01.04L	demonstrate knowledge of regulatory requirements pertaining to pneumatic and gravity material handling system components	identify ***trade standards*** pertaining to pneumatic and gravity material handling system components

RANGE OF VARIABLES

components include: chutes, explosion ducts, blast gates, relief vents, explosion dampers, blowers, separating devices (bag houses, cyclones), air locks, isolators, hoppers, bins

tools and equipment include: see Appendix B

procedures used to prepare for installation of pneumatic and gravity material handling system components include: determining equipment requirements, verifying duct sizing, determining penetration locations, performing site measurements, demolishing and removing existing systems and components, performing on-site coordination, staging (storing material), planning, distributing (material to installation area), sectioning (pre-assembling on-site), erecting, completing final inspection

considerations when installing pneumatic and gravity material handling system components include: manufacturers' specifications, building materials, environmental conditions, field design modifications, site conditions, equipment requirements, design limitations

trade standards include: SMACNA, ASHRAE, NBC, ANSI, CSA, NFPA, CWB

C-12.02 Installs mechanized material handling system components

Essential Skills	Document Use, Numeracy, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
no	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-12.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-12.02.02P	determine location of mechanized material handling system components	location of mechanized material handling system components is determined according to specifications and job requirements
C-12.02.03P	assemble mechanized material handling system components	mechanized material handling system components are assembled according to tagging, drawings and job specifications
C-12.02.04P	complete connections	connections are welded and fastened according to job requirements and specifications
C-12.02.05P	secure mechanized material handling system components	mechanized material handling system components are secured to supports, bases or hanging systems according to job specifications
C-12.02.06P	select and install fittings and components	fittings and components are selected and installed according to job requirements
C-12.02.07P	select and install ***material handling lining***	***material handling lining*** is selected and installed

RANGE OF VARIABLES

tools and equipment include: see Appendix B

material handling lining includes: ceramic, UHMW, polyurethane, composite

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-12.02.01L	demonstrate knowledge of installation procedures for mechanized material handling system components, and the associated ***tools and equipment***	define terminology associated with mechanized material handling system components
		identify ***tools and equipment*** used for installing mechanized material handling system components and procedures for use
		identify ***types of mechanized material handling system components*** and describe their applications
		describe the procedure to complete a connection
C-12.02.02L	demonstrate knowledge of drawings and specifications	interpret information pertaining to installing mechanized material handling system components found on drawings and specifications
C-12.02.03L	demonstrate knowledge of safe work practices and procedures related to installing mechanized material handling system components	identify hazards and describe ***safe work practices and procedures*** pertaining to installing mechanized material handling system components
C-12.02.04L	demonstrate knowledge of regulatory requirements pertaining to mechanized material handling system components	identify ***trade standards*** pertaining to mechanized material handling system components

RANGE OF VARIABLES

tools and equipment include: see Appendix B

types of mechanized material handling system components include: chutes, slides, conveyors, augers

safe work practices and procedures include: lock-out and tag-out, identifying pinch points, working around moving equipment

trade standards include: SMACNA, ASHRAE, NBC, ANSI, CSA, NFPA

TASK C-13 Applies thermal insulation, lagging, cladding and flashing

TASK DESCRIPTOR

Sheet metal workers apply insulation, lagging, cladding and flashing to prevent condensation, limit operating costs, increase the efficiency of equipment through the conservation of energy, and to protect insulation and ductwork from damage due to environmental exposure. For this task, application may include on-site fabrication.

C-13.01 Applies thermal insulation to components

Essential Skills Thinking, Document Use, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	no	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
C-13.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-13.01.02P	select insulation	insulation is selected according to job specifications and ***trade standards***
C-13.01.03P	identify location to be insulated	location to be insulated is identified according to drawings, job specifications and ***trade standards***
C-13.01.04P	measure, lay out and cut insulation pieces	insulation pieces are measured, laid out and cut according to job requirements
C-13.01.05P	secure insulation	insulation is secured by applying ***fasteners and components***

RANGE OF VARIABLES

tools and equipment include: knives, end cutters, pin spotters, banders, snips
trade standards include: SMACNA, NFPA, NBC
fasteners and components include: pins, z-bars, glue, insulation washers, bands

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-13.01.01L	demonstrate knowledge of the procedures used to apply thermal insulation to components and the associated ***tools and equipment***	identify types and properties of thermal insulation used for insulating components
		identify ***tools and equipment*** used to apply thermal insulation to components, and describe their applications, limitations and procedures for use
C-13.01.02L	demonstrate knowledge of drawings and specifications	interpret information pertaining to the insulation of components found on drawings and specifications
C-13.01.03L	demonstrate knowledge of ***safe work practices and procedures*** pertaining to applying thermal insulation to components	identify hazards and describe ***safe work practices and procedures*** associated with applying thermal insulation to components
C-13.01.04L	demonstrate knowledge of regulatory requirements pertaining to insulating components	identify ***trade standards*** pertaining to insulating components

RANGE OF VARIABLES

tools and equipment include: knives, end cutters, pin spotters, banders, snips
safe work practices and procedures include: using PPE, elevating devices, well-ventilated areas
trade standards include: SMACNA, NFPA, NBC

C-13.02 Applies lagging and cladding to components

Essential Skills Document Use, Numeracy, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
C-13.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-13.02.02P	select ***material*** and ***fasteners***	***material*** and ***fasteners*** are selected according to drawings and job requirements
C-13.02.03P	measure, lay out, cut and form ***material***	***material*** is measured, laid out, cut and formed to ensure fit according to drawings and job requirements

C-13.02.04P	select ***seams and joints***	***seams and joints*** are selected according to job requirements and specifications
C-13.02.05P	form ***seams and joints*** for lagging and cladding	***seams and joints*** are formed according to job requirements and specifications
C-13.02.06P	overlap ***seams and joints*** and slope ***material***	***seams and joints*** are overlapped and material is sloped to shed moisture according to job requirements
C-13.02.07P	secure and seal ***material***	***material*** is secured and sealed using ***fasteners***

RANGE OF VARIABLES

tools and equipment include: snips, brakes, rollers, roll forming machines, banding tools, tape measures, trammel points, button punches, portable power tools

material includes: metal (copper, aluminum, stainless steel), plastic, composite

fasteners include: banding, screws, sealants, adhesives, expansion springs

seams and joints include: slip-lock, lapped, pittsburgh

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-13.02.01L	demonstrate knowledge of the procedures used to apply lagging and cladding to components and the associated ***tools and equipment***	identify types and properties of lagging and cladding used to apply to components
		identify ***tools and equipment*** used to apply lagging and cladding to components, and describe their applications, limitations and procedures for use
		identify the methods used to secure and seal ***material***, and ***seams and joints***
		demonstrate layout methods
C-13.02.02L	demonstrate knowledge of drawings and specifications	interpret information pertaining to the application of lagging and cladding to components found on drawings and specifications
C-13.02.03L	demonstrate knowledge of calculations required to apply lagging and cladding to components	calculate measurements of ***materials*** before cutting
		calculate seam and joint allowances

RANGE OF VARIABLES

tools and equipment include: snips, brakes, rollers, roll forming machines, banding tools, tape measures, trammel points, button punches, portable power tools

material includes: metal (copper, aluminum, stainless steel), plastic, composite

seams and joints include: slip-lock, lapped, pittsburgh

C-13.03 Applies flashing to components

Essential Skills	Document Use, Numeracy, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-13.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-13.03.02P	select material	material is selected according to requirements, drawings and specifications
C-13.03.03P	measure and modify flashing	flashing is measured and modified to fit on-site conditions
C-13.03.04P	complete seams and joints	seams and joints are completed in order to shed moisture
C-13.03.05P	secure and seal material	material is secured and sealed using ***fasteners*** to ensure a weather-tight seal

RANGE OF VARIABLES

tools and equipment include: button punch, seamers, flat screw driver, rubber mallet, set square, caulking gun, snips, portable power tools, soldering equipment

fasteners include: screws, sealants, adhesives, rivets

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-13.03.01L	demonstrate knowledge of the procedures used to apply flashing to components and the associated ***tools and equipment***	identify types and properties of flashing used to apply to components
		identify ***tools and equipment*** used to apply flashing to components and describe their applications, limitations and procedures for use
		identify the methods used to apply flashing
		identify ***considerations*** when installing flashing to components
C-13.03.02L	demonstrate knowledge of drawing interpretation	interpret information pertaining to the application of flashing to components found on drawings and specifications
C-13.03.03L	demonstrate knowledge of calculations required to apply flashing	calculate measurements of flashing before installing

RANGE OF VARIABLES

tools and equipment include: button punch, seamers, flat screw driver, rubber mallet, set square, caulking gun, snips, portable power tools, soldering equipment

considerations include: isolators, building materials, environmental conditions, field design modifications

TASK C-14 Performs leak testing, air balancing and commissioning

TASK DESCRIPTOR

Sheet metal workers perform testing, adjusting, balancing and leak testing to ensure that the system operates efficiently at its specified performance level. Sheet metal workers also participate in the commissioning of building systems.

C-14.01 Performs leak tests

Essential Skills Numeracy, Document Use, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-14.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
C-14.01.02P	seal and cap test section using ***materials***	test section is sealed and capped using ***materials*** according to job requirements and specifications
C-14.01.03P	determine allowable system leakage rate	allowable system leakage rate is determined by comparing leakage test results to ***trade standards*** and job specifications
C-14.01.04P	pressurize ductwork to predetermined pressure	ductwork is pressurized to predetermined pressure by attaching blower to duct according to ***trade standards*** and job specifications
C-14.01.05P	identify and mark leaking areas	leaking areas are identified and marked when leakage is higher than allowable leakage rate
C-14.01.06P	reseal and retest leaking areas	leaking areas are resealed and retested once sealant has cured according to manufacturers' specifications
C-14.01.07P	document test results	test results are documented according to job specifications

RANGE OF VARIABLES

tools and equipment include: testing and monitoring equipment, snips, drills, electrical testing devices, smoke bombs

materials include: end caps, polyethylene, tape, sealers, gaskets

trade standards include: SMACNA, ASHRAE, AHJ

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-14.01.01L	demonstrate knowledge of the procedures used to perform leak tests and the associated ***tools and equipment***	define terminology associated with leak tests
		identify ***tools and equipment*** used in performing leak tests and describe their applications and procedures for use
		identify requirements and limitations pertaining to performing leak tests
		identify ***problems pertaining to air and material handling systems*** and describe the procedures used to prevent and correct them
		identify ***types of tests*** relating to air and material handling system components and describe the procedures used to perform them
C-14.01.02L	demonstrate knowledge of drawings and specifications	interpret information pertaining to performing leak tests found on drawings and specifications
C-14.01.03L	demonstrate knowledge of safe work practices and procedures pertaining to performing leak tests	identify hazards and describe safe work practices and procedures associated with performing leak tests
C-14.01.04L	demonstrate knowledge of codes and regulations pertaining to performing leak tests	identify ***trade standards*** pertaining to performing leak tests on air and material handling systems

RANGE OF VARIABLES

tools and equipment include: testing and monitoring equipment, snips, drills, electrical testing devices, smoke bombs

problems pertaining to air and material handling systems include: lack of or excessive air pressure, improper installation (duct sizing, noise)

types of tests include: pressure test, smoke test

trade standards include: SMACNA, ASHRAE, AHJ

C-14.02 Performs testing, adjusting and balancing (TAB)

Essential Skills Numeracy, Writing, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-14.02.01P	select and use ***tools and testing equipment***	***tools and testing equipment*** are selected and used according to job requirements
C-14.02.02P	verify dampers, filters and coils	dampers are verified to ensure they are open, and filters and coils are verified for cleanliness
C-14.02.03P	perform duct traverse	duct traverse is performed by creating test ports in ductwork by drilling holes, to determine volume and velocity of system
C-14.02.04P	perform calculations	calculations are performed to determine airflow and compare to design specifications
C-14.02.05P	adjust ***equipment and components***	***equipment and components*** are adjusted to achieve required airflow at the unit
C-14.02.06P	test and adjust main, zone and branch ducts and individual outlets	main, zone and branch ducts and individual outlets are adjusted to meet design specifications
C-14.02.07P	document balancing results	balancing results are documented according to job specifications

RANGE OF VARIABLES

tools and testing equipment include: drills, velometers, flow hoods, multimeters, thermometers, anemometers, psychrometers, pitot tubes, manometers, tachometers

equipment and components include: motor pulleys, dampers, blower pulleys, three-stage fans, variable speed drives, test port

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-14.02.01L	demonstrate knowledge of the procedures used to perform testing, adjusting and balancing (TAB) on air handling systems, and the associated ***tools and testing equipment***	define terminology associated with TAB
		identify ***tools and testing equipment*** used in TAB, and describe their applications and procedures for use
		identify requirements and limitations pertaining to TAB
		identify problems pertaining to air handling systems and describe procedures used to prevent and correct them
		explain the importance of TAB to ensure optimal system performance
		describe the procedures and techniques used to perform balancing on air handling systems
		describe the procedures used to adjust air handling system ***equipment and components*** to optimize performance
		identify ***types of tests*** relating to air handling system ***equipment and components*** and describe the procedures used to perform them
C-14.02.02L	demonstrate knowledge of drawings and specifications	interpret information pertaining to performing TAB found on drawings and specifications
C-14.02.03L	demonstrate knowledge of codes and regulations pertaining to performing TAB	identify ***trade standards*** pertaining to performing TAB on air handling systems

RANGE OF VARIABLES

tools and testing equipment include: drills, velometers, flow hoods, multimeters, thermometers, anemometers, psychrometers, pitot tubes, manometers, tachometers

equipment and components include: motor pulleys, dampers, blower pulleys, three-stage fans, variable speed drives, test port

types of tests include: airflow, pressure, velocity, volume

trade standards include: Testing, Adjusting and Balancing Bureau (TABB), SMACNA

C-14.03 Participates in the commissioning of air and material handling systems

Essential Skills	Oral Communication, Working with Others, Writing

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
C-14.03.01P	meet with commissioning agent throughout project	meetings with the commissioning agent are held throughout the project to verify work completed so far
C-14.03.02P	provide ***documentation*** to commissioning agent	***documentation*** is provided to commissioning agent according to job specifications
C-14.03.03P	perform walk-around with commissioning agent	walk-around with commissioning agent is performed to identify locations of equipment and deficiencies
C-14.03.04P	address deficiencies cited on commissioning report	deficiencies cited on commissioning report are addressed
C-14.03.05P	label equipment	equipment is labelled according to job specifications for the purpose of identification, commissioning and maintenance
C-14.03.06P	educate building manager or owner on system operation and maintenance	system operation and maintenance information is contained in the turnover documents

RANGE OF VARIABLES

documentation includes: equipment shop drawings, as-built drawings, test results

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-14.03.01L	demonstrate knowledge of commissioning and its purpose	define terminology associated with commissioning
		explain the purpose of commissioning and identify the types of air and material handling systems and components
		interpret ***documentation*** pertaining to commissioning
C-14.03.02L	demonstrate knowledge of the procedures used to commission air and material handling systems and components	describe the procedures used to commission air and material handling systems and components

RANGE OF VARIABLES

documentation includes: equipment shop drawings, as-built drawings, test results

MAJOR WORK ACTIVITY D

Installs roofing and specialty products

TASK D-15 Installs metal roofing and cladding/siding systems

TASK DESCRIPTOR

Sheet metal workers install metal roofing and cladding products to provide low maintenance, longevity of the building and protection from the elements. Metal roofs and cladding can also add to the aesthetics of the building.

D-15.01 Lays out roof and walls

Essential Skills Document Use, Thinking, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	no	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
D-15.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-15.01.02P	inspect building	building is inspected according to ***trade standards*** and ***job specifications***
D-15.01.03P	establish reference lines	reference lines are established using ***tools and equipment*** according to ***job specifications***
D-15.01.04P	confirm site measurements	site measurements are confirmed according to ***job specifications***
D-15.01.05P	mark openings	openings are marked according to ***job specifications***
D-15.01.06P	determine orientation of seams and joints	orientation of seams and joints are determined taking into consideration the prevailing wind and according to building dimensions, ***trade standards*** and ***job specifications***
D-15.01.07P	determine desired overall appearance	desired overall appearance is determined according to ***job specifications***
D-15.01.08P	prepare sheeting for ***installation procedures***	sheeting is prepared for ***installation procedures*** according to site conditions, ***trade standards*** and ***job specifications***

RANGE OF VARIABLES

tools and equipment include: transits, laser levels, framing square, chalk lines

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB

job specifications include: penetrations, structural supports, manufacturers' specifications, engineering and architectural specifications, drawings including shop drawings, details, sketches and interference drawings

installation procedures include: pre-drilling, hoisting

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-15.01.01L	demonstrate knowledge of procedures for laying out metal roofing and walls, and the associated ***tools and equipment***	define terminology associated with metal roofing and walls
		identify ***tools and equipment*** used to lay out metal roofing and walls, and describe their applications and procedures for use
		identify types of materials used in fabricating metal roofing and walls
		identify ***types of components*** associated with metal roofing and walls, and describe their applications
		describe the ***procedures used to lay out metal roofing and walls***, and their associated components
		identify ***types of roof structures*** and construction features and describe their applications
		describe the procedures used to install materials to roofs or walls in preparation for installation of metal roofing and walls
D-15.01.02L	demonstrate knowledge of safe work practices and ***procedures pertaining to laying out metal roofing and walls***	identify hazards and describe safe work practices and ***procedures pertaining to the laying out of metal roofing and walls***
D-15.01.03L	demonstrate knowledge of drawing interpretation	interpret information pertaining to metal roofing and walls, found on drawings and specifications
D-15.01.04L	demonstrate knowledge of ***trade standards*** pertaining to metal roofing and walls	identify ***trade standards*** pertaining to the installation of metal roofing and walls
D-15.01.05L	demonstrate knowledge of calculating material required	identify procedures used to calculate material required

RANGE OF VARIABLES

tools and equipment include: transits, laser levels, framing square, chalk lines

types of components include: roof drainage, flashing, soffit and fascia, roof vents, wall panels, cladding/siding

procedures used to lay out metal roofing and walls include: check for square, determine starting point, establish reference lines

types of roof structures include: hip, gable, pitched, flat, green

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB

D-15.02 Installs insulation, isolation material and building envelope components

Essential Skills Reading, Numeracy, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	no	yes	no	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
D-15.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-15.02.02P	install components of ***building envelope***	***building envelope components*** are installed according to manufacturers' and ***job specifications***, and ***trade standards***
D-15.02.03P	select and use ***fasteners***	***fasteners*** are selected and used according to manufacturers' and ***job specifications***
D-15.02.04P	determine paneling system requirements	paneling system requirements are determined according to manufacturers' specifications and engineered drawings
D-15.02.05P	install ***panel mounting system***	***panel mounting system*** is installed according to manufacturers' and ***job specifications***, and engineered drawings
D-15.02.06P	apply and fasten insulation to structure	insulation is applied and fastened to structure according to site conditions, manufacturers' and ***job specifications***, and engineered drawings
D-15.02.07P	apply ***isolation material*** to structure	***isolation material*** is applied to structure according to design and manufacturers' specifications

RANGE OF VARIABLES

tools and equipment include: screwdrivers, paint brushes, hammer-staplers, drills, profile cutters, cut-saws

building envelope components include: felt paper, ice and water shield, self-adhesive membrane, wall and roof panels

job specifications include: penetrations, structural supports, manufacturers' specifications, engineering and architectural specifications, drawings including shop drawings, details, sketches and interference drawings

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB

fasteners include: pin bolts, screws, powder-actuated fasteners

panel mounting system includes: z-bars, stand-offs, j-bars, clips and/or cleats

isolation material includes: neoprene, caulking, wood, tape, paint

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-15.02.01L	demonstrate knowledge of procedures for installing insulation, isolation materials and ***building envelope components***, and the associated ***tools and equipment***	define terminology associated with insulation, isolation materials and ***building envelope components***
		identify ***tools and equipment*** used to install insulation, isolation materials and ***building envelope components***, and describe their applications and procedures for use
		identify ***materials to be installed to prepare surfaces*** for installation of metal roofing, cladding/siding and architectural metals
		describe the procedures used to install insulation, isolation materials and ***building envelope components***
		identify types of fasteners for installing insulation, isolation materials and ***building envelope components***, and describe their applications
D-15.02.02L	demonstrate knowledge of safe work practices and procedures pertaining to installing insulation, isolation materials and ***building envelope components***	identify hazards and describe safe work practices and procedures pertaining to installing insulation, isolation materials and ***building envelope components***
D-15.02.03L	demonstrate knowledge of drawing interpretation	interpret information pertaining to the installation of insulation, isolation materials and ***building envelope components***, found on drawings and specifications

D-15.02.04L	demonstrate knowledge of regulatory requirements pertaining to insulation, isolation materials and ***building envelope components***	identify codes and regulations pertaining to the installation of insulation, isolation materials and ***building envelope components***
D-15.02.05L	demonstrate knowledge of calculating material required	identify procedures used to calculate material required

RANGE OF VARIABLES

building envelope components include: felt paper, ice and water shield, self-adhesive membrane, wall and roof panels

tools and equipment include: screwdrivers, paint brushes, hammer-staplers, drills, profile cutters, cut-saws

materials to be installed to prepare surfaces include: insulation, primer, waterproof membrane, isolation material

D-15.03 Installs roofing and cladding/siding system components

Essential Skills	Document Use, Numeracy, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
D-15.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-15.03.02P	select and use ***fasteners***	***fasteners*** are selected and used according to ***job specifications*** and ***trade standards***
D-15.03.03P	determine starting point	starting point is determined to achieve minimal waste and finished appearance according to ***job specifications*** and ***trade standards***
D-15.03.04P	install required flashing	flashing required is installed according to ***job specifications*** and ***trade standards***
D-15.03.05P	cut, fit and fasten panels to the structure and mounting system	panels are cut, fitted and fastened to the structure and mounting system following reference lines
D-15.03.06P	install expansion joints	expansion joints are installed according to ***job specifications*** and ***trade standards***
D-15.03.07P	install coping, finish flashing, drainage and downspouts	coping, finish flashing, drainage and downspouts are installed according to ***job specifications*** and ***trade standards***

RANGE OF VARIABLES

tools and equipment include: drills, seamers, framing squares, laser levels, screw guns, hand tools

fasteners include: pre-engineered fasteners, screws, nails, bolts, welding, powder-actuated fasteners, expansion anchors

job specifications include: penetrations, structural supports, manufacturers' specifications, engineering and architectural specifications, drawings including shop drawings, details, sketches and interference drawings

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-15.03.01L	demonstrate knowledge of procedures for installing roofing and cladding/siding system components, and the associated ***tools and equipment***	identify ***tools and equipment*** used to install roofing and cladding/siding system components, and describe their applications and procedures for use
		identify ***considerations and requirements*** relating to the installation of roofing and cladding/siding system components
		identify types of fasteners for installing roofing and cladding/siding system components, and describe their applications
		describe the procedures used to install materials to roofs or walls in preparation for installation of roofing and cladding/siding system components
		describe the ***procedures used to install roofing and cladding/siding system components***
D-15.03.02L	demonstrate knowledge of calculating material required	identify procedures used to calculate material required

RANGE OF VARIABLES

tools and equipment include: drills, seamers, framing squares, laser levels, screw guns, hand tools

considerations and requirements include: building materials, roof slope, expansion and contraction, prevailing winds and weather conditions, appearance

procedures used to install roofing and cladding/siding system components include: cut, fit, secure, seal

D-15.04 Seals exposed joints

Essential Skills	Document Use, Oral Communication, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	no	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
D-15.04.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-15.04.02P	select ***sealant***	***sealant*** is selected according to ***job specifications*** and ***trade standards***
D-15.04.03P	prepare surface for ***sealant***	surface is prepared by cleaning and installing backer rod as required
D-15.04.04P	apply ***sealant***	***sealant*** is applied according to ***job specifications, trade standards*** and weather conditions
D-15.04.05P	apply joint and seam caps	joint and seam caps are applied to secure, to seal and to ensure watershed

RANGE OF VARIABLES

tools and equipment include: caulking guns, soldering irons, tooling devices

sealant includes: caulking, solder, mastic, butyl tape

job specifications include: engineering, architectural and manufacturers' specifications, drawings including shop drawings, details, sketches

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-15.04.01L	demonstrate knowledge of procedures for sealing exposed joints, and the associated ***tools and equipment***	identify ***tools and equipment*** used to seal exposed joints, and describe their applications and procedures for use
		describe the procedures used to seal exposed joints
		identify types of sealants used to seal exposed joints

RANGE OF VARIABLES

tools and equipment include: caulking guns, soldering irons, tooling devices

D-15.05 Installs decking

Essential Skills Oral Communication, Working with Others, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	no	NV	yes	no	yes	no	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
D-15.05.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-15.05.02P	determine ***material*** required	***material*** required for the job is determined by ***trade standards*** and ***job specifications***
D-15.05.03P	cut and fit decking	decking is cut and fitted according to drawings and specifications
D-15.05.04P	fasten decking	decking is fastened using ***fasteners***
D-15.05.05P	frame out non-structural openings	non-structural openings are framed out
D-15.05.06P	finish exposed welds	exposed welds are finished to prevent corrosion

RANGE OF VARIABLES

tools and equipment include: welding equipment, abrasive cut-off saws, hand crimpers

material includes: metal pans, Q decking

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB

job specifications include: engineering, architectural and manufacturers' specifications, penetrations, structural supports, drawings including shop drawings, details, sketches

fasteners include: screws, dimple tools, rivets, welds

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-15.05.01L	demonstrate knowledge of procedures for installing decking, and the associated ***tools and equipment***	identify ***tools and equipment*** used to install decking, and describe their applications and procedures for use
		identify types of decking and describe their applications
		identify types of ***fasteners*** for installing decking and describe their applications
		identify types of ***material*** used for decking and describe their applications
		describe the procedures used to install decking
D-15.05.02L	demonstrate knowledge of safe work practices and procedures pertaining to installing decking	identify hazards and safe work practices and procedures pertaining to installing decking
D-15.05.03L	demonstrate knowledge of drawing interpretation	interpret information pertaining to the installation of decking found on drawings and specifications
D-15.05.04L	demonstrate knowledge of calculating material required	identify procedures used to calculate material required

RANGE OF VARIABLES

tools and equipment include: welding equipment, abrasive cut-off saws, hand crimpers
fasteners include: screws, dimple tools, rivets, welds
material includes: metal pans, Q decking

TASK D-16 Installs exterior components

TASK DESCRIPTOR

Sheet metal workers install exterior components such as awnings and signage for functional and aesthetic reasons.

D-16.01 Prepares surface

Essential Skills Document Use, Thinking, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	no	NV	yes	no	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
D-16.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-16.01.02P	check alignment of exterior surface	alignment of exterior surface is checked for aesthetic purposes and ***job specifications*** to ensure ease of installation
D-16.01.03P	identify fastening points	fastening points are identified according to site conditions and ***job specifications***
D-16.01.04P	determine fastening system	fastening system is determined according to product material type, ***trade standards*** and ***job specifications***
D-16.01.05P	clean installation area	installation area is cleaned using ***cleaning tools*** and ***chemicals*** according to material type
D-16.01.06P	score surface	surface is scored for adherence according to material type
D-16.01.07P	apply waterproofing membrane and flashing	waterproofing membrane and flashing are applied to ensure watertight construction
D-16.01.08P	install fastening system	fastening system is installed according to ***trade standards*** and ***job specifications***

RANGE OF VARIABLES

tools and equipment include: grinders, putty knives, hammer drills and drills, welder, screw guns

job specifications include: penetrations, structural supports, manufacturers' specifications, engineering and architectural specifications, drawings including shop drawings, details, sketches and interference drawings

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB

cleaning tools include: scrapers, grinders, wire brushes
chemicals include: degreasers, acids, primers, paint

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-16.01.01L	demonstrate knowledge of preparing surfaces for the installation of exterior components and the associated ***tools and equipment***	identify ***tools and equipment*** used to prepare surface and procedures for use
		describe procedure for identifying fastening points
		identify ***types of fastening systems*** used for installation
		identify types of ***cleaning tools,*** and ***chemicals*** used for preparing the surface for installation
		describe the procedures used to prepare surfaces for installation
		describe procedures for installing fastening systems

RANGE OF VARIABLES

tools and equipment include: grinders, putty knives, hammer drills and drills, welder, screw guns
types of fastening systems include: backing material, structural supports, stand-offs, clips
cleaning tools include: scrapers, grinders, wire brushes
chemicals include: degreasers, acids, primers, paint

D-16.02 Fastens exterior components

Essential Skills	Reading, Working with Others, Thinking

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	no	NV	yes	no	yes	yes	yes	NV	NV	NV

	SKILLS	
	Performance Criteria	**Evidence of Attainment**
D-16.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-16.02.02P	select exterior components and ***fasteners***	exterior components and ***fasteners*** are selected according to application and material type

D-16.02.03P	modify exterior components	exterior components are modified according to job conditions and requirements
D-16.02.04P	mount exterior components	exterior components are mounted according to ***trade standards*** and ***job specifications*** using ***fasteners***
D-16.02.05P	seal joints	joints are sealed by soldering and/or caulking according to ***trade standards*** and ***job specifications*** to maintain a weatherproof seal

RANGE OF VARIABLES

tools and equipment include: drills, screwdrivers, impact drivers, hammers

fasteners include: anchors, nail-ins, screws, adhesives

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB

job specifications include: engineering, architectural and manufacturers' specifications, penetrations, drawings including shop drawings, details, sketches

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-16.02.01L	demonstrate knowledge of fastening exterior components and the associated ***tools and equipment***	identify ***tools and equipment*** used to fasten exterior components
		identify ***types of exterior components*** and describe their applications
		identify types of ***fasteners*** used to fasten exterior components
		identify types of sealants used to seal joints
		describe procedure to solder and caulk joints
		describe the procedures used to fasten exterior components

RANGE OF VARIABLES

tools and equipment include: drills, screwdrivers, impact drivers, hammers
types of exterior components include: awnings, signage
fasteners include: anchors, nail-ins, screws, adhesives

TASK D-17 Installs specialty products

TASK DESCRIPTOR

Sheet metal workers install specialty products in residential, industrial, commercial and institutional (ICI) locations such as commercial kitchens, food processing plants, pharmaceutical laboratories, medical facilities, manufacturing plants and marine environments. They also design and install stainless or non-stainless architectural products on or inside a variety of buildings.

D-17.01 Installs stainless steel specialty products

Essential Skills Thinking, Numeracy, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
D-17.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-17.01.02P	install components	components are installed according to ***trade standards***, ***job specifications*** and site conditions
D-17.01.03P	select and use fasteners and hangers	fasteners and hangers are selected and used according to application, ***trade standards*** and ***job specifications***
D-17.01.04P	isolate differing materials from each other	differing materials are isolated from each other to avoid galvanic corrosion and/or cross-contamination
D-17.01.05P	assemble components	components are assembled according to ***trade standards***, ***job specifications*** and site conditions
D-17.01.06P	finish stainless steel specialty products	stainless steel specialty products are finished using ***sealants and coating*** and ***tools and equipment*** according to ***requirements*** and ***job specifications***

RANGE OF VARIABLES

tools and equipment include: welding and soldering equipment, grinders, sanders, buffers and buffing compound, hand tools, drills, rivets

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB, Health Canada

job specifications include: engineering, architectural and manufacturers' specifications, penetrations, structural supports, drawings including shop drawings, details, sketches

sealants and coating include: caulking, food grade caulking, silicone, butyl, epoxy, welds, powder coating, paint, epoxy paint

requirements include: sanitary, aesthetic

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-17.01.01L	demonstrate knowledge of stainless steel specialty products and their applications	define terminology associated with stainless steel specialty products
		identify ***tools and equipment*** used to install stainless steel specialty products, and describe their applications, limitations and procedures for use
		identify ***types of stainless steel specialty products*** and describe their applications
		identify types of fasteners and fastening methods used to install stainless steel specialty products and describe their applications
		describe the procedures used to install stainless steel specialty products
		describe the procedures used to finish and apply ***sealants and coating*** to stainless steel specialty products
D-17.01.02L	demonstrate knowledge of safe work practices and procedures pertaining to installing stainless steel specialty products	identify hazards and safe work practices and procedures pertaining to the installation of stainless steel specialty products
D-17.01.03L	demonstrate knowledge of regulatory requirements pertaining to stainless steel specialty products	identify ***trade standards*** and ***job specifications*** pertaining to the installation of stainless steel specialty products
D-17.01.04L	demonstrate knowledge of drawing interpretation	interpret information pertaining to the installation of stainless steel specialty products found in ***job specifications***
D-17.01.05L	demonstrate knowledge of metals and their properties, characteristics and applications	define terminology associated with metallurgy
		describe the ***properties of metals***
		describe ***identification systems for types of stainless steel and their finishes***

D-17.01.06L	demonstrate knowledge of metallurgic principles	describe the ***effects metal working has on metallurgic properties***
		identify ***practices that can create problems when working with stainless steel***, and describe the procedures used to prevent or correct these problems

RANGE OF VARIABLES

tools and equipment include: welding and soldering equipment, grinders, sanders, buffers and buffing compound, hand tools, drills, rivets

types of stainless steel specialty products include: kitchen, medical, food processing, pharmaceutical, laboratory, decorative

sealants and coating include: caulking, food grade caulking, silicone, butyl, epoxy, welds, powder coating, paint, epoxy paint

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB, Health Canada

job specifications include: engineering, architectural and manufacturers' specifications, penetrations, structural supports, drawings including shop drawings, details, sketches

properties of metals include: ductility, malleability, elasticity, hardness, composition, physical

identification systems for types of stainless steel and their finishes include: numbering, gauging, lettering

effects metal working has on metallurgic properties include: stress, contraction, expansion, distortion, work hardening, annealing, galvanic corrosion

practices that can create problems when working with stainless steel include: forming, cutting/shearing, punching, drilling, joining, welding, grinding, sanding, polishing/buffing, storage and handling

D-17.02 Installs non-stainless steel specialty products

Essential Skills Thinking, Numeracy, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	yes	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
D-17.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-17.02.02P	install components	components are installed according to ***trade standards*** and ***job specifications***
D-17.02.03P	select and use fasteners and hangers	fasteners and hangers are selected and used according to ***trade standards*** and ***job specifications***
D-17.02.04P	isolate differing materials from each other	differing materials are isolated from each other to avoid galvanic corrosion and/or cross-contamination

D-17.02.05P	assemble components	components are assembled according to ***trade standards*** and ***job specifications***
D-17.02.06P	finish non-stainless steel specialty products	non-stainless steel specialty products are finished using ***sealants, coating and oxidizers,*** and ***tools and equipment*** according to ***requirements*** and ***job specifications***

RANGE OF VARIABLES

tools and equipment include: welding and soldering equipment, grinders, sanders, buffers and buffing compounds, hand tools, drills, rivets

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB, Health Canada

job specifications include: engineering, architectural and manufacturers' specifications, penetrations, structural supports, drawings including shop drawings, details, sketches

sealants, coating and oxidizers include: solders, welding materials, caulking, paint, epoxy paint, fiberglass mat, glues, solvents, primers

requirements include: sanitary, aesthetic, increased awareness of PPE and ventilation

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-17.02.01L	demonstrate knowledge of non-stainless steel specialty products and their applications	define terminology associated with non-stainless steel specialty products
		identify ***tools and equipment*** used to install non-stainless steel specialty products, and describe their applications, limitations and procedures for use
		identify ***types of non-stainless steel specialty products*** and describe their applications
		identify types of fasteners and fastening methods used to install non-stainless steel specialty products and describe their applications
		describe the procedures used to install non-stainless steel specialty products
		describe the procedures used to finish and apply ***sealants, coating and oxidizers*** to non-stainless steel specialty products
D-17.02.02L	demonstrate knowledge of safe work practices and procedures pertaining to installing non-stainless steel specialty products	identify hazards and safe work practices and procedures pertaining to the installation of non-stainless steel specialty products

D-17.02.03L	demonstrate knowledge of regulatory requirements pertaining to non-stainless steel specialty products	identify ***trade standards*** and ***job specifications*** pertaining to the installation of non-stainless steel specialty products
D-17.02.04L	demonstrate knowledge of drawing interpretation	interpret information, pertaining to the installation of non-stainless steel specialty products, found in ***job specifications***

RANGE OF VARIABLES

tools and equipment include: welding and soldering equipment, grinders, sanders, buffers and buffing compounds, hand tools, drills, rivets

types of non-stainless steel specialty products are both metal and non-metal products and include: kitchen, manufacturing, medical, food processing, pharmaceutical, laboratory, decorative, underground

sealants, coating and oxidizers include: solders, welding materials, caulking, paint, epoxy paint, fiberglass mat, glues, solvents, primers

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB, Health Canada

job specifications include: engineering, architectural and manufacturers' specifications, penetrations, structural supports, drawings including shop drawings, details, sketches

D-17.03 Installs marine products (Not Common Core)

Essential Skills Thinking, Numeracy, Continuous Learning

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	no	no	no	no	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
D-17.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
D-17.03.02P	install components	components are installed according to ***trade standards***, ***job specifications*** and site conditions
D-17.03.03P	select materials to be used to install marine products	materials are selected according to ***trade standards*** and ***job specifications***
D-17.03.04P	select and use fasteners and hangers	fasteners and hangers are selected and used according to ***trade standards*** and ***job specifications***
D-17.03.05P	isolate differing materials from each other	differing materials are isolated from each other to avoid galvanic corrosion and/or cross-contamination

D-17.03.06P	assemble components	components are assembled according to ***trade standards*** and ***job specifications***
D-17.03.07P	finish marine products	marine products are finished using ***sealants and coating, tools and equipment*** according to ***requirements*** and ***job specifications***

RANGE OF VARIABLES

tools and equipment include: welding and soldering equipment, grinders, sanders, buffers and buffing compounds, hand tools, drills, rivets

trade standards include: AHJ, SMACNA, ASHRAE, NFPA, CSA, ANSI, NBC, CWB, Health Canada, Transportation Safety Board (TSB)

job specifications include: engineering, architectural and manufacturers' specifications, penetrations, structural supports, drawings including shop drawings, details, sketches

sealants and coating include: solders, welding materials, caulking, all types of coatings, fiberglass mat, glues, solvents, primers

requirements include: sanitary, aesthetic

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-17.03.01L	demonstrate knowledge of marine products and their applications	define terminology associated with marine products
		identify ***tools and equipment*** used to install marine products, and describe their applications, limitations and procedures for use
		identify ***types of marine products*** and describe their applications
		identify types of fasteners and fastening methods used to install marine products and describe their applications
		describe the procedures used to install marine products
		identify ***special considerations for installing marine products***
		describe differences in installing in dry dock versus floating locations
D-17.03.02L	demonstrate knowledge of safe work practices and procedures pertaining to installing marine products	identify hazards and safe work practices and procedures pertaining to the installation of marine products
D-17.03.03L	demonstrate knowledge of regulatory requirements pertaining to marine products	interpret ***job specifications*** pertaining to the installation of marine products
D-17.03.04L	demonstrate knowledge of drawing interpretation	interpret information pertaining to the installation of marine products, found on drawings and specifications

RANGE OF VARIABLES

tools and equipment include: welding and soldering equipment, grinders, sanders, buffers and buffing compounds, hand tools, drills, rivets

types of marine products may be metal or non-metal and include: kitchen, laboratory, decorative, sandwich panels (wall and ceiling), doors, water-resistant louvers

special considerations for installing marine products include: working without levels or squares on non-level or square surfaces, increased awareness of PPE, confined space, ventilation and life safety including flotation devices, working from a single benchmark

job specifications include: engineering, architectural and manufacturers' specifications, penetrations, structural supports, drawings including shop drawings, details, sketches

MAJOR WORK ACTIVITY E

Performs maintenance and repair

TASK E-18 Performs scheduled maintenance

TASK DESCRIPTOR

Sheet metal workers perform scheduled maintenance to minimize repair costs, increase longevity and enhance system performance.

E-18.01 Performs maintenance inspections

Essential Skills Writing, Oral Communication, Document Use

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	no	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
E-18.01.01P	obtain service schedule	service schedule with a list of equipment and components to be inspected is obtained according to manufacturers' specifications, and site and environmental conditions
E-18.01.02P	verify inspection checklist	inspection checklist is verified for itemization of equipment components to be inspected
E-18.01.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
E-18.01.04P	perform required ***tests and readings***	***tests and readings*** are performed according to job requirements
E-18.01.05P	conduct sensory inspection	sensory inspection is conducted to identify possible faults
E-18.01.06P	record and report findings on inspection checklist	findings are recorded and reported on inspection checklist
E-18.01.07P	provide record of inspection report to client and keep record on file	record of inspection report is provided to client and kept on file

RANGE OF VARIABLES

tools and equipment include: multimeters, air-testing equipment, hand tools, testing devices

tests and readings include: amp draws, resistance, voltage, air pressure, filter conditions, vibration, temperature, noise, flow rate

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-18.01.01L	demonstrate knowledge of inspection procedures for system components and the associated ***tools and equipment***	define terminology associated with the inspection of system components
		identify ***tools and equipment*** used to inspect system components, and describe their applications, limitations and procedures for use
		identify ***considerations*** for the inspection of system components
E-18.01.02L	demonstrate knowledge of ***testing devices*** and their applications	describe the procedures used to diagnose system faults in system components
		describe procedures for using ***testing devices***
E-18.01.03L	demonstrate knowledge of safe work practices and procedures pertaining to the inspection of system components	identify hazards and describe safe work practices and procedures pertaining to the inspection of system components
E-18.01.04L	demonstrate knowledge of performing calculations to determine system performance	describe the procedures used to perform calculations to determine system performance

RANGE OF VARIABLES

tools and equipment include: multimeters, air-testing equipment, hand tools, testing devices

considerations include: sounds, vibration, odours, heat build-up

testing devices include: thermal imaging devices, multimeters, tachometers, belt-tensioning tools, thermometers, stethoscope, refrigeration gauges, leak detectors, manometer

E-18.02 Services components

Essential Skills	Document Use, Thinking, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	no	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
E-18.02.01P	verify inspection checklist	inspection checklist is verified for recommended servicing
E-18.02.02P	verify normal operating conditions and specific accessories	normal operating conditions and specific accessories are verified according to manufacturers' specifications
E-18.02.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
E-18.02.04P	clean and replace filters	filters are cleaned and replaced according to maintenance schedule or site requirements
E-18.02.05P	clean and replace components	components are cleaned by performing ***cleaning method*** and replaced according to maintenance schedule
E-18.02.06P	adjust and replace pulleys and belts	pulleys and belts are adjusted for alignment and tension according to manufacturers' specifications and replaced according to wear, sensory inspection and maintenance schedule
E-18.02.07P	lubricate bearings and motor oil ports	bearings and motor oil ports are lubricated according to manufacturers' specifications and maintenance schedule

RANGE OF VARIABLE

tools and equipment include: grease guns, hand tools, portable power tools, hoisting and rigging equipment

cleaning methods include: degreasing, using compressed air, vacuuming, pressure washing, soaking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-18.02.01L	demonstrate knowledge of servicing procedures for system components and the associated ***tools and equipment***	define terminology associated with the servicing of system components
		identify ***tools and equipment*** used to service system components and describe their applications, limitations and procedures for use

		identify ***considerations*** for the servicing of system components
		describe the ***procedures used to service system components***
E-18.02.02L	demonstrate knowledge of safe work practices and procedures pertaining to the servicing of system components	identify hazards and describe safe work practices and procedures pertaining to the servicing of system components
E-18.02.03L	demonstrate knowledge of performing calculations to determine system performance	describe the procedures used to perform calculations to determine system performance

RANGE OF VARIABLE

tools and equipment include: grease guns, hand tools, portable power tools, hoisting and rigging equipment

considerations include: sounds, vibration, odours, heat build-up

procedures used to service system components include: changing consumables (filters, pads, trays, bags, seals), cleaning components, lubricating, making adjustments, performing lock-out

TASK E-19 Repairs faulty systems and components

TASK DESCRIPTOR

Sheet metal workers repair building systems and equipment such as heating, ventilation and air conditioning and conveyance systems to return them to normal operating conditions and specifications.

E-19.01 Diagnoses system faults

Essential Skills Thinking, Numeracy, Reading

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	no	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
E-19.01.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
E-19.01.02P	conduct sensory inspections	sensory inspections are conducted to identify system faults
E-19.01.03P	perform required ***tests and readings***	***tests and readings*** are performed as indicated by system faults
E-19.01.04P	identify source of performance issues	source of performance issues are identified by evaluating ***information***

E-19.01.05P	evaluate performance of system	performance of system is evaluated against design requirements
E-19.01.06P	locate and identify worn, faulty and missing components	worn, faulty and missing components are located and identified
E-19.01.07P	recommend course of action	repair or replacement of components is recommended as required

RANGE OF VARIABLES

tools and equipment include: pitot tubes, multimeters, air-testing equipment, thermometers, stethoscopes, refrigeration gauges, leak detectors

tests and readings include: amperage draws, air pressure readings, vibration, temperature, resistance, voltage, gas pressure, humidity

information includes: history of work done, deficiency report, maintenance records, client feedback, observations, test results

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-19.01.01L	demonstrate knowledge of diagnosing system faults and the associated ***tools and equipment***	define terminology associated with system faults
		identify ***tools and equipment*** used to diagnose system faults, and describe their applications, limitations and procedures for use
		identify ***symptoms of system faults***
		identify types of ***tests and readings*** required to diagnose system faults
E-19.01.02L	demonstrate knowledge of performing calculations to determine system performance	describe the procedures used to perform calculations to determine system performance

RANGE OF VARIABLES

tools and equipment include: pitot tubes, multimeters, air-testing equipment, thermometers, stethoscopes, refrigeration gauges, leak detectors

symptoms of system faults include: sounds, vibration, odours, heat build-up, increased amperage draw, mould, decreased airflow

tests and readings include: amperage draws, air pressure readings, vibration, temperature, resistance, voltage, gas pressure, humidity

E-19.02 Repairs worn or faulty components

Essential Skills	Document Use, Thinking, Numeracy

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	NV	no	yes	yes	yes	yes	NV	NV	NV

SKILLS

	Performance Criteria	Evidence of Attainment
E-19.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to job requirements
E-19.02.02P	order ***components***	***components*** are ordered according to job requirements
E-19.02.03P	shut off ***utility services*** to the appliance	***utility services*** to the appliance are shut off according to job requirements and safety procedures
E-19.02.04P	disassemble equipment and ***components***	equipment and ***components*** are disassembled in required sequence according to job requirements
E-19.02.05P	replace and modify faulty and obsolete ***components***	faulty and obsolete ***components*** are replaced and modified if required
E-19.02.06P	reassemble and tighten ***components***	***components*** are reassembled and tightened according to manufacturers' specifications
E-19.02.07P	perform ***tests and readings***	***tests and readings*** are performed to verify that system is operating according to job requirements
E-19.02.08P	prepare service history	service history is recorded in logbook according to job standards

RANGE OF VARIABLES

tools and equipment include: hand tools, portable power tools, diagnostic equipment
components include: fan belts, motors, isolators, pulleys, coils, fasteners, ductwork, batteries, controls
utility services include: gas, electrical, water
tests and readings include: amperage draws, air pressure readings, filter conditions

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-19.02.01L	demonstrate knowledge of procedures for repairing worn or faulty ***components*** and the associated ***tools and equipment***	define terminology associated with the repair of worn or faulty ***components***
		identify ***tools and equipment*** used to repair worn or faulty ***components***, and describe their applications, limitations and procedures for use
		identify ***considerations*** for the repair of worn or faulty ***components***
		describe the procedures used to repair worn or faulty ***components***
E-19.02.02L	demonstrate knowledge of safe work practices and procedures pertaining to the repair of worn or faulty ***components***	identify hazards and describe safe work practices and procedures pertaining to the repair of worn or faulty ***components***
E-19.02.03L	demonstrate knowledge of codes, regulations and ***trade standards*** pertaining to the repair of worn or faulty ***components***	identify codes, regulations and ***trade standards*** pertaining to the repair of worn or faulty ***components***
E-19.02.04L	demonstrate knowledge of electrical components and equipment	identify ***electrical devices*** and describe their purpose
E-19.02.05L	demonstrate knowledge of performing calculations to determine system performance	describe the procedures used to perform calculations to determine system performance

RANGE OF VARIABLES

components include: fan belts, motors, isolators, pulleys, coils, fasteners, ductwork, batteries, controls

tools and equipment include: hand tools, portable power tools, diagnostic equipment

considerations include: type of replacement components, manufacturers' specifications, location of components, downtime during repair

trade standards include: SMACNA, ASHRAE, ANSI, NBC, CSA, Health Canada, TSB

electrical devices include: circuit breakers, disconnects, overload heaters, GFI, fuses, PLC, motors, variable speed drives (VSD), flow switches, thermostats

APPENDIX A
ACRONYMS

AHJ	Authority having jurisdiction
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
BIM	building information modelling
CAD	computer-aided design
CNC	Computer Numerical Control
CSA	Canadian Standards Association
CWB	Canadian Welding Bureau
GMAW	gas metal arc welding
GTAW	gas tungsten arc welding
HRV	heat recovery ventilator
HVAC	heating, ventilation and air conditioning
LEED	Leadership in Energy and Environmental Design
MUA	make-up air unit
NBC	National Building Code
NFPA	National Fire Protection Association
OBD	Opposed Blade Damper
OH&S	Occupational Health and Safety
PPE	personal protective equipment
PSI	pre-safety inspection
PVC	polyvinyl chloride
RFI	request for information
RTU	roof top unit
SDS	Safety Data Sheet
SMACNA	Sheet Metal and Air Conditioning National Association
SMAW	shielded metal arc welding
TAB	testing, adjusting and balancing
TABB	Testing, Adjusting and Balancing Bureau
TDC	transverse duct connectors
TDF	transverse duct flange
TSB	Transportation Safety Board
ULC	Underwriters Laboratories of Canada
WETT	Wood Energy Transfer Technology
WHMIS	Workplace Hazardous Materials Information System

APPENDIX B

TOOLS AND EQUIPMENT / OUTILS ET ÉQUIPEMENT

Hand Tools / Outils à main

adjustable wrench	clés à molette
aviation snips R.H. and L.H. (various)	cisailles aviation pour coupe à droite et à gauche (divers)
ball peen hammer	marteaux à panne ronde
banding tools	outils de cerclage
bulldog snips	cisailles Bulldog
bumping hammers	marteaux à débosseler
caulking gun	pistolets à calfeutrer
C-clamp	serre-joints en C
center punch	pointeaux centreurs
chalk line	cordeaux à craie
chipping hammer	marteaux burineurs
chisels	burins
combination snip	cisailles universelles
divider	compas à pointes sèches
drift pin	broches d'assemblage
duct puller/stretcher	tireurs et tendeurs de conduits
files	limes
groove seamer – hand groover	agrafeuses rainées – fraises manuelles à rainer
hacksaw	scies à métaux
hand crimpers	sertisseuses à main
hand dolly	tables à main
hand notcher	encocheuses à main
hand seamer/folding pliers	agrafeuses à main/plieuses manuelles
hex keys	clés hexagonales
hole punch	emporte-pièces
levels	niveaux
locking pliers	pince-étaux
magnets	aimants
mallet	maillets
marking pen	marqueurs
paint brush	pinceaux
pipe wrench	clés à tuyau
pliers	pinces
plumb bob	fils à plomb
riveter	riveteuse
prick punch	pointeaux de traçage
rivet set	bouterolles
riveting hammer	marteaux à riveter
scraper	grattoirs
scratch awl	pointes à tracer
screwdrivers	tournevis
scriber	traçoirs
setting hammer	marteaux à restreindre
side cutters	pinces coupantes de côté

socket set	jeux de douilles
soldering coppers	fers à souder
straight edge	règles droites
tap and die	tarauds et filières
wire and bolt cutters	coupe-fils et coupe-boulons
wire brushes	brosses métalliques
wrenches	clés

Portable Power Tools and Accessories / Outils mécaniques portatifs et accessoires

air compressor	compresseurs d’air
angle drill	perceuses d’angle
angle grinder	meuleuses d’angle
chop saw	scies à sectionner
circular saw	scies circulaires
cordless drill	perceuses sans fil
die grinder	meuleuses à rectifier les matrices
double cutter	fraises doubles
drill bits	forets
electric drill	perceuses électriques
generator	génératrices
hammer drill	marteaux perforateurs
hole saw	scies emporte-pièces
impact wrench	clés à chocs
jigsaw	scies sauteuses
nibbler	grignoteuses
spray gun	pistolets pulvérisateurs
pneumatic hammer	marteaux pneumatiques
pneumatic riveter	riveteuses pneumatiques
polisher and buffer	polisseuses
portable band saw	scies à ruban portatives
portable plasma cutter	coupeuses au plasma portatives
powder-actuated tool	fixateurs à cartouches
reciprocating saw	scies alternatives
seamer	agrafeuses
step bits	forets étagés
unishear	cisailles Unishear

Shop Tools and Equipment / Outils et équipement d’atelier

abrasive cut-off saw	scies à tronçonner abrasives
angle iron roller	cintreuses de cornières
band iron bender	plieuses de feuillard de fer
band saw	scies à ruban
bar folder	plieuses de barre
box and pan brake	plieuses pour boîte et plateau
button lock machine	machines à bouton de blocage
cleat folder	plieuses de clavettes
cleat machine	machines à clavettes
clinch lock machine	machines pour le clinchage de joints
cold cut saw	scies à froid
cut to length line	lignes de cisaillage
dimpler	emboutisseuses
drill index	calibres à forets
drill press	perceuses à colonne

foot shear	cisailles à pédale
grinder	meuleuses
hand brake	plieuses à main
hydraulic press	presses hydrauliques
lever bench shear	cisailles d’établi à levier
magnetic brake	plieuses magnétiques
manual notcher	encocheuses à main
pattern	patrons
pin spotter	localisateurs de goupilles
pipe-threader, cutter, reamer	filières à tuyaux, coupe-tuyaux, alésoirs à tuyaux
Pittsburgh machine	machines à joint à agrafe Pittsburgh
power brake	presse-plieuses mécaniques
power notcher	encocheuses mécaniques
power press	presses mécaniques
power punch	poinçons mécaniques
power roll former	machines à profiler mécaniques
power sander or polisher	ponceuses ou polisseuses mécaniques
power shear	cisailles mécaniques
punching shear	cisailles-poinçonneuses
rivet press	presses à riveter
riveting gun	pistolets à riveter
rotary punch	poinçons rotatifs
slitter	machines à refendre
snap-lock machine	machines pour plis snap lock
spiral duct machine	machine à conduits d’airs hélicoïdaux
transverse duct connector (TDC)/ transverse duct flange (TDF) machine	machines pour raccords de conduits transversaux et pour bride de conduits transversaux

Rotary Machines / Machines rotatives

combination beading and crimping machine	machines à border et à sertir
double seaming equipment	équipement pour agrafage double
easy edger	machines à border d’utilisation facile
ring and circle shears	cisailles circulaires à arbres inclinés
slip roll former	cintreuses à glissement
turning machines and attachments (such as elbow seaming, burring, beading, wiring, crimping)	tours et accessoires (comme pour l’agrafage sur bords relevés, l’ébarbage, le roulage de bord, l’enroulement de fil métallique, le sertissage)

Metal Forming Bench Stakes / Enclumettes pour la mise en forme de tôles

anvil	enclume
beak horn	bigorne
bench plate	table d’établi
blow horn	tas
candle mould	pour moule à chandelle
copper smith	de chaudronnier
creasing stake	bigorne à crêper
double seaming	pour agrafage double
double seaming with heads	pour agrafage double avec tête
hatchet	en forme de hachette
hollow mandrel	à mandrin creux
solid mandrel	à mandrin lisse
square	à tête carrée

Welding, Brazing, Soldering and Cutting Equipment / Équipement de brasage tendre, de brasage fort et de coupe

AC power unit	blocs d'alimentation c.a.
AC/DC power unit	blocs d'alimentation c.a./c.c.
butane torch	torches au butane
electric soldering iron	fers à souder électriques
gas metal arc welding (GMAW) equipment	équipement de soudage par procédé GMAW
gas tungsten arc welding (GTAW) equipment	équipement de soudage par procédé GTAW
laser cutting equipment	équipement de découpe au laser
oxy-fuel welding (OFW) equipment	équipement de soudage oxyacétylénique
plasma cutting equipment	équipement de découpe au plasma
shielded metal arc welding (SMAW) equipment	équipement de soudage par procédé SMAW
soldering coppers	fers à souder
soldering furnace or pot	fours ou pots à souder
spot welder	appareils de soudage par points
strongback	plaques de renfort
tiger torch	buses de lance-flammes
water jet cutting equipment	équipement de découpe au jet d'eau

Layout and Drafting Equipment / Équipement de traçage et de dessin

beam compass	compas à verge
circumference rule	règles de circonférence
combination square	équerres combinées
compass	compas
divider	compas à pointes sèches
drafting arm	bras orientable de planche à dessin
drafting pencil	crayons à dessin
drafting table	tables à dessin
eraser shield	gabarits à effacer
framing square	équerres de charpentier
parallel bar	barres parallèles
protractor	rapporteurs d'angle
scale ruler	règles graduées
set square	équerres à dessin
stencil	pochoirs
template	gabarits
trammel points	pointes d'un compas à verge
triangle	équerres à dessin
T-square	équerres en T

Measuring Tools / Instruments de mesure

angle finder	détecteurs d'angle
angle rule	rapporteurs d'angle
bench rule	règles d'établi
caliper	compas d'épaisseur
laser level	niveaux à laser
laser measure	mesures au laser
micrometer	micromètres
tape measure	rubans à mesurer
transit level	niveaux théodolites
vernier caliper	pieds à coulisse

Access Equipment / Équipement d'accès

aerial work platforms	plateformes de travail élévatrices
ladders	échelles
mast climbing lift	plateformes de travail sur mât
scaffolds	échafaudages
swing stage	échafaudages suspendus

Hoisting and Rigging Equipment / Équipement de hissage et de gréage

cable	câbles
chain blocks	palans à chaîne
chain hoist	palans à chaîne
chokers	étrangleurs
come-along	palans manuels
fork lift	chariots élévateurs à fourches
grip hoist	treuils manuels
hydraulic hoist	palans hydrauliques
material lift	monte-charges
overhead crane	ponts roulants
pulley (gin wheel)	poulies
rope	cordes
shackles	manilles
slings	élingues

Testing Equipment / Équipement d'essai

ammeter	ampèremètres
anemometer	anémomètres
calibrated flow hood	hottes à flux jaugées
CO_2 tester	contrôleurs de CO_2
digital combustion analyzer	analyseurs de combustion numériques
digital manometer	manomètres numériques
digital multimeter	multimètres numériques
digital scope	oscilloscopes numériques
digital thermometer	thermomètres numériques
duct thermometer	thermomètres pour conduits
grommet or plug	passe-fils ou bouchons
hygrometer	hygromètres
inclined manometer	manomètres à tube incliné
magnehelic pressure gauge	manomètres Magnehelic
mechanical tachometer	tachymètres mécaniques
micro amp meter	microampèremètres
multimeter	multimètres
CO tester	analyseurs de CO
O_2 tester	analyseurs d'O_2
pitot tube	tubes de Pitot
pressure gauge	manomètres
pressure tester	vérificateurs de pression
psychrometer	psychromètres
smoke tester	fumimètres
stack thermometer	thermomètres de gaz d'échappement
stethoscope	stéthoscopes
stop watch	chronomètres
strobe tachometer	tachymètres stroboscopiques

tachometer	tachymètres
U tube manometer	manomètres à tube en U
velometer	vélomètres

Computer Assisted Tools and Office Equipment / Outils assistés par ordinateur et materiel de bureau

computer hardware	matériel informatique
digital camera	caméras numériques
fax machine	télécopieurs
hand held personal computer (smart phone, tablet, laptop)	ordinateurs personnels portatifs (téléphone intelligent, tablette, ordinateur portable)
numerical control/computer numerical control equipment (NC/CNC) (plasma, laser, water jet)	équipement de commande numérique et de commande numérique par ordinateur (NC/CNC) (à l'arc plasma, au laser, à jet d'eau)
printer/scanner	imprimantes/numériseurs
software packages	progiciels

Personal Protective Equipment and Safety Equipment / Équipement de sécurité et de protection individuelle

coveralls	combinaisons de travail
eye protection	protection oculaire
eye wash station	douches oculaires
face shield	écrans faciaux
fall arrest equipment	dispositifs antichute
fire extinguisher	extincteurs
first aid kit	trousses de premiers soins
floatation devices	dispositifs de flottaison
fume exhaust system	systèmes d'évacuation de la fumée
gloves	gants
hard hat	casques de sécurité
hearing protection	protection auditive
high visibility safety vest	gilets de haute visibilité
leather apron	tabliers de cuir
reflective vest	gilets à bandes réflectrices
respiratory protection	protection des voies respiratoires
safety boots	bottes de sécurité
sun protection	protection contre le soleil
welding screen	écrans de soudeur
welding helmet	casques de soudeur
welding jacket	sarraus de soudeur

APPENDIX C
GLOSSARY / GLOSSAIRE

annealing	process by which metal is heated to relieve stress, changing the metal's strength and hardness	**recuit**	procédé consistant à chauffer le métal pour éliminer les tensions internes, changeant ainsi la résistance et la dureté du métal
backer rod	small foam rod or cord used to fill gaps between building materials	**tige d'appui**	petite tige ou cordon en mousse pour combler les écarts entre les matériaux de construction
blank piece	piece of material cut to size prior to notching or marking	**flan**	pièce de matériau coupée aux dimensions requises pour l'encochage ou le traçage
brake	manual or power equipment used to bend and form metal; may be CNC or manually controlled	**presse-plieuse**	équipement manuel ou mécanique utilisé pour plier et former le métal. Peut être contrôlé par CNC ou manuellement
breeching	the portion of a combustion venting system between appliance and the chimney or stack used for exhausting fumes and gases	**collecteur de fumée**	partie d'un réseau d'évacuation à combustion située entre l'appareil et la cheminée utilisée pour évacuer la fumée et les gaz
building envelope	a barrier between the interior and exterior environment of the building that serves as an outer shell to protect the indoor environment from elements such as moisture	**enveloppe de bâtiment**	barrière entre l'intérieur et l'extérieur du bâtiment qui sert de couche externe pour protéger l'intérieur du bâtiment contre les éléments comme l'humidité
burglar bars	heavy steel bars installed inside ductwork to prevent access	**barres antivol**	épaisses barres en acier installées dans les réseaux de conduits pour empêcher les entrées

cladding	a material (metal or composite) that covers another material to provide a skin or a layer; it is intended to control infiltration of weather elements or for aesthetic purposes	**placage**	matériau (métallique ou en composite) qui en recouvre un autre pour fournir un revêtement ou une couche. Il sert à contrôler l'infiltration d'éléments météorologiques ou à embellir
code B-139	provides minimum requirements for the installation of, alteration to, or addition to oil-burning equipment, components and accessories	**code B-139**	énonce les exigences minimales visant l'installation, la modification ou l'ajout des appareils de combustion, de composants et d'accessoires
code B-149	provides safety requirements for the installation of natural gas and propane appliances, equipment, components, and accessories where gas is to be used for fuel purposes	**code B-149**	énonce les exigences de sécurité visant l'installation des appareils de gaz naturel et de propane, des appareillages, des composants et des accessoires où le gaz est utilisé comme combustible
coping (architectural)	material used as the capping of a wall	**chaperon (architectural)**	matériau utilisé comme surfaçage d'un mur
crimper	power or manual tool used to allow round or square sheet metal pipes that are the same size to be corrugated to fit together	**sertisseuse**	outil électrique ou manuel utilisé pour permettre aux tuyaux en tôle ronds ou carrés de la même taille d'être ondulés pour s'insérer l'un dans l'autre
damper	valve or plate that stops or regulates the flow of air or materials	**volet**	soupape ou plaque qui bloque ou régularise le débit d'air ou les matériaux
duct traverse	series of evenly spaced pressure readings inside of a duct to measure various pressures at points within the duct	**point d'échantillonnage du conduit**	série de lectures de pression uniformément espacées à l'intérieur du conduit pour mesurer diverses pressions aux points à l'intérieur du conduit

flashing	thin piece of sheet metal or other impervious material installed to prevent the passage of water into a structure from an angle or joint	**solin**	mince pièce de tôle ou d'un autre matériau imperméable installée pour empêcher l'infiltration d'eau dans une structure par une cornière ou un joint
interference drawings	drawings that show the coordinated layout of all mechanical, electrical, structural and architectural systems and how the placement of different systems may interfere with one another	**figures d'interférence**	dessins qui montrent la disposition coordonné de tous les systèmes mécaniques, électriques, structurels et architecturaux et comment le placement de différents systèmes peut interférer les uns avec les autres
isolation	product used between two dissimilar metals to prevent galvanic corrosion (used in roofing, air handling and material handling applications)	**isolation**	produit utilisé entre deux métaux de nature différente afin d'empêcher l'électrolyse (utilisée dans les applications de toiture, de traitement de l'air et de manipulation de matériaux
isolator	components that minimize noise, sound and vibration transfer	**isolateur**	composant qui minimise le bruit, les sons et les vibrations
lagging	protects insulation from damage and provides a barrier around the insulation; it also creates a true, flat and even surface for aesthetic purposes	**revêtement calorifuge**	protège l'isolant des dommages et fournit une barrière autour de l'isolant. Crée aussi une surface droite, plate et égale pour des raisons d'esthétique
parallel line development	method of pattern development based upon lines at an equal distance at all points	**développement en traits parallèles**	méthode de conception de modèle reposant sur le fait qu'une ligne qui est parallèle à une autre se trouve à une distance égale à tous les points
plasma cutting	process used to cut metal using a plasma torch	**coupage au jet de plasma**	méthode utilisée pour couper à l'aide d'un chalumeau à plasma
radial line development	method of conical pattern development where all points radiate from a common apex	**développement de lignes radiales**	méthode de conception de modèle conique où tous les points partent d'un sommet commun

seam/lock	any process of connecting two pieces or two ends of metal together	**joint/agrafe**	toute méthode consistant à joindre deux pièces ou deux bords de métal
shear	equipment or a process of cutting sheet metal	**cisailles ou cisaillement**	équipement ou méthode de coupage de tôle
stake	equipment used in forming material by hand; usually found in a sheet metal shop	**enclume**	matériel utilisé pour le formage de matériau à la main ; on la trouve habituellement en tôlerie
stand-offs	material or device used to create a gap between two layers of material	**pièce d'espacement**	matériau ou dispositif utilisé pour créer un espace entre deux couches de matériau
stretch-out	gross stretch-out: overall length of material, including locks and seams; net stretch-out: overall length of material, not including locks and seams	**développement**	développement brut : longueur hors tout du matériau, comprenant toutes les agrafes et tous les joints; développement net : longueur hors tout du matériau, à l'exclusion des agrafes et des joints
strongback	support to keep a welding joint straight and prevent weld distortion	**plaque de renfort**	appui permettant de garder le joint de soudure droit et d'empêcher la distorsion due à la soudure
thermal insulation	material installed on the outside of duct used to reduce the rate of heat transfer	**isolant thermique**	matériau installé à l'extérieur de la conduite utilisé pour réduire le taux de transfert de chaleur
triangulation development	method of pattern development using right angle triangles and two known points to find a third unknown point	**triangulation**	méthode de conception de modèle à l'aide de triangles à angle droit et de deux points connus pour trouver un troisième point inconnu