

RED SEAL

OCCUPATIONAL

STANDARD

SHEET METAL WORKER



Title: Sheet Metal Worker

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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](mailto:redseal-sceaurouge@hrsdc-rhdcc.gc.ca)

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

**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

ACKNOWLEDGEMENTS

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|  |  |
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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.

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:

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 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.

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](http://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-assisted 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.

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.

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% |

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| --- | --- | --- | --- | --- |
| 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 |  |

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| B – Performs fabrication | 31% |

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| 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 |  |  |

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| C – Installs air and material handling systems | 35% |

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| 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 |

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| D – Installs roofing and specialty products | 8% |

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| 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) |

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| E – Performs maintenance and repair | 6% |

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| --- | --- | --- | --- | --- |
| 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 |  |

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 |

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| **Essential Skills** | Thinking, Document Use, Continuous Learning |

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| **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 |

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| --- | --- | --- |
|  | 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

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| --- | --- | --- |
|  | 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

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| --- | --- |
| A-1.02 | Maintains safe work environment |

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| **Essential Skills** | Thinking, Oral Communication, Document Use |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 |

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| --- | --- | --- |
|  | 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

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| --- | --- | --- |
|  | 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

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

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| **Essential Skills** | Thinking, Working with Others, Oral Communication |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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.

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| --- | --- |
| A-2.01 | Uses hand and portable power tools |

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| --- | --- |
| **Essential Skills** | Thinking, Continuous Learning, Document Use |

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| **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 |

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| --- | --- | --- |
|  | 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

|  |  |
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| A-2.02 | Uses shop tools and equipment |

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| **Essential Skills** | Thinking, Digital Technology, Oral Communication |

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| **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 |

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| --- | --- | --- |
|  | 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

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

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| **Essential Skills** | Thinking, Document Use, Continuous Learning |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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

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| --- | --- | --- |
|  | 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

|  |  |
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| A-2.04 | Uses resistance spot welding equipment |

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| **Essential Skills** | Thinking, Document Use, Continuous Learning |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 |

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| **Essential Skills** | Thinking, Document Use, Continuous Learning |

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| **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

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

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| **Essential Skills** | Thinking, Document Use, Continuous Learning |

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| **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

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| --- | --- | --- |
|  | 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

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

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| **Essential Skills** | Thinking, Document Use, Continuous Learning |

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| **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

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| --- | --- | --- |
|  | 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 plasma arc cutting procedures | describe the procedures used to prepare 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

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| A-2.08 | Uses soldering and brazing equipment |

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| **Essential Skills** | Thinking, Document Use, Continuous Learning |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 equipmentare 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

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| A-2.09 | Uses measuring and layout equipment |

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| **Essential Skills** | Thinking, Document Use, Numeracy |

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| **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 |

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| --- | --- | --- |
|  | 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 |

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|  | 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

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| A-2.10 | Uses testing and inspection devices |

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| **Essential Skills** | Document Use, Thinking, Numeracy |

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| **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 |

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|  | 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 |

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|  | 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

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| A-2.11 | Uses stationary and mobile work platforms |

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| **Essential Skills** | Document Use, Working with Others, Thinking |

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| **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 |

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|  | 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

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|  | 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 storestationary and mobile work platforms |
| A-2.11.02L | demonstrate knowledge of safe work practices and procedures pertaining tostationary 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 tostationary 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

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| A-2.12 | Uses hoisting, rigging and positioning equipment |

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| **Essential Skills** | Oral Communication, Thinking, Working with Others |

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| **NL** | **NS** | **PE** | **NB** | **QC** | **ON** | **MB** | **SK** | **AB** | **BC** | **NT** | **YT** | **NU** |
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|  | SKILLS | |
|  | **Performance Criteria** | **Evidence of Attainment** |
| A-2.12.01P | select and use hoisting, rigging and positioning equipment | hoisting, rigging and positioning equipment is selectedand usedaccording 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

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|  | 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 tohoisting, 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.

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| A-3.01 | Uses trade-related documentation |

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| **Essential Skills** | Document Use, Thinking, Writing |

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| **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 |

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|  | 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

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|  | 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

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| A-3.02 | Interprets drawings |

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| **Essential Skills** | Thinking, Document Use, Working with Others |

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| **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 |

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|  | 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

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|  | 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

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| A-3.03 | Organizes materials and equipment for project |

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| **Essential Skills** | Working with Others, Thinking, Oral Communication |

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| **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 |

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|  | SKILLS | |
|  | **Performance Criteria** | **Evidence of Attainment** |
| A-3.03.01P | use materials and equipment | materials and equipmentare 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 equipmentrequirements 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

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|  | 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

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| A-3.04 | Performs basic design and field modifications |

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| **Essential Skills** | Thinking, Numeracy, Oral Communication |

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| **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 |

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|  | 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 |

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|  | 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.

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| A-4.01 | Uses communication techniques |

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| **Essential Skills** | Oral Communication, Working with Others, Continuous Learning |

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| **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 |

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| --- | --- | --- |
|  | 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

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|  | 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

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| A-4.02 | Uses mentoring techniques |

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| **Essential Skills** | Working with Others, Oral Communication, Continuous Learning |

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| **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 |

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|  | 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

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|  | 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.

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| B-5.01 | Develops patterns using simple and straight line layout |

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| **Essential Skills** | Numeracy, Thinking, Document Use |

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| **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 |

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|  | 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 |

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|  | 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

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| B-5.02 | Develops patterns using parallel line method |

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| **Essential Skills** | Numeracy, Thinking, Document Use |

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| **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 |

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|  | 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 |

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|  | 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

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| B-5.03 | Develops patterns using radial line method |

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| **Essential Skills** | Numeracy, Thinking, Document Use |

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| **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 |

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|  | 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 |

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|  | 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

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| B-5.04 | Develops patterns using triangulation method |

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| **Essential Skills** | Numeracy, Thinking, Document Use |

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| **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 |

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|  | 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 |

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|  | 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

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| B-5.05 | Uses computer technology for pattern development |

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| **Essential Skills** | Document Use, Digital Technology, Thinking |

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| **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 |

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|  | 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

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|  | 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.

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| B-6.01 | Cuts ductwork, fittings and components |

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| **Essential Skills** | Numeracy, Document Use, Thinking |

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| **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 |

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|  | 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

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|  | 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

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| B-6.02 | Forms ductwork, fittings and components |

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| **Essential Skills** | Numeracy, Document Use, Thinking |

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| **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 |

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|  | 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

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|  | 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

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| B-6.03 | Insulates ductwork, fittings and components |

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| **Essential Skills** | Numeracy, Document Use, Reading |

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| **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 |

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|  | 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

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|  | 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

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| B-6.04 | Assembles ductwork, fittings and components |

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| **Essential Skills** | Numeracy, Thinking, Document Use |

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| **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 |

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|  | 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

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|  | 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

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| B-6.05 | Fabricates dampers |

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| **Essential Skills** | Numeracy, Document Use, Thinking |

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| **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 |

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|  | 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

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|  | 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

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| B-6.06 | Fabricates hanger systems, supports and bases |

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| **Essential Skills** | Numeracy, Reading, Thinking |

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| **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 |

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|  | 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)

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|  | 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.

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

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| **Essential Skills** | Numeracy, Thinking, Document Use |

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| **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 |

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|  | 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

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|  | 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

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| B-7.02 | Forms flashing, roofing, sheeting and cladding |

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| **Essential Skills** | Numeracy, Document Use, Thinking |

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| **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 |

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|  | 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

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|  | 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.

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| B-8.01 | Cuts material for specialty products |

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| **Essential Skills** | Numeracy, Thinking, Document Use |

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| **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 |

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|  | 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

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|  | 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

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| B-8.02 | Forms specialty products |

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| **Essential Skills** | Numeracy, Document Use, Thinking |

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| **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 |

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|  | 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

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|  | 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

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| B-8.03 | Assembles specialty products |

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| **Essential Skills** | Thinking, Document Use, Numeracy |

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| **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 |

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|  | 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

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|  | 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

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| B-8.04 | Finishes specialty products |

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| **Essential Skills** | Continuous Learning, Document Use, Thinking |

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| **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 |

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|  | 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

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|  | 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.

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| C-9.01 | Performs on-site measurements |

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| **Essential Skills** | Numeracy, Document Use, Thinking |

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| **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 |

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|  | 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

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|  | 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

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| C-9.02 | Performs demolitions for renovations |

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| **Essential Skills** | Oral Communication, Thinking, Working with Others |

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| **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 |

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|  | 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

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|  | 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

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| C-9.03 | Installs penetrations and sleeves |

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| **Essential Skills** | Thinking, Working with Others, Oral Communication |

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| **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 |

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|  | 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)

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|  | 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

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| C-9.04 | Installs supports and bases |

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| **Essential Skills** | Document Use, Thinking, Numeracy |

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| **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 |

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|  | 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

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|  | 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

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| C-9.05 | Installs hangers, cables, braces and brackets |

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| **Essential Skills** | Thinking, Reading, Numeracy |

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| **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 |

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|  | 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

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|  | 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 specificationspertaining 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.

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| C-10.01 | Installs chimney |

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| **Essential Skills** | Document Use, Numeracy, Thinking |

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| **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 |

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|  | 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

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|  | 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

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

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| **Essential Skills** | Thinking, Document Use, Numeracy |

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| **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 |

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|  | 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

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|  | 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)

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| C-10.03 | Installs high efficiency appliances and mechanical equipment |

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| **Essential Skills** | Numeracy, Thinking, Document Use |

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| **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 |

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|  | 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

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|  | 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.

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| C-11.01 | Installs air handling equipment |

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| **Essential Skills** | Working with Others, Document Use, Thinking |

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| **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 |

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|  | 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

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|  | KNOWLEDGE | |
|  | **Learning Outcomes** | **Learning Objectives** |
| C-11.01.01L | demonstrate knowledge of installation procedures for air handling equipmentand the associated ***tools and equipment*** | define terminology associated with air handling equipment |
|  |  | identify ***tools and equipment*** used for installing air handling equipmentand 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 equipmentfound 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

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| C-11.02 | Installs sheet metal ducts and fittings |

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| **Essential Skills** | Thinking, Document Use, Working with Others |

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| **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 |

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|  | 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

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|  | 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

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| C-11.03 | Installs dampers |

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| **Essential Skills** | Document Use, Thinking, Working with Others |

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| **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 |

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|  | 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

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|  | 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

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| C-11.04 | Installs fire and fire/smoke dampers |

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| **Essential Skills** | Thinking, Working with Others, Document Use |

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| **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 |

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|  | 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

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|  | 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

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| C-11.05 | Installs registers, grilles, diffusers and louvers |

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| **Essential Skills** | Document Use, Thinking, Numeracy |

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| **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 |

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|  | 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

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|  | 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

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| C-11.06 | Installs terminal boxes |

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| **Essential Skills** | Document Use, Numeracy, Thinking |

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| **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 |

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|  | 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

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|  | 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

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| C-11.07 | Installs coils |

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| **Essential Skills** | Thinking, Document Use, Numeracy |

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| **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 |

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|  | 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

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|  | 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

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| C-11.08 | Installs system component accessories |

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| **Essential Skills** | Thinking, Document Use, Numeracy |

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| **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 |

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|  | 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

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|  | 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

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| C-11.09 | Installs plenums |

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| **Essential Skills** | Thinking, Document Use, Working with Others |

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| **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 |

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| --- | --- | --- |
|  | 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.

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| C-12.01 | Installs pneumatic and gravity material handling system components |

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| **Essential Skills** | Document Use, Numeracy, Thinking |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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

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| --- | --- | --- |
|  | 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

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| C-12.02 | Installs mechanized material handling system components |

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| **Essential Skills** | Document Use, Numeracy, Thinking |

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| **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 componentsand 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.

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| C-13.01 | Applies thermal insulation to components |

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| **Essential Skills** | Thinking, Document Use, Numeracy |

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| **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 |

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| --- | --- | --- |
|  | 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

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|  | 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

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| C-13.02 | Applies lagging and cladding to components |

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| **Essential Skills** | Document Use, Numeracy, Thinking |

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| **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 |

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| --- | --- | --- |
|  | 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 tojob 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

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|  | 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

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| C-13.03 | Applies flashing to components |

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| **Essential Skills** | Document Use, Numeracy, Thinking |

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| **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 |

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| --- | --- | --- |
|  | 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

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| --- | --- | --- |
|  | 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.

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| C-14.01 | Performs leak tests |

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| **Essential Skills** | Numeracy, Document Use, Thinking |

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| **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 |

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| --- | --- | --- |
|  | 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

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| --- | --- | --- |
|  | 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

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

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| **Essential Skills** | Numeracy, Writing, Thinking |

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| **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 |

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| --- | --- | --- |
|  | 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

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|  | 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

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

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| **Essential Skills** | Oral Communication, Working with Others, Writing |

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| **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

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|  | 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.

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| D-15.01 | Lays out roof and walls |

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| **Essential Skills** | Document Use, Thinking, Numeracy |

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| **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 |

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| --- | --- | --- |
|  | 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 jobrequirements |
| 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

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|  | 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

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

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| **Essential Skills** | Reading, Numeracy, Thinking |

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| **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 |

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|  | 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 jobrequirements |
| 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

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|  | 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

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| D-15.03 | Installs roofing and cladding/siding system components |

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| **Essential Skills** | Document Use, Numeracy, Thinking |

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| **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 |

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|  | 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 jobrequirements |
| 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

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|  | 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

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| D-15.04 | Seals exposed joints |

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| **Essential Skills** | Document Use, Oral Communication, Continuous Learning |

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| **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 |

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| --- | --- | --- |
|  | 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

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|  | 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

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| D-15.05 | Installs decking |

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| **Essential Skills** | Oral Communication, Working with Others, Thinking |

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| **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 |

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|  | 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

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|  | 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.

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| D-16.01 | Prepares surface |

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| **Essential Skills** | Document Use, Thinking, Numeracy |

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| **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 |

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|  | 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

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|  | 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 installingfastening 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

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| D-16.02 | Fastens exterior components |

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| **Essential Skills** | Reading, Working with Others, Thinking |

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| **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 |

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| --- | --- | --- |
|  | 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 componentsare 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

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|  | 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.

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| D-17.01 | Installs stainless steel specialty products |

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| **Essential Skills** | Thinking, Numeracy, Continuous Learning |

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| **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 |

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| --- | --- | --- |
|  | 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

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|  | 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 |

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| --- | --- |
| **Essential Skills** | Thinking, Numeracy, Continuous Learning |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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

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| --- | --- | --- |
|  | 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

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| D-17.03 | Installs marine products (Not Common Core) |

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| **Essential Skills** | Thinking, Numeracy, Continuous Learning |

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| **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

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| --- | --- | --- |
|  | 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.

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| E-18.01 | Performs maintenance inspections |

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| **Essential Skills** | Writing, Oral Communication, Document Use |

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| **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

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| --- | --- | --- |
|  | 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 |

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| **Essential Skills** | Document Use, Thinking, Numeracy |

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| **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.

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| E-19.01 | Diagnoses system faults |

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| **Essential Skills** | Thinking, Numeracy, Reading |

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| **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 |

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| --- | --- | --- |
|  | 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

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| --- | --- | --- |
|  | 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

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| --- | --- |
| E-19.02 | Repairs worn or faulty components |

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| --- | --- |
| **Essential Skills** | Document Use, Thinking, Numeracy |

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| **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-assisted 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

Hand Tools

|  |  |
| --- | --- |
| adjustable wrench |  |
| aviation snips R.H. and L.H. (various) |  |
| ball peen hammer |  |
| banding tools |  |
| bulldog snips |  |
| bumping hammers |  |
| caulking gun |  |
| C-clamp |  |
| center punch |  |
| chalk line |  |
| chipping hammer |  |
| chisels |  |
| combination snip |  |
| divider |  |
| drift pin |  |
| duct puller/stretcher |  |
| files |  |
| groove seamer – hand groover |  |
| hacksaw |  |
| hand crimpers |  |
| hand dolly |  |
| hand notcher |  |
| hand seamer/folding pliers |  |
| hex keys |  |
| hole punch |  |
| levels |  |
| locking pliers |  |
| magnets |  |
| mallet |  |
| marking pen |  |
| paint brush |  |
| pipe wrench |  |
| pliers |  |
| plumb bob |  |
| riveter |  |
| prick punch |  |
| rivet set |  |
| riveting hammer |  |
| scraper |  |
| scratch awl |  |
| screwdrivers |  |
| scriber |  |
| setting hammer |  |
| side cutters |  |
| socket set |  |
| soldering coppers |  |
| straight edge |  |
| tap and die |  |
| wire and bolt cutters |  |
| wire brushes |  |
| wrenches |  |

Portable Power Tools and Accessories

|  |  |
| --- | --- |
| air compressor |  |
| angle drill |  |
| angle grinder |  |
| chop saw |  |
| circular saw |  |
| cordless drill |  |
| die grinder |  |
| double cutter |  |
| drill bits |  |
| electric drill |  |
| generator |  |
| hammer drill |  |
| hole saw |  |
| impact wrench |  |
| jigsaw |  |
| nibbler |  |
| spray gun |  |
| pneumatic hammer |  |
| pneumatic riveter |  |
| polisher and buffer |  |
| portable band saw |  |
| portable plasma cutter |  |
| powder‑actuated tool |  |
| reciprocating saw |  |
| seamer |  |
| step bits |  |
| unishear |  |

Shop Tools and Equipment

|  |  |
| --- | --- |
| abrasive cut-off saw |  |
| angle iron roller |  |
| band iron bender |  |
| band saw |  |
| bar folder |  |
| box and pan brake |  |
| button lock machine |  |
| cleat folder |  |
| cleat machine |  |
| clinch lock machine |  |
| cold cut saw |  |
| cut to length line |  |
| dimpler |  |
| drill index |  |
| drill press |  |
| foot shear |  |
| grinder |  |
| hand brake |  |
| hydraulic press |  |
| lever bench shear |  |
| magnetic brake |  |
| manual notcher |  |
| pattern |  |
| pin spotter |  |
| pipe-threader, cutter, reamer |  |
| Pittsburgh machine |  |
| power brake |  |
| power notcher |  |
| power press |  |
| power punch |  |
| power roll former |  |
| power sander or polisher |  |
| power shear |  |
| punching shear |  |
| rivet press |  |
| riveting gun |  |
| rotary punch |  |
| slitter |  |
| snap-lock machine |  |
| spiral duct machine |  |
| transverse duct connector (TDC)/ transverse duct flange (TDF) machine |  |

Rotary Machines

|  |  |
| --- | --- |
| combination beading and crimping machine |  |
| double seaming equipment |  |
| easy edger |  |
| ring and circle shears |  |
| slip roll former |  |
| turning machines and attachments (such as elbow seaming, burring, beading, wiring, crimping) |  |

Metal Forming Bench Stakes

|  |  |
| --- | --- |
| anvil |  |
| beak horn |  |
| bench plate |  |
| blow horn |  |
| candle mould |  |
| copper smith |  |
| creasing stake |  |
| double seaming |  |
| double seaming with heads |  |
| hatchet |  |
| hollow mandrel |  |
| solid mandrel |  |
| square |  |

Welding, Brazing, Soldering and Cutting Equipment

|  |  |
| --- | --- |
| AC power unit |  |
| AC/DC power unit |  |
| butane torch |  |
| electric soldering iron |  |
| gas metal arc welding (GMAW) equipment |  |
| gas tungsten arc welding (GTAW) equipment |  |
| laser cutting equipment |  |
| oxy-fuel welding (OFW) equipment |  |
| plasma cutting equipment |  |
| shielded metal arc welding (SMAW) equipment |  |
| soldering coppers |  |
| soldering furnace or pot |  |
| spot welder |  |
| strongback |  |
| tiger torch |  |
| water jet cutting equipment |  |

Layout and Drafting Equipment

|  |  |
| --- | --- |
| beam compass |  |
| circumference rule |  |
| combination square |  |
| compass |  |
| divider |  |
| drafting arm |  |
| drafting pencil |  |
| drafting table |  |
| eraser shield |  |
| framing square |  |
| parallel bar |  |
| protractor |  |
| scale ruler |  |
| set square |  |
| stencil |  |
| template |  |
| trammel points |  |
| triangle |  |
| T-square |  |

Measuring Tools

|  |  |
| --- | --- |
| angle finder |  |
| angle rule |  |
| bench rule |  |
| caliper |  |
| laser level |  |
| laser measure |  |
| micrometer |  |
| tape measure |  |
| transit level |  |
| vernier caliper |  |

Access Equipment

|  |  |
| --- | --- |
| aerial work platforms |  |
| ladders |  |
| mast climbing lift |  |
| scaffolds |  |
| swing stage |  |

Hoisting and Rigging Equipment

|  |  |
| --- | --- |
| cable |  |
| chain blocks |  |
| chain hoist |  |
| chokers |  |
| come-along |  |
| fork lift |  |
| grip hoist |  |
| hydraulic hoist |  |
| material lift |  |
| overhead crane |  |
| pulley (gin wheel) |  |
| rope |  |
| shackles |  |
| slings |  |

Testing Equipment

|  |  |
| --- | --- |
| ammeter |  |
| anemometer |  |
| calibrated flow hood |  |
| CO₂ tester |  |
| digital combustion analyzer |  |
| digital manometer |  |
| digital multimeter |  |
| digital scope |  |
| digital thermometer |  |
| duct thermometer |  |
| grommet or plug |  |
| hygrometer |  |
| inclined manometer |  |
| magnehelic pressure gauge |  |
| mechanical tachometer |  |
| micro amp meter |  |
| multimeter |  |
| CO tester |  |
| O₂ tester |  |
| pitot tube |  |
| pressure gauge |  |
| pressure tester |  |
| psychrometer |  |
| smoke tester |  |
| stack thermometer |  |
| stethoscope |  |
| stop watch |  |
| strobe tachometer |  |
| tachometer |  |
| U tube manometer |  |
| velometer |  |

Computer Assisted Tools and Office Equipment

|  |  |
| --- | --- |
| computer hardware |  |
| digital camera |  |
| fax machine |  |
| hand held personal computer (smart phone, tablet, laptop) |  |
| numerical control/computer numerical control equipment (NC/CNC) (plasma, laser, water jet) |  |
| printer/scanner |  |
| software packages |  |

Personal Protective Equipment and Safety Equipment

|  |  |
| --- | --- |
| coveralls |  |
| eye protection |  |
| eye wash station |  |
| face shield |  |
| fall arrest equipment |  |
| fire extinguisher |  |
| first aid kit |  |
| floatation devices |  |
| fume exhaust system |  |
| gloves |  |
| hard hat |  |
| hearing protection |  |
| high visibility safety vest |  |
| leather apron |  |
| reflective vest |  |
| respiratory protection |  |
| safety boots |  |
| sun protection |  |
| welding screen |  |
| welding helmet |  |
| welding jacket |  |

APPENDIX C

GLOSSARY

|  |  |  |  |
| --- | --- | --- | --- |
| **annealing** | process by which metal is heated to relieve stress, changing the metal’s strength and hardness |  |  |
| **backer rod** | small foam rod or cord used to fill gaps between building materials |  |  |
| **blank piece** | piece of material cut to size prior to notching or marking |  |  |
| **brake** | manual or power equipment used to bend and form metal; may be CNC or manually controlled |  |  |
| **breeching** | the portion of a combustion venting system between appliance and the chimney or stack used for exhausting fumes and gases |  |  |
| **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 |  |  |
| **burglar bars** | heavy steel bars installed inside ductwork to prevent access |  |  |
| **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 |  |  |
| **code B-139** | provides minimum requirements for the installation of, alteration to, or addition to oil-burning equipment, components and accessories |  |  |
| **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 |  |  |
| **coping (architectural)** | material used as the capping of a wall |  |  |
| **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 |  |  |
| **damper** | valve or plate that stops or regulates the flow of air or materials |  |  |
| **duct traverse** | series of evenly spaced pressure readings inside of a duct to measure various pressures at points within the duct |  |  |
| **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 |  |  |
| **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 |  |  |
| **isolation** | product used between two dissimilar metals to prevent galvanic corrosion (used in roofing, air handling and material handling applications) |  |  |
| **isolator** | components that minimize noise, sound and vibration transfer |  |  |
| **lagging** | protects insulation from damage and provides a barrier around the insulation; it also creates a true, flat and even surface for aesthetic purposes |  |  |
| **parallel line development** | method of pattern development based upon lines at an equal distance at all points |  |  |
| **plasma cutting** | process used to cut metal using a plasma torch |  |  |
| **radial line development** | method of conical pattern development where all points radiate from a common apex |  |  |
| **seam/lock** | any process of connecting two pieces or two ends of metal together |  |  |
| **shear** | equipment or a process of cutting sheet metal |  |  |
| **stake** | equipment used in forming material by hand; usually found in a sheet metal shop |  |  |
| **stand-offs** | material or device used to create a gap between two layers of material |  |  |
| **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 |  |  |
| **strongback** | support to keep a welding joint straight and prevent weld distortion |  |  |
| **thermal insulation** | material installed on the outside of duct used to reduce the rate of heat transfer |  |  |
| **triangulation development** | method of pattern development using right angle triangles and two known points to find a third unknown point |  |  |