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# Red Seal Occupational Standard

## Gasfitter - Class A

INTERPROVINCIAL STANDARD
CANADA
NORME INTERPROVINCIALE

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Employment and Social Development Canada
Emploi et Développement social Canada

Canada

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# Foreword

***The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Red Seal Occupational Standard (RSOS) as the Red Seal standard for the Gasfitter - Class A 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) funds 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 occupational standards.

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 Sectoral Initiatives Directorate
Employment and Social Development Canada
140 Promenade du Portage, Phase IV
Gatineau, Quebec K1A 0J9

# Acknowledgements

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Special thanks are offered to the following representatives who contributed greatly to the original draft of the standard and provided expert advice throughout its development:

| | |
|---|---|
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This standard was prepared by the Apprenticeship and Sectoral Initiatives Directorate of ESDC. The coordinating, facilitating and processing of this standard were undertaken by employees of the standards development team of the Trades and Apprenticeship Division and of Alberta, the host jurisdiction for this trade.

# Structure of the Occupational Standard

This standard contains the following sections:

**Methodology:** an overview of the process for development, review, validation and weighting of the standard

**Description of the Gasfitter – Class A Trade:** an overview of the trade's duties, work environment, job requirements, similar occupations and career progression

**Trends in the Gasfitter – Class A Trade:** some of the trends identified by industry as being the most important for workers in this trade

**Skills for Success Summary:** an overview of how each of the skills for success (formerly called essential skills) is applied in this trade

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

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

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

**Pie Chart of Red Seal Examination Weightings:** a graph which depicts the national percentages of exam questions assigned to the major work activities

**Task Matrix and Weightings:** a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard and the national percentages of exam questions assigned to the major work activities and tasks

**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

**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

**Range of Variables:** elements and examples (not all inclusive) that provide a more in-depth description of a term used in the performance criteria and evidence of attainment

**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 of Variables:** elements and examples (not all inclusive) that provide a more in-depth description of a term used in the learning outcomes and learning objectives

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

**Appendix B – Tools and Equipment / Outils et équipement:** a bilingual non-exhaustive list of tools and equipment used in this trade

**Appendix C – Glossary / Glossaire:** bilingual definitions or explanations of selected technical terms used in the standard

# Methodology

**Development of the Standard**

A draft standard is developed by a broad group of trade representatives, including tradespeople, instructors and employers at a National Workshop led by a team of facilitators. This draft standard breaks down all the tasks performed in the occupation and describes the knowledge and abilities required for a tradesperson to demonstrate competence in the trade.

**Online Survey**

Stakeholders are asked to review and validate the activities described in the new standard via an online survey. These stakeholders are invited to participate in this consultation through apprenticeship authorities, as well as national stakeholder groups.

**Draft Review**

The RSOS development team forwards a copy of the standard to provincial and territorial authorities who consult with industry representatives to review it. Their recommendations are assessed and incorporated into the standard.

**Validation and Weighting**

Participating provinces and territories also consult with industry to validate and weight the document for the purpose of planning the makeup of the Red Seal Interprovincial Examination for the trade. They validate and weight the major work activities (MWA), tasks and sub-tasks, of the standard as follows:

| | |
|---|---|
| **MWA** | Each jurisdiction assigns a percentage of questions to each MWA for an examination that would cover the entire trade. |
| **Tasks** | Each jurisdiction assigns a percentage of exam questions to each task within a MWA. |
| **Sub-tasks** | Each jurisdiction indicates, with a “yes” or “no”, whether or not each sub-task is performed by skilled workers within the occupation in its jurisdiction. |

The results of this exercise are submitted to the RSOS development team who then analyzes the data and incorporates it into the document. The RSOS provides the individual jurisdictional validation results as well as the national averages of all responses. The national averages for MWA and task weighting guide the Interprovincial Red Seal Examination plan for the trade.

The validation of the RSOS is used to identify common core sub-tasks across Canada for the occupation. If at least 70% of the responding jurisdictions’ industry performs a sub-task, it shall be considered common core. Interprovincial Red Seal Examination questions are limited to the common core sub-tasks identified through this validation process.

**Definitions for Validation and Weighting**

| | |
|---|---|
| **yes** | sub-task performed by qualified workers in the occupation in that province or territory |
| **no** | sub-task not performed by qualified workers in the occupation in that province or territory |
| **NV** | standard Not Validated by that province or territory |
| **ND** | trade Not Designated in a province or territory |
| **Not Common Core (NCC)** | sub-task, task or MWA performed less than 70% of responding jurisdictions; these will not be tested by the Interprovincial Red Seal Examination for the trade |
| **National Average %** | average percentage of questions assigned to each MWA and task in Interprovincial Red Seal Examination for the trade |

**Provincial/Territorial Abbreviations**

| | |
|---|---|
| **NL** | Newfoundland and Labrador |
| **NS** | Nova Scotia |
| **PE** | Prince Edward Island |
| **NB** | New Brunswick |
| **QC** | Quebec |
| **ON** | Ontario |
| **MB** | Manitoba |
| **SK** | Saskatchewan |
| **AB** | Alberta |
| **BC** | British Columbia |
| **NT** | Northwest Territories |
| **YT** | Yukon Territory |
| **NU** | Nunavut |

# Description of the Gasfitter – Class A Trade

Gasfitters – Class A design, install, test, adjust, maintain, and repair fuel piping systems, venting, air supply systems, appliances, equipment and accessories in various sectors.

Gasfitters – Class A may work in residential, manufacturing, industrial, commercial, and institutional (ICI) sectors where large fuel-fired appliances and equipment are encountered. These appliances can consume thousands of cubic meters of fuel per hour and may have very sophisticated burner management systems that rely on monitoring and safety interlocks and an integrated operating interface.

They work on appliances and equipment including those exceeding 400 000 British Thermal Units per hour (Btuhs) or 120 kilowatts (kW).

Appliances and equipment may include boilers, burners, makeup air units, furnaces, process burners, domestic and commercial equipment, and various other fuel-fired equipment. Some can be quite complex and may incorporate sophisticated electronic control systems and monitoring circuits.

Depending on regional and jurisdictional regulations and limitations, fuels may include natural gas, manufactured gas, oil, liquefied petroleum gas, digester gas, landfill gas, biogas, hydrogen or a mixture or dilution of any of these gases.

Gasfitters – Class A may be employed to repair and extend gas lines, and install, repair and service pipes and fittings between mains and buildings. They may also be employed in the propane, compressed natural gas (CNG) and hydrogen industry to install and service propane containers, vaporizers, metering, dispensing and pumping equipment. With the increase in demand for renewable natural gas (RNG), gasfitters – class A may work in landfill, digester and biogas facilities used to produce and supply RNG to utilities and for internal use.

For health and safety reasons, the gas fitting trade is regulated across Canada.

In some jurisdictions, to perform tasks such as welding, rigging and hoisting, gasfitters - class A may need to acquire additional certification.

As the volume of fuel gas at a facility increases, so does the risk. It is essential that gasfitters – class A have strong mechanical aptitudes, problem-solving skills and a good understanding of electrical/electronic control systems, combustion theory and flame safeguard systems, and their regulatory requirements. There is a requirement for strong mathematical, spatial visualization and communication skills. Gasfitters – Class A must be able to interpret drawings and technical manuals.

Conditions may be stressful as the work environment for gasfitters – class A is varied and may involve working in extreme or adverse conditions both indoors and outdoors. They may work in confined spaces, at heights, around heavy equipment and piping systems and may be required to respond to hazardous emergencies at any time. There are hazards involved in working with electricity, flammable and toxic gases, and power tools.

Gasfitters – Class A require manual dexterity and upper and lower limb coordination. Good physical condition is important because the work often requires considerable standing, lifting and moving of heavy items. They are also required to crouch, bend, kneel, crawl and twist when moving around equipment and piping systems.

This standard recognizes similarities or overlaps with the work of other trades such as gasfitters – class B, plumbers, steamfitters/pipefitters, oil heat system technicians, welders, refrigeration and air conditioning mechanics, electricians, sheet metal workers, and instrumentation and control technicians. Experienced gasfitters – class A often act as mentors and coaches to apprentices in the trade. Career advancement opportunities may include supervisory positions such as supervisor, maintenance manager or service manager, starting their own contracting business, working for provincial/territorial regulators or becoming trainers.

# Trends in the Gasfitter – Class A Trade

**Technology and Environmental**

Gasfitters need to be aware of the several initiatives being developed and implemented to reduce greenhouse gas emissions both federally and through provincial/territorial mandates and policies. These strategies recommend actions that focus on RNG produced by landfill, digester, and biogas facilities, and on hydrogen production and utilization.

Landfill, digester and biogas facilities capture and utilize methane gas produced from the anaerobic digestion of organic waste materials that would otherwise pollute the environment through uncontrolled methane production while decomposing (methane gas has 20 to 30 times the heat-trapping capabilities of carbon dioxide). RNG produced from biogas, landfill gas and digester gas at these facilities can be used to supplement existing natural gas utility pipeline infrastructure, decreasing the amount of fossil fuel extraction needed to produce energy. This fuel can be used by fuel-burning appliances at the facility, or it can be compressed and dispensed to vehicles as CNG.

Landfill, digester and biogas facilities range in size from small-scale systems designed for animal waste or food waste, to large industrial systems designed to treat municipal wastewater, industrial wastewater, municipal solid waste and agricultural waste.

Hydrogen can be used for producing low-carbon synthetic fuels to reduce emissions in transportation and industry. When burned in appliances or used in a fuel cell, hydrogen produces no carbon emissions. Hydrogen can be dispensed to vehicle storage tanks for fuel cells and hydrogen/diesel combustion engines, and stationary power systems, especially important for industrial sites and remote communities currently powered by diesel. When blended into the natural gas grid, hydrogen can displace fossil fuels to heat and power homes and buildings.

**Health and Safety**

Due to increased health and safety concerns and regulations, air quality is a priority when installing and servicing systems. As well, governing agencies have an increasing enforcement causing gasfitters to be much more aware of compliance requirements such as working with fuel burning equipment, direct-vent or sealed combustion equipment.

In some jurisdictions, building codes now require the installation of residential carbon monoxide systems. Commercial full-emission detection systems allow many more elements of detection to be monitored such as hazardous gases.

Occupational health and safety training such as Workplace Hazardous Materials Information System (WHMIS), first aid, fall arrest, aerial platform and confined space are necessary in today's working environment.

**Tools and Equipment**

There are new tools and equipment for installing piping. Battery-powered tools such as powered threaders and press connect fitting tools assist in installing piping in a safer and more efficient manner.

There is an increased functionality of tools such as Bluetooth enabled combustion analyzers, manometers and temperature sensors that allow better logging and tracking of results.

**Products**

The mandates for carbon reduction have had an impact on improving appliance efficiencies and more sophisticated burner and building management systems. Equipment across the trade that is used for heating, ventilation and air conditioning (HVAC) are becoming more energy efficient, integrate with home automation systems and incorporate sophisticated electronic control systems and monitoring circuits.

With the increased use of Wi-Fi enabled communication and tracking systems, gasfitters can remotely check equipment at the customer's location. This also enables gasfitters to verify technical information on the internet. With no/low carbon technology, hydrogen and hydrogen blend appliances and technology is increasing and has the potential of becoming the future of the trade.

These new appliances and systems have increased the training and knowledge requirements for gasfitters in electrical, electronics and control systems.

Gasfitters must be aware of the procedures and jurisdictional regulations for recycling products and materials that are removed from service as new recycling facilities emerge.

# Skills for Success Summary

Skills for Success are needed in a quickly changing world for work, learning and life. They are foundational for building other skills and important for effective social interaction. Everyone benefits from having these skills as they help individuals get a job, progress at their current job and change jobs. They also help individuals become active members of their community and succeed in learning.

Through extensive research and consultations, the Government of Canada launched the new Skills for Success model renewing the previous Essential Skills framework to better reflect the needs of the current and future labour market.

The summary presented here is based on existing Essential Skills profiles and will be updated to align with the new Skills for Success model over time.

## Reading

Gasfitters read descriptions and explanations on work orders and memos from supervisors and customers on details of the work tasks and activities that need to be done. They read warnings and instructions on labels, signs, tags and placards to make decisions about special precautions or procedures that are needed for a particular job. They must interpret and apply manufacturers' specifications, codes, and regulatory requirements when installing, maintaining, servicing, and decommissioning equipment or systems.

## Document Use

Gasfitters use manufacturers' specification sheets, equipment manuals and code books to locate technical information and operation settings to complete installation, maintenance and repair procedures. They refer to drawings, pictures and diagrams in equipment manuals to troubleshoot equipment problems and complete repair and replacement procedures. Gasfitters use and read schematic drawings to understand various systems such as equipment, control, electrical, gas supply and energy distribution systems.

## Writing

Gasfitters write detailed notes in logbooks, notebooks, layout drawings and inspection checklists to keep records of equipment installation, changes and deficiencies. They provide descriptive texts on work orders to provide description of work performed, equipment deficiencies and required remedial actions. Gasfitters create as-built diagrams and sketches. Gasfitters may complete sections of incident or accident reports.

## Oral Communication

Gasfitters communicate with customers, managers, supervisors, coworkers and other trades to discuss equipment problems and outline job requirements, legal implications and negotiate repair processes. They also follow up with customers after jobs are completed to explain equipment operation and answer questions. Gasfitters may also communicate with a range of officials, such as provincial/territorial regulators and engineers.

## Numeracy

Gasfitters calculate materials needed and determine estimates for installation or service jobs. Gasfitters convert length and volume measurement from metric to imperial units and vice versa. They also perform calculations for venting, combustion air and gas pipe sizing requirements. They take measurements such as distance, volume, temperature and pressure. Gasfitters must be able to convert different units of energy. These calculations and measurements are used for such things as sizing combustion air, energy distribution and exhaust gas analysis.

## Thinking

Gasfitters problem solve when facing unexpected installation, service and removal problems. They may decide to not enter homes or buildings where personal health and safety may be at risk. Based on their sensory inspections, their knowledge of instrumentation, controls and equipment performance and the urgency to restart systems, gasfitters determine how to troubleshoot, maintain or replace equipment or components. They may also decide how and where to install system components to meet manufacturers' specifications, code requirements and maintain efficiency. Gasfitters evaluate efficiency of fuel-fired systems. They also plan and organize their daily tasks.

## Working with Others

Gasfitters may work alone or with a team depending on the task requirements. When working with others, they may coordinate with other trades and contractors. They mentor and train apprentices and coworkers on the job.

## Digital Technology

Gasfitters use computer programs and instrumentation to create installation layouts or to troubleshoot system or equipment problems. They use computers to interface with equipment and programming, changing parameters and maintaining control systems. They use electronic communication to communicate with customers, coworkers, suppliers or subcontractors.

## Continuous Learning

Gasfitters often have in-house training or attend seminars to update their required site-specific and safety certifications such as WHMIS, fall arrest training, first aid and many others. Gasfitters must become proficient with new equipment, technology, regulations, codes and procedures by attending training sessions and seminars, reading manuals and through on-the-job experience.

# Roles and Opportunities for Skilled Trades in a Sustainable Future

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

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

For example:

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

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

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

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

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

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

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

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

- the Montreal Protocol for phasing out R22 refrigerants.

- energy efficiency programs such as ENERGY STAR.

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

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

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

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

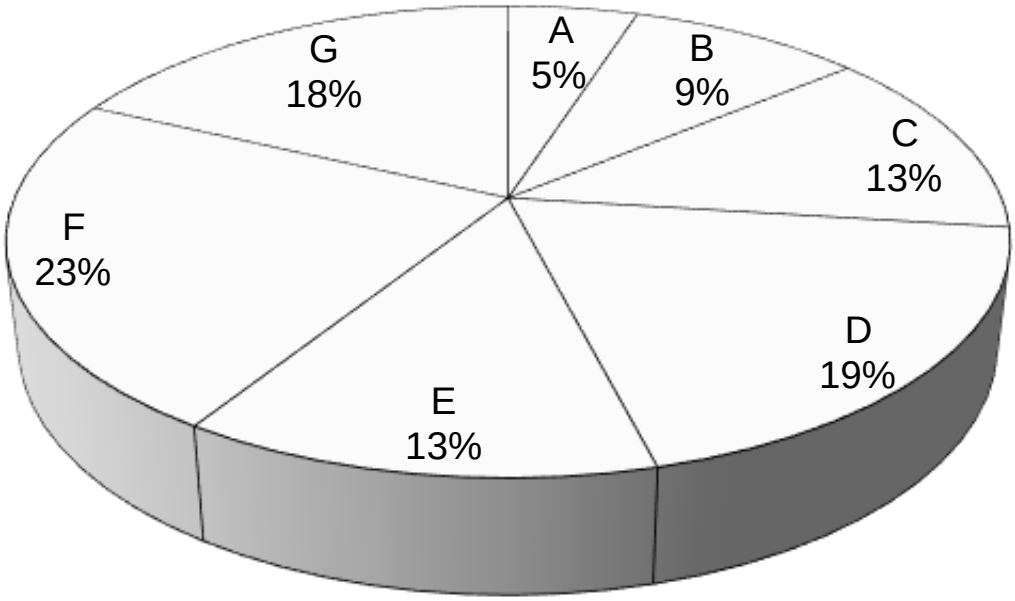
# Industry Expected Performance

All tasks must be performed according to the applicable jurisdictional codes, standards and regulations. All health and safety standards must be respected and observed. Work should be performed efficiently and to a high quality without material waste or environmental damage. All requirements of employers, engineers, designers, manufacturers, provincial/territorial regulators, customers, and quality assurance and control policies 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 maintain 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, codes, regulations and standards as well as languages of instruction in apprenticeship programs.

# Pie Chart of Red Seal Examination and Weightings




| | | |
|---|---|---|
| MWA A | Performs common occupational skills | 5% |
| MWA B | Installs fuel piping and tubing systems | 9% |
| MWA C | Installs venting and air supply systems | 13% |
| MWA D | Installs controls and electrical systems | 19% |
| MWA E | Installs and converts fuel systems, appliances and ancillary equipment | 13% |
| MWA F | Tests and commissions fuel systems, appliances and ancillary equipment | 23% |
| MWA G | Services fuel systems, appliances and ancillary equipment | 18% |

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. The Interprovincial examination for this trade has 100 questions.

# Gasfitter – Class A
# Task Matrix and Weightings

## A – Performs common occupational skills — 5%

| | | | |
|---|---|---|---|
| **Task A-1**<br>Performs safety-related functions<br>22% | **A-1.01**<br>Maintains safe work environment | **A-1.02**<br>Uses personal protective equipment (PPE) and safety equipment | |
| **Task A-2**<br>Uses tools and equipment<br>38% | **A-2.01**<br>Uses hand and power tools | **A-2.02**<br>Uses technical instruments and testers | **A-2.03**<br>Uses access equipment |
| | **A-2.04**<br>Operates lifting, rigging and hoisting equipment | | |
| **Task A-3**<br>Organizes work<br>36% | **A-3.01**<br>Interprets documents | **A-3.02**<br>Selects systems, equipment and components | **A-3.03**<br>Plans for installation, service and maintenance |
| **Task A-4**<br>Uses communication and mentoring techniques<br>4% | **A-4.01**<br>Uses communication techniques | **A-4.02**<br>Uses mentoring techniques | |

## B – Installs fuel piping and tubing systems — 9%

| | | | |
|---|---|---|---|
| **Task B-5**<br>Selects and installs piping for fuel systems<br>52% | **B-5.01**<br>Selects piping for fuel systems | **B-5.02**<br>Prepares piping for fuel systems | **B-5.03**<br>Installs piping for fuel systems |
| **Task B-6**<br>Selects and installs tubing for fuel systems<br>48% | **B-6.01**<br>Selects tubing for fuel systems | **B-6.02**<br>Prepares tubing for fuel systems | **B-6.03**<br>Installs tubing for fuel systems |

## C – Installs venting and air supply systems

**13%**

| | | | |
|---|---|---|---|
| **Task C-7**<br>**Selects and installs venting systems**<br>**39%** | **C-7.01**<br>**Selects materials for venting systems** | **C-7.02**<br>**Prepares materials for venting systems** | **C-7.03**<br>**Installs venting systems** |
| **Task C-8**<br>**Selects and installs air supply systems**<br>**35%** | **C-8.01**<br>**Selects materials for air supply systems** | **C-8.02**<br>**Prepares materials for air supply systems** | **C-8.03**<br>**Installs air supply systems** |
| **Task C-9**<br>**Selects and installs draft control systems**<br>**26%** | **C-9.01**<br>**Selects components for draft control systems** | **C-9.02**<br>**Installs components for draft control systems** | |

## D – Installs controls and electrical systems

**19%**

| | | |
|---|---|---|
| **Task D-10**<br>**Selects and installs combustion control systems**<br>**23%** | **D-10.01**<br>**Selects combustion control components** | **D-10.02**<br>**Installs combustion control components** |
| **Task D-11**<br>**Selects and installs flame safeguard systems**<br>**25%** | **D-11.01**<br>**Selects flame safeguard components** | **D-11.02**<br>**Installs flame safeguard components** |
| **Task D-12**<br>**Selects and installs operating control systems**<br>**21%** | **D-12.01**<br>**Selects operating control components** | **D-12.02**<br>**Installs operating control components** |
| **Task D-13**<br>**Selects and installs electrical systems**<br>**19%** | **D-13.01**<br>**Selects electrical components** | **D-13.02**<br>**Installs electrical components** |
| **Task D-14**<br>**Selects and installs automation and instrumentation control systems**<br>**12%** | **D-14.01**<br>**Selects automation and instrumentation control components** | **D-14.02**<br>**Installs automation and instrumentation control components** |

## E – Installs and converts fuel systems, appliances and ancillary equipment

**13%**

| | | | |
|---|---|---|---|
| **Task E-15**<br>**Selects, installs and converts fuel systems, appliances and ancillary equipment**<br>45% | **E-15.01**<br>**Selects appliances and ancillary equipment** | **E-15.02**<br>**Installs appliances and ancillary equipment** | **E-15.03**<br>**Installs fuel conversion components** |
| **Task E-16**<br>**Selects and installs propane and natural gas storage, handling and dispensing systems**<br>35% | **E-16.01**<br>**Selects propane and natural gas storage, handling and dispensing systems** | **E-16.02**<br>**Installs propane and natural gas storage, handling and dispensing systems** | |
| **Task E-17**<br>**Selects and installs other fuel storage, handling and dispensing systems**<br>20% | **E-17.01**<br>**Selects other fuel storage, handling and dispensing systems** | **E-17.02**<br>**Installs other fuel storage, handling and dispensing systems** | |

## F – Tests and commissions fuel systems, appliances and ancillary equipment

**23%**

| | | | |
|---|---|---|---|
| **Task F-18**<br>**Tests fuel delivery systems**<br>39% | **F-18.01**<br>**Selects testing equipment and procedures** | **F-18.02**<br>**Tests fuel piping and tubing systems** | |
| **Task F-19**<br>**Commissions fuel systems, appliances and ancillary equipment**<br>61% | **F-19.01**<br>**Performs start-up procedures** | **F-19.02**<br>**Performs testing, adjusting and balancing procedures** | **F-19.03**<br>**Completes commissioning report and handover** |

## G – Services fuel systems, appliances and ancillary equipment 18%

| | | | |
|---|---|---|---|
| **Task G-20**<br>**Maintains fuel systems, appliances and ancillary equipment**<br>**42%** | **G-20.01**<br>**Inspects system components and operation** | **G-20.02**<br>**Performs maintenance activities** | |
| **Task G-21**<br>**Repairs fuel systems, appliances and ancillary equipment**<br>**43%** | **G-21.01**<br>**Diagnoses system components and operation** | **G-21.02**<br>**Replaces components** | **G-21.03**<br>**Verifies operation** |
| **Task G-22**<br>**Decommissions fuel systems, appliances and ancillary equipment**<br>**15%** | **G-22.01**<br>**Disconnects appliances and ancillary equipment** | **G-22.02**<br>**Removes appliances and ancillary equipment** | |

# Major Work Activity A
# Performs common occupational skills

## Task A-1 Performs safety-related functions

### Task Descriptor

Gasfitters must be able to recognize hazards and protect themselves, others, property and the environment when working with gas systems and equipment. They must wear personal protective equipment (PPE), use safety equipment, and follow manufacturers' specifications when performing certain tasks. They must follow codes, standards and regulations related to workplace safety.

### A-1.01 Maintains safe work environment

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-1.01.01P | identify and address ***hazards*** | ***hazards*** are identified and addressed according to ***codes, standards and regulations*** |
| A-1.01.02P | report and follow up on ***hazards*** to customers, management, coworkers, other trades or Authority Having Jurisdiction (AHJ) | ***hazards*** are reported and followed up to customers, management, coworkers, other trades or AHJ |
| A-1.01.03P | handle and store ***hazardous materials*** | ***hazardous materials*** are handled and stored according to Workplace Hazardous Materials Information System (WHMIS) and Transportation of Dangerous Goods (TDG) procedures |
| A-1.01.04P | remove, recycle and dispose of ***hazardous materials*** | ***hazardous materials*** are removed, recycled and disposed of according to WHMIS and TDG procedures |
| A-1.01.05P | install ***safety protection*** | ***safety protection*** is installed according to site specifications, ***safety regulations*** and company policies |
| A-1.01.06P | identify and implement ventilation in workspace | ventilation in workspace is identified and implemented according to Occupational Health and Safety (OHS), company policies and site specifications |

| | | |
|---|---|---|
| A-1.01.07P | follow ***confined space procedures*** | ***confined space procedures*** are followed according to OHS, company policies and site specifications |
| A-1.01.08P | keep cables and straps safe | cables and straps are kept safe by preventing them from being a hazard whether in use or being stored |
| A-1.01.09P | follow lock-out and tag-out procedures to isolate ***energy sources*** | lock-out and tag-out procedures are followed according to OHS, company policies and site specifications to isolate ***energy sources*** |
| A-1.01.10P | follow elevated height procedures and requirements | elevated height procedures and requirements are followed according to B149.1, OHS, company policies and site specifications |
| A-1.01.11P | perform air analysis and identify ***dangerous air substances*** | air analysis is performed to ensure air quality and ***dangerous air substances*** are identified according to B149.1, ***safety regulations***, company policies and site specifications |
| A-1.01.12P | protect surrounding area when using torches or open flame | surrounding area is protected when using torches or open flame |
| A-1.01.13P | maintain clean and tidy work site | clean and tidy work site is maintained to avoid injuries to self and others |
| A-1.01.14P | coordinate tasks with other workers | tasks with other workers are coordinated to avoid injury to self and others |
| A-1.01.15P | participate in safety meetings and discussions | safety meetings and discussions are held to ensure that information is recorded and distributed to all ***team members*** |
| A-1.01.16P | identify location of WHMIS manuals and Safety Data Sheets (SDS) | location of WHMIS manuals and SDS are identified |
| A-1.01.17P | clear path for access to and egress from confined spaces | path for access to and egress from confined spaces is cleared according to site safety specifications |

## Range of Variables

***hazards*** include: poor housekeeping that could cause personal injury, equipment or environmental damage, presence of dangerous substances (asbestos, silica)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: Canadian Standards Association (CSA) (Natural Gas and Propane Installation Code [B149.1]; Propane Storage and Handling Code [B149.2]; Code for the Field Approval of Fuel-Related Components on Appliances and Equipment [B149.3]; Installation Code for Propane Fuel Systems and Containers on Motor Vehicles [B149.5]; Code for Digester Gas, Landfill Gas, and Biogas Generation and Utilization [B149.6]; Natural Gas Refuelling Stations Installation Code [B108]; Boiler, Pressure Vessel, and Pressure Piping Code [B51]), Canadian Hydrogen Installation Code (CAN/BNQ 1784), Canadian Electrical Code (CEC), National Building Code (NBC), AHJ, National Fire Protection Association (NFPA), American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME), TDG, OHS, WHMIS, Environmental Emergencies Regulations, provincial/territorial standards

***hazardous materials*** include: threading oil, solvents, fuels, pipe thread compounds

***safety protection*** includes: signage, barrier tape, barricades

***safety regulations*** include: OHS, WHMIS

***confined space procedures*** include: ensuring clear path of access to and egress, testing air quality of confined spaces on a continuous basis using calibrated handheld devices

***energy sources*** include: electrical, hydronic, pneumatic, mechanical, centrifugal, kinetic

***dangerous air substances*** include: CO, $H_2S$, Lower Explosive Level/Upper Explosive Level (LEL/UEL)

***team members*** include: other tradespersons, customers, employers

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-1.01.01L | demonstrate knowledge of safe work practices | describe safe work practices to maintain healthy and safe work environment |
| | | identify ***hazards*** and associated mitigating procedures |
| | | describe procedures to handle, store, remove, recycle and dispose of ***hazardous materials*** |
| | | identify ***safety protection*** and describe its uses |
| | | describe ***confined space procedures*** |
| | | describe procedures to lock out and tag out hazardous energies |
| | | describe workers' rights and responsibilities |
| | | describe components of safety meetings and discussions |
| | | describe ***emergency procedures*** |
| | | describe hot work permit procedures |
| | | describe characteristics of stored energy potential (pneumatic, electrical, mechanical, chemical, hydronic, centrifugal) |

| | | |
|---|---|---|
| A-1.01.02L | demonstrate knowledge of ***training and certification requirements*** pertaining to workplace safety | identify ***training and certification requirements*** pertaining to workplace safety |
| A-1.01.03L | demonstrate knowledge of regulatory requirements pertaining to safety | identify and describe jurisdictional ***safety regulations*** to maintain a safe work environment |
| | | identify ***components of WHMIS*** |
| | | identify and describe jurisdictional requirements for handling, storing, recycling and disposing of ***hazardous materials*** |
| | | describe jurisdictional environmental protection procedures |

## Range of Variables

***hazards*** include: poor housekeeping that could cause personal injury, equipment or environmental damage, presence of dangerous substances (asbestos, silica)

***hazardous materials*** include: threading oil, solvents, fuels, pipe thread compounds

***safety protection*** includes: signage, barrier tape, barricades

***confined space procedures*** include: ensuring clear path of access to and egress, testing air quality of confined spaces on a continuous basis using calibrated handheld devices

***emergency procedures*** include: what to do in case of alarms, closest hospital, fire safety (chemical, muster points), identify location of on-site first aid stations and equipment, evacuation procedures

***training and certification requirements*** include: WHMIS, fall protection, confined space entry, site-specific training requirements

***safety regulations*** include: OHS, WHMIS

***components of WHMIS*** include: SDS, labels, training

## A-1.02 Uses personal protective equipment (PPE) and safety equipment

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-1.02.01P | select and use ***PPE*** and ***safety equipment*** | ***PPE*** and ***safety equipment*** are selected and used according to task |
| A-1.02.02P | inspect ***PPE*** and ***safety equipment*** before each use | ***PPE*** and ***safety equipment*** are inspected before each use |
| A-1.02.03P | identify unsafe, outdated, damaged or defective ***PPE*** and ***safety equipment***, and remove from service | unsafe, outdated, damaged or defective ***PPE*** and ***safety equipment*** are identified and removed from service according to company policies and manufacturers' specifications |

| | | |
|---|---|---|
| A-1.02.04P | ensure proper fit of ***PPE*** and ***safety equipment*** | ***PPE*** and ***safety equipment*** are properly fitted according to manufacturers' specifications |
| A-1.02.05P | organize ***PPE*** and ***safety equipment*** | ***PPE*** and ***safety equipment*** are organized according to OHS regulations and company policies |
| A-1.02.06P | clean and store ***PPE*** and ***safety equipment*** | ***PPE*** and ***safety equipment*** are cleaned and stored according to manufacturers' specifications |
| A-1.02.07P | obtain mandatory safety certifications for ***PPE*** and ***safety equipment*** | mandatory safety certifications for ***PPE*** and ***safety equipment*** are obtained according to OHS, company policies and manufacturers' specifications |

## Range of Variables

***PPE*** includes: detection devices (carbon monoxide, combustible gas), safety glasses, gloves, face shields, hearing protection, respiratory equipment, safety footwear, hard hats, fire retardants
***safety equipment*** includes: fall arrest devices, first-aid kits, eye wash stations

| | **Knowledge** | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-1.02.01L | demonstrate knowledge of ***PPE*** and ***safety equipment***, their characteristics, applications and limitations | identify ***PPE*** and ***safety equipment***, and describe their characteristics, applications and limitations |
| | | describe operating principles of ***PPE*** and ***safety equipment*** |
| A-1.02.02L | demonstrate knowledge of procedures to use and maintain ***PPE*** and ***safety equipment*** | identify ***hazards*** and describe safe work practices to use and maintain ***PPE*** and ***safety equipment*** |
| | | describe procedures to select and use ***PPE*** and ***safety equipment*** |
| | | describe procedures to ensure proper fit of ***PPE*** and ***safety equipment*** |
| | | describe procedures to inspect, identify and remove damaged, worn or unsafe ***PPE*** and ***safety equipment*** from service |
| | | describe procedures to maintain and store ***PPE*** and ***safety equipment*** |
| A-1.02.03L | demonstrate knowledge of training and certification requirements to use ***PPE*** and ***safety equipment*** | identify training and certification requirements to use ***PPE*** and ***safety equipment*** |
| A-1.02.04L | demonstrate knowledge of standards and regulations pertaining to ***PPE*** and ***safety equipment*** | identify standards and regulations pertaining to ***PPE*** and ***safety equipment*** |

### Range of Variables

***PPE*** includes: detection devices (carbon monoxide, combustible gas), safety glasses, gloves, face shields, hearing protection, respiratory equipment, safety footwear, hard hats, fire retardants
***safety equipment*** includes: fall arrest devices, first-aid kits, eye wash stations
***hazards*** include: damaged, worn and outdated equipment, improper use

## Task A-2 Uses tools and equipment

### Task Descriptor

Gasfitters use tools and equipment to perform daily tasks in their trade in a safe and efficient manner. They maintain these tools and equipment to ensure longevity and safe operation.

### A-2.01 Uses hand and power tools

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-2.01.01P | select and use hand and power tools | hand and power tools are selected and used according to task, and manufacturers' recommendations and specifications |
| A-2.01.02P | inspect hand and power tools before each use | hand and power tools are inspected before each use |
| A-2.01.03P | identify unsafe, damaged or defective hand and power tools, and remove from service | unsafe, damaged or defective hand and power tools are identified and removed from service according to company policies and manufacturers' instructions |
| A-2.01.04P | clean and lubricate hand and power tools | hand and power tools are cleaned and lubricated according to manufacturers' recommendations |
| A-2.01.05P | store hand and power tools | hand and power tools are stored according to manufacturers' recommendations |

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-2.01.01L | demonstrate knowledge of hand and power tools, their characteristics and applications | identify hand and power tools, and describe their characteristics and applications |

| | | |
|---|---|---|
| | | interpret information pertaining to hand and power tools found in manufacturers' information |
| A-2.01.02L | demonstrate knowledge of procedures to use hand and power tools | identify ***hazards*** and describe safe work practices to use hand and power tools |
| | | describe procedures to inspect hand and power tools |
| | | describe procedures to use hand and power tools |
| | | describe procedures to identify and remove unsafe, worn, damaged or defective hand and power tools from service |
| | | describe procedures to store and maintain hand and power tools |
| A-2.01.03L | demonstrate knowledge of training and certification requirements to use power tools | identify training and certification requirements to use power tools |
| A-2.01.04L | demonstrate knowledge of regulatory requirements pertaining to hand and power tools | identify codes and regulations pertaining to hand and power tools |

## Range of Variables

***hazards*** include: damaged, worn and outdated equipment, improper use, electrical hazards (e.g., faulty switches, damaged extension cords)

## A-2.02 Uses technical instruments and testers

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-2.02.01P | select and use ***technical instruments and testers*** | ***technical instruments and testers*** are selected and used according to task and manufacturers' specifications |
| A-2.02.02P | inspect ***technical instruments and testers*** before each use | ***technical instruments and testers*** are inspected before each use to check accuracy and safety |
| A-2.02.03P | identify unsafe, outdated, damaged or defective ***technical instruments and testers***, and remove from service | unsafe, outdated, damaged or defective ***technical instruments and testers*** are identified, and removed from service according to company policies and manufacturers' instructions |

| | | |
|---|---|---|
| A-2.02.04P | interpret results provided by ***technical instruments and testers*** | results provided by ***technical instruments and testers*** are interpreted |
| A-2.02.05P | calibrate ***technical instruments and testers*** | ***technical instruments and testers*** are calibrated according to manufacturers' specifications |
| A-2.02.06P | perform ***tests and analysis*** | ***tests and analysis*** are performed according to test conditions, manufacturers' specifications and code requirements |
| A-2.02.07P | store ***technical instruments and testers*** | ***technical instruments and testers*** are stored according to manufacturers' specifications |

## Range of Variables

***technical instruments and testers*** include: multimeters, megohmmeters, pressure gauges, ground resistance testers, thermocouple testers, combustion analyzers, signal generators, digital and incline manometers, thermometers, pyrometers, combustible gas and carbon monoxide detectors

***tests and analysis*** include: circuit voltage, current and resistance tests; pressure tests; indoor air quality tests; leak tests; gas analysis; combustion analysis

| | **Knowledge** | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-2.02.01L | demonstrate knowledge of ***technical instruments and testers***, their characteristics and applications | identify ***technical instruments and testers***, and describe their characteristics and applications |
| | | interpret information pertaining to ***technical instruments and testers*** found in manufacturers' specifications |
| | | describe ***gas properties*** and their associated tests |
| A-2.02.02L | demonstrate knowledge of procedures to use ***technical instruments and testers*** | identify ***hazards*** and describe safe work practices to use ***technical instruments and testers*** |
| | | describe procedures to inspect, identify and remove damaged, worn or unsafe ***technical instruments and testers*** from service |
| | | describe procedures to calibrate ***technical instruments and testers*** |
| | | describe procedures to use ***technical instruments and testers*** |
| | | identify types of ***tests and analysis*** performed with ***technical instruments and testers*** |
| | | describe procedures to store ***technical instruments and testers*** |

| | | |
|---|---|---|
| A-2.02.03L | demonstrate knowledge of procedures, principles and concepts to interpret results provided by ***technical instruments and testers*** | interpret results provided by ***technical instruments and testers*** |
| | | describe principles and concepts of chemistry and physics |
| | | apply combustion formulas |
| | | describe emissions and flue gas composition |
| | | describe environmental emissions requirements |
| | | describe appliance thermal efficiencies |
| | | describe draft velocity and vent pressures |
| | | describe flue gas recirculation and effects on combustion |
| | | describe indoor air quality requirements |
| | | describe external static pressure (ESP) testing requirements |
| | | describe appliance temperature rise testing requirements |
| | | describe principles and concepts of electronics and electricity |
| | | interpret electrical readings |
| A-2.02.04L | demonstrate knowledge of training requirements to use ***technical instruments and testers*** | identify training requirements to use ***technical instruments and testers*** |
| A-2.02.05L | demonstrate knowledge of regulatory requirements pertaining to ***technical instruments and testers*** | identify codes and regulations pertaining to results from ***technical instruments and testers*** |

## Range of Variables

***technical instruments and testers*** include: multimeters, megohmmeters, pressure gauges, ground resistance testers, thermocouple testers, combustion analyzers, signal generators, digital and incline manometers, thermometers, pyrometers, combustible gas and carbon monoxide detectors

***gas properties*** include: limits of flammability, flame speed, ignition temperature, specific gravity, calorific value

***hazards*** include: damaged, worn and outdated equipment; improper use; electrical hazards; environmental conditions

***tests and analysis*** include: circuit voltage, current and resistance tests; pressure tests; indoor air quality tests; leak tests; gas analysis; combustion analysis

## A-2.03 Uses access equipment

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-2.03.01P | select ***access equipment*** | ***access equipment*** is selected taking into consideration ***unstable conditions***, and according to task and manufacturers' specifications |
| A-2.03.02P | inspect ***access equipment*** before each use | ***access equipment*** is inspected before each use according to operating instructions and OHS |
| A-2.03.03P | identify unsafe, outdated, damaged or defective ***access equipment***, and remove from service | unsafe, outdated, damaged or defective ***access equipment*** is identified and removed from service according to company policies and manufacturers' specifications |
| A-2.03.04P | set up and operate ***access equipment*** | ***access equipment*** is set up and operated according to OHS regulations, company policies and manufacturers' specifications |
| A-2.03.05P | clean and maintain ***access equipment*** | ***access equipment*** is cleaned and maintained according to manufacturers' specifications |
| A-2.03.06P | dismantle and store ***access equipment*** | ***access equipment*** is dismantled and stored according to manufacturers' specifications |

### Range of Variables

***access equipment*** includes: ladders, mobile elevated work platforms (MEWP), scaffolding
***unstable conditions*** include: soft and uneven ground, wind, hard-to-reach locations

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-2.03.01L | demonstrate knowledge of ***access equipment***, their characteristics and applications | identify ***access equipment***, and describe their characteristics and applications |
| | | interpret information pertaining to ***access equipment*** found in manufacturers' specifications |
| A-2.03.02L | demonstrate knowledge of procedures to use and operate ***access equipment*** | identify ***hazards*** and describe safe work practices to use and operate ***access equipment*** |

| | | |
|---|---|---|
| | | describe procedures to inspect, identify and remove damaged or worn ***access equipment*** from service |
| | | describe procedures to use and operate ***access equipment*** |
| | | describe procedures to clean and maintain ***access equipment*** |
| | | describe procedures to set up, dismantle and store ***access equipment*** |
| A-2.03.03L | demonstrate knowledge of training and certification requirements to use and operate ***access equipment*** | identify training and certification requirements to use and operate ***access equipment*** |
| A-2.03.04L | demonstrate knowledge of regulatory requirements pertaining to ***access equipment*** | identify codes and regulations pertaining to ***access equipment*** |

## Range of Variables

***access equipment*** includes: ladders, mobile elevated work platforms (MEWP), scaffolding
***hazards*** include: damaged, worn and outdated equipment; improper use; electrical hazards; environmental condition

## A-2.04 Operates lifting, rigging and hoisting equipment

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-2.04.01P | select and tie knots | knots are selected and tied according to load and application |
| A-2.04.02P | select and use ***lifting, rigging and hoisting equipment*** | ***lifting, rigging and hoisting equipment*** is selected and used according to OHS regulations, company policies, and engineers' and manufacturers' specifications |
| A-2.04.03P | inspect ***lifting, rigging and hoisting equipment*** before each use | ***lifting, rigging and hoisting equipment*** is inspected before each use |
| A-2.04.04P | identify unsafe, outdated, damaged or defective ***lifting, rigging and hoisting equipment***, and tag and remove from service | unsafe, outdated, damaged or defective ***lifting, rigging and hoisting equipment*** are identified, tagged and removed from service according to OHS regulations, company policies and manufacturers' specifications |

| | | |
|---|---|---|
| A-2.04.05P | set up load | load is set up to enable access for lifting chains and slings according to OHS regulations, company policies and manufacturers' specifications |
| A-2.04.06P | locate lifting points | lifting points are located to ensure proper sling angle and to balance and secure load |
| A-2.04.07P | secure load | load is secured using ***rigging methods*** according to company policies, engineer's and manufacturers' specifications, and safety procedures |
| A-2.04.08P | guide and control load | load is guided and controlled using rigging and tag lines |
| A-2.04.09P | communicate with equipment operators | equipment operators are communicated with using approved ***communication methods*** |
| A-2.04.10P | maintain and store ***lifting, rigging and hoisting equipment*** | ***lifting, rigging and hoisting equipment*** is maintained and stored in designated area according to company policies and manufacturers' specifications |

## Range of Variables

***lifting, rigging and hoisting equipment*** includes: spreader beams, slings, chokers

***rigging methods*** include: choking, slinging and securing hooks

***communication methods*** include: standard crane and hoist hand signals, two-way radios, video, radio, mobile phones

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-2.04.01L | demonstrate knowledge of ***lifting, rigging and hoisting equipment***, their characteristics and applications | identify ***lifting, rigging and hoisting equipment***, and describe their characteristics and applications |
| | | interpret information pertaining to ***lifting, rigging and hoisting equipment*** found in manufacturers' specifications |
| | | identify types of knots and hitches used for lifting, rigging and hoisting |
| A-2.04.02L | demonstrate knowledge of procedures to operate ***lifting, rigging and hoisting equipment*** | identify ***hazards*** and describe safe work practices to operate ***lifting, rigging and hoisting equipment*** |
| | | describe procedures to inspect ***lifting, rigging and hoisting equipment*** |
| | | describe procedures to identify and remove damaged, worn, or unsafe ***lifting, rigging and hoisting equipment*** from service |
| | | describe procedures to operate ***lifting, rigging and hoisting equipment*** |

| | | |
|---|---|---|
| | | identify ***communication methods*** used for lifting, rigging and hoisting |
| | | identify ***rigging and hoisting practices*** |
| | | identify ***rigging methods*** |
| A-2.04.03L | demonstrate knowledge of training and certification requirements to use and operate ***lifting, rigging and hoisting equipment*** | identify training and certification requirements to use and operate ***lifting, rigging and hoisting equipment*** |
| A-2.04.04L | demonstrate knowledge of regulatory requirements pertaining to ***lifting, rigging and hoisting equipment*** | identify codes and regulations pertaining to ***lifting, rigging and hoisting equipment*** |

### Range of Variables

***lifting, rigging and hoisting equipment*** includes: spreader beams, slings, chokers

***hazards*** include: damaged, worn and outdated equipment; improper use; electrical hazards; environmental condition

***communication methods*** include: standard crane and hoist hand signals, two-way radios, video, radio, mobile phones

***rigging and hoisting practices*** include: load weight calculations, working load limits, sling angles

***rigging methods*** include: choking, slinging and securing hooks

# Task A-3 Organizes work

### Task Descriptor

Gasfitters plan and prepare for installation, service and maintenance by using and interpreting drawings, specifications and codes. They may also prepare drawings and provide specifications for installation. They select systems and their components according to the job requirements. In organizing their work, gasfitters lay out fuel-fired equipment and systems, and check for the availability of equipment and personnel. They also ensure that all documentation is in order. Gasfitters work with other trades to ensure timely and safe completion of site work.

## A-3.01 Interprets documents

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-3.01.01P | select ***documents*** | ***documents*** are selected according to job requirements |
| A-3.01.02P | review ***documents*** | ***documents*** are reviewed for inconsistencies and accuracy |

| | | |
|---|---|---|
| A-3.01.03P | obtain permits | permits are obtained prior to starting job according to jurisdictional regulations |
| A-3.01.04P | select and use technical instruments to prepare plan | technical instruments are selected and used to prepare plan according to task |
| A-3.01.05P | measure lengths and dimensions of equipment and pipe | lengths and dimensions of equipment and pipe are measured to ensure consistency with job installation |
| A-3.01.06P | calculate ***material requirements*** | ***material requirements*** are calculated according to ***documents*** |
| A-3.01.07P | identify orientation of equipment and pipes | orientation of equipment and pipes are identified to determine installation location and to avoid conflicts with other objects according to ***codes*** |
| A-3.01.08P | create isometric drawings | isometric drawings are created using plans and drawings to assist in determining material requirements and layout |
| A-3.01.09P | use ***codes*** to determine minimum amount and type of material | ***codes*** are used to determine minimum amount and type of material according to ***drawings*** and specifications |
| A-3.01.10P | use ***codes*** to confirm and calculate minimum service clearances, access requirements and allowances | ***codes*** are used to confirm and calculate minimum service clearances, access requirements and allowances |
| A-3.01.11P | prepare schematic diagrams from plans and drawings | schematic diagrams are prepared from plans and drawings using standard formats, symbols and reference systems |
| A-3.01.12P | trace electrical processes through schematics and block diagrams | electrical processes are traced through schematics and block diagrams to determine control device requirements using specifications and ***codes*** |
| A-3.01.13P | cross-reference all ***documents*** | ***documents*** are cross-referenced to each other for accuracy |
| A-3.01.14P | develop as-built drawings | as-built drawings are developed according to completed installation |

## Range of Variables

***documents*** include: drawings, specifications, codes, permits, manufacturers' instructions, quality assurance (QA)/quality control (QC) manuals, QA/QC registrations, provincial/territorial regulatory notices

***material requirements*** include: fittings, hangers, supports, piping

***codes*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CEC, NBC, AHJ, NFPA, ANSI/ASME, TDG

***drawings*** include: schematics, isometrics, wiring diagrams, layouts, interconnections, elevations, block and single lines, mechanical, process flow diagrams, piping and instrumentation drawings (P&ID)

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-3.01.01L | demonstrate knowledge of ***documents***, their characteristics and applications | identify types of ***documents*** and describe their characteristics and applications |
| | | identify and describe ***codes*** and regulatory requirements pertaining to task |
| | | identify ***information found on drawings*** |
| | | confirm ***drawing*** information as related to ***code*** requirements |
| | | identify conventionally accepted symbols, abbreviations, National Electrical Manufacturers Association (NEMA) numbers |
| | | identify and describe electrical terminology |
| A-3.01.02L | demonstrate knowledge of procedures to create installation plan | identify technical instruments used to perform measurements and calculations, and describe their procedures for use |
| | | interpret ***documents*** to create plan |
| | | identify ***views used on drawings*** |
| | | calculate material requirements |
| | | describe procedures to prepare schematic diagrams, isometric and as-built drawings |

## Range of Variables

***documents*** include: drawings, specifications, codes, permits, manufacturers' instructions, quality assurance (QA)/quality control (QC) manuals, QA/QC registrations, provincial/territorial regulatory notices

***codes*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CEC, NBC, AHJ, NFPA, ANSI/ASME, TDG

***information found on drawings*** includes: lines, legend, symbols and abbreviations, title block, notes and specifications, schedules, units of measurement (metric/imperial), seismic

***drawings*** include: schematics, isometrics, wiring diagrams, layouts, interconnections, elevations, block and single lines, mechanical, process flow diagrams, piping and instrumentation drawings (P&ID)

***views used on drawings*** include: elevation, plan, section, detail, 3-D

## A-3.02 Selects systems, equipment and components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-3.02.01P | identify and choose ***systems***, ***equipment*** and component requirements | ***systems***, ***equipment*** and component requirements are identified and chosen according to manufacturers' specifications, system capacity, site conditions, ***codes, standards and regulations*** |
| A-3.02.02P | interpret and apply heat loss calculations for job requirements | heat loss calculations for job requirements are interpreted and applied |
| A-3.02.03P | size ***systems*** | ***systems*** are sized taking into consideration ***factors*** according to appliance input, job and manufacturers' specifications, ***codes, standards and regulations*** |
| A-3.02.04P | determine on-site availability and capacity of drainage, ***fuel***, electrical and control compatibility | on-site availability and capacity of drainage, ***fuel***, electrical and control compatibility are determined to compare with ***equipment*** requirements and manufacturers' specifications |
| A-3.02.05P | submit QA/QC manual | QA/QC manual is submitted according to AHJ and company policies |

### Range of Variables

***systems*** include: fuel-fired appliances, fuel-gas piping, dispensing, venting, air supply, controls

***equipment*** includes: boilers, cooking equipment, forced warm-air equipment, water heaters, decorative appliances, process ovens and furnaces, atmosphere generators

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME, TDG

***factors*** include: electrical, environmental requirements, customer requirements, location, future growth

***fuels*** include: natural gas, manufactured gas, liquefied petroleum gas, digester gas, landfill gas, biogas, hydrogen, propane gas and air, hydrogen-natural gas, propane, propylene, butanes (normal butane or isobutane), butylene, combination of fuels

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-3.02.01L | demonstrate knowledge of ***systems***, ***equipment***, their components, characteristics, applications and operation | identify types of ***systems***, ***equipment*** and their components, and describe their characteristics and applications |
| | | describe operating principles of ***systems***, ***equipment*** and their components |
| | | interpret information pertaining to ***systems***, ***equipment*** and their components found on drawings and specifications |
| | | describe principles and concepts of electronics and electricity |
| | | describe principles and concepts of gas utilization |
| | | identify ***gas properties***, and describe their characteristics and applications |
| | | identify gas system pressure requirements |
| | | identify and describe venting system combinations and category of appliances I, II, III and IV |
| | | identify altitude elevation rated equipment and describe their characteristics and applications |
| | | identify components and their symbols on valve trains (main and pilot) |
| | | describe regulator applications, clearances, sizing and their accessories |
| | | identify types of fans, auxiliary fans, and dampers and interlocks for equipment and describe their characteristics and applications |
| | | interpret sizing charts and identify calculations needed to size ***systems*** |
| | | identify ***factors*** to consider when selecting and locating ***equipment*** |
| | | identify elements of QA/QC manual, and describe their characteristics and applications |
| A-3.02.02L | demonstrate knowledge of procedures to select ***systems***, ***equipment*** and their components | describe procedures to select ***systems***, ***equipment*** and their components |
| | | identify ***hazards*** to consider when selecting ***systems***, ***equipment*** and their components |

| | | |
|---|---|---|
| | | describe procedures to size ***systems***, ***equipment*** and their components |
| A-3.02.03L | demonstrate knowledge of manufacturers' training and certification requirements for selecting and sizing ***systems***, ***equipment*** and their components | identify training and certification requirements for selecting and sizing ***systems***, ***equipment*** and their components |
| A-3.02.04L | demonstrate knowledge of regulatory requirements pertaining to ***systems***, ***equipment*** and their components | identify ***codes, standards and regulations*** pertaining to ***systems***, ***equipment*** and their components |

## Range of Variables

***systems*** include: fuel-fired appliances, fuel-gas piping, dispensing, venting, air supply, controls

***equipment*** includes: boilers, cooking equipment, forced warm-air equipment, water heaters, decorative appliances, process ovens and furnaces, atmosphere generators

***gas properties*** include: limits of flammability, flame speed, ignition temperature, specific gravity, calorific value

***factors*** include: electrical, environmental requirements, customer requirements, location, future growth

***hazards*** include: uncertified equipment, incorrect fuel, electrical hazards (e.g., faulty switches, damaged extension cords)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME, TDG

## A-3.03 Plans for installation, service and maintenance

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-3.03.01P | determine labour requirements | labour requirements are determined according to job requirements |
| A-3.03.02P | acquire permits | permits are acquired according to job, site and AHJ requirements |
| A-3.03.03P | select tools and equipment and confirm availability | tools and equipment are selected, and availability is confirmed according to job requirements |
| A-3.03.04P | coordinate work schedules with other trades, customers and inspectors | work schedules with other trades, customers and inspectors are coordinated according to job requirements |
| A-3.03.05P | acquire and distribute ***documentation*** | ***documentation*** is acquired and distributed according to job requirements |
| A-3.03.06P | coordinate logistics of transportation and placement of equipment, material and labour to job site | logistics of transportation and placement of equipment, material and labour to job site are coordinated |

| | | |
|---|---|---|
| A-3.03.07P | create bill of material | bill of material is created according to job requirements |
| A-3.03.08P | order and acquire materials | materials are ordered and acquired according to bill of material |
| A-3.03.09P | coordinate ***job site documentation*** | ***job site documentation*** is coordinated according to job site requirements |

## Range of Variables

***documentation*** includes: plans, drawings, equipment specifications, safety procedures, permits
***job site documentation*** includes: daily logs, time sheets, as-built final drawings, work orders

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-3.03.01L | demonstrate knowledge of installation, maintenance and service plans | identify ***documentation*** and ***job site documentation*** relevant to job planning and execution, and describe their characteristics and applications |
| | | identify safety codes and regulations pertaining to installation, service and maintenance |
| A-3.03.02L | demonstrate knowledge of procedures to plan for installation, maintenance and service | describe procedures to plan for installation, maintenance and service of systems and equipment |
| | | describe procedures to create bill of materials |
| | | describe procedures to obtain permits |
| | | describe procedures used to coordinate job tasks and procedures |
| | | describe procedures used to estimate work requirements |

## Range of Variables

***documentation*** includes: plans, drawings, equipment specifications, safety procedures, permits
***job site documentation*** includes: daily logs, time sheets, as-built final drawings, work orders

# 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 the activities related to communication in the workplace and mentoring skills.

## A-4.01 Uses communication techniques

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-4.01.01P | demonstrate communication practices with individuals or in a group | instructions and messages are interpreted by all parties involved in communication |
| A-4.01.02P | listen using ***active listening*** practices | ***active listening*** practices are utilized |
| A-4.01.03P | speak clearly using correct industry terminology to ensure understanding | understanding of message is confirmed by both parties |
| A-4.01.04P | receive and respond to instructions | response to instructions indicates understanding |
| A-4.01.05P | receive and respond to feedback on work completed or performed | response to feedback indicates understanding and corrective measures are taken |
| A-4.01.06P | provide and explain feedback | explanation and feedback are provided, and task is carried out as directed |
| A-4.01.07P | communicate understanding and comfort level in performing trade tasks | opportunities for practice and gradual exposure to new tasks is offered and understanding is confirmed |
| A-4.01.08P | use questions to improve communication | questions enhance understanding, on-the-job training and goal setting |
| A-4.01.09P | participate in safety and information meetings | meetings are attended, information is relayed to workforce, and is applied |
| A-4.01.10P | send and receive ***electronic messages*** | ***electronic messages*** are sent and received using professionalism, plain language and clear expressions according to company policies |

## Range of Variables

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

***electronic messages*** include: email, text messages

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| A-4.01.01L | demonstrate knowledge of trade terminology | define terminology used in trade |
| A-4.01.02L | demonstrate knowledge of effective communication practices | describe importance of using effective verbal and non-verbal communication with ***people in the workplace*** |
| | | describe importance of teamwork |
| | | identify ***sources of information*** to effectively communicate |
| | | identify communication and ***learning styles*** |
| | | describe effective listening and speaking skills |
| | | describe how to receive and give instructions effectively |
| | | identify ***personal responsibilities and attitudes*** that contribute to on-the-job success |
| | | identify value of equity, diversity and inclusion in workplace |
| | | identify communication that constitutes bullying, ***harassment*** and ***discrimination*** |
| | | identify communication styles appropriate to different systems and applications of ***electronic messages*** |

## Range of Variables

***people in the workplace*** include: other tradespeople, colleagues, apprentices, supervisors, customers, jurisdictional representatives, manufacturers, office administrators

***sources of information*** include: regulations, codes, occupational health and safety requirements, jurisdictional requirements, prints, drawings, specifications, company and customer documentation

***learning styles*** include: visual, auditory, kinesthetic

***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***: as defined by the Canadian and jurisdictional Human Rights Commissions

***discrimination***: as defined by the Canadian Human Rights Act and jurisdictional human rights laws

***electronic messages*** include: email, text messages

## A-4.02 Uses mentoring techniques

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| A-4.02.01P | identify and communicate learning objective and point of lesson | apprentice or learner can explain objective and point of lesson |
| A-4.02.02P | link lesson to other lessons and project | lesson order and unplanned learning opportunities are defined |
| A-4.02.03P | demonstrate 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 apprentice or learner to practice a skill | ***practice conditions*** are set up so that skill can be practiced safely by apprentice or learner |
| A-4.02.05P | set up conditions where apprentice or learner feels comfortable communicating and asking questions | conditions are such that apprentice or learner feels comfortable communicating and asking questions |
| A-4.02.06P | recognize and discuss multiple possible techniques for performing trade tasks and options that may be best for apprentice or learner | multiple possible techniques for performing trade tasks and options that may be best for apprentice or learner are recognized and discussed |
| A-4.02.07P | assess apprentice or learner's ability to perform tasks with increasing independence | performance of apprentice or learner improves with practice to a point where task can be done with little supervision |
| A-4.02.08P | give supportive and corrective feedback | apprentice or learner adopts best practice after having been given supportive or corrective feedback |
| A-4.02.09P | support apprentices or learners in pursuing technical training opportunities | technical training is completed within timeframe prescribed by apprenticeship authority |
| A-4.02.10P | support anti-***harassment*** and anti-***discrimination*** practices in workplace | workplace is ***harassment*** and ***discrimination***-free |
| A-4.02.11P | support accommodations and alternate work practices that are appropriate for apprentice or learner | accommodations and alternate work practices that are appropriate for apprentice or learner are supported |
| A-4.02.12P | assess apprentice or learner suitability to trade during probationary period | apprentice or learner is given constructive feedback that helps them identify their own strengths and weaknesses and suitability for trade |

## Range of Variables

***steps required to demonstrate a skill*** include: understanding who, what, where, when, why, and how, explaining, showing, giving encouragement, following up to ensure skill is performed correctly
***practice conditions*** mean: guided, limited independence, full independence
***harassment***: as defined by the Canadian and jurisdictional Human Rights Commissions
***discrimination***: as defined by the *Canadian Human Rights Act* and jurisdictional human rights laws

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

## Range of Variables

***skills for success (essential skills)*** are: adaptability, collaboration, communication, creativity and innovation, digital, numeracy, problem solving, reading, writing

***learning styles*** include: visual, auditory, kinesthetic

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

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

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

# Major Work Activity B
# Installs fuel piping and tubing systems

## Task B-5 Selects and installs piping for fuel systems

### Task Descriptor

Gasfitters select, prepare and install a variety of piping for fuel systems. Preparation and installation of piping includes cutting, joining, supporting, identifying and protecting according to codes, standards, regulations and manufacturers' specifications.

### B-5.01 Selects piping for fuel systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| B-5.01.01P | select ***piping for fuel systems*** | ***piping for fuel systems*** is selected according to job specifications, ***codes, standards and regulations*** |
| B-5.01.02P | inspect ***piping for fuel systems*** | ***piping for fuel systems*** is inspected to identify ***deficiencies*** |
| B-5.01.03P | select ***support materials*** | ***support materials*** are selected according to job and manufacturers' specifications |
| B-5.01.04P | select ***fasteners*** | ***fasteners*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |

### Range of Variables

***piping for fuel systems*** include: plastic, steel, stainless steel, non-ferrous, hoses, connectors
***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, NBC, AHJ, NFPA, ANSI/ASME, UNS
***deficiencies*** include: impurities, dents, cracks
***support materials*** include: hangers, brackets, braces, clips, strapping, clamps, rods
***fasteners*** include: screws, nails, nuts and bolts, anchors

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| B-5.01.01L | demonstrate knowledge of ***piping for fuel systems***, their ***characteristics***, applications and operation | identify types of ***piping for fuel systems***, and describe their ***characteristics*** and applications |
| | | describe ***operating principles of piping for fuel systems*** |
| | | interpret information pertaining to ***piping for fuel systems*** found on drawings, job specifications, ***codes, standards and regulations*** |
| B-5.01.02L | demonstrate knowledge of procedures to select ***piping for fuel systems*** | describe procedures to select ***piping for fuel systems*** |
| | | describe procedures to inspect ***piping for fuel systems*** |
| | | identify restrictions on use of ***piping for fuel systems*** |
| B-5.01.03L | demonstrate knowledge of training and certification requirements to select ***piping for fuel systems*** | identify training and certification requirements to select ***piping for fuel systems*** |
| B-5.01.04L | demonstrate knowledge of regulatory requirements pertaining to ***piping for fuel systems*** | identify ***codes, standards and regulations*** pertaining to ***piping for fuel systems*** |

## Range of Variables

***piping for fuel systems*** include: plastic, steel, stainless steel, non-ferrous, hoses, connectors

***characteristics*** include: grades, composition, sizes, wall thickness

***operating principles of piping for fuel systems*** include: maximum allowable pressure, system pressure drop, flow rates

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, NBC, AHJ, NFPA, ANSI/ASME, UNS

## B-5.02 Prepares piping for fuel systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| B-5.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| B-5.02.02P | calculate ***piping for fuel systems*** length and fitting allowances | ***piping for fuel systems*** length and fitting allowances are calculated |
| B-5.02.03P | calculate offset and rolling offset dimensions | offset and rolling offset dimensions are calculated according to spool sheets, drawings and site conditions |
| B-5.02.04P | calculate dimensions | dimensions are calculated according to spool sheets, drawings and site conditions |
| B-5.02.05P | measure and mark ***piping for fuel systems*** to length | ***piping for fuel systems*** is measured and marked to length according to spool sheets, drawings and site conditions considering fitting allowances |
| B-5.02.06P | cut ***piping for fuel systems*** to length | ***piping for fuel systems*** is cut to length according to job specifications |
| B-5.02.07P | ream ***piping for fuel systems*** to remove burrs and scales from ends | ***piping for fuel systems*** is reamed to remove burrs and scales from ends |
| B-5.02.08P | chamfer ends | ends are chamfered according to size and manufacturers' specifications of ***piping for fuel systems*** |
| B-5.02.09P | bevel, square and clean ***piping for fuel systems*** end for joining | ***piping for fuel systems*** end is bevelled, squared and cleaned for joining according to manufacturers' specifications, ***codes, standards and regulations*** |
| B-5.02.10P | seal ends using ***materials*** until ***piping for fuel systems*** is installed | ends are sealed using ***materials*** until ***piping for fuel systems*** is installed to prevent contamination |

### Range of Variables

***tools and equipment*** include: pipe cutters, reamers, chamfering tools, grinders, files, marking devices, chop saws, threaders

***piping for fuel systems*** include: plastic, steel, stainless steel, non-ferrous, hoses, connectors

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, NBC, AHJ, NFPA, ANSI/ASME, UNS

***materials*** include: caps, plugs

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| B-5.02.01L | demonstrate knowledge of ***piping for fuel systems***, their ***characteristics***, applications and operation | identify types of ***piping for fuel systems*** and describe their ***characteristics*** and applications |
| | | describe ***operating principles of piping for fuel systems*** |
| | | interpret information pertaining to ***piping for fuel systems*** found on drawings and job specifications |
| | | describe thermal coefficient of expansion of ***piping for fuel systems*** |
| | | identify restrictions on use of ***piping for fuel systems*** |
| B-5.02.02L | demonstrate knowledge of ***procedures to prepare piping for fuel systems*** | identify ***tools and equipment*** used to prepare ***piping for fuel systems***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to prepare ***piping for fuel systems*** |
| | | describe ***procedures to prepare piping for fuel systems*** |
| | | identify ***deficiencies*** found while inspecting ***piping for fuel systems*** |
| | | describe ***procedures to measure piping for fuel systems*** |
| | | explain ***trade math concepts*** |
| | | explain metric and imperial systems of measurement and conversions |
| B-5.02.03L | demonstrate knowledge of training and certification requirements to prepare ***piping for fuel systems*** | identify training and certification requirements to prepare ***piping for fuel systems*** |
| B-5.02.04L | demonstrate knowledge of regulatory requirements pertaining to ***piping for fuel systems*** | identify ***codes, standards and regulations*** pertaining to ***piping for fuel systems*** |

## Range of Variables

***piping for fuel systems*** include: plastic, steel, stainless steel, non-ferrous, hoses, connectors

***characteristics*** include: grades, composition, sizes, schedule

***operating principles of piping for fuel systems*** include: maximum allowable pressure, system pressure drop, flow rates

***procedures to prepare piping for fuel systems*** include: calculating offset and rolling offset dimensions; measuring, marking, cutting, bevelling, squaring and cleaning piping; sealing ends of piping

***tools and equipment*** include: pipe cutters, reamers, chamfering tools, grinders, files, marking devices, chop saws, threaders

***hazards*** include: dust, exposed fibres, burrs, sparks, fumes, sharp edges, burns

***deficiencies*** include: impurities, dents, cracks, burrs, scales

***procedures to measure piping for fuel systems*** include: centre-to-centre, end-to-centre, end-to-end, gain or loss, measuring of angles

***trade math concepts*** include: Pythagorean theorem, algebra, trigonometry, area and capacity, converting units of energy

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, NBC, AHJ, NFPA, ANSI/ASME, UNS

## B-5.03 Installs piping for fuel systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| B-5.03.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to manufacturers' specifications |
| B-5.03.02P | identify style of joint and approved ***fittings*** | style of joint and approved ***fittings*** are identified according to manufacturers' specifications, ***codes, standards and regulations*** |
| B-5.03.03P | select ***fittings*** | ***fittings*** are selected according to site conditions |
| B-5.03.04P | clean ***piping for fuel systems*** and ***fittings*** | ***piping for fuel systems*** and ***fittings*** are cleaned to remove ***impurities*** according to ***joining method*** |
| B-5.03.05P | select ***joining compound*** | ***joining compound*** is selected according to manufacturers' specifications, ***codes, standards and regulations*** |
| B-5.03.06P | join ***piping for fuel systems*** | ***piping for fuel systems*** is joined using ***joining methods*** |

| | | |
|---|---|---|
| B-5.03.07P | follow sequence of bolt tensioning and torquing | sequence of bolt tensioning and torquing are followed according to manufacturers' specifications |
| B-5.03.08P | position and fasten ***support materials*** | ***support materials*** are positioned and fastened using ***fasteners*** according to manufacturers' specifications, ***codes, standards and regulations*** |
| B-5.03.09P | ***protect*** and support ***piping for fuel systems*** | ***piping for fuel systems*** is ***protected*** and supported according to site conditions, job and manufacturers' specifications, ***codes, standards and regulations*** |
| B-5.03.10P | label section of ***piping for fuel systems*** | section of ***piping for fuel systems*** is labelled according to job specifications, ***codes, standards and regulations*** |

## Range of Variables

***tools and equipment*** include: heat fusion machines, electrofusion machines, hand tools, power tools, power dies

***fittings*** include: risers, tees, couplings, bends, valves, unions, caps, plugs, adapters, flanges

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, NBC, AHJ, NFPA, ANSI/ASME, UNS

***piping for fuel systems*** include: plastic, steel, stainless steel, non-ferrous, hoses, connectors

***impurities*** include: dirt, oil, moisture, filings, scale

***joining methods*** include: threaded, welded, flanged, pressed, fused

***joining compounds*** include: pipe dope, thread sealant tape, primers, glues

***support materials*** include: hangers, brackets, braces, clips, strapping, clamps, rods

***fasteners*** include: screws, nails, nuts and bolts, anchors

***protection*** includes: wood, bollards, paint, sleeves, cathodic

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| B-5.03.01L | demonstrate knowledge of ***fittings, joining compounds***, and hangers and supports for joints, their characteristics and applications | identify types of ***fittings, joining compounds***, and hangers and supports for joints, and describe their characteristics and applications |
| | | interpret information pertaining to ***fittings, joining compounds***, and hangers and supports for joints found in manufacturers' specifications, ***codes, standards and regulations*** |
| B-5.03.02L | demonstrate knowledge of ***procedures to install piping for fuel systems*** | identify ***tools and equipment*** used to install ***piping for fuel systems***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install ***piping for fuel systems*** |

| | | |
|---|---|---|
| | | describe ***procedures to install piping for fuel systems*** |
| | | identify ***joining methods*** |
| | | identify ***impurities*** removed while cleaning ***piping for fuel systems*** |
| | | describe methods of preventing electrolysis |
| | | describe methods of pipe tracing |
| | | describe thermal coefficient of expansion |
| | | explain piping identification and describe its purpose |
| B-5.03.03L | demonstrate knowledge of training and certification requirements to install ***piping for fuel systems*** | identify training and certification requirements to install ***piping for fuel systems*** |
| B-5.03.04L | demonstrate knowledge of regulatory requirements pertaining to ***piping for fuel systems*** | identify ***codes, standards and regulations*** pertaining to ***piping for fuel systems*** |

## Range of Variables

***fittings*** include: risers, tees, couplings, bends, valves, unions, caps, plugs, adapters, flanges

***joining compounds*** include: pipe dope, thread sealant tape, primers, glues

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, NBC, AHJ, NFPA, ANSI/ASME, UNS

***procedures to install piping for fuel systems*** include: identifying style of joint, selecting fittings, cleaning piping and fittings, selecting joining compounds, joining piping, following sequence of bolt tensioning and torquing, positioning and fastening support materials, protecting and supporting piping, labelling section of piping

***tools and equipment*** include: heat fusion machines, electrofusion machines, hand tools, power tools, power dies

***piping for fuel systems*** include: plastic, steel, stainless steel, non-ferrous, hoses, connectors

***hazards*** include: working at heights, repetitive movements, dust, exposed fibres, burrs, sparks, fumes, sharp edges, welder's flash, heavy lifting

***joining methods*** include: threaded, welded, flanged, pressed, fused

***impurities*** include: dirt, oil, moisture, filings, scale

# Task B-6 Selects and installs tubing for fuel systems

## Task Descriptor

Gasfitters select, prepare and install a variety of tubing for fuel systems. Preparation and installation of tubing include cutting, bending, joining, supporting and protecting according to codes, standards, regulations and manufacturers' specifications.

## B-6.01 Selects tubing for fuel systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| B-6.01.01P | select ***tubing for fuel systems*** | ***tubing for fuel systems*** is selected according to job specifications, ***codes, standards and regulations*** |
| B-6.01.02P | inspect ***tubing for fuel systems*** | ***tubing for fuel systems*** is inspected to identify ***deficiencies*** |
| B-6.01.03P | select ***support materials*** | ***support materials*** are selected according to job and manufacturers' specifications |
| B-6.01.04P | select ***fasteners*** | ***fasteners*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***tubing for fuel systems*** include: seamless copper, corrugated stainless steel tubing (CSST), seamless steel

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME, UNS

***deficiencies*** include: impurities, dents, cracks, kinks

***support materials*** include: hangers, brackets, braces, clips, strapping, clamps, rods

***fasteners*** include: screws, nails, nuts and bolts, anchors

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| B-6.01.01L | demonstrate knowledge of ***tubing for fuel systems***, their ***characteristics***, applications and operation | identify types of ***tubing for fuel systems***, and describe their ***characteristics*** and applications |
| | | describe ***operating principles of tubing for fuel systems*** |
| | | interpret information pertaining to ***tubing for fuel systems*** found on drawings and specifications |
| B-6.01.02L | demonstrate knowledge of procedures to select ***tubing for fuel systems*** | describe procedures to select ***tubing for fuel systems*** |
| | | describe procedures to inspect ***tubing for fuel systems*** |
| | | identify restrictions on use of ***tubing for fuel systems*** |
| | | identify ***deficiencies*** found while inspecting ***tubing for fuel systems*** |
| B-6.01.03L | demonstrate knowledge of training and certification requirements to select ***tubing for fuel systems*** | identify training and certification requirements to select ***tubing for fuel systems*** |
| B-6.01.04L | demonstrate knowledge of regulatory requirements pertaining to ***tubing for fuel systems*** | identify ***codes, standards and regulations*** pertaining to ***tubing for fuel systems*** |

## Range of Variables

***tubing for fuel systems*** include: seamless copper, corrugated stainless steel tubing (CSST), seamless steel

***characteristics*** include: coating, sizes, wall thickness

***operating principles of tubing for fuel systems*** include: maximum allowable pressure, system pressure drop, flow rates

***deficiencies*** include: impurities, dents, cracks, kinks

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME, UNS

## B-6.02 Prepares tubing for fuel systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| B-6.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to manufacturers' specifications |
| B-6.02.02P | calculate offset and rolling offset dimensions | offset and rolling offset dimensions are calculated according to spool sheets, drawings and site conditions |
| B-6.02.03P | measure ***tubing for fuel systems*** to dimensions | ***tubing for fuel systems*** is measured to dimensions according to spool sheets, drawings and site conditions, considering fitting, bend and flare allowances |
| B-6.02.04P | mark ***tubing for fuel systems*** | ***tubing for fuel systems*** is marked |
| B-6.02.05P | cut ***tubing for fuel systems*** to length | ***tubing for fuel systems*** is cut to length according to job specifications |
| B-6.02.06P | ream and chamfer ***tubing for fuel systems*** to remove burrs from ends | ***tubing for fuel systems*** is reamed and chamfered to remove burrs from ends |
| B-6.02.07P | measure and mark bend points | bend points are measured and marked according to spool sheets, drawings and site conditions |
| B-6.02.08P | bend ***tubing for fuel systems*** | ***tubing for fuel systems*** is bent to match determined dimensions and angles |
| B-6.02.09P | seal ends until ***tubing for fuel systems*** is installed | ends are sealed using ***materials*** until tubing is installed to prevent contamination |

### Range of Variables

***tool and equipment*** include: tubing cutters, reamers, chamfering tools, marking devices, flaring tools, benders, torches

***tubing for fuel systems*** include: seamless copper, CSST, seamless steel

***materials*** include: caps, plugs, couplings, reducers, elbows, tees

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| B-6.02.01L | demonstrate knowledge of ***tubing for fuel systems***, their ***characteristics***, applications and operation | identify types of ***tubing for fuel systems***, and describe their ***characteristics*** and applications |
| | | describe ***operating principles of tubing for fuel systems*** |

| | | |
|---|---|---|
| | | interpret information pertaining to ***tubing for fuel systems*** found on drawings and job specifications |
| B-6.02.02L | demonstrate knowledge of ***procedures to prepare tubing for fuel systems*** | identify ***tools and equipment*** used to prepare ***tubing for fuel systems***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to prepare tubing for fitting |
| | | describe ***procedures to prepare tubing for fuel systems*** |
| | | describe ***procedures to measure tubing*** |
| | | explain ***trade math concepts*** |
| | | explain metric and imperial systems of measurement and conversions |
| B-6.02.03L | demonstrate knowledge of training and certification requirements to prepare ***tubing for fuel systems*** | identify training and certification requirements to prepare ***tubing for fuel systems*** |
| B-6.02.04L | demonstrate knowledge of regulatory requirements pertaining to ***tubing for fuel systems*** | identify ***codes, standards and regulations*** pertaining to ***tubing for fuel systems*** |

## Range of Variables

***tubing for fuel systems*** include: seamless copper, CSST, seamless steel

***characteristics*** include: coating, sizes, wall thickness

***operating principles of tubing for fuel systems*** include: maximum allowable pressure, system pressure drop, flow rates

***procedures to prepare tubing for fuel systems*** include: calculating offset and rolling offset dimensions; measuring, marking, bending, cutting, reaming, chamfering and sealing tubing for fuel systems

***tool and equipment*** include: tubing cutters, reamers, chamfering tools, marking devices, flaring tools, benders, torches

***hazards*** include: dust, exposed fibres, burrs, sparks, fumes, sharp edges, burns

***procedures to measure tubing*** include: centre-to-centre, end-to-centre, end-to-end, gain or loss, measuring of angles

***trade math concepts*** include: Pythagorean theorem, algebra, trigonometry, area and capacity, converting units of energy

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, NBC, AHJ, NFPA, ANSI/ASME, UNS

## B-6.03 Installs tubing for fuel systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| B-6.03.01P | select and use ***tools and equipment***, and ***materials*** | ***tools and equipment***, and ***materials*** are selected and used according to material and joining practice, manufacturers' specifications, ***codes, standards and regulations*** |
| B-6.03.02P | identify ***style of joint*** | ***style of joint*** is identified according to manufacturers' specifications, ***codes, standards and regulations*** |
| B-6.03.03P | select ***fittings*** | ***fittings*** are selected according to material and joining practice, ***codes, standards and regulations*** |
| B-6.03.04P | clean ***tubing for fuel systems*** and ***fittings*** | ***tubing for fuel systems*** and ***fittings*** are cleaned to remove ***impurities*** |
| B-6.03.05P | assemble ***fittings*** on ***tubing for fuel systems*** | ***fittings*** on ***tubing for fuel systems*** are assembled according to manufacturers' specifications |
| B-6.03.06P | join ***tubing for fuel systems*** | ***tubing for fuel systems*** is joined using ***joining methods*** |
| B-6.03.07P | position and fasten ***support materials*** | ***support materials*** are positioned and fastened using ***fasteners*** according to manufacturers' specifications, ***codes, standards and regulations*** |
| B-6.03.08P | ***protect*** and support ***tubing for fuel systems*** | ***tubing for fuel systems*** is ***protected*** and supported according to site conditions, job and manufacturers' specifications, ***codes, standards and regulations*** |
| B-6.03.09P | label section of ***tubing for fuel systems*** | section of ***tubing for fuel systems*** is labelled according to job specifications, ***codes, standards and regulations*** |

## Range of Variables

***tool and equipment*** include: tubing cutters, reamers, chamfering tools, marking devices, flaring tools, benders, torches

***materials*** include: fluxes, brazing rods, lubricants

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, NBC, AHJ, NFPA, ANSI/ASME, UNS

***styles of joints*** include: brazed, flared, press connect, mechanical fitting other than ball sleeve compression

***fittings*** include: risers, tees, couplings, bends, valves, unions, caps, plugs, adapters, flanges, flare nuts, press connect, mechanical fitting other than ball sleeve compression

***tubing for fuel systems*** include: seamless copper, CSST, seamless steel

***impurities*** include: dirt, oil, moisture, filings, scale

***joining methods*** include: brazing, flaring, using press connect, using mechanical fitting other than ball sleeve compression

***support materials*** include: hangers, brackets, braces, clips, strapping, clamps, rods

***fasteners*** include: screws, nails, nuts and bolts, anchors

***protection*** includes: wood, bollards, sleeves, cathodic

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| B-6.03.01L | demonstrate knowledge of ***materials, fittings, support materials, fasteners*** and ***protection*** used to install ***tubing for fuel systems*** | identify types of ***materials, fittings, support materials, fasteners*** and ***protection*** used to install ***tubing for fuel systems*** |
| | | interpret information pertaining to ***materials, fittings, support materials, fasteners*** and ***protection*** found in manufacturers' specifications |
| B-6.03.02L | demonstrate knowledge of ***procedures to install tubing for fuel systems*** | identify ***tools and equipment*** used to install ***tubing for fuel systems***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install ***tubing for fuel systems*** |
| | | describe ***procedures to install tubing for fuel systems*** |
| | | identify ***impurities*** found while cleaning ***tubing for fuel systems*** and ***fittings*** |
| | | identify ***styles of joints*** |
| | | describe methods of preventing electrolysis |
| | | describe thermal coefficient of expansion |
| | | explain tubing identification and describe its purpose |

| | | |
|---|---|---|
| B-6.03.03L | demonstrate knowledge of training and certification requirements to install ***tubing for fuel systems*** | identify training and certification requirements to install ***tubing for fuel systems*** |
| B-6.03.04L | demonstrate knowledge of regulatory requirements pertaining to ***tubing for fuel systems*** | identify ***codes, standards and regulations*** pertaining to ***tubing for fuel systems*** |

## Range of Variables

***materials*** include: fluxes, brazing rods, lubricants

***fittings*** include: risers, tees, couplings, bends, valves, unions, caps, plugs, adapters, flanges, flare nuts, press connect, mechanical fitting other than ball sleeve compression

***support materials*** include: hangers, brackets, braces, clips, strapping, clamps, rods

***fasteners*** include: screws, nails, nuts and bolts, anchors

***protection*** includes: wood, bollards, sleeves, cathodic

***tubing for fuel systems*** include: seamless copper, CSST, seamless steel

***procedures to install tubing for fuel systems*** include: identifying style of joint, selecting fittings, cleaning tubing and fittings, assembling fittings, joining tubing, positioning and fastening support materials, protecting and supporting tubing, labelling section of tubing

***tool and equipment*** include: tubing cutters, reamers, chamfering tools, marking devices, flaring tools, benders, torches

***hazards*** include: dust, exposed fibres, burrs, sparks, fumes, sharp edges, burns

***impurities*** include: dirt, oil, moisture, filings, scale

***styles of joints*** include: brazed, flared, press connect, mechanical fitting other than ball sleeve compression

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, NBC, AHJ, NFPA, ANSI/ASME, UNS

# Major Work Activity C
# Installs venting and air supply systems

## Task C-7 Selects and installs venting systems

### Task Descriptor

Gasfitters install venting systems to convey potential hazardous gases to a safe location.

### C-7.01 Selects materials for venting systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| C-7.01.01P | determine location of venting lines, terminations and condensation drain traps | location of venting lines, terminations and condensation drain traps are determined according to ***factors*** while considering structure without impacting its integrity |
| C-7.01.02P | select ***support materials*** | ***support materials*** are selected according to job and manufacturers' specifications, ***codes, standards and regulations*** |
| C-7.01.03P | select ***protection materials*** | ***protection materials*** are selected according to job and manufacturers' specifications, ***codes, standards and regulations*** |
| C-7.01.04P | select ***venting materials*** | ***venting materials*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |
| C-7.01.05P | select ***fasteners*** | ***fasteners*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***factors*** include: drawings, manufacturers' specifications, best practices, codes, standards and regulations

***support materials*** include: hangers, brackets, braces, strapping

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

***protection materials*** include: wood, drywall, insulating millboard, metal, fire stops

***venting materials*** include: fittings, flashings, pipes, sleeves, liners, connectors, fire stops, sealants, chimneys, terminations, adapters, glues, primers, gaskets, lubricants

***fasteners*** include: bolts, anchors, straps, screws, clamps

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| C-7.01.01L | demonstrate knowledge of venting systems, their ***characteristics***, applications and operation | identify types of venting systems and describe their ***characteristics*** and applications |
| | | describe ***operating principles of venting systems*** |
| | | interpret information pertaining to venting systems found on drawings and manufacturers' specifications |
| | | describe draft and how it is created and controlled |
| | | describe venting system combinations and category of appliances I, II, III and IV |
| C-7.01.02L | demonstrate knowledge of ***support materials***, ***protection materials, venting materials*** and ***fasteners***, their characteristics, applications and operation | identify types of ***support materials***, and describe their characteristics and applications |
| | | identify types of ***protection materials*** and describe their characteristics and applications |
| | | identify types of ***venting materials*** and describe their classifications, ***characteristics*** and applications |
| | | identify types of ***fasteners*** and describe their characteristics and applications |
| | | interpret information pertaining to ***support materials, protection materials***, ***venting materials*** and ***fasteners***, found on drawings, manufacturers' specifications, ***codes, standards and regulations*** |
| C-7.01.03L | demonstrate knowledge of ***procedures to select venting systems*** | describe ***procedures to select venting systems*** |
| | | identify ***hazards*** and describe safe work practices to select venting systems |

| | | |
|---|---|---|
| C-7.01.04L | demonstrate knowledge of training and certification requirements to select venting systems | identify training and certification requirements to select venting systems |
| C-7.01.05L | demonstrate knowledge of regulatory requirements pertaining to venting systems | identify ***codes, standards and regulations*** pertaining to venting systems |

## Range of Variables

***characteristics*** (of venting materials) include: gauge, size, composition (plastic, stainless steel, copper, aluminum, galvanized steel, masonry)

***operating principles of venting systems*** include: draft velocity, pressure, temperature, condensate collection and neutralizers

***support materials*** include: hangers, brackets, braces, strapping

***protection materials*** include: wood, drywall, insulating millboard, metal, fire stops

***venting materials*** include: fittings, flashings, pipes, sleeves, liners, connectors, fire stops, sealants, chimneys, terminations, adapters, glues, primers, gaskets, lubricants

***fasteners*** include: bolts, anchors, straps, screws, clamps

***procedures to select venting systems*** include: determining location of venting lines, terminations and condensation drain traps; selecting support, venting, protection materials and fasteners

***hazards*** include: dust, exposed fibres, burrs, sparks, fumes, sharp edges, burns

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

## C-7.02 Prepares materials for venting systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| C-7.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task and manufacturers' specifications |
| C-7.02.02P | calculate ***venting material*** length and fitting allowances | ***venting material*** length and fitting allowances are calculated according to system requirements, manufacturers' specifications, ***codes, standards and regulations*** |
| C-7.02.03P | measure section length | section length is measured according to location of venting termination and appliance |
| C-7.02.04P | cut ***venting materials*** to length | ***venting materials*** are cut to length according to calculations |

| | | |
|---|---|---|
| C-7.02.05P | ream, chamfer or crimp ***venting materials*** | ***venting materials*** are reamed, chamfered or crimped according to manufacturers' specifications |
| C-7.02.06P | dry fit ***components*** and ***fittings*** | ***components*** and ***fittings*** are dry fit according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***tools and equipment*** include: hacksaws, chop saws, plastic pipe cutters, tin snips, reamers, chamfers, crimpers, mitre boxes

***venting materials*** include: fittings, flashings, pipes, sleeves, fasteners, connectors, fire stops, sealants, adhesives, chimneys

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

***components*** include: locking bands, mechanical connections, terminations

***fittings*** include: tees, couplings, bends, caps, plugs, adapters

| | **Knowledge** | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| C-7.02.01L | demonstrate knowledge of ***venting materials***, their ***characteristics***, applications and operation | identify types of ***venting materials***, and describe their ***characteristics*** and applications |
| | | describe operating principles of ***venting materials*** |
| | | interpret information pertaining to ***venting materials*** found on drawings and manufacturers' specifications |
| C-7.02.02L | demonstrate knowledge of venting systems, their characteristics, applications and operation | identify types of venting systems and describe their characteristics and applications |
| | | describe ***operating principles of venting systems*** |
| | | interpret information pertaining to venting systems found on drawings and manufacturers' specifications |
| C-7.02.03L | demonstrate knowledge of ***procedures to prepare materials for venting systems*** | identify ***tools and equipment*** used to prepare materials for venting systems, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to prepare materials for venting systems |

| | | |
|---|---|---|
| | | describe ***procedures to prepare materials for venting systems*** |
| C-7.02.04L | demonstrate knowledge of regulatory requirements pertaining to venting systems | identify ***codes, standards and regulations*** pertaining to venting systems |

## Range of Variables

***venting materials*** include: fittings, flashings, pipes, sleeves, fasteners, connectors, fire stops, sealants, adhesives, chimneys

***characteristics*** (of venting materials) include: gauge, composition (plastic, stainless steel, copper, aluminum, galvanized steel, masonry)

***operating principles of venting systems*** include: draft velocity, pressure, temperature, condensate collection and neutralizers

***procedures to prepare materials for venting systems*** include: calculating venting material length and fitting allowances, measuring section length, cutting venting materials to length, reaming, chamfering or crimping venting materials, dry fitting components and fittings

***tools and equipment*** include: hacksaws, chop saws, plastic pipe cutters, tin snips, reamers, chamfers, crimpers, mitre boxes

***hazards*** include: repetitive movements, dust, exposed fibres, burrs, sparks, fumes, sharp edges, heavy lifting

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

## C-7.03 Installs venting systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| C-7.03.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| C-7.03.02P | identify, measure and mark location of ***support materials*** for venting systems | location of ***support materials*** for venting systems are identified, measured and marked according to job and manufacturers' specifications, ***codes, standards and regulations*** |
| C-7.03.03P | position ***support materials*** for venting systems | ***support materials*** for venting systems are positioned according to job and manufacturers' specifications, ***codes, standards and regulations*** |
| C-7.03.04P | fasten ***support materials*** to structure | ***support materials*** are fastened to structure using ***fasteners*** |
| C-7.03.05P | ***prepare connectors*** for joining | ***connectors are prepared*** for joining according to manufacturers' specifications |

| | | |
|---|---|---|
| C-7.03.06P | mount venting systems on supports | venting systems are mounted on supports according to manufacturers' specifications, ***codes, standards and regulations*** |
| C-7.03.07P | connect ***components*** and ***fittings*** | ***components*** and ***fittings*** are connected using ***connecting methods*** according to manufacturers' specifications, ***codes, standards and regulations*** |
| C-7.03.08P | terminate venting systems | venting systems are terminated according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***tools and equipment*** include: hacksaws, chop saws, plastic pipe cutters, tin snips, reamers, chamfers, crimpers, mitre boxes, wrenches, fastening tools

***support materials*** include: hangers, brackets, braces

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

***fasteners*** include: bolts, anchors, straps, screws, clamps

***preparing connectors*** includes: cleaning, priming, gluing, lubricating

***components*** include: locking bands, mechanical connections, terminations

***fittings*** include: tees, couplings, bends, caps and terminations, plugs, adapters

***connecting methods*** include: solvent welding, brazing, welding, using clamps and mechanical fittings

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| C-7.03.01L | demonstrate knowledge of venting systems, their characteristics, applications and operation | identify types of venting systems, and describe their characteristics and applications |
| | | describe ***operating principles of venting systems*** |
| | | interpret information pertaining to venting systems found on drawings and manufacturers' specifications |
| C-7.03.02L | demonstrate knowledge of ***procedures to install venting systems*** | identify ***tools and equipment*** used to install venting systems, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install venting systems |
| | | describe ***procedures to install venting systems*** |
| | | identify ***venting considerations*** |
| | | describe ***procedures to measure for support materials*** |
| | | describe stack, draft and chimney effects |

| | | |
|---|---|---|
| | | describe heat recovery systems and scrubbers |
| | | explain metric and imperial systems of measurement and conversions |
| C-7.03.03L | demonstrate knowledge of training and certification requirements to install venting systems | identify training and certification requirements to install venting systems |
| C-7.03.04L | demonstrate knowledge of regulatory requirements pertaining to venting systems | identify ***codes, standards and regulations*** pertaining to venting systems |

## Range of Variables

***operating principles of venting systems*** include: draft velocity, pressure, temperature, condensate collection and neutralizers

***procedures to install venting systems*** include: identifying, measuring and marking location of support materials; positioning and fastening support materials; preparing connectors for joining; mounting venting on supports; connecting components and fittings; terminating venting systems

***tools and equipment*** include: hacksaws, chop saws, plastic pipe cutters, tin snips, reamers, chamfers, crimpers, mitre boxes, wrenches, fastening tools

***hazards*** include: repetitive movements, dust, exposed fibres, burrs, sparks, fumes, sharp edges, heavy lifting

***venting considerations*** include: condensation, draining, grade, flue gas velocity, combustion analyzer test points, material clearances for natural and mechanical draft

***procedures to measure for support materials*** include: centre-to-centre, end-to-centre, end-to-end

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

# Task C-8 Selects and installs air supply systems

## Task Descriptor

Gasfitters install air supply systems to maintain safe and efficient operation of gas appliances. They must be thoroughly familiar with prevailing construction methods, air infiltration, exhaust equipment, and consider the building as a system. In this task, air supply systems include combustion, excess, dilution and ventilation air for appliances located in a building or a structure.

## C-8.01 Selects materials for air supply systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| C-8.01.01P | determine location of air supply systems, intakes and terminations | location of air supply systems, intakes and terminations are determined according to ***factors*** while considering structure without impacting its integrity |
| C-8.01.02P | calculate ***air supply material*** length, size, fitting allowances and round duct equivalence | ***air supply material*** length, fitting allowances and round duct equivalence are calculated according to system requirements, manufacturers' specifications, ***codes, standards and regulations*** |
| C-8.01.03P | select ***air supply materials*** | ***air supply materials*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |
| C-8.01.04P | select ***support materials*** | ***support materials*** are selected according to job and manufacturers' specifications, and ***codes, standards and regulations*** |
| C-8.01.05P | select ***protection materials*** | ***protection materials*** are selected according to job and manufacturers' specifications, and ***codes, standards and regulations*** |
| C-8.01.06P | select ***fasteners*** | ***fasteners*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***factors*** include: drawings, manufacturers' specifications, best practices, codes, standards and regulations

***air supply materials*** include: fittings, pipes, fasteners, turning vanes, terminations, grilles, louvres

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

***support materials*** include: hangers, brackets, braces, strapping

***protection materials*** include: wood, drywall, insulating millboard, metal, fire stops

***fasteners*** include: bolts, anchors, straps, screws

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| C-8.01.01L | demonstrate knowledge of air supply systems, their characteristics, applications and operation | identify ***types of air supply systems***, and describe their characteristics and applications |
| | | describe ***operating principles of air supply systems*** |
| | | interpret information pertaining to air supply systems found on drawings and manufacturers' specifications |
| C-8.01.02L | demonstrate knowledge of ***support materials***, ***protection materials, air supply materials*** and ***fasteners***, their characteristics, applications and operation | identify types of ***support materials*** and describe their characteristics and applications |
| | | identify types of ***protection materials*** and describe their characteristics and applications |
| | | identify types of ***air supply materials*** and describe their ***characteristics*** and applications |
| | | identify types of ***fasteners*** and describe their characteristics and applications |
| | | interpret information pertaining to ***support materials***, ***protection materials, air supply materials*** and ***fasteners*** found on drawings and manufacturers' specifications |
| C-8.01.03L | demonstrate knowledge of ***procedures to select air supply systems*** | describe ***procedures to select air supply systems*** |
| C-8.01.04L | demonstrate knowledge of regulatory requirements pertaining to air supply systems | identify ***codes, standards and regulations*** pertaining to air supply systems |

## Range of Variables

***types of air supply systems*** include: natural/passive, mechanical

***operating principles of air supply systems*** include: sizing, duct free area, fitting resistance, thermal traps, stack effects, grille/louver efficiency, building depressurization

***support materials*** include: hangers, brackets, braces, strapping

***protection materials*** include: wood, drywall, insulating millboard, metal, fire stops

***air supply materials*** include: fittings, pipes, fasteners, turning vanes, terminations, grilles, louvres

***characteristics*** (of air supply materials) include: gauge, composition (wood, plastic, stainless steel, galvanized steel, specialty materials), fire ratings

***fasteners*** include: bolts, anchors, straps, screws

***procedures to select air supply systems*** include: determining location of air supply systems, intakes and terminations; calculating air supply material length, size, fitting allowances and round duct equivalence; selecting support, venting, protection materials and fasteners

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

## C-8.02 Prepares materials for air supply systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| C-8.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| C-8.02.02P | measure section length | section length is measured according to location of air supply termination or appliance connection |
| C-8.02.03P | cut ***air supply materials*** to length | ***air supply materials*** are cut to length according to calculations |
| C-8.02.04P | ream, chamfer or crimp ***air supply materials*** | ***air supply materials*** are reamed, chamfered or crimped according to manufacturers' specifications |
| C-8.02.05P | dry fit ***components*** and ***fittings*** | ***components*** and ***fittings*** are dry fit according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***tools and equipment*** include: hacksaws, chop saws, plastic pipe cutters, tin snips, reamers, chamfers, crimpers, mitre boxes, bar folders, measuring tapes, notchers, rippers, seamers, stretchers, power tools

***air supply materials*** include: fittings, pipes, fasteners, turning vanes, terminations, grilles, louvres, ducting

***components*** include: locking bands, mechanical connections, terminations

***fittings*** include: tees, couplings, bends, caps, plugs, adapters

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| C-8.02.01L | demonstrate knowledge of ***air supply materials***, their characteristics, applications and operation | identify types of ***air supply materials*** and describe their ***characteristics*** and applications |
| | | describe operating principles of ***air supply materials*** |
| | | interpret information pertaining to ***air supply materials*** found on drawings and manufacturers' specifications |
| C-8.02.02L | demonstrate knowledge of air supply systems, their characteristics, applications and operation | identify ***types of air supply systems***, and describe their characteristics and applications |
| | | describe ***operating principles of air supply systems*** |
| | | interpret information pertaining to air supply systems found on drawings and manufacturers' specifications |
| C-8.02.03L | demonstrate knowledge of ***procedures to prepare materials for air supply systems*** | identify ***tools and equipment*** used to prepare materials for air supply systems, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to prepare materials for air supply systems |
| | | describe ***procedures to prepare materials for air supply systems*** |
| C-8.02.04L | demonstrate knowledge of regulatory requirements pertaining to air supply systems | identify ***codes, standards and regulations*** pertaining to air supply systems |

## Range of Variables

***air supply materials*** include: fittings, pipes, fasteners, turning vanes, terminations, grilles, louvres, ducting

***characteristics*** (of air supply materials) include: gauge, composition (wood, plastic, stainless steel, galvanized steel, specialty materials), fire ratings

***types of air supply systems*** include: natural/passive, mechanical

***operating principles of air supply systems*** include: sizing, duct free area, fitting resistance, thermal traps, stack effects, grille/louver efficiency, building depressurization

***procedures to prepare materials for air supply systems*** include: measuring section length; cutting air supply materials to length; reaming, chamfering or crimping air supply materials; dry fitting components and fittings

***tools and equipment*** include: hacksaws, chop saws, plastic pipe cutters, tin snips, reamers, chamfers, crimpers, mitre boxes, bar folders, measuring tapes, notchers, rippers, seamers, stretchers, power tools

***hazards*** include: repetitive movements, dust, exposed fibres, burrs, sparks, fumes, sharp edges, heavy lifting

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

## C-8.03 Installs air supply systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| C-8.03.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| C-8.03.02P | identify, measure and mark location of ***support materials*** for air supply systems | location of ***support materials*** for air supply systems are identified, measured and marked according to job and manufacturers' specifications, and ***codes, standards and regulations*** |
| C-8.03.03P | position ***support materials*** for air supply systems | ***support materials*** for air supply systems are positioned according to job and manufacturers' specifications, and ***codes, standards and regulations*** |
| C-8.03.04P | fasten ***support materials*** to structure | ***support materials*** are fastened to structure using ***fasteners*** |
| C-8.03.05P | ***prepare connectors*** for joining | ***connectors are prepared*** for joining according to manufacturers' specifications |
| C-8.03.06P | connect ***components*** and ***fittings*** | ***components*** and ***fittings*** are connected using ***connecting methods*** |

| | | |
|---|---|---|
| C-8.03.07P | mount and assemble air supply systems on supports | air supply systems are mounted and assembled on supports according to job and manufacturers' specifications, and ***codes, standards and regulations*** |
| C-8.03.08P | seal joint connections using sealants or mechanical joints | joint connections are sealed using sealants or mechanical joints to prevent leakage according to manufacturers' specifications, ***codes, standards and regulations*** |
| C-8.03.09P | terminate air supply systems | air supply systems are terminated according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***tools and equipment*** include: hacksaws, chop saws, plastic pipe cutters, tin snips, reamers, chamfers, crimpers, mitre boxes, bar folders, measuring tapes, notchers, rippers, seamers, stretchers, power tools, rigging equipment

***support materials*** include: hangers, brackets, braces

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CEC, NBC, AHJ, NFPA, ANSI/ASME

***fasteners*** include: bolts, anchors, straps, screws, clamps

***preparing connectors*** includes: cleaning, priming, gluing, lubricating

***components*** include: locking bands, mechanical connections, terminations

***fittings*** include: tees, couplings, bends, caps, plugs, adapters

***connecting methods*** include: cementing, brazing, welding

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| C-8.03.01L | demonstrate knowledge of air supply systems, their characteristics, applications and operation | identify ***types of air supply systems***, and describe their characteristics and applications |
| | | describe ***operating principles of air supply systems*** |
| | | interpret information pertaining to air supply systems found on drawings and manufacturers' specifications |
| C-8.03.02L | demonstrate knowledge of concepts and fundamentals relating to air supply systems | describe concepts and fundamentals relating to combustion |
| | | explain how air supply affects combustion |
| | | define building as a system |
| | | describe draft and how it is created |
| | | describe combustion air supply methods |

| | | |
|---|---|---|
| | | describe combustion, excess, dilution, relief, secondary and primary ventilation requirements and applications |
| | | describe sizing charts and calculations of combustion, excess, dilution, relief, secondary, primary and ventilation air |
| | | describe grille and louver sizing allowances and restrictions |
| | | explain calculations for ***conditions*** |
| | | describe ***characteristics of air*** |
| | | describe psychrometric characteristics and charts |
| | | describe air supply requirements for various ***appliance categories*** |
| C-8.03.03L | demonstrate knowledge of ***procedures to install air supply systems*** | identify ***tools and equipment*** used to install air supply systems, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install air supply systems |
| | | describe ***procedures to install air supply systems*** |
| | | describe ***procedures to measure for support materials*** |
| C-8.03.04L | demonstrate knowledge of regulatory requirements pertaining to air supply systems | identify ***codes, standards and regulations*** pertaining to air supply systems |

## Range of Variables

***types of air supply systems*** include: natural/passive, mechanical

***operating principles of air supply systems*** include: sizing, duct free area, fitting resistance, thermal traps, stack effects, grille/louver efficiency, building depressurization

***conditions*** include: free area, air volume

***characteristics of air*** include: humidity, dewpoint, relative density, temperature, composition

***appliance categories*** include: I, II, III and IV

***procedures to install air supply systems*** include: identifying, measuring and marking location of support materials; positioning and fastening support materials; preparing connectors for joining; mounting air supply systems on supports; connecting components and fittings; terminating air supply systems

***tools and equipment*** include: hacksaws, chop saws, plastic pipe cutters, tin snips, reamers, chamfers, crimpers, mitre boxes, bar folders, measuring tapes, notchers, rippers, seamers, stretchers, power tools, rigging equipment

***hazards*** include: repetitive movements, dust, exposed fibres, burrs, sparks, fumes, sharp edges, heavy lifting

***procedures to measure for support materials*** include: centre-to-centre, end-to-centre, end-to-end

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CEC, NBC, AHJ, NFPA, ANSI/ASME

# Task C-9 Selects and installs draft control systems

## Task Descriptor

Gasfitters install draft control systems to maintain safe and efficient operation of gas appliances. In this task, draft control systems include draft hoods and diverters, barometric dampers (single and double-acting) and mechanical forced and induced draft control devices.

## C-9.01 Selects components for draft control systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| C-9.01.01P | determine location of draft control equipment and ***components*** | location of draft control equipment and ***components*** is determined according to drawings, manufacturers' specifications, best practices, ***codes, standards and regulations*** |
| C-9.01.02P | select ***support materials*** | ***support materials*** are selected according to job and manufacturers' specifications, ***codes, standards and regulations*** |
| C-9.01.03P | select draft control equipment and ***components*** | draft control equipment and ***components*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |
| C-9.01.04P | select ***fasteners*** | ***fasteners*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***components*** include: fans, blowers, motors, controls, pressure switches, dampers, gauges, flow indicators, conductors

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

***support materials*** include: hangers, brackets, braces, strapping

***fasteners*** include: bolts, anchors, straps, screws, clamps

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| C-9.01.01L | demonstrate knowledge of draft control systems, their ***components***, characteristics, applications and operation | identify types of ***natural draft control systems*** and their ***components***, and describe their characteristics and applications |
| | | identify types of ***mechanical draft control systems*** and their ***components***, and describe their characteristics and applications |
| | | describe ***operating principles of draft control systems*** |
| | | interpret information pertaining to draft control systems found on drawings and manufacturers' specifications |
| | | define building as a system |
| | | describe draft and how it is created |
| | | describe combustion draft control methods |
| C-9.01.02L | demonstrate knowledge of ***support materials*** and ***fasteners***, their characteristics, applications and operation | identify types of ***support materials*** and describe their characteristics and applications |
| | | identify types of ***fasteners*** and describe their characteristics and applications |
| | | interpret information pertaining to ***support materials*** and ***fasteners*** found on drawings and manufacturers' specifications |
| C-9.01.03L | demonstrate knowledge of ***procedures to select draft control systems*** | describe ***procedures to select draft control systems*** |
| C-9.01.04L | demonstrate knowledge of regulatory requirements pertaining to draft control systems | identify ***codes, standards and regulations*** pertaining to draft control systems |

## Range of Variables

***components*** include: fans, blowers, motors, controls, pressure switches, dampers, gauges, flow indicators, conductors

***natural draft control systems*** include: barometric dampers, draft hoods, draft diverters

***mechanical draft control systems*** include: induced, forced, balanced

***operating principles of draft control systems*** include: draft velocity, pressure, temperature

***support materials*** include: hangers, brackets, braces, strapping

***fasteners*** include: bolts, anchors, straps, screws, clamps

***procedures to select draft control systems*** include: determining location of draft control systems and components; selecting support materials, draft control equipment and components, and fasteners

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

## C-9.02 Installs components for draft control systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| C-9.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| C-9.02.02P | identify, measure and mark location of ***support materials*** for draft control systems | location of ***support materials*** for draft control systems are identified, measured and marked according to job and manufacturers' specifications, and ***codes, standards and regulations*** |
| C-9.02.03P | position ***support materials*** for draft control systems | ***support materials*** for draft control systems are positioned according to job and manufacturers' specifications, and ***codes, standards and regulations*** |
| C-9.02.04P | fasten ***support materials*** to structure | ***support materials*** are fastened to structure using ***fasteners*** |
| C-9.02.05P | mount draft control system ***components*** on supports | draft control system ***components*** are mounted on supports according to manufacturers' specifications, ***codes, standards and regulations*** |
| C-9.02.06P | ***prepare connectors*** for joining | ***connectors are prepared*** for joining according to manufacturers' specifications |
| C-9.02.07P | connect ***components*** and ***fittings*** | ***components*** and ***fittings*** are connected using ***connecting methods*** |

## Range of Variables

***tools and equipment*** include: hand tools, power tools, lifting equipment, gauges

***support materials*** include: hangers, brackets, braces

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

***fasteners*** include: bolts, anchors, straps, screws, clamps

***components*** include: fans, blowers, motors, controls, pressure switches, dampers, gauges, flow indicators, conductors

***preparing connectors*** includes: crimping, folding, fastening, drilling

***fittings*** include: tees, couplings, bends, caps, plugs, adapters

***connecting methods*** include: cementing, brazing, welding

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| C-9.02.01L | demonstrate knowledge of draft control systems, their ***components***, characteristics, applications and operation | identify types of ***natural draft control systems*** and their ***components***, and describe their characteristics and applications |
| | | identify types of ***mechanical draft control systems*** and their ***components***, and describe their characteristics and applications |
| | | describe ***operating principles of draft control systems*** |
| C-9.02.02L | demonstrate knowledge of ***procedures to install draft control systems and their components*** | identify ***tools and equipment*** used to install draft control systems and their ***components***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install draft control systems |
| | | describe ***procedures to install draft control systems and their components*** |
| | | identify sizing calculations for draft control systems |
| | | identify procedures to test draft control systems and their components |
| C-9.02.03L | demonstrate knowledge of regulatory requirements pertaining to draft control systems | identify ***codes, standards and regulations*** pertaining to draft control systems |

## Range of Variables

***components*** include: fans, blowers, motors, controls, pressure switches, dampers, gauges, flow indicators, conductors

***natural draft control systems*** include: barometric dampers, draft hoods, draft diverters

***mechanical draft control systems*** include: induced, forced, balanced

***operating principles of draft control systems*** include: draft velocity, pressure, temperature

***procedures to install draft control systems and their components*** include: identifying, measuring and marking location of support materials; positioning and fastening support materials; mounting draft control systems on supports; preparing connectors for joining; connecting components and fittings

***tools and equipment*** include: hand tools, power tools, lifting equipment, gauges

***hazards*** include: repetitive movements, dust, exposed fibres, burrs, sparks, fumes, sharp edges, heavy lifting, electrocution

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), NBC, AHJ, NFPA, ANSI/ASME

# Major Work Activity D
# Installs controls and electrical systems

## Task D-10 Selects and installs combustion control systems

### Task Descriptor

Gasfitters assemble, place, secure and connect combustion control systems in residential, industrial, commercial and institutional (ICI) sectors.

The controls enable the systems to start, stop, monitor and modulate to obtain safe and energy efficient operation.

### D-10.01 Selects combustion control components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-10.01.01P | verify original equipment specifications | original equipment specifications are verified |
| D-10.01.02P | select and verify ***components*** | ***components*** are selected and verified according to ***factors*** |
| D-10.01.03P | select location and ***enclosures*** | location and ***enclosures*** are selected according to job and manufacturers' specifications, certifying bodies, ***codes, standards and regulations*** |

### Range of Variables

***components*** include: pressure transmitters, servo motors, control modules, fuel air ratio controls, NOx controls, programmable logic controllers (PLC), variable frequency drives (VFD), supervisory systems, $O_2$, NOx and CO monitors

***factors*** include: site requirements, type of equipment, manufacturers' specifications, certifying bodies, codes, standards and regulations

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-10.01.01L | demonstrate knowledge of combustion control systems, their ***components***, characteristics, applications and operation | identify combustion control systems and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of combustion control systems and their ***components*** |
| | | interpret information pertaining to combustion control systems and their ***components*** found on drawings and specifications |
| | | describe combustion theory and formulas |
| | | describe fuel-air ratios |
| D-10.01.02L | demonstrate knowledge of ***electrical systems*** and their ***components***, their characteristics, applications and operation | describe ***electricity principles*** |
| | | identify ***electrical systems*** and their ***components***, and describe their characteristics, applications and operation |
| | | identify electrical symbols and wiring diagrams |
| | | describe ***types of circuits*** |
| | | identify and describe conductors, semi-conductors and insulators |
| D-10.01.03L | demonstrate knowledge of regulatory requirements pertaining to combustion controls and their ***components*** | identify ***codes, standards and regulations*** pertaining to combustion controls and their ***components*** |
| | | identify certifying bodies responsible for combustion controls and their ***components*** |

## Range of Variables

***components*** include: pressure transmitters, servo motors, control modules, fuel air ratio controls, NOx controls, programmable logic controllers (PLC), variable frequency drives (VFD), supervisory systems, $O_2$, NOx and CO monitors

***electrical systems*** include: milli voltage, low voltage, line voltage (single [1] phase, three [3] phase), AC/DC, resistive

***electrical system components*** include: starters, capacitors, temperature switches, relays, disconnects, transformers, flow switches, pressure switches, line voltage filters, overload and overcurrent protection, limit switches, pumps, interlocks, motors, actuators, speed drives

***electricity principles*** include: Ohm's Law, Kirchhoff's Laws

***types of circuits*** include: series, parallel, series/parallel

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

## D-10.02 Installs combustion control components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-10.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| D-10.02.02P | install mounting points and brackets for ***combustion control components*** | mounting points and brackets for ***combustion control components*** are installed according to manufacturers' specifications |
| D-10.02.03P | install certified ***enclosures*** | certified ***enclosures*** are installed according to job and manufacturers' specifications, and ***codes, standards and regulations*** |
| D-10.02.04P | mount and connect combustion control and ***components*** | combustion control and ***components*** are mounted and connected according to manufacturers' specifications, ***codes, standards and regulations*** |
| D-10.02.05P | program and configure control modules | control modules are programmed and configured according to job specifications, ***codes, standards and regulations*** |
| D-10.02.06P | verify, set up and confirm operation prior to commissioning | operation is verified, set up and confirmed prior to commissioning |
| D-10.02.07P | update drawings to create as-built final drawings | drawings are updated to create as-built final drawings |

### Range of Variables

***tools and equipment*** include: hand tools, drills, multimeters, signal generators, wire strippers, wiring identification equipment, network cabling tools and testers

***combustion control components*** include: pressure transmitters, servo motors, control modules, fuel air ratio controls, NOx controls, PLCs, VFDs, supervisory systems, $O_2$, NOx and CO monitors

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-10.02.01L | demonstrate knowledge of combustion control systems, their ***components***, characteristics, applications and operation | identify combustion control systems and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of combustion control systems and their ***components*** |
| | | interpret information pertaining to combustion control systems and their ***components*** found on drawings and specifications |
| | | describe combustion theory and formulas |
| | | describe fuel-air ratios |
| D-10.02.02L | demonstrate knowledge of ***electrical systems*** and their ***components***, their characteristics, applications and operation | describe ***electricity principles*** |
| | | identify ***electrical systems*** and their ***components***, and describe their characteristics, applications and operation |
| | | identify electrical symbols and wiring diagrams |
| | | describe ***types of circuits*** |
| | | identify and describe conductors, semi-conductors and insulators |
| D-10.02.03L | demonstrate knowledge of procedures to install combustion controls and their ***components*** | identify ***tools and equipment*** used to install combustion controls and their ***components***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install combustion controls and their ***components*** |
| | | describe ***procedures to install combustion controls and their components*** |
| | | identify ***site-specific and regional considerations*** for installation |
| D-10.02.04L | demonstrate knowledge of training and certification requirements to install combustion control systems | identify training and certification requirements to install combustion control systems |
| D-10.02.05L | demonstrate knowledge of regulatory requirements pertaining to combustion control systems and their ***components*** | identify ***codes, standards and regulations*** pertaining to combustion control systems and their ***components*** |
| | | identify certifying bodies responsible for combustion controls and their ***components*** |

## Range of Variables

***combustion control components*** include: pressure transmitters, servo motors, control modules, fuel air ratio controls, NOx controls, PLCs, VFDs, supervisory systems, $O_2$, NOx and CO monitors

***electrical systems*** include: milli voltage, low voltage, line voltage (single [1] phase, three [3] phase), AC/DC, resistive

***electrical system components*** include: starters, capacitors, temperature switches, relays, disconnects, transformers, flow switches, pressure switches, line voltage filters, overload and overcurrent protection, limit switches, pumps, interlocks, motors, actuators, speed drives

***electricity principles*** include: Ohm's Law, Kirchhoff's Laws

***types of circuits*** include: series, parallel, series/parallel

***tools and equipment*** include: hand tools, drills, multimeters, signal generators, wire strippers, wiring identification equipment, network cabling tools and testers

***hazards*** include: energy sources, environmental, working at heights, confined spaces

***procedures to install combustion controls and their components*** include: verifying original equipment specifications; selecting and verifying components; selecting location and enclosures; installing mounting points and brackets for components; installing certified enclosures; mounting and connecting combustion controls and components; programming and configuring control modules; verifying, setting up and confirming operation prior to commissioning; creating as-built final drawings

***site-specific and regional considerations*** include: seismic restraints, climate, ambient temperature, altitude

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

# Task D-11 Selects and installs flame safeguard systems

## Task Descriptor

Gasfitters assemble, place, secure and connect flame safeguard systems in residential and ICI sectors. A flame safeguard system controls the safety aspects of establishing and maintaining a flame during the run period and monitoring during the off period.

## D-11.01 Selects flame safeguard components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-11.01.01P | verify original equipment specifications | original equipment specifications are verified |
| D-11.01.02P | select and verify ***components*** | ***components*** are selected and verified according to ***factors*** |
| D-11.01.03P | select location and ***enclosures*** | location and ***enclosures*** are selected according to job and manufacturers' specifications, certifying bodies, ***codes, standards and regulations*** |

### Range of Variables

***components*** include: flame rods or scanners (ultraviolet [UV], infrared [IR], self-checking), wiring base, chassis, display, purge timer, flame amplifier, hot surface ignition (HSI), direct spark ignitor (DSI), pilots

***factors*** include: site requirements, certifying bodies, type of equipment, manufacturers' specifications, codes, standards and regulations

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-11.01.01L | demonstrate knowledge of ***flame safeguards***, their ***components***, characteristics, applications and operation | identify types of ***flame safeguards*** and their ***components***, and describe their characteristics and applications |
| | | describe types and operation of ignition systems |
| | | describe operating principles of ***flame safeguards*** and their ***components*** |

| | | |
|---|---|---|
| | | describe sequence of operation of flame safeguards |
| | | interpret information pertaining to ***flame safeguards*** and their ***components*** found on drawings and specifications |
| D-11.01.02L | demonstrate knowledge of regulatory requirements pertaining to ***flame safeguards*** and their ***components*** | identify ***codes, standards and regulations*** pertaining to ***flame safeguards*** and their ***components*** |
| | | identify certifying bodies responsible for ***flame safeguards*** and their ***components*** |

## Range of Variables

***flame safeguards*** include: solid state, microprocessor, programmable, non-programmable

***components*** include: flame rods or scanners (ultraviolet [UV], infrared [IR], self-checking), wiring base, chassis, display, purge timer, flame amplifier, hot surface ignition (HSI), direct spark ignitor (DSI), pilots

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

## D-11.02 Installs flame safeguard components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-11.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| D-11.02.02P | install mounting points and brackets for ***components*** | mounting points and brackets for ***components*** are installed according to manufacturers' specifications |
| D-11.02.03P | install certified ***enclosures*** | certified ***enclosures*** are installed according to job and manufacturers' specifications, and ***codes, standards and regulations*** |
| D-11.02.04P | mount and connect ***flame safeguards*** and ***components*** | ***flame safeguards*** and ***components*** are mounted and connected according to manufacturers' installation procedures |
| D-11.02.05P | configure ***flame safeguard*** | ***flame safeguard*** is configured according to ***job specifications*** |
| D-11.02.06P | verify, set up and confirm operation prior to commissioning | operation is verified, set up and confirmed prior to commissioning |
| D-11.02.07P | update drawings to create as-built final drawings | drawings are updated to create as-built final drawings |

## Range of Variables

***tools and equipment*** include: hand tools, drills, multimeters, signal generators, wire strippers, wiring identification equipment, network cabling tools and testers

***components*** include: flame rods or scanners (UV, IR, self-checking), wiring bases, chassis, displays, purge timers, flame amplifiers, HSI, DSI, pilots

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

***flame safeguards*** include: solid state, microprocessor, programmable, non-programmable

***job specifications*** include: purge times, flame amplifiers

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-11.02.01L | demonstrate knowledge of ***flame safeguards***, their ***components***, characteristics, applications and operation | identify types of ***flame safeguards*** and their ***components***, and describe their characteristics and applications |
| | | describe types and operation of ignition systems |
| | | describe operating principles of ***flame safeguards*** and their ***components*** |
| | | describe sequence of operation of ***flame safeguards*** |
| | | identify component and system compatibility when performing upgrading/conversions |
| | | interpret information pertaining to ***flame safeguards*** and their ***components*** found on drawings and specifications |
| D-11.02.02L | demonstrate knowledge of ***procedures to install flame safeguards and their components*** | identify ***tools and equipment*** used to install ***flame safeguards*** and their ***components***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install ***flame safeguards*** and their ***components*** |
| | | describe ***procedures to install flame safeguards and their components*** |
| | | identify ***site-specific and regional considerations*** for installation |
| D-11.02.03L | demonstrate knowledge of regulatory requirements pertaining to ***flame safeguards*** and their ***components*** | identify ***codes, standards and regulations*** pertaining to ***flame safeguards*** and their ***components*** |
| | | identify certifying bodies responsible for ***flame safeguards*** and their ***components*** |

### Range of Variables

***flame safeguards*** include: solid state, microprocessor, programmable, non-programmable

***components*** include: flame rods or scanners (UV, IR, self-checking), wiring bases, chassis, displays, purge timers, flame amplifiers, HSI, DSI, pilots

***procedures to install flame safeguards and their components*** include: verifying original equipment specifications; selecting and verifying components; selecting location and enclosures; installing mounting points and brackets for components; installing certified enclosures; mounting and connecting flame safeguards and components; configuring flame safeguard; verifying, setting up and confirming operation of flame safeguard prior to commissioning; creating as-built final drawings

***tools and equipment*** include: hand tools, drills, multimeters, signal generators, wire strippers, wiring identification equipment, network cabling tools and testers

***hazards*** include: energy sources, environmental, working at heights, confined spaces, static discharge

***site-specific and regional considerations*** include: climate, ambient temperature

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

## Task D-12 Selects and installs operating control systems

### Task Descriptor

Gasfitters assemble, place, secure and connect limits and operating control systems in residential, and ICI sectors.

The operating control system's function is to start, stop, monitor and modulate the appliance's operation to ensure its safe and efficient operation.

### D-12.01 Selects operating control components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-12.01.01P | verify original equipment specifications | original equipment specifications are verified |
| D-12.01.02P | select and verify ***components*** | ***components*** are selected and verified according to ***factors*** |
| D-12.01.03P | select location and ***enclosures*** | location and ***enclosures*** are selected according to job and manufacturers' specifications, certifying bodies, ***codes, standards and regulations*** |

## Range of Variables

***components*** include: on-off operators, low and high gas pressure switches, combustion air proving switches, high limit controls, gas valves, temperature controls, liquid level controls, alternate fuel controls (e.g. digester gas, fuel selector switches, flame arrestors, oil valves, return oil systems), waste fuel system components (fuel oil preheat systems), interlocks, control point instrumentation (e.g., resistance temperature detectors [RTD], pressure transducers, thermocouples, flow meters), PLCs, programmable thermostats

***factors*** include: site requirements, certifying bodies, type of equipment, manufacturers' specifications, codes, standards and regulations

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-12.01.01L | demonstrate knowledge of operating controls, their ***components***, characteristics, applications and operation | identify types of operating controls and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of operating controls and their ***components*** |
| | | describe sequence of operation of operating and limit controls |
| | | interpret information pertaining to operating controls and their ***components*** found on drawings and specifications |
| | | describe operation of computer interfaces and programs |
| | | describe types of ***control signals and protocols*** |
| | | describe integration of different types of controls |
| D-12.01.02L | demonstrate knowledge of regulatory requirements pertaining to operating controls and their ***components*** | identify ***codes, standards and regulations*** pertaining to operating controls and their ***components*** |
| | | identify certifying bodies responsible for operating controls and their ***components*** |

## Range of Variables

***components*** include: on-off operators, low and high gas pressure switches, combustion air proving switches, high limit controls, gas valves, temperature controls, liquid level controls, alternate fuel controls (e.g. digester gas, fuel selector switches, flame arrestors, oil valves, return oil systems), waste fuel system components (fuel oil preheat systems), interlocks, control point instrumentation (e.g., resistance temperature detectors [RTD], pressure transducers, thermocouples, flow meters), PLCs, programmable thermostats

***control signals and protocols*** include: 4 to 20 milliamps (mA), 0-10 DC volts, Modbus, BACnet, Hypertext Transfer Protocol (HTTP), Address Resolution Protocol (ARP), Wheatstone bridge

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

## D-12.02 Installs operating control components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-12.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| D-12.02.02P | install mounting points and brackets for operating control ***components*** | mounting points and brackets for operating control ***components*** are installed according to manufacturers' specifications |
| D-12.02.03P | install certified ***enclosures*** | certified ***enclosures*** are installed according to job and manufacturers' specifications, ***codes, standards and regulations*** |
| D-12.02.04P | mount and connect operating control ***components*** | operating control ***components*** are mounted and connected according to manufacturers' installation procedures and venting requirements |
| D-12.02.05P | configure operating controls | operating controls are configured according to ***job specifications*** |
| D-12.02.06P | verify, set up and confirm operation prior to commissioning | operation is verified, set up and confirmed prior to commissioning |
| D-12.02.07P | update drawings to create as-built final drawings | drawings are updated to create as-built final drawings |

## Range of Variables

***tools and equipment*** include: hand tools, drills, multimeters, signal generators, wiring identification equipment, network cabling tools and testers

***components*** include: on-off operators, low and high gas pressure switches, combustion air proving switches, high limit controls, gas valves, temperature controls, liquid level controls, alternate fuel controls (e.g., digester gas, fuel selector switches, flame arrestors, oil valves, return oil systems), waste fuel system components (fuel oil preheat system), interlocks, control point instrumentation (e.g., RTDs, pressure transducers, thermocouples, flow meters), PLCs, programmable thermostats

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

***job specifications*** include: set points, high limits, minimum/maximum gas pressures

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-12.02.01L | demonstrate knowledge of operating controls, their ***components***, characteristics, applications and operation | identify types of operating controls and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of operating controls and their ***components*** |
| | | describe sequence of operation of operating and limit controls |
| | | interpret information pertaining to operating controls and their ***components*** found on drawings and specifications |
| | | describe operation of computer interfaces and programs |
| | | describe types of ***control signals and protocols*** |
| | | describe integration of different types of controls |
| D-12.02.02L | demonstrate knowledge of ***procedures to install operating controls and their components*** | identify ***tools and equipment*** used to install operating controls and their ***components***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install operating controls and their ***components*** |
| | | describe ***procedures to install operating controls and their components*** |
| | | identify ***site-specific and regional considerations*** for installation |
| D-12.02.03L | demonstrate knowledge of regulatory requirements pertaining to operating controls and their ***components*** | identify ***codes, standards and regulations*** pertaining to operating controls and their ***components*** |
| | | identify certifying bodies responsible for operating controls and their ***components*** |

### Range of Variables

***components*** include: on-off operators, low and high gas pressure switches, combustion air proving switches, high limit controls, gas valves, temperature controls, liquid level controls, alternate fuel controls (e.g., digester gas, fuel selector switches, flame arrestors, oil valves, return oil systems), waste fuel system components (fuel oil preheat system), interlocks, control point instrumentation (e.g., RTDs, pressure transducers, thermocouples, flow meters), PLCs, programmable thermostats

***control signals and protocols*** include: 4 to 20 mA, 0-10 DC volts, Modbus, BACnet, HTTP, ARP, Wheatstone bridge

***procedures to install operating controls and their components*** include: verifying original equipment specifications; selecting and verifying components; selecting location and enclosures; installing mounting points and brackets; installing certified enclosures; mounting and connecting components; configuring operating controls; verifying, setting up and confirming operation prior to commissioning; creating as-built final drawings

***tools and equipment*** include: hand tools, drills, multimeters, signal generators, wiring identification equipment, network cabling tools and testers

***hazards*** include: energy sources, environmental, working at heights, confined spaces, hazardous materials (e.g., mercury, silica, asbestos, ceramic fibre insulation, lead)

***site-specific and regional considerations*** include: seismic restraints, climate, ambient temperature, altitude

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA

# Task D-13 Selects and installs electrical systems

### Task Descriptor

Gasfitters assemble, place, secure and connect electrical components (from the disconnect to the appliance) in residential and ICI sectors. In some provinces and territories, gasfitters may be restricted in electrical work they can perform and must coordinate work as needed with appropriate trades.

Electrical components enable system operation by providing power to sub-systems such as electronic controls, pumps and motors to obtain the designed condition and maintain safe operation.

## D-13.01 Selects electrical components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-13.01.01P | verify ***original equipment specifications*** | ***original equipment specifications*** are verified |
| D-13.01.02P | select and verify ***electrical components*** | ***electrical components*** are selected and verified according to ***factors*** |

| | | |
|---|---|---|
| D-13.01.03P | select and size conductors for application | conductors for application are selected and sized according to ***codes, standards and regulations*** |
| D-13.01.04P | select location and ***enclosures*** | location and ***enclosures*** are selected according to job and manufacturers' specifications, certifying bodies, ***codes, standards and regulations*** |

## Range of Variables

***original equipment specifications*** include: voltage, current, phase, resistance, revolutions per minute (RPM)

***electrical components*** include: transformers, relays (solid-state relays [SSR], electromechanical relays), motor starters, motors, capacitors, power supplies, protective devices (overload, overcurrent), resistors, actuators, silicon-controlled rectifiers (SCR), DC motor controls and electronically commutated motors (ECM), VFDs, line voltage filters, line voltage reactors, switches and limits, disconnects and motor control centre (MCC) panels, power factor correction devices, uninterrupted power supply (UPS)

***factors*** include: site requirements, type of equipment, manufacturers' specifications, certifying bodies, codes, standards and regulations

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ1784, CEC, NBC, AHJ, NFPA

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-13.01.01L | demonstrate knowledge of ***electrical components***, their characteristics, applications and operation | identify types of ***electrical components*** and describe their characteristics and applications |
| | | describe operating principles of ***electrical components*** |
| | | interpret information pertaining to ***electrical components*** found on drawings and specifications |
| D-13.01.02L | demonstrate knowledge of ***electrical systems***, their characteristics, applications and operation | describe ***electricity principles*** |
| | | identify ***electrical systems***, and describe their characteristics, applications and operation |
| | | identify electrical symbols and wiring diagrams |
| | | describe ***types of circuits*** |
| | | identify and describe conductors, semi-conductors and insulators |

| | | |
|---|---|---|
| D-13.01.03L | demonstrate knowledge of regulatory requirements pertaining to ***electrical components*** | identify ***codes, standards and regulations*** pertaining to ***electrical components*** |
| | | identify certifying bodies responsible for electrical systems and their ***components*** |

## Range of Variables

***electrical components*** include: transformers, relays (solid-state relays [SSR], electromechanical relays), motor starters, motors, capacitors, power supplies, protective devices (overload, overcurrent), resistors, actuators, silicon-controlled rectifiers (SCR), DC motor controls and electronically commutated motors (ECM), VFDs, line voltage filters, line voltage reactors, switches and limits, disconnects and motor control centre (MCC) panels, power factor correction devices, uninterrupted power supply (UPS)

***electrical systems*** include: milli voltage, low voltage, line voltage (single [1] phase, three [3] phase), AC/DC, resistive

***electricity principles*** include: Ohm's Law, Kirchhoff's Laws

***types of circuits*** include: series, parallel, series/parallel

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ1784, CEC, NBC, AHJ, NFPA

## D-13.02 Installs electrical components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-13.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| D-13.02.02P | install mounting points and brackets for ***electrical components*** | mounting points and brackets for ***electrical components*** are installed according to manufacturers' specifications |
| D-13.02.03P | install certified ***enclosures*** | certified ***enclosures*** are installed according to job and manufacturers' specifications, ***codes, standards and regulations*** |
| D-13.02.04P | mount and connect ***electrical components*** | ***electrical components*** are mounted and connected according to manufacturers' specifications, ***codes, standards and regulations*** |
| D-13.02.05P | perform wiring of ***electrical components*** | wiring of ***electrical components*** is performed according to ***best practices***, ***codes, standards and regulations*** |
| D-13.02.06P | configure VFDs and ECMs | VFDs and ECMs are configured according to ***job specifications*** |

| | | |
|---|---|---|
| D-13.02.07P | verify, set up and confirm operation prior to commissioning | operation is verified, set up and confirmed prior to commissioning |
| D-13.02.08P | update drawings to create as-built final drawings | drawings are updated to create as-built final drawings |

## Range of Variables

***tools and equipment*** include: hand tools, drills, multimeters, signal generators, wiring identification equipment, network cabling tools and testers

***electrical components*** include: transformers, relays (SSR, electromechanical), motor starters, motors, capacitors, power supplies, protective devices (overload, overcurrent), resistors, actuators, SCRs, motor controls, DC motor controls and ECMs, VFDs, line voltage filters, line voltage reactors, switches and limits, disconnects and MCC panels, power factor correction devices, UPS

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

***best practices*** include: grouped and well-organized wire runs; end wire labelling and identification; approved connection techniques; isolation of control lines, communication lines and line voltage; create and update representative as-built drawings

***job specifications*** include: efficiency, performance

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-13.02.01L | demonstrate knowledge of ***electrical components***, their characteristics, applications and operation | identify types of ***electrical components***, and describe their characteristics and applications |
| | | describe operating principles of ***electrical components*** |
| | | interpret information pertaining to ***electrical components*** found on drawings and specifications |
| D-13.02.02L | demonstrate knowledge of ***electrical systems***, their characteristics, applications and operation | describe ***electricity principles*** |
| | | identify ***electrical systems***, and describe their characteristics, applications and operation |
| | | identify electrical symbols and wiring diagrams |
| | | describe ***types of circuits*** |
| | | identify and describe conductors, semi-conductors and insulators |
| D-13.02.03L | demonstrate knowledge of ***procedures to install electrical components*** | identify ***tools and equipment*** used to install ***electrical components***, and describe their procedures for use |

| | | |
|---|---|---|
| | | identify ***hazards*** and describe safe work practices to install ***electrical components*** |
| | | describe ***procedures to install electrical components*** |
| D-13.02.04L | demonstrate knowledge of regulatory requirements pertaining to ***electrical components*** and their ***components*** | identify ***codes, standards and regulations*** pertaining to ***electrical components*** and their ***components*** |
| | | identify certifying bodies responsible for electrical systems and their ***components*** |

## Range of Variables

***electrical components*** include: transformers, relays (SSR, electromechanical), motor starters, motors, capacitors, power supplies, protective devices (overload, overcurrent), resistors, actuators, SCRs, motor controls, DC motor controls and ECMs, VFDs, line voltage filters, line voltage reactors, switches and limits, disconnects and MCC panels, power factor correction devices, UPS

***electrical systems*** include: milli voltage, low voltage, line voltage (single [1] phase, three [3] phase), AC/DC, resistive

***electricity principles*** include: Ohm's Law, Kirchhoff's Laws

***types of circuits*** include: series, parallel, series/parallel

***procedures to install electrical components*** include: verifying original equipment specifications; selecting and verifying electrical components; selecting and sizing conductors for application; selecting location and enclosures; installing mounting points and brackets; installing certified enclosures; mounting and connecting electrical components; performing wiring of electrical components; configuring VFDs and ECMs; verifying, setting up and confirming operation prior to commissioning; creating as-built final drawings

***tools and equipment*** include: hand tools, drills, multimeters, signal generators, wiring identification equipment, network cabling tools and testers

***hazards*** include: energy sources, environmental, working at heights, confined spaces, hazardous materials (e.g., mercury, silica, asbestos, ceramic fibre insulation, lead)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

# Task D-14 Selects and installs automation and instrumentation control systems

## Task Descriptor

Gasfitters assemble, place, secure and connect automation and instrumentation control systems in residential and ICI sectors.

Automation control systems are used to control single units such as boilers as well as multiple heating applications for buildings.

Instrumentation control systems are used to control the flow of mediums such as liquid, steam and air.

Automation and instrumentation control systems provide monitoring, management, scheduling, load shedding, energy conservation, and enabling/disabling of equipment and processes to achieve efficiencies and precise parameter control.

## D-14.01 Selects automation and instrumentation control components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-14.01.01P | verify ***original equipment specifications*** | ***original equipment specifications*** are verified |
| D-14.01.02P | select and verify ***components*** | ***components*** are selected and verified according to ***factors*** |
| D-14.01.03P | select ***communication protocols*** | ***communication protocols*** are selected according to existing building automation system (BAS) and ***component*** specifications |
| D-14.01.04P | select location and ***enclosures*** | location and ***enclosures*** are selected according to job and manufacturers' specifications, certifying bodies, ***codes, standards and regulations*** |

## Range of Variables

***original equipment specifications*** include: voltage, network protocols

***components*** include: control point instrumentation (RTDs, transducers, $O_2$ and CO sensors, flow meters, proportional, integral and derivative [PID] components), set point instrumentation (BAS, process, stand-alone controllers)

***factors*** include: site requirements, certifying bodies, type of equipment, manufacturers' specifications, codes, standards and regulations

***communication protocols*** include: baud rates, network communication protocols (Modbus, BACnet [MSTP, IP], HTTP, ARP, HART, local operation network [LON]), serial port protocols (e.g., RS-232, RS-485, RS-422), communication speeds, wireless networks (e.g., Wi-Fi, ZigBee, Z-Wave)

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.3, B149.5), CEC, NBC, AHJ

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-14.01.01L | demonstrate knowledge of automation and instrumentation control systems, their ***components***, characteristics, applications and operation | identify types of automation and instrumentation control systems and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of automation and instrumentation control systems and their ***components*** |
| | | interpret information pertaining to automation and instrumentation control systems and their ***components*** found on drawings and specifications |
| D-14.01.02L | demonstrate knowledge of ***communication protocols***, their characteristics and applications | identify ***communication protocols***, and describe their characteristics and applications |
| D-14.01.03L | demonstrate knowledge of ***electrical systems***, their characteristics, applications and operation | describe ***electricity principles*** |
| | | identify ***electrical systems*** and describe their characteristics, applications and operation |
| | | identify electrical symbols and wiring diagrams |
| | | describe ***types of circuits*** |
| | | identify and describe conductors, semi-conductors and insulators |
| D-14.01.04L | demonstrate knowledge of regulatory requirements pertaining to automation and instrumentation control systems and their ***components*** | identify ***codes, standards and regulations*** pertaining to automation and instrumentation control systems and their ***components*** |

| | |
|---|---|
| | identify certifying bodies responsible for automation and instrumentation control systems and their ***components*** |

## Range of Variables

***components*** include: control point instrumentation (RTDs, transducers, $O_2$ and CO sensors, flow meters, proportional, integral and derivative [PID] components), set point instrumentation (BAS, process, stand-alone controllers)

***communication protocols*** include: baud rates, network communication protocols (Modbus, BACnet [MSTP, IP], HTTP, ARP, HART, local operation network [LON]), serial port protocols (e.g., RS-232, RS-485, RS-422), communication speeds, wireless networks (e.g., Wi-Fi, ZigBee, Z-Wave)

***electrical systems*** include: milli voltage, low voltage, line voltage (single [1] phase, three [3] phase), AC/DC, resistive

***electricity principles*** include: Ohm's Law, Kirchhoff's Laws

***types of circuits*** include: series, parallel, series/parallel

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.3, B149.5), CEC, NBC, AHJ

## D-14.02 Installs automation and instrumentation control components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| D-14.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| D-14.02.02P | install mounting points and brackets for ***components*** and cabling | mounting points and brackets for ***components*** and cabling are installed according to manufacturers' specifications |
| D-14.02.03P | install ***enclosures*** | ***enclosures*** are installed according to job and manufacturers' specifications, ***codes, standards and regulations*** |
| D-14.02.04P | mount and connect automation and instrumentation control systems, and their ***components*** | automation and instrumentation control systems, and their ***components*** are mounted and connected according to manufacturers' specifications |
| D-14.02.05P | perform wiring of automation and instrumentation control systems | wiring of automation and instrumentation control systems is performed according to ***best practices***, ***codes, standards and regulations*** |
| D-14.02.06P | program and configure controllers | controllers are programmed and configured according to job specifications such as control sequence requirements |

| | | |
|---|---|---|
| D-14.02.07P | check control configurations | control configurations are checked to ensure they are set according to manufacturers' installation requirements and job specifications |
| D-14.02.08P | verify, set up and confirm operation prior to commissioning | operation is verified, set up and confirmed prior to commissioning |
| D-14.02.09P | update drawings to create as-built final drawings | drawings are updated to create as-built final drawings |

## Range of Variables

***tools and equipment*** include: hand tools, wiring identification equipment, network cabling tools and testers

***components*** include: control point instrumentation (RTDs, transducers, $O_2$ and CO sensors, flow meters, PID components), set point instrumentation (BAS, process, stand-alone controllers)

***enclosures*** include: structures, existing or new panels (e.g., control, electrical, junction), junction boxes, switch boxes

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.3, B149.5), CEC, NBC, AHJ

***best practices*** include: grouped and well-organized wire runs; end wire labelling and identification; approved connection techniques; isolation of control lines, communication lines and line voltage; create and update representative as-built drawings

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| D-14.02.01L | demonstrate knowledge of automation and instrumentation control systems, their ***components***, characteristics, applications and operation | identify types of automation and instrumentation control systems and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of automation and instrumentation control systems, and their ***components*** |
| | | interpret information pertaining to automation and instrumentation control systems, and their ***components*** found on drawings and specifications |
| D-14.02.02L | demonstrate knowledge of ***communication protocols***, their characteristics and applications | identify ***communication protocols***, and describe their characteristics and applications |
| D-14.02.03L | demonstrate knowledge of ***electrical systems***, their characteristics, applications and operation | describe ***electricity principles*** |
| | | identify ***electrical systems***, and describe their characteristics, applications and operation |
| | | identify electrical symbols and wiring diagrams |
| | | describe ***types of circuits*** |

| | | |
|---|---|---|
| | | identify and describe conductors, semi-conductors and insulators |
| D-14.02.04L | demonstrate knowledge of ***procedures to install automation and instrumentation control systems and their components*** | identify ***tools and equipment*** used to install automation and instrumentation control systems, and their ***components***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install automation and instrumentation control systems, and their ***components*** |
| | | describe ***procedures to install automation and instrumentation control systems, and their components*** |
| D-14.02.05L | demonstrate knowledge of regulatory requirements automation and instrumentation control systems, and their ***components*** | identify ***codes, standards and regulations*** pertaining to automation and instrumentation control systems, and their ***components*** |
| | | identify certifying bodies responsible for automation and instrumentation control systems, and their ***components*** |

## Range of Variables

***components*** include: control point instrumentation (RTDs, transducers, $O_2$ and CO sensors, flow meters, PID components), set point instrumentation (BAS, process, stand-alone controllers)

***communication protocols*** include: baud rates, network communication protocols (Modbus, BACnet [MSTP, IP], HTTP, ARP, HART, local operation network [LON]), serial port protocols (e.g., RS-232, RS-485, RS-422), communication speeds, wireless networks (e.g., Wi-Fi, ZigBee, Z-Wave)

***electrical systems*** include: milli voltage, low voltage, line voltage (single [1] phase, three [3] phase), AC/DC, resistive

***electricity principles*** include: Ohm's Law, Kirchhoff's Laws

***types of circuits*** include: series, parallel, series/parallel

***procedures to install automation and instrumentation control systems, and their components*** include: selecting and verifying components; selecting communication protocols; selecting location and enclosures; installing mounting points and brackets for components and cabling; installing enclosures; mounting and connecting automation and instrumentation control systems and their components; performing wiring of systems; programming and configuring controllers; checking control configurations; verifying, setting up and confirming operation prior to commissioning; creating as-built final drawings

***tools and equipment*** include: hand tools, wiring identification equipment, network cabling tools and testers

***hazards*** include: energy sources, environmental, working at heights, confined spaces, hazardous materials (e.g., mercury, silica, asbestos, ceramic fibre insulation, lead)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.3, B149.5), CEC, NBC, AHJ

# Major Work Activity E
# Installs and converts fuel systems, appliances and ancillary equipment

## Task E-15 Selects, installs and converts fuel systems, appliances and ancillary equipment

### Task Descriptor

Gasfitters install and connect appliances to gas piping systems and energy distribution systems. They also install components that convert appliances and systems from one energy source to another.

### E-15.01 Selects appliances and ancillary equipment

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| E-15.01.01P | identify location for ***appliances and ancillary equipment***, and their ***components*** | location for ***appliances and ancillary equipment***, and their ***components*** is identified according to layout, site conditions, job specifications, ***codes, standards and regulations*** |
| E-15.01.02P | measure placement of ***appliances and ancillary equipment***, and their ***components*** | placement of ***appliances and ancillary equipment***, and their ***components*** is measured according to layout, site conditions, manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.01.03P | select ***appliances and ancillary equipment***, and their ***components*** | ***appliances and ancillary equipment***, and their ***components*** are selected according to manufacturers' specifications, site requirements, ***codes, standards and regulations*** |
| E-15.01.04P | select ***valve train components*** | ***valve train components*** are selected according to manufacturers' specifications, site requirements, ***codes, standards and regulations*** |
| E-15.01.05P | select ***joining methods*** | ***joining methods*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |

| | | |
|---|---|---|
| E-15.01.06P | select ***joining compounds*** | ***joining compounds*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.01.07P | select ***fasteners*** | ***fasteners*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.01.08P | select accessories | accessories are selected according to manufacturers' specifications, site requirements, ***codes, standards and regulations*** |

## Range of Variables

***appliances and ancillary equipment*** include: hydronic, steam, domestic hot water, hot air systems, humidification, kitchen and process equipment, ovens, kilns, decorative appliances

***appliance and ancillary equipment components*** include: regulators, valves, overpressure protection, valve trains

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CEC, NBC, AHJ, NFPA, ANSI/ASME

***valve train components*** include: solenoids, gas valves, gas valve actuators, regulators, low/high gas pressure switches, firing valves, gauges, burners, manual shutoff valves, thermocouple shutoff valves, dual combination control shutoffs, safety shutoffs with proof of closure, safety vents, input flow control valves, input flow control valves with mechanical stop and low fire stop switches, bypass pressure regulators, pressure test points, valve proving systems, fuel filtrations

***joining methods*** include: flanged, flared, brazed, welded, press-connect, plastic fusion

***joining compounds*** include: thread compounds, thread sealing tapes, gaskets, brazing alloys, welding alloys

***fasteners*** include: rods, anchors, hangers, bolts, clamps, tie wires, zip ties, epoxies

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| E-15.01.01L | demonstrate knowledge of ***appliances and ancillary equipment***, their ***components***, characteristics, applications and operation | identify types of ***appliances and ancillary equipment***, and their ***components***, and describe their characteristics and applications |
| | | identify types of ***valve train components***, and describe their characteristics and applications |
| | | describe operating principles of ***appliances and ancillary equipment***, and their ***components*** |
| | | identify ***burner types*** |
| | | describe principles and concepts of gas utilization |
| | | describe fuel types and characteristics |
| | | describe principles of combustion |

| | | |
|---|---|---|
| | | describe input gas pressures, flow rates and British Thermal Units per hour (Btuh) inputs |
| | | interpret information pertaining to ***appliances and ancillary equipment***, and their ***components***, found on drawings and specifications |
| E-15.01.02L | demonstrate knowledge of training and certification requirements to install ***appliances and ancillary equipment***, and their ***components*** | identify training and certification requirements to install ***appliances and ancillary equipment***, and their ***components*** |
| E-15.01.03L | demonstrate knowledge of regulatory requirements pertaining to ***appliances and ancillary equipment***, and their ***components*** | identify ***codes, standards and regulations*** pertaining to ***appliances and ancillary equipment***, and their ***components*** |
| | | identify certifying bodies responsible for ***appliances and ancillary equipment***, and their ***components*** |

## Range of Variables

***appliances and ancillary equipment*** include: hydronic, steam, domestic hot water, hot air systems, humidification, kitchen and process equipment, ovens, kilns, decorative appliances

***appliance and ancillary equipment components*** include: regulators, valves, overpressure protection, valve trains

***valve train components*** include: solenoids, gas valves, gas valve actuators, regulators, low/high gas pressure switches, firing valves, gauges, burners, manual shutoff valves, thermocouple shutoff valves, dual combination control shutoffs, safety shutoffs with proof of closure, safety vents, input flow control valves, input flow control valves with mechanical stop and low fire stop switches, bypass pressure regulators, pressure test points, valve proving systems, fuel filtrations

***burner types*** include: nozzle mix, pre-mix (zero-governor), diffusion, rectifier, raw gas, low $NO_X$, atmospheric, immersion, forced draft, induced draft, fan assist, infrared, radiant, dual fuel

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CEC, NBC, AHJ, NFPA, ANSI/ASME

## E-15.02 Installs appliances and ancillary equipment

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| E-15.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| E-15.02.02P | install hangers and supports | hangers and supports are installed according to site conditions, ***codes, standards and regulations*** |
| E-15.02.03P | lift and move ***appliances and ancillary equipment***, and their ***components*** into place | ***appliances and ancillary equipment***, and their ***components*** are lifted and moved into place according to site conditions, ***codes, standards and regulations*** |
| E-15.02.04P | secure and place ***appliances and ancillary equipment***, and their ***components*** in supports | ***appliances and ancillary equipment***, and their ***components*** are secured and placed in supports using ***fasteners*** according to drawings and manufacturers' specifications |
| E-15.02.05P | secure and align ***appliances and ancillary equipment***, and their ***components*** to housekeeping pads | ***appliances and ancillary equipment***, and their ***components*** are secured and aligned to housekeeping pads using ***fasteners*** according to drawings and manufacturers' specifications |
| E-15.02.06P | assemble ***valve train components*** | ***valve train components*** are assembled according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.02.07P | fasten supports to valve train | supports are fastened to valve train to ensure valve train is supported according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.02.08P | fasten supports to accessories | supports are fastened to accessories according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.02.09P | assemble final connection points | final connection points are assembled using approved ***joining methods*** and ***joining compounds*** according to manufacturers' specifications, ***codes, standards and regulations*** |

| | | |
|---|---|---|
| E-15.02.10P | verify, set up and confirm operation prior to commissioning | operation is verified, set up and confirmed prior to commissioning |
| E-15.02.11P | update drawings to create as-built final drawings | drawings are updated to create as-built final drawings |

## Range of Variables

***tools and equipment*** include: dollies, hoisting and rigging equipment, pipefitting tools (hand and power tools)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA, ANSI/ASME

***appliances and ancillary equipment*** include: hydronic, steam, domestic hot water, hot air systems, humidification, kitchen and process equipment, ovens, kilns, decorative appliances

***appliance and ancillary equipment components*** include: regulators, valves, overpressure protection, valve trains

***fasteners*** include: rods, anchors, hangers, bolts, clamps, tie wires, zip ties, epoxies

***valve train components*** include: solenoids, gas valves, gas valve actuators, regulators, low/high gas pressure switches, firing valves, gauges, burners, manual shutoff valves, thermocouple shutoff valve, dual combination control shutoff, safety shutoff with proof of closure, safety vent, input flow control valve, input flow control valve with mechanical stop and low fire stop switch, bypass pressure regulator, pressure test points, valve proving system, fuel filtration

***joining methods*** include: flanged, flared, brazed, welded, press-connect, plastic fusion

***joining compounds*** include: thread compounds, thread sealing tapes, gaskets, brazing alloys, welding alloys

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| E-15.02.01L | demonstrate knowledge of ***appliances and ancillary equipment***, their ***components***, accessories, characteristics, applications and operation | identify types of ***appliances and ancillary equipment***, and their ***components*** and accessories, and describe their characteristics and applications |
| | | describe operating principles of ***appliances and ancillary equipment***, and their ***components*** and accessories |
| | | identify types of ***valve train components***, and describe their characteristics and applications |
| | | identify ***burner types*** |
| | | describe principles and concepts of gas utilization |
| | | describe fuel types and characteristics |
| | | describe principles of combustion |
| | | describe input gas pressures, flow rates and Btuh inputs |

| | | |
|---|---|---|
| | | interpret information pertaining to ***appliances, ancillary equipment***, and their ***components*** found on drawings and specifications |
| E-15.02.02L | demonstrate knowledge of ***procedures to install appliances and ancillary equipment, and their components*** | identify ***tools and equipment*** used to install ***appliances and ancillary equipment***, and their ***components***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install ***appliances and ancillary equipment*** |
| | | describe ***procedures to install appliances and ancillary equipment, and their components*** |
| E-15.02.03L | demonstrate knowledge of ***procedures to install valve trains and their components*** | identify ***tools and equipment*** used to install valve trains and their ***components***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install valve trains and their ***components*** |
| | | describe ***procedures to install valve trains and their components*** |
| E-15.02.04L | demonstrate knowledge of ***procedures to install appliance and ancillary equipment accessories*** | identify ***tools and equipment*** used to install ***appliance and ancillary equipment*** accessories, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install ***appliance and ancillary equipment*** accessories |
| | | describe ***procedures to install appliance and ancillary equipment accessories*** |
| E-15.02.05L | demonstrate knowledge of regulatory requirements pertaining to ***appliances and ancillary equipment***, and their ***components*** and accessories | identify ***codes, standards and regulations*** pertaining to ***appliances and ancillary equipment***, and their ***components*** and accessories |
| | | identify certifying bodies responsible for ***appliances and ancillary equipment***, and their ***components*** and accessories |

## Range of Variables

***appliances and ancillary equipment*** include: hydronic, steam, domestic hot water, hot air systems, humidification, kitchen and process equipment, ovens, kilns, decorative appliances

***appliance and ancillary equipment components*** include: regulators, valves, overpressure protection, valve trains

***burner types*** include: nozzle mix, pre-mix (zero-governor), diffusion, rectifier, raw gas, low $NO_X$, atmospheric, immersion, forced draft, induced draft, fan assist, infrared, radiant, dual fuel

***procedures to install appliances and ancillary equipment, and their components*** include: identifying location, measuring placement, installing hangers and supports, lifting and moving equipment into place, securing and placing equipment in supports, securing and aligning equipment to housekeeping pads

***tools and equipment*** include: dollies, hoisting and rigging equipment, pipefitting tools (hand and power tools)

***hazards*** include: energy sources, environmental, working at heights, confined spaces, hazardous materials (e.g., mercury, silica, asbestos, ceramic fibre insulation, lead)

***procedures to install valve trains and their components*** include: selecting valve train components, joining compounds and fasteners, installing hangers and supports, assembling valve train components, fastening supports to valve train, assembling final connection points

***procedures to install appliance and ancillary equipment accessories*** include: selecting accessories, joining compounds and fasteners; fastening support to accessories; assembling final connection points

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA, ANSI/ASME

***fasteners*** include: rods, anchors, hangers, bolts, clamps, tie wires, zip ties, epoxies

***valve train components*** include: solenoids, gas valves, gas valve actuators, regulators, low/high gas pressure switches, firing valves, gauges, burners, manual shutoff valves, thermocouple shutoff valve, dual combination control shutoff, safety shutoff with proof of closure, safety vent, input flow control valve, input flow control valve with mechanical stop and low fire stop switch, bypass pressure regulator, pressure test points, valve proving system, fuel filtration

***joining methods*** include: flanged, flared, brazed, welded, press-connect, plastic fusion

***joining compounds*** include: thread compounds, thread sealing tapes, gaskets, brazing alloys, welding alloys

## E-15.03 Installs fuel conversion components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| E-15.03.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| E-15.03.02P | lift and move ***fuel conversion components*** into place | ***fuel conversion components*** are lifted and moved into place according to site conditions, ***codes, standards and regulations*** |

| | | |
|---|---|---|
| E-15.03.03P | secure and place ***fuel conversion components*** in supports | ***fuel conversion components*** are secured and placed in supports using ***fasteners*** according to drawings and manufacturers' specifications |
| E-15.03.04P | confirm existing equipment hangers and supports are adequate for conversion | existing equipment hangers and supports are adequate for conversion according to job requirements, manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.03.05P | confirm venting and electrical components are adequate for conversion | venting and electrical components are adequate for conversion according to job requirements, manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.03.06P | leave previous energy source in safe and environmentally stable condition | previous energy source is left in safe and environmentally stable condition by capping lines and terminating connections |
| E-15.03.07P | assemble ***fuel conversion components*** | ***fuel conversion components*** are assembled according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.03.08P | fasten supports for ***fuel conversion components*** | supports are fastened for ***fuel conversion components*** according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.03.09P | assemble final connection points | final connection points are assembled using ***joining methods*** and ***joining compounds*** according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-15.03.10P | verify, set up and confirm operation prior to commissioning | operation is verified, set up and confirmed prior to commissioning |
| E-15.03.11P | update drawings to create as-built final drawings | drawings are updated to create as-built final drawings |

## Range of Variables

***tools and equipment*** include: dollies, hoisting and rigging equipment, pipefitting tools (hand and power tools)

***fuel conversion components*** include: orifices, regulators, overpressure protection, piping, gauges, burners, flame rectification, flame safeguards, solenoids, gas valves, gas valve actuators, low/high gas pressure switches, firing valves, manual shutoff valves, thermocouple shutoff valves, dual combination control shutoffs, safety shutoffs with proof of closure, safety vents, input flow control valves, input flow control valves with mechanical stop and low fire stop switches, bypass pressure regulators, pressure test points, valve proving systems, fuel filtration

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA, ANSI/ASME

***fasteners*** include: rods, anchors, hangers, bolts, clamps, tie wires, zip ties, epoxies

***joining methods*** include: flanged, flared, brazed, welded, press-connect, plastic fusion

***joining compounds*** include: thread compounds, thread sealing tapes, gaskets, brazing alloys, welding alloys

| | **Knowledge** | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| E-15.03.01L | demonstrate knowledge of ***fuel conversion components***, characteristics, applications and operation | identify types of ***fuel conversion components***, and describe their characteristics and applications |
| | | identify ***burner types*** |
| | | describe operating principles of ***fuel conversion components*** |
| | | describe principles and concepts of gas utilization |
| | | describe fuel types and characteristics |
| | | describe principles of combustion |
| | | describe input gas pressures, flow rates and Btuh inputs |
| | | describe combustion chamber design and characteristics |
| | | describe venting and air supply requirements |
| | | interpret information pertaining to ***fuel conversion components*** found on drawings and specifications |
| E-15.03.02L | demonstrate knowledge of ***procedures to install fuel conversion components*** | identify ***tools and equipment*** used to install ***fuel conversion components***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install ***fuel conversion components*** |
| | | describe ***procedures to install fuel conversion components*** |

| | | |
|---|---|---|
| E-15.03.03L | demonstrate knowledge of training and certification requirements to install ***fuel conversion components*** | identify training and certification requirements to install ***fuel conversion components*** |
| E-15.03.04L | demonstrate knowledge of regulatory requirements pertaining to ***fuel conversion components*** | identify ***codes, standards and regulations*** pertaining to ***fuel conversion components*** |
| | | identify certifying bodies responsible for ***fuel conversion components*** |

## Range of Variables

***fuel conversion components*** include: orifices, regulators, overpressure protection, piping, gauges, burners, flame rectification, flame safeguards, solenoids, gas valves, gas valve actuators, low/high gas pressure switches, firing valves, manual shutoff valves, thermocouple shutoff valves, dual combination control shutoffs, safety shutoffs with proof of closure, safety vents, input flow control valves, input flow control valves with mechanical stop and low fire stop switches, bypass pressure regulators, pressure test points, valve proving systems, fuel filtration

***burner types*** include: nozzle mix, pre-mix (zero-governor), diffusion, rectifier, raw gas, low $NO_X$, atmospheric, immersion, forced draft, induced draft, fan assist, infrared, radiant, dual fuel

***procedures to install fuel conversion components*** include: identifying location, measuring placement, installing hangers and supports, lifting and moving equipment into place, securing and placing equipment in supports

***tools and equipment*** include: dollies, hoisting and rigging equipment, pipefitting tools (hand and power tools)

***hazards*** include: energy sources, environmental, working at heights, confined spaces, hazardous materials (e.g., mercury, silica, asbestos, ceramic fibre insulation, lead)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6), CEC, NBC, AHJ, NFPA, ANSI/ASME

# Task E-16 Selects and installs propane and natural gas storage, handling and dispensing systems

## Task Descriptor

Gasfitters install propane and natural gas storage tanks and cylinders, dispensers, safety devices and vaporizers for distribution and use.

## E-16.01 Selects propane and natural gas storage, handling and dispensing systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| E-16.01.01P | identify location for propane and natural gas storage, handling and dispensing systems, and their ***components*** | location for propane and natural gas storage, handling and dispensing systems, and their ***components*** is identified according to layout, site conditions, job specifications, ***codes, standards and regulations*** |
| E-16.01.02P | measure placement of propane and natural gas storage, handling and dispensing systems, and their ***components*** | placement of propane and natural gas storage, handling and dispensing systems, and their ***components*** is measured according to layout, site conditions, job specifications, ***codes, standards and regulations*** |
| E-16.01.03P | select propane and natural gas storage, handling and dispensing systems, and their ***components*** | propane and natural gas storage, handling and dispensing systems, and their ***components*** are selected according to ***criteria*** |
| E-16.01.04P | select components for cryogenic applications | components for cryogenic applications are selected according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-16.01.05P | select ***joining compounds*** | ***joining compounds*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-16.01.06P | select ***fasteners*** | ***fasteners*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***components*** include: tanks, cylinders, dispensers, vaporizers, gauges, emergency shut-off devices, heaters, over-pressure protection, excessive flow protection, internal safety control valves, pumps, breakaway fittings, cathodic protection (anodes, impressed current), metering devices

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B139, B149.1, B149.2, B149.5, B108, B51), CEC, NBC, AHJ, NFPA, ANSI/ASME

***criteria*** include: individual tank capacity, total storage capacity does not exceed restrictions based on facility type and location, system load, design ambient temperature, certification, distance to adjoining properties and buildings, tank location (above or below ground), liquid or gas storage (liquefied petroleum gas [LPG], liquefied natural gas [LNG], compressed natural gas [CNG]), pressure, bulk, fleet or public dispensing, cylinder or vehicle refuelling, horizontal or vertical tank

***joining compounds*** include: thread compounds, thread sealing tapes, gaskets, brazing alloys, welding alloys

***fasteners*** include: rods, anchors, hangers, bolts, clamps, tie wires, zip ties, epoxies

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| E-16.01.01L | demonstrate knowledge of propane and natural gas storage, handling and dispensing systems, their ***components*** characteristics, applications and operation | identify propane and natural gas storage, handling and dispensing systems, and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of propane and natural gas storage, handling and dispensing systems, and their ***components*** |
| | | interpret information pertaining to propane and natural gas storage, handling and dispensing systems found on drawings and specifications |
| | | describe procedures for sizing propane and natural gas storage, handling and dispensing systems |
| E-16.01.02L | demonstrate knowledge of training and certification requirements to install propane and natural gas storage, handling and dispensing systems, and their ***components*** | identify training and certification requirements to install propane and natural gas storage, handling and dispensing systems, and their ***components*** |
| E-16.01.03L | demonstrate knowledge of regulatory requirements pertaining to propane and natural gas storage, handling and dispensing systems, and their ***components*** | identify ***codes, standards and regulations*** pertaining to propane and natural gas storage, handling and dispensing systems, and their ***components*** |
| | | identify certifying bodies responsible for propane and natural gas storage, handling and dispensing systems, and their ***components*** |

## Range of Variables

***components*** include: tanks, cylinders, dispensers, vaporizers, gauges, emergency shut-off devices, heaters, over-pressure protection, excessive flow protection, internal safety control valves, pumps, breakaway fittings, cathodic protection (anodes, impressed current), metering devices

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B139, B149.1, B149.2, B149.5, B108, B51), CEC, NBC, AHJ, NFPA, ANSI/ASME

## E-16.02 Installs propane and natural gas storage, handling and dispensing systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| E-16.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| E-16.02.02P | installs hangers and supports | hangers and supports are installed according to site conditions, ***codes, standards and regulations*** |
| E-16.02.03P | assemble piping and ***components*** | piping and ***components*** are assembled according to job specifications, site conditions, ***codes, standards and regulations*** |
| E-16.02.04P | confirm placement of vehicle protection barricades in designated space | vehicle protection barricades are in place in designated space according to job specifications, site conditions, ***codes, standards and regulations*** |
| E-16.02.05P | place tanks and cylinders on level, solid and non-combustible base, and secure to base | tanks and cylinders are placed on level, solid, non-combustible base and secured to base using fasteners according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-16.02.06P | bury tanks | tanks are buried according to job and manufacturers' specifications, site conditions, ***codes, standards and regulations*** |
| E-16.02.07P | connect manifold and ***components*** to distribution system for vapour and liquid withdrawal | manifold and ***components*** are connected to distribution system for vapour and liquid withdrawal according to job and manufacturers' specifications, site conditions, ***codes, standards and regulations*** |

| | | |
|---|---|---|
| E-16.02.08P | verify, set up and confirm operation prior to commissioning | operation is verified, set up and confirmed prior to commissioning |
| E-16.02.09P | update drawings to create as-built final drawings | drawings are updated to create as-built final drawings |

## Range of Variables

***tools and equipment*** include: dollies, hoisting and rigging equipment, pipefitting tools (hand and power tools)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B139, B149.1, B149.2, B149.5, B108, B51), CEC, NBC, AHJ, NFPA, ANSI/ASME

***components*** include: tanks, cylinders, dispensers, vaporizers, gauges, emergency shut-off devices, heaters, over-pressure protection, excessive flow protection, internal safety control valves, pumps, breakaway fittings, cathodic protection (anodes, impressed current), metering devices

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| E-16.02.01L | demonstrate knowledge of propane and natural gas storage, handling and dispensing systems, their ***components*** characteristics, applications and operation | identify propane and natural gas storage, handling and dispensing systems, and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of propane and natural gas storage, handling and dispensing systems, and their ***components*** |
| | | interpret information pertaining to propane and natural gas storage, handling and dispensing systems found on drawings and specifications |
| | | describe procedures for sizing propane and natural gas storage, handling and dispensing systems |
| | | describe intrinsically safe devices and equipment for hazardous environments and systems |
| E-16.02.02L | demonstrate knowledge of ***procedures to install propane and natural gas storage, handling and dispensing systems*** | identify ***tools and equipment*** used to install propane and natural gas storage, handling and dispensing systems, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install propane and natural gas handling systems |
| | | describe ***procedures to install propane and natural gas storage, handling and dispensing systems*** |
| | | describe input gas pressures, flow rates and system loads |

| | | |
|---|---|---|
| | | describe vapour and liquid withdrawal, flaring, and tank and cylinder purging and evacuation procedures |
| E-16.02.03L | demonstrate knowledge of training and certification requirements to install propane and natural gas storage, handling and dispensing systems, and their ***components*** | identify training and certification requirements to install propane and natural gas storage, handling and dispensing systems, and their ***components*** |
| E-16.02.04L | demonstrate knowledge of regulatory requirements pertaining to propane and natural gas storage, handling and dispensing systems, and their ***components*** | identify ***codes, standards and regulations*** pertaining to propane and natural gas storage, handling and dispensing systems, and their ***components*** |
| | | identify certifying bodies responsible for propane and natural gas storage, handling and dispensing systems, and their ***components*** |

## Range of Variables

***components*** include: tanks, cylinders, dispensers, vaporizers, gauges, emergency shut-off devices, heaters, over-pressure protection, excessive flow protection, internal safety control valves, pumps, breakaway fittings, cathodic protection (anodes, impressed current), metering devices

***procedures to install propane and natural gas storage, handling and dispensing systems*** include: identifying and preparing location for system; measuring placement of system and components; installing hangers and supports; assembling piping and components; placing tanks and cylinders; burying tanks; selecting piping, supports, fittings and vehicle protection barricades; performing pressure test on piping lines; verifying, setting up and confirming operation prior to commissioning; creating as-built final drawings

***tools and equipment*** include: dollies, hoisting and rigging equipment, pipefitting tools (hand and power tools)

***hazards*** include: energy sources, liquid burns, vapour pooling of fuel, environmental, working at heights, confined spaces, hazardous materials (e.g., mercury, silica, asbestos, ceramic fibre insulation, lead)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B139, B149.1, B149.2, B149.5, B108, B51), CEC, NBC, AHJ, NFPA, ANSI/ASME

# Task E-17 Selects and installs other fuel storage, handling and dispensing systems

## Task Descriptor

Gasfitters install other fuel storage tanks and cylinders, piping, safety devices, dispensers and vaporizers for distribution and use. These can include systems for fuels such as hydrogen, biogas, digester gas, landfill gas, oil, diesel, waste oil and manufactured gas. In some jurisdictions, gasfitters may have limitations or require additional certifications to perform work on systems utilizing some fuel gases and liquid fuels.

## E-17.01 Selects other fuel storage, handling and dispensing systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| E-17.01.01P | identify location for ***other fuel*** storage, handling and dispensing systems, and their ***components*** | location for ***other fuel*** storage, handling and dispensing systems, and their ***components*** is identified according to layout, site conditions, job specifications, ***codes, standards and regulations*** |
| E-17.01.02P | measure placement of ***other fuel*** storage, handling and dispensing systems, and their ***components*** | placement of ***other fuel*** storage, handling and dispensing systems, and their ***components*** is measured according to layout, site conditions, ***codes, standards and regulations*** |
| E-17.01.03P | select ***other fuel*** storage, handling and dispensing systems, and their ***components*** | ***other fuel*** storage, handling and dispensing systems, and their ***components*** are selected according to ***criteria,*** job specifications, ***codes, standards and regulations*** |
| E-17.01.04P | select ***joining compounds*** | ***joining compounds*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-17.01.05P | select ***fasteners*** | ***fasteners*** are selected according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***other fuels (note that certain fuels may not be worked on by gasfitters in some provinces and territories)*** include: hydrogen, biogas, digester gas, landfill gas, oil, diesel, waste oil, manufactured gas

***components*** include: tanks, cylinders, dispensers, compressors, drip/sediment traps, filters, flame arrestors, gauges, emergency shut-off devices, over-pressure protection, excessive flow protection, internal safety control valves, pumps, breakaway fittings, cathodic protection (anodes, impressed current), metering devices, electrolysers, flare stacks

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.3, B149.5, B149.6, B51), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

***criteria*** include: storage capacity, load demand, certification, distance to adjoining properties and buildings, tank location (above or below ground), fuel type, pressure, bulk, fleet or public vehicle dispensing, horizontal or vertical tanks, internal use or supply to gas utility grid, design ambient temperature

***joining compounds*** include: thread compounds, thread sealing tapes, gaskets, brazing alloys, welding alloys

***fasteners*** include: rods, anchors, hangers, bolts, clamps, tie wires, zip ties, epoxies

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| E-17.01.01L | demonstrate knowledge of ***other fuel*** storage, handling and dispensing systems, their ***components***, characteristics, applications and operation | identify ***other fuel*** storage, handling and dispensing systems, and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of ***other fuel*** storage, handling and dispensing systems, and their ***components*** |
| | | interpret information pertaining to ***other fuel*** storage, handling and dispensing systems found on drawings and specifications |
| E-17.01.02L | demonstrate knowledge of training and certification requirements to select ***other fuel*** storage, handling and dispensing systems, and their ***components*** | identify training and certification requirements to select ***other fuel*** storage, handling and dispensing systems, and their ***components*** |
| E-17.01.03L | demonstrate knowledge of regulatory requirements pertaining to ***other fuel*** storage, handling and dispensing systems, and their ***components*** | identify ***codes, standards and regulations*** pertaining to ***other fuel*** storage, handling and dispensing systems, and their ***components*** |
| | | identify certifying bodies responsible for ***other fuel*** storage, handling and dispensing systems, and their ***components*** |

## Range of Variables

***other fuels (note that certain fuels may not be worked on by gasfitters in some provinces and territories)*** include: hydrogen, biogas, digester gas, landfill gas, oil, diesel, waste oil, manufactured gas

***components*** include: tanks, cylinders, dispensers, compressors, drip/sediment traps, filters, flame arrestors, gauges, emergency shut-off devices, over-pressure protection, excessive flow protection, internal safety control valves, pumps, breakaway fittings, cathodic protection (anodes, impressed current), metering devices, electrolysers, flare stacks

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.3, B149.5, B149.6, B51), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

## E-17.02 Installs other fuel storage, handling and dispensing systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| E-17.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| E-17.02.02P | install hangers and supports | hangers and supports are installed according to site conditions, ***codes, standards and regulations*** |
| E-17.02.03P | assemble piping and ***components*** | piping and ***components*** are assembled according to job specifications, site conditions, ***codes, standards and regulations*** |
| E-17.02.04P | confirm placement of vehicle protection barricades in designated space | vehicle protection barricades are in place in designated space according to ***codes, standards and regulations*** |
| E-17.02.05P | place tanks on level, solid and non-combustible base, and secure to base | tanks are placed on level, solid, non-combustible base and secured to base using fasteners according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-17.02.06P | connect manifold and ***components*** to distribution system for vapour and liquid withdrawal | manifold and ***components*** are connected to distribution system for vapour and liquid withdrawal according to manufacturers' specifications, ***codes, standards and regulations*** |
| E-17.02.07P | verify, set up and confirm operation prior to commissioning | operation is verified, set up and confirmed prior to commissioning |
| E-17.02.08P | update drawings to create as-built final drawings | drawings are updated to create as-built final drawings |

## Range of Variables

***tools and equipment*** include: dollies, hoisting and rigging equipment, pipefitting tools (hand and power tools)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.3, B149.5, B149.6, B51), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

***components*** include: tanks, cylinders, dispensers, compressors, drip/sediment traps, filters, flame arrestors, gauges, emergency shut-off devices, over-pressure protection, excessive flow protection, internal safety control valves, pumps, breakaway fittings, cathodic protection (anodes, impressed current), metering devices, electrolysers, flare stacks

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| E-17.02.01L | demonstrate knowledge of ***other fuel*** storage, handling and dispensing systems, their ***components***, characteristics, applications and operation | identify ***other fuel*** storage, handling and dispensing systems, and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of ***other fuel*** and natural gas storage, handling and dispensing systems, and their ***components*** |
| | | interpret information pertaining to ***other fuel*** storage, handling and dispensing systems found on drawings and specifications |
| | | describe intrinsically safe devices and equipment for hazardous environments and systems |
| E-17.02.02L | demonstrate knowledge of ***procedures to install other fuel storage, handling and dispensing systems, and their components*** | identify ***tools and equipment*** used to install ***other fuel*** storage, handling and dispensing systems, and their ***components***, and describe their procedures for use |
| | | identify ***hazards*** and describe safe work practices to install ***other fuel*** storage, handling and dispensing systems, and their ***components*** |
| | | describe ***procedures to install other fuel storage, handling and dispensing systems, and their components*** |
| | | describe input gas pressures, flow rates and system loads |
| | | describe vapour and liquid withdrawal, flaring, and tank purging and evacuation procedures |
| E-17.02.03L | demonstrate knowledge of training and certification requirements to install ***other fuel*** storage, handling and dispensing systems, and their ***components*** | identify training and certification requirements to install ***other fuel*** storage, handling and dispensing systems, and their ***components*** |

| | | |
|---|---|---|
| E-17.02.04L | demonstrate knowledge of regulatory requirements pertaining to ***other fuel*** storage, handling and dispensing systems, and their ***components*** | identify ***codes, standards and regulations*** pertaining to ***other fuel*** storage, handling and dispensing systems, and their ***components*** |
| | | identify certifying bodies responsible for ***other fuel*** storage, handling and dispensing systems, and their ***components*** |

## Range of Variables

***other fuels (note that certain fuels may not be worked on by gasfitters in some provinces and territories)*** include: hydrogen, biogas, digester gas, landfill gas, oil, diesel, waste oil, manufactured gas

***components*** include: tanks, cylinders, dispensers, compressors, drip/sediment traps, filters, flame arrestors, gauges, emergency shut-off devices, over-pressure protection, excessive flow protection, internal safety control valves, pumps, breakaway fittings, cathodic protection (anodes, impressed current), metering devices, electrolysers, flare stacks

***procedures to install other fuel storage, handling and dispensing systems***, ***and their components*** include: identifying and preparing location for other fuel system; selecting piping, supporting, fittings and vehicle protection barricades; installing hangers and supports; assembling piping and components; placing tanks; connecting manifold and component to distribution system; performing pressure test on piping lines; verifying, setting up and confirming operation prior to commissioning; creating as-built final drawings

***tools and equipment*** include: dollies, hoisting and rigging equipment, pipefitting tools (hand and power tools)

***hazards*** include: energy sources, environmental, working at heights, confined spaces, hazardous materials (e.g., mercury, silica, asbestos, ceramic fibre insulation, lead), site-specific hazards

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.3, B149.5, B149.6, B51), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

# Major Work Activity F
# Tests and commissions fuel systems, appliances and ancillary equipment

## Task F-18 Tests fuel delivery systems

### Task Descriptor

Gasfitters test fuel delivery systems and components to ensure safety and efficiency. Testing of the system is done after installation to verify that the system meets the design parameters and criteria prior to commissioning the system.

### F-18.01 Selects testing equipment and procedures

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| F-18.01.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| F-18.01.02P | select ***testing procedure*** | ***testing procedure*** is selected according to specifications, ***codes, standards and regulations*** |

### Range of Variables

***tools and equipment*** include: gauges, valves, manometers, electronic testers, leak detection devices, pressure sources, purge burners, flare stacks

***testing procedures*** include: isolating system; installing testing equipment; performing system pressurization testing; recording and comparing test results to code requirements, manufacturers' specifications and AHJ; purging procedures; performing flaring off and gasifying; reconnecting after testing; painting and identifying piping; performing leak test

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108, B51), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| F-18.01.01L | demonstrate knowledge of fuel piping and tubing systems, their characteristics, applications and operation | identify fuel piping and tubing systems, and describe their characteristics and applications |
| | | describe operating principles of fuel piping and tubing systems |
| | | interpret information pertaining to testing of fuel piping and tubing systems found on drawings, specifications, ***codes, standards and regulations*** |
| F-18.01.02L | demonstrate knowledge of ***testing procedures*** for fuel piping and tubing systems | identify ***hazards*** and describe safe work practices to test fuel piping and tubing systems |
| | | identify ***tools and equipment*** used to test fuel piping and tubing systems, and describe their procedures for use |
| | | describe ***testing procedures*** for fuel piping and tubing systems |
| | | describe purge calculations |
| F-18.01.03L | demonstrate knowledge of regulatory and QA/QC manual requirements to test fuel piping and tubing systems | identify QA/QC manuals, ***codes, standards and regulations*** to test fuel piping and tubing systems |
| | | identify ***jurisdictional testing requirements*** |

## Range of Variables

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108, B51), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

***testing procedures*** include: isolating system; installing testing equipment; performing system pressurization testing; recording and comparing test results to code requirements, manufacturers' specifications and AHJ; purging procedures; performing flaring off and gasifying; reconnecting after testing; painting and identifying piping; performing leak test

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion)

***tools and equipment*** include: gauges, valves, manometers, electronic testers, leak detection devices, pressure sources, purge burners, flare stacks

***jurisdictional testing requirements*** include: witness sign-off, reporting and engineers' inspection, AHJ inspection

## F-18.02 Tests fuel piping and tubing systems

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| F-18.02.01P | isolate ***fuel piping and tubing system*** for testing | ***fuel piping and tubing system*** is isolated for testing according to ***codes, standards and regulations*** |
| F-18.02.02P | install ***testing equipment*** | ***testing equipment*** is installed according to ***codes, standards and regulations*** |
| F-18.02.03P | perform system pressurization | system pressurization is performed using ***testing medium*** |
| F-18.02.04P | record and compare test results to QA/QC manuals, ***codes, standards and regulations*** | test results are recorded and compared to QA/QC manuals, ***codes, standards and regulations*** |
| F-18.02.05P | perform flaring off and purging procedures | flaring off and purging procedures are performed for safe gasification of piping and tubing |
| F-18.02.06P | reconnect after testing, and paint and identify (label) piping and tubing | piping and tubing is reconnected after testing, painted and identified (labelled) according to ***codes, standards and regulations*** |
| F-18.02.07P | perform leak test | leak test is performed using ***methods*** |

### Range of Variables

***fuel piping and tubing systems*** include: gas meters, pressure-sensitive equipment

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108, B51), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

***testing equipment*** includes: gauges, valves, manometers, electronic testers, leak detection devices, pressure sources

***testing mediums*** include: air, nitrogen, $CO_2$

***methods*** include: approved leak testing solution, electronic combustible gas leak detector

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| F-18.02.01L | demonstrate knowledge of ***fuel piping and tubing systems***, their characteristics, applications and operation | identify ***fuel piping and tubing systems***, and describe their characteristics and applications |
| | | describe operating principles of ***fuel piping and tubing systems*** |

| | | |
|---|---|---|
| | | interpret information pertaining to testing of ***fuel piping and tubing systems*** found on drawings and specifications |
| F-18.02.02L | demonstrate knowledge of ***procedures to test fuel piping and tubing systems*** | identify ***hazards*** and describe safe work practices to test ***fuel piping and tubing systems*** |
| | | identify tools and equipment used to test ***fuel piping and tubing systems***, and describe their procedures for use |
| | | describe ***procedures to test fuel piping and tubing systems*** |
| F-18.02.03L | demonstrate knowledge of regulatory requirements to test ***fuel piping and tubing systems*** | identify ***codes, standards and regulations*** to test ***fuel piping and tubing systems*** |

## Range of Variables

***fuel piping and tubing systems*** include: gas meters, pressure-sensitive equipment

***procedures to test fuel piping and tubing systems*** include: isolating system, installing testing equipment, performing system pressurization testing, recording and comparing test results, performing flaring off and purging procedures, reconnecting after testing, painting and identifying piping, performing leak test

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion), pneumatic test failure

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108, B51), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

# Task F-19 Commissions fuel systems, appliances and ancillary equipment

## Task Descriptor

Gasfitters verify the operation of the entire system after installation to ensure that it meets codes, standards and regulations, and attains optimum performance. Providing documentation and explanation to the end user is also a key responsibility when commissioning a system.

## F-19.01 Performs start-up procedures

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| F-19.01.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| F-19.01.02P | perform ***installation checks*** | ***installation checks*** are performed according to installation specifications, ***codes, standards and regulations*** |
| F-19.01.03P | check electrical configurations | electrical configurations are checked to ensure voltage and amperage are set to appliance requirements, including rotation checks |
| F-19.01.04P | perform series of dry runs | series of dry runs are performed to test electrical, electronic and control operation |
| F-19.01.05P | follow manufacturers' and AHJ start-up procedures | manufacturers' and AHJ start-up procedures, including permits and permissions are followed |
| F-19.01.06P | commission fuel systems | fuel systems are commissioned according to manufacturers' specifications, ***codes, standards and regulations*** |
| F-19.01.07P | perform start-up of appliances and ancillary equipment | start-up of appliances and ancillary equipment is performed according to manufacturers' specifications, ***codes, standards and regulations*** |

## Range of Variables

***tools and equipment*** include: gauges, valves, manometers, electronic testers, multimeters
***installation checks*** include: valve train components, linkages, safeties, type of fuel, electrical inputs
***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| F-19.01.01L | demonstrate knowledge of procedures to commission fuel systems and perform start-up of appliances and ancillary equipment | identify ***hazards*** and describe safe work practices to perform procedures to commission fuel systems and perform start-up of appliances and ancillary equipment |
| | | identify ***tools and equipment*** used to perform start-up procedures, and describe their procedures for use |
| | | describe ***start-up procedures*** |
| F-19.01.02L | demonstrate knowledge of training and certification requirements to commission fuel systems and perform start-up of appliances and ancillary equipment | identify training and certification requirements to commission fuel systems and perform start-up of appliances and ancillary equipment |
| F-19.01.03L | demonstrate knowledge of regulatory requirements pertaining to commissioning of fuel systems and performing start-up procedures on appliances and ancillary equipment | identify ***codes, standards and regulations*** pertaining to commissioning of fuel systems and performing start-up procedures on appliances and ancillary equipment |

## Range of Variables

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries (e.g., burns), atmospheric (explosion), pneumatic test failure

***tools and equipment*** include: gauges, valves, manometers, electronic testers, multimeters

***start-up procedures*** include: performing installation checks, checking electrical configurations, performing series of dry runs, following manufacturers' and AHJ start-up procedures, commissioning fuel systems, performing start-up of appliances and ancillary equipment

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

## F-19.02 Performs testing, adjusting and balancing procedures

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| F-19.02.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| F-19.02.02P | introduce fuel and adjust ***components*** | fuel is introduced and ***components*** are adjusted based on readings to achieve mixtures required for complete and efficient combustion, and according to manufacturers' specifications |
| F-19.02.03P | verify ***conditions*** to match system requirements | ***conditions*** are verified to match system requirements |
| F-19.02.04P | evaluate appliance and equipment performance | appliance and equipment performance are evaluated by verifying ***factors*** |
| F-19.02.05P | verify ***system start-up procedures*** | ***system start-up procedures*** are verified according to manufacturers' specifications, ***codes, standards and regulations*** |
| F-19.02.06P | adjust and calibrate controls | controls are adjusted and calibrated according to manufacturers' specifications, system demands, ***codes, standards and regulations*** |
| F-19.02.07P | perform ***functional operation and safety checks*** | ***functional operation and safety checks*** are performed |
| F-19.02.08P | operate appliance and equipment through several cycles | appliance and equipment are operated through several cycles to ensure they meet manufacturers' specifications |

## Range of Variables

***tools and equipment*** include: manometers, multimeters, combustion analyzers, thermometers

***components*** include: valves, dampers, regulators, operating controls, fan speeds

***conditions*** include: medium quality, flow rates, temperature, pressures, ESP

***factors*** include: air gas mix; combustion air volume; stack temperature; combustion analysis; CO, $CO_2$ and $O_2$ levels

***system start-up procedures*** include: boil-outs in hot water and steam systems, refractory and equipment curing

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

***functional operation and safety checks*** include: flame safeguards, combustion controls, draft controls, permissives, limits and interlocks

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| F-19.02.01L | demonstrate knowledge of measurements, ratios, theories, formulas and calculations | describe combustion measurements, theories, formulas and calculations |
| | | describe fuel-air measurements, ratios, theories, formulas and calculations |
| F-19.02.02L | demonstrate knowledge of ***fuel systems, appliances and ancillary equipment***, their ***components***, characteristics, applications and operation | identify types of ***fuel systems, appliances and ancillary equipment,*** and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of ***fuel systems, appliances and ancillary equipment***, and their ***components*** |
| | | interpret information pertaining to ***fuel systems, appliances and ancillary equipment***, and their ***components*** found on drawings and specifications |
| F-19.02.03L | demonstrate knowledge of ***procedures to test, adjust and balance fuel systems, appliances and ancillary equipment, and their components*** | identify ***hazards*** and describe safe work practices to test, adjust and balance ***fuel systems, appliances and ancillary equipment***, and their ***components*** |
| | | identify ***tools and equipment*** used to test, adjust and balance ***fuel systems, appliances and ancillary equipment,*** and their ***components***, and describe their procedures for use |
| | | describe ***procedures to test, adjust and balance fuel systems, appliances and ancillary equipment, and their components*** |
| | | describe calculations such as pre- and post-purge times based on volumes and number of air changes |
| | | describe combustion system and allowable products of combustion |
| F-19.02.04L | demonstrate knowledge of regulatory requirements pertaining to testing, adjusting and balancing of ***fuel systems, appliances and ancillary equipment***, and their ***components*** | identify ***codes, standards and regulations*** pertaining to testing, adjusting and balancing of ***fuel systems, appliances and ancillary equipment***, and their ***components*** |

## Range of Variables

***fuel systems, appliances and ancillary equipment*** include: storage, handling and dispensing systems; hydronic; steam; domestic hot water; hot air system; humidification; kitchen and process equipment; ovens; kilns

***components*** include: valves, dampers, regulators, operating controls, fan speeds

***procedures to test, adjust and balance fuel systems, appliances and ancillary equipment, and their components*** include: adjusting components, adjusting and calibrating controls, performing calculations, taking measurements, performing functional operation and safety checks, evaluating appliance and equipment performance, performing start-up procedures, operating appliance and equipment through several cycles

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion), pneumatic test failure

***tools and equipment*** include: manometers, multimeters, combustion analyzers, thermometers

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

## F-19.03 Completes commissioning report and handover

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| F-19.03.01P | record ***testing results*** and compare to manufacturers' baseline information | ***testing results*** are recorded and compared to manufacturers' baseline information |
| F-19.03.02P | prepare and submit documentation required by job site, AHJ, and engineering and manufacturers' specifications | documentation required by job site, AHJ, and engineering and manufacturers' specifications are prepared and submitted |
| F-19.03.03P | explain system operational procedures and specifications to end user | system operational procedures and specifications are explained to end user |

## Range of Variables

***testing results*** include: voltages, pressures, efficiencies, temperatures, amperages, combustion analysis, flow rates

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| F-19.03.01L | demonstrate knowledge of documentation requirements for commissioning, their characteristics and applications | identify documentation requirements for commissioning, and describe their characteristics and applications |
| | | interpret information pertaining to documentation requirements for commissioning found in specifications |
| F-19.03.02L | demonstrate knowledge of procedures to complete commissioning reports and handover | describe procedures to complete commissioning reports |
| | | describe procedures to hand over systems to end users |
| F-19.03.03L | demonstrate knowledge of regulatory requirements pertaining to commissioning reports | identify ***codes, standards and regulations*** pertaining to commissioning reports |

## Range of Variables

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

# Major Work Activity G
# Services fuel systems, appliances and ancillary equipment

## Task G-20 Maintains fuel systems, appliances and ancillary equipment

### Task Descriptor

Maintaining fuel systems, appliances and ancillary equipment is important to ensure safe operation, optimal efficiency and reliable service.

### G-20.01 Inspects system components and operation

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| G-20.01.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| G-20.01.02P | verify that installation conforms to manufacturers' specifications, ***codes, standards and regulations*** | installation is verified that it conforms to manufacturers' specifications, ***codes, standards and regulations*** |
| G-20.01.03P | inspect ***fuel delivery system components*** and verify operation | ***fuel delivery system components*** are inspected, and operation is verified |
| G-20.01.04P | verify operation of ***controls*** | ***controls*** are verified to ensure they operate according to end-user requirements, manufacturers' specifications, ***codes, standards and regulations*** |
| G-20.01.05P | inspect ***heat delivery systems*** | ***heat delivery systems*** are inspected to identify operation, wear, damage or deterioration |
| G-20.01.06P | inspect venting, chimneys and air supply | venting, chimneys and air supply are inspected to ensure operation according to ***codes, standards and regulations*** |

| | | |
|---|---|---|
| G-20.01.07P | inspect refractory components of combustion chamber and heat exchangers | refractory components of combustion chamber and heat exchangers are inspected to identify cracks and deterioration |
| G-20.01.08P | inspect ***mechanical components*** | ***mechanical components*** are inspected to identify operation, wear, damage and deterioration |
| G-20.01.09P | perform sensory inspection of ***safety components*** to check operation | sensory inspection of ***safety components*** is performed to check operation |
| G-20.01.10P | verify functional operation of flame safeguard systems | flame safeguard systems are verified as operational |
| G-20.01.11P | verify functional operation of combustion control systems | combustion control systems are verified as operational |
| G-20.01.12P | verify functional operation of draft control systems | draft control systems are verified as operational |
| G-20.01.13P | verify functional operation of fuel valve train | fuel valve train is verified as operational |
| G-20.01.14P | test ***safety limits*** and ***controls*** | ***safety limits*** and ***controls*** are tested to verify operation |
| G-20.01.15P | inspect burner performance | burner performance is inspected by confirming fuel consumption and using ***combustion data*** |
| G-20.01.16P | inspect condensate lines | condensate lines are inspected to verify they are clean and clear of debris |
| G-20.01.17P | inspect fuel valves | fuel valves are inspected to ensure complete closure |
| G-20.01.18P | use computers to communicate with control systems and components to verify and adjust operation | control systems and components operation are verified and adjusted using computers |

## Range of Variables

***tools and equipment*** include: manometers, pressure and temperature gauges, multimeters, combustion analyzers, leak detectors, computers, electronic devices

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

***fuel delivery system components*** include: gas lines, burners, valve trains, regulators, metres

***controls*** include: permissives, limits, interlocks

***heat delivery systems*** include: radiators, heat exchangers, ducts, piping, pumps, blowers, valves

***mechanical components*** include: switches, valves, dampers, fans, motors, linkages

***safety components*** include: UV and infrared scanners, flame-monitoring systems, thermopiles, thermocouples

***safety limits*** include: high limit, high and low water cut-offs, flow switches, high and low gas pressure switches

***combustion data*** includes: verify air gas mix using a combustion analyzer; combustion air volume; stack temperature; CO, $CO_2$ and $O_2$ levels; draft data; NOx; SOx

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| G-20.01.01L | demonstrate knowledge of ***fuel systems, appliances and ancillary equipment***, their components, characteristics, applications and operation | identify types of ***fuel systems, appliances and ancillary equipment,*** and their components, and describe their characteristics and applications |
| | | describe operating principles of ***fuel systems, appliances and ancillary equipment***, and their components |
| | | interpret information pertaining to ***fuel systems, appliances and ancillary equipment***, and their components found on drawings and specifications |
| G-20.01.02L | demonstrate knowledge of concepts and fundamentals related to fuel | describe concepts and fundamentals related to fuel |
| G-20.01.03L | demonstrate knowledge of concepts and fundamentals related to electricity | describe concepts and fundamentals related to electricity |
| G-20.01.04L | demonstrate knowledge of concepts and fundamentals related to combustion | describe concepts and fundamentals related to combustion |
| G-20.01.05L | demonstrate knowledge of ***procedures to inspect system components and operation*** | identify ***hazards*** and describe safe work practices to inspect system components and operation |
| | | identify ***tools and equipment*** used to inspect system components and operation, and describe their procedures for use |
| | | describe ***procedures to inspect system components and operation*** |
| | | describe sequence of operation to assist with inspection of systems |
| G-20.01.06L | demonstrate knowledge of regulatory requirements pertaining to inspection of system components and operation | identify AHJ, ***codes, standards and regulations*** pertaining to inspection of system components and operation |

## Range of Variables

***fuel systems, appliances and ancillary equipment*** include: storage, handling and dispensing systems; hydronic; steam; domestic hot water; hot air system; humidification; kitchen and process equipment; ovens; kilns

***procedures to inspect system components and operation*** include: verifying that installation of system conforms to manufacturers' specifications, codes, standards and regulations; performing system inspections; verifying operation of system and controls; verifying functional operation of system; using computers to communicate with control systems and components

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion), atmospheric contamination (CO), hazardous materials

***tools and equipment*** include: manometers, pressure and temperature gauges, multimeters, combustion analyzers, leak detectors, computers, electronic devices

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

## G-20.02 Performs maintenance activities

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| G-20.02.01P | select and use tools and equipment | tools and equipment are selected and used according to task |
| G-20.02.02P | replace ***components*** | ***components*** are replaced according to maintenance schedule |
| G-20.02.03P | clean ***components*** | ***components*** are cleaned according to manufacturers' specifications |
| G-20.02.04P | lubricate ***components*** | ***components*** are lubricated according to manufacturers' specifications to ensure smooth operation of system |
| G-20.02.05P | remove components | components are removed using hoisting equipment |
| G-20.02.06P | adjust burner | burner is adjusted to safe and functional operation and manufacturers' and AHJ requirements |
| G-20.02.07P | document repairs required for predictive component replacement | repairs required for predictive component replacement are documented according to maintenance schedule |

## Range of Variables

***components*** (to be replaced) include: belts, flame rods, filters, gaskets

***components*** (to be cleaned) include: combustion chambers, burners, flame rods, scanners, blowers, heat exchangers

***components*** (to be lubricated) include: valves, linkages, motors, bearings, dampers

***components*** include: belts, flame rods, filters, gaskets, combustion chambers, burners, scanners, blowers, heat exchangers, valves, linkages, motors, bearings, dampers

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| G-20.02.01L | demonstrate knowledge of ***fuel systems, appliances and ancillary equipment***, their ***components***, characteristics, applications and operation | identify types of ***fuel systems, appliances and ancillary equipment***, and their ***components***, and describe their characteristics and applications |
| | | describe operating principles of ***fuel systems, appliances and ancillary equipment***, and their ***components*** |
| | | interpret information pertaining to ***fuel systems, appliances and ancillary equipment***, and their ***components*** found on drawings and specifications |
| G-20.02.02L | demonstrate knowledge of ***procedures to maintain fuel systems, appliances and ancillary equipment, and their components*** | identify ***hazards*** and describe safe work practices to maintain ***fuel systems, appliances and ancillary equipment***, and their ***components*** |
| | | identify tools and equipment used to maintain ***fuel systems, appliances and ancillary equipment***, and their ***components***, and describe their procedures for use |
| | | describe ***procedures to maintain fuel systems, appliances and ancillary equipment, and their components*** |
| G-20.02.03L | demonstrate knowledge of regulatory requirements pertaining to maintenance of ***fuel systems, appliances and ancillary equipment***, and their ***components*** | identify ***codes, standards and regulations*** pertaining to maintenance of ***fuel systems, appliances and ancillary equipment***, and their ***components*** |

## Range of Variables

***fuel systems, appliances and ancillary equipment*** include: storage, handling and dispensing systems; hydronic; steam; domestic hot water; hot air system; humidification; kitchen and process equipment; ovens; kilns

***components*** include: belts, flame rods, filters, gaskets, combustion chambers, burners, scanners, blowers, heat exchangers, valves, linkages, motors, bearings, dampers

***procedures to maintain fuel systems, appliances and ancillary equipment***, ***and their components*** include: removing, replacing, cleaning, lubricating and adjusting components; documenting required repairs

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

# Task G-21 Repairs fuel systems, appliances and ancillary equipment

## Task Descriptor

Gasfitters repair fuel systems, appliances and ancillary equipment by diagnosing problems and isolating problem areas. They replace faulty components to correct the issue. It is important to subsequently verify the operation of the repaired system and fully document the repair work.

## G-21.01 Diagnoses system components and operation

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| G-21.01.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| G-21.01.02P | verify equipment performance | equipment performance is verified to identify faults or erratic operation |
| G-21.01.03P | apply trade knowledge to isolate problems | trade knowledge is applied to isolate problems |
| G-21.01.04P | check operation of ***electrical components*** | operation of ***electrical components*** is checked to manufacturers' specifications |
| G-21.01.05P | check fuel pressures | fuel pressures are checked to ensure switches meet operational parameters |

| | | |
|---|---|---|
| G-21.01.06P | inspect burner performance | burner performance is inspected using ***combustion data*** |
| G-21.01.07P | set up diagnostic monitoring devices | diagnostic monitoring devices are set up to record and identify operating conditions and interpret fault codes |

## Range of Variables

***tools and equipment*** include: manometers, draft gauges, combustion analyzers, multimeters

***electrical components*** include: fuses, transformers, contacts, relays, limit switches, control devices, flame safeguard systems

***combustion data*** includes: verify air gas mix using a combustion analyzer; combustion air volume; stack temperature; CO, $CO_2$ and $O_2$ levels; draft data; NOx; SOx

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| G-21.01.01L | demonstrate knowledge of ***fuel systems, appliances and ancillary equipment***, their components, characteristics, applications and operation | identify types of ***fuel systems, appliances and ancillary equipment,*** and their components, and describe their characteristics and applications |
| | | describe operating principles of ***fuel systems, appliances and ancillary equipment***, and their components |
| | | interpret information pertaining to ***fuel systems, appliances and ancillary equipment***, and their components found on drawings and specifications |
| G-21.01.02L | demonstrate knowledge of concepts and fundamentals related to fuel | describe concepts and fundamentals related to fuel |
| G-21.01.03L | demonstrate knowledge of concepts and fundamentals related to electricity | describe concepts and fundamentals related to electricity |
| G-21.01.04L | demonstrate knowledge of concepts and fundamentals related to combustion | describe concepts and fundamentals related to combustion |
| G-21.01.05L | demonstrate knowledge of ***procedures to diagnose fuel systems, appliances and ancillary equipment, and their components*** | identify ***hazards*** and describe safe work practices to diagnose ***fuel systems, appliances and ancillary equipment***, and their components |
| | | identify ***tools and equipment*** used to diagnose ***fuel systems, appliances and ancillary equipment***, and their components, and describe their procedures for use |
| | | describe ***procedures to diagnose fuel systems, appliances and ancillary equipment, and their components*** |
| G-21.01.06L | demonstrate knowledge of manufacturers' training to diagnose ***fuel systems, appliances and ancillary equipment***, and their components | identify manufacturers' training to diagnose ***fuel systems, appliances and ancillary equipment***, and their components |

| | | |
|---|---|---|
| G-21.01.07L | demonstrate knowledge of regulatory requirements to diagnose ***fuel systems, appliances and ancillary equipment***, and their components | identify ***codes, standards and regulations*** to diagnose ***fuel systems, appliances and ancillary equipment***, and their components |
| | | identify ***documentation*** |

## Range of Variables

***fuel systems, appliances and ancillary equipment*** include: storage, handling and dispensing systems; hydronic; steam; domestic hot water; hot air system; humidification; kitchen and process equipment; ovens; kilns

***procedures to diagnose fuel systems, appliances and ancillary equipment, and their components*** include: verifying equipment performance to identify faults or erratic operation, applying trade knowledge to isolate problems, checking operation of electrical components and fuel pressures, inspecting burner performance, setting up diagnostic monitoring devices to record and identify operating conditions, interpreting fault codes

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion)

***tools and equipment*** include: manometers, draft gauges, combustion analyzers, multimeters

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CEC, NBC, AHJ, NFPA, ANSI/ASME

***documentation*** includes: service reports, check sheets, permits

## G-21.02 Replaces components

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| G-21.02.01P | identify appliance and equipment | appliance and equipment are identified by make, model number, serial number and manufacturers' code |
| G-21.02.02P | source out parts, availability of equipment and compatibility of replacement parts | parts, availability of equipment and compatibility of replacement parts are sourced out |
| G-21.02.03P | verify replacement parts are all included and operate | replacement parts are verified that they are all included and operate according to specifications |
| G-21.02.04P | select and use tools and equipment | tools and equipment are selected and used according to task |
| G-21.02.05P | perform lock-out and tag-out procedures on system to isolate energy sources | system is locked out and tagged out to isolate energy sources |
| G-21.02.06P | remove and reassemble ***components*** to access repair area | ***components*** are removed and reassembled to access repair area |

| | | |
|---|---|---|
| G-21.02.07P | disconnect and reconnect wiring and linkages | wiring and linkages are disconnected and reconnected |
| G-21.02.08P | ***record*** configuration of components | configuration of components is ***recorded*** to facilitate reassembly |
| G-21.02.09P | remove defective components and install replacement components | defective components are removed, and replacement components are installed |
| G-21.02.10P | dispose of and recycle defective components | defective components are disposed of and recycled according to AHJ |

## Range of Variables

***components*** include: protective covers, shields

***record*** includes: making sketches, taking photographs, marking components, storing data

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| G-21.02.01L | demonstrate knowledge of ***fuel systems, appliances and ancillary equipment***, their components, characteristics, applications and operation | identify types of ***fuel systems, appliances and ancillary equipment***, and their components, and describe their characteristics and applications |
| | | describe operating principles of ***fuel systems, appliances and ancillary equipment***, and their components |
| | | interpret information pertaining to ***fuel systems, appliances and ancillary equipment***, and their components found on drawings and specifications |
| G-21.02.02L | demonstrate knowledge of ***procedures to replace components*** | identify ***hazards*** and describe safe work practices to replace components |
| | | identify tools and equipment used to replace components, and describe their procedures for use |
| | | describe ***procedures to replace components*** |
| G-21.02.03L | demonstrate knowledge of regulatory requirements pertaining to replacement of components | identify ***codes, standards and regulations*** pertaining to replacement of components |

## Range of Variables

***fuel systems, appliances and ancillary equipment*** include: storage, handling and dispensing systems; hydronic; steam; domestic hot water; hot air system; humidification; kitchen and process equipment; ovens; kilns

***procedures to replace components*** include: identifying appliance and equipment; sourcing out parts, availability of equipment and compatibility of replacement parts; verifying replacement parts are all included and operational; performing lock-out and tag-out procedures on system; removing and reassembling components to access repair area; disconnecting and reconnecting wiring and linkages; recording configuration of components; removing defective components; installing replacement components; disposing of and recycling defective components

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME, TDG

## G-21.03 Verifies operation

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| G-21.03.01P | select and use ***tools and equipment*** | ***tools and equipment*** are selected and used according to task |
| G-21.03.02P | remove lock-out and tag-out and restore energy sources | lock-out and tag-out are removed and energy sources are restored |
| G-21.03.03P | check operation of system | system is checked that it operates according to manufacturers' specifications, ***codes, standards and regulations*** |
| G-21.03.04P | perform ***tests*** | ***tests*** are performed to verify operation |
| G-21.03.05P | verify ***electrical components*** | ***electrical components*** are verified they have correct rotation and are at rated operating parameters |
| G-21.03.06P | verify ***mechanical components*** | ***mechanical components*** are verified they are operational |
| G-21.03.07P | check lighting and operation of burner | burner is checked to ensure safe lighting and operation |

| | | |
|---|---|---|
| G-21.03.08P | operate system through several cycles and monitor performance throughout | system is operated through several cycles and performance is monitored throughout |
| G-21.03.09P | complete ***documentation*** | ***documentation*** is completed according to company policies, manufacturers' requirements, ***codes, standards and regulations*** |

## Range of Variables

***tools and equipment*** include: manometers, draft gauges, combustion analyzers, multimeters

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

***tests*** include: combustion analysis; flame safeguard tests; functional operation of permissives, limits and interlocks

***electrical components*** include: motors, blowers, capacitors, contactors, relays

***mechanical components*** include: valves, regulators, switches, pumps, bearings, seals, linkages, dampers

***documentation*** includes: service reports, check sheets, permits, warrantees

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| G-21.03.01L | demonstrate knowledge of ***fuel systems, appliances and ancillary equipment***, their components, characteristics, applications and operation | identify types of ***fuel systems, appliances and ancillary equipment***, and their components, and describe their characteristics and applications |
| | | describe operating principles of ***fuel systems, appliances and ancillary equipment***, and their components |
| | | interpret information pertaining to ***fuel systems, appliances and ancillary equipment***, and their components found on drawings and specifications |
| G-21.03.02L | demonstrate knowledge of ***procedures to verify operation of fuel systems, appliances and ancillary equipment, and their components*** | identify ***hazards*** and describe safe work practices to verify operation of ***fuel systems, appliances and ancillary equipment***, and their components |
| | | identify ***tools and equipment*** used to verify operation of ***fuel systems, appliances and ancillary equipment***, and their components, and describe their procedures for use |

| | | |
|---|---|---|
| | | describe ***procedures to verify operation of fuel systems, appliances and ancillary equipment, and their components*** |
| G-21.03.03L | demonstrate knowledge of regulatory requirements to verify operation of ***fuel systems, appliances and ancillary equipment***, and their components | identify ***codes, standards and regulations*** to verify operation of ***fuel systems, appliances and ancillary equipment***, and their components |

### Range of Variables

***fuel systems, appliances and ancillary equipment*** include: storage, handling and dispensing systems; hydronic; steam; domestic hot water; hot air system; humidification; kitchen and process equipment; ovens; kilns

***procedures to verify operation of fuel systems, appliances and ancillary equipment, and their components*** include: removing lock-out and tag-out, checking operation of system, performing tests, verifying electrical and mechanical components, checking lighting and operation of burner, operating system through several cycles and monitoring performance throughout, completing documentation

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion)

***tools and equipment*** include: manometers, draft gauges, combustion analyzers, multimeters

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

# Task G-22 Decommissions fuel systems, appliances and ancillary equipment

### Task Descriptor

Gasfitters decommission fuel systems, appliances and ancillary equipment for upgrading, retrofitting or demolition. Safety and isolation of energy sources are very important.

## G-22.01 Disconnects appliances and ancillary equipment

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| G-22.01.01P | select and use tools and equipment | tools and equipment are selected and used according to task |
| G-22.01.02P | perform lock-out and tag-out procedures for ***energy sources*** | lock-out and tag-out procedures are performed for ***energy sources*** |

| | | |
|---|---|---|
| G-22.01.03P | isolate and terminate ***energy sources*** | ***energy sources*** are isolated and terminated according to site requirements, AHJ, ***codes, standards and regulations*** |
| G-22.01.04P | rig and hoist heavy equipment and components | heavy equipment and components are rigged and hoisted for removal |
| G-22.01.05P | disconnect and terminate control wires and tubing | control wires and tubing are disconnected and terminated |
| G-22.01.06P | isolate, purge and cap gas supply | gas supply is isolated, purged and capped according to ***codes, standards and regulations*** |
| G-22.01.07P | disconnect and cap venting system | venting system is disconnected and capped |
| G-22.01.08P | disconnect and cap ***distribution system*** | ***distribution system*** is disconnected and capped |
| G-22.01.09P | isolate ***accessories*** from system and remove ***energy sources*** | ***accessories*** are isolated from system and ***energy sources*** are removed to disable function |
| G-22.01.10P | disconnect ***accessories*** from appliance | ***accessories*** are disconnected from appliance |
| G-22.01.11P | check for leaks | systems are checked for leaks to ensure they are safe according to safe work practices, ***codes, standards and regulations*** |

## Range of Variables

***energy sources*** include: electrical, hydronic, pneumatic, mechanical, centrifugal, kinetic

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

***distribution systems*** include: piping for distribution system, ductwork

***accessories*** include: heating and cooling coils, humidifiers, electronic air cleaners, filtration systems, pumps

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| G-22.01.01L | demonstrate knowledge of ***procedures to disconnect appliances and ancillary equipment*** | identify ***hazards*** and describe safe work practices to disconnect appliances and ancillary equipment |
| | | identify tools and equipment used to disconnect appliances and ancillary equipment, and describe their procedures for use |
| | | describe ***procedures to disconnect appliances and ancillary equipment*** |
| | | describe building systems and impact of decommissioning fuel systems |

| | | |
|---|---|---|
| G-22.01.02L | demonstrate knowledge of training and certification requirements to disconnect appliances and ancillary equipment | identify training and certification requirements to disconnect appliances and ancillary equipment |
| G-22.01.03L | demonstrate knowledge of regulatory requirements to disconnect appliances and ancillary equipment | identify ***codes, standards and regulations*** to disconnect appliances and ancillary equipment |

## Range of Variables

***procedures to disconnect appliances and ancillary equipment*** include: performing lock-out and tag-out procedures; isolating and terminating energy sources; rigging and hoisting heavy equipment and components; disconnecting and terminating control wires and tubing; isolating, purging and capping gas supply; disconnecting and capping venting and distribution systems; isolating accessories from system and removing energy sources; disconnecting accessories from appliance; checking for leaks

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME

## G-22.02 Removes appliances and ancillary equipment

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

| | Skills | |
|---|---|---|
| | **Performance Criteria** | **Evidence of Attainment** |
| G-22.02.01P | select and use tools and equipment | tools and equipment are selected and used according to task |
| G-22.02.02P | rig and hoist heavy appliances, ancillary equipment and components | heavy appliances, ancillary equipment and components are rigged and hoisted for removal |
| G-22.02.03P | coordinate with ***personnel*** to move appliances and ancillary equipment | ***personnel*** to move appliances and ancillary equipment is coordinated |
| G-22.02.04P | remove appliances, accessories and ancillary equipment as required | appliances, accessories and ancillary equipment are removed as required |
| G-22.02.05P | store appliances and ancillary equipment | appliances and ancillary equipment are stored according to site requirements |
| G-22.02.06P | dispose of and recycle appliances, accessories and ancillary equipment | appliances, accessories and ancillary equipment are disposed of and recycled according to environmental acts, jurisdictional regulations and best practices |

## Range of Variables

***personnel*** include: designates, other tradespersons, contractors

| | Knowledge | |
|---|---|---|
| | **Learning Outcomes** | **Learning Objectives** |
| G-22.02.01L | demonstrate knowledge of ***procedures to remove appliances, ancillary equipment and their components*** | identify ***hazards*** and describe safe work practices to remove appliances, ancillary equipment and their components |
| | | identify tools and equipment used to remove appliances, ancillary equipment and their components, and describe their procedures for use |
| | | describe ***procedures to remove appliances, ancillary equipment and their components*** |
| G-22.02.02L | demonstrate knowledge of training and certification requirements to remove appliances, ancillary equipment and their components | identify training and certification requirements to remove appliances, ancillary equipment and their components |
| G-22.02.03L | demonstrate knowledge of regulatory requirements pertaining to removal and disposal of appliances, ancillary equipment and their components | identify ***codes, standards and regulations*** pertaining to removal and disposal of appliances, ancillary equipment and their components |

## Range of Variables

***procedures to remove appliances, ancillary equipment and their components*** include: rigging and hoisting heavy appliances and ancillary equipment, and their components; coordinating with personnel to move appliances and ancillary equipment; removing appliances, accessories and ancillary equipment; storing appliances and ancillary equipment; disposing of and recycling appliances, accessories and ancillary equipment

***hazards*** include: compressed gas, flammable gas, equipment failure, electrocution, alternate energy systems, physical injuries, atmospheric (explosion)

***codes, standards and regulations (note that certain codes may not be adopted in some provinces and territories)*** include: CSA (B149.1, B149.2, B149.3, B149.5, B149.6, B108), CAN/BNQ 1784, CEC, NBC, AHJ, NFPA, ANSI/ASME, TDG

# Appendix A
# Acronyms

| | |
|---|---|
| ARP | Address Resolution Protocol |
| AHJ | Authority Having Jurisdiction |
| ANSI | American National Standards Institute |
| ASME | American Society of Mechanical Engineers |
| BAS | building automation system |
| Btuh | British thermal units per hour |
| CCUS | carbon capture, utilization and storage |
| CEC | Canadian Electrical Code |
| CNG | compressed natural gas |
| CNZEAA | Canadian Net-Zero Emissions Accountability Act |
| CSA | Canadian Standards Association |
| CSST | corrugated stainless steel tubing |
| DSI | direct spark ignitor |
| ECM | electronically commutated motors |
| ESP | external static pressure |
| HEPA | high-efficiency particulate air |
| HSI | hot surface ignition |
| HTTP | Hypertext Transfer Protocol |
| HVAC | heating, ventilation and air conditioning |
| ICI | industrial, commercial and institutional |
| IR | infrared |
| kW | kilowatts |
| LEED | Leadership in Energy and Environmental Design |
| LNG | liquefied natural gas |
| LPG | liquefied petroleum gas |
| LON | local operation network |
| mA | milliamps |
| MCC | motor control centre |
| MEWP | mobile elevated work platforms |
| MIG | Metal Inert Gas |
| NBC | National Building Code |
| NECB | National Energy Code of Canada for Buildings |
| NEMA | National Electrical Manufacturers Association |
| NFPA | National Fire Protection Association |
| OHS | Occupational Health and Safety |
| PID | proportional, integral and derivative |

| | |
|---|---|
| P&ID | piping and instrumentation drawings |
| PLC | programmable logic controller |
| PPE | personal protective equipment |
| QA | quality assurance |
| QC | quality control |
| RNG | renewable natural gas |
| RPM | revolutions per minute |
| RTD | resistance temperature detector |
| SCBA | self-contained breathing apparatus |
| SCR | silicon-controlled rectifiers |
| SDS | Safety Data Sheets |
| SSR | solid-state relay |
| TDG | Transport of Dangerous Goods |
| TIG | Tungsten Inert Gas |
| UPS | uninterrupted power supply |
| UV | ultraviolet |
| VFD | variable frequency drive |
| WHMIS | Workplace Hazardous Materials Information System |
| ZCB | Zero Carbon Building |
| ZEV | zero-emission vehicle |

# Appendix B
# Tools and Equipment/Outils et équipement

## Personal Protective Equipment (PPE) and Safety Equipment/Équipement de protection individuelle (EPI) et de sécurité

| | |
|---|---|
| air quality monitors | dispositifs de surveillance de la qualité de l'air |
| aprons | tabliers |
| arc flash protection | protecteurs contre les arcs électriques |
| barricades/guardrails/pylons | barrières, garde-corps, cônes |
| detection devices (carbon monoxide, combustible gas) | détecteurs (de monoxyde de carbone, de gaz combustible) |
| eye wash kits | trousses de rinçage oculaire |
| face shields | écrans faciaux |
| fall-arrest and restraint systems | dispositifs antichute et systèmes de retenue |
| fire blankets | couvertures antifeu |
| fire extinguishers | extincteurs |
| fire-retardant clothing | vêtements ignifuges |
| first-aid kits | trousses de premiers soins |
| gloves (industrial rubber [low/high voltage] and leather) | gants (en cuir et en caoutchouc industriel [haute et basse tension]) |
| hard hats | casques de protection |
| hearing protection (plugs, muffs) | protecteurs d'oreilles (bouche-oreilles, casque antibruit) |
| high-visibility clothing | gilet de haute visibilité |
| leather chaps | jambières de cuir |
| lock-out devices and padlocks | dispositifs de verrouillage et cadenas |
| masks (dust, particle and filter) | masques (antipoussières, antiparticules et filtrants) |
| overalls (fire-rated) | salopettes (résistantes au feu) |
| rain suits | ensembles de pluie |
| respirators | appareils de protection respiratoire |
| respirator cartridges | cartouches filtrantes de l'appareil respiratoire |
| respiratory masks | masques respiratoires |
| rubber boots | bottes en caoutchouc |
| safety boots | bottes de sécurité |
| safety glasses/goggles | lunettes de sécurité et de protection |
| self-contained breathing apparatus (SCBA) | appareils respiratoires autonomes (ARA) |
| warning signs and caution tape | panneaux d'avertissement et rubans de mise en garde |
| welder visors | visières de soudage |
| welding screens | écrans de soudeur |

## Hand Tools/Outils à main

| | |
|---|---|
| adjustable wrenches | clés réglables |
| angle finders | rapporteurs d'angles |
| bearing pullers | extracteurs de roulement |
| bolt cutters | coupe-boulons |
| bolt dies | filières à boulons |
| bolt taps | tarauds à boulons |
| brooms | balais |

| | |
|---|---|
| brushes (wire, paint, acid and fitting) | brosses (métalliques, brosses à peinturer, brosses pour application d'acide, de raccords) |
| callipers | pieds à coulisse |
| caulking guns | pistolets à calfeutrer |
| C-clamps | serre-joints en C |
| centre-point sets | ensembles de pointeaux centreurs |
| chalk lines | cordeaux traceurs |
| chisels | ciseaux |
| cloths (sand, emery, sandpaper) | toiles (abrasives, toiles d'émeri, papiers abrasifs) |
| cold-chisel sets | jeux de ciseaux à froid |
| combination wire strippers | pinces à dénuder combinées |
| combination wrench sets (imperial and metric) | jeux de douilles (métrique et impérial) |
| conduit benders | cintreuses de tuyaux |
| crimpers | sertisseurs |
| crowbars | leviers |
| differential pressure gauges | manomètres différentiels |
| dollies | plateaux roulants |
| draft gauges | indicateurs de tirage |
| drift-punch sets | ensembles de chasse-goupilles |
| extendable mirrors | miroirs extensibles |
| feeler gauges | jauges d'épaisseur |
| files | limes |
| fish tapes | rubans de tirage |
| flange alignment pins | chevilles de positionnement à collet |
| flange spreaders (jacks) | écarteurs de bride (crics) |
| flaring tools | outils à évaser |
| flashlights | lampes de poche |
| folding rules | règles pliantes |
| fuse pullers | arrache-fusibles |
| gas cylinders, and soldering and brazing equipment | bouteilles de gaz comprimé et matériel de brasage et de brasage tendre |
| gas leak detector solution | solution de détection de fuites de gaz |
| gasket cutters | coupeurs de joints |
| grease guns | pistolets graisseurs |
| hacksaws | scies à métaux |
| hammers (claw, ball peen, sledge, brass, chipping, soft-face) | marteaux (arrache-clous, à panne ronde, masses, en laiton, à piquer, massettes) |
| hand crimpers | sertisseurs à main |
| hand drills | perceuses à main |
| hand saws | scies à main |
| hex/torx keys (set) | ensembles de clés à six pans et torx |
| hole saws | scies-cloche |
| ignition tools (sparker, torch) | dispositifs d'allumage (allumeurs, chalumeaux) |
| keyhole saws | scies à guichet |
| knives | couteaux |
| knockout (k.o.) sets | ensembles de scies emporte-pièces |
| labelling machines | étiqueteuses |
| levels (line, laser and transit) | niveaux (de ligne, à laser et théodolites) |
| nut driver sets | ensembles de tourne-écrous |
| oiling cans | burettes à huile |
| orifice drills | perceuses d'orifice |
| pencils and pads | crayons et bloc-notes |
| PEX pipe expanders (manual) | outils à main pour agrandir les tuyaux en polyéthylène réticulé |
| picks | pics |

| | |
|---|---|
| pipe cutters (single-wheel, multi-wheel) | coupe-tuyaux (à roulette unique, à roulettes) |
| pipe stands (roller and V type) | supports à tuyaux (à tête de rouleau, à tête en V) |
| pipe taps | tarauds pour tuyauterie |
| pipe threaders | filières à tuyaux |
| pipe vises (chain and yokes, tri-stand and bench vise) | étaux à tuyaux (à chaine et à charnière, sur trépied et d'établi) |
| pipe wraparounds | bandes à tracer pour tuyaux |
| pipe wrenches | clés à tuyaux |
| pitot tubes (velometer) | tubes de Pitot (vélomètres) |
| plastic pipe cutters | coupes-tuyaux pour plastique |
| pullers | extracteurs |
| punches | poinçons |
| purging equipment | matériel de purge de gaz |
| rasps | râpes |
| ratchets | clés à rochet |
| reamers | alésoirs |
| scratch awls | pointes à tracer |
| screw extractors | extracteurs de vis |
| screwdrivers (complete set) | tournevis (ensemble complet) |
| shovels | pelles |
| socket sets (imperial and metric) | jeux de clés combinées (impérial et métrique) |
| spacing tools | outils d'espacement |
| spud wrenches | clés à mâchoires |
| squares | équerres |
| strikers | gâches |
| swaging tools | outils de sertissage |
| swedge (hand flaring tool) | outils de sertissage (outil à évaser à main) |
| T squares | équerres en T |
| tap and die sets | jeux de tarauds et de filières |
| tape measurers | rubans à mesurer |
| threading hand dies | filières à main |
| tin snips | cisailles de ferblantier |
| tip cleaners | nettoyeurs de buse |
| toolboxes | boîtes à outils |
| torches | chalumeaux |
| torque wrenches | clés dynamométriques |
| transfer pumps (hand-operated) | pompes de transfert (manuelles) |
| tri-squares | équerres de menuisier |
| tube benders | cintreuses de tuyaux rigides |
| tube cleaners | nettoie-tubes |
| tube cutters | coupe-tubes |
| utility brushes | brosses à usages multiples |
| wire strippers | pinces à dénuder |
| wood chisels | ciseaux à bois |

## Power Tools/Outils mécaniques

| | |
|---|---|
| air compressors and accessories | compresseurs d'air et accessoires |
| air tools | outils pneumatiques |
| arc welders (electrical, fuel) | soudeuses à l'arc (électriques, essence) |
| band saws | scies à ruban |
| blowers | soufflantes |
| chop-saws | tronçonneuses à disque |
| circular saws | scies circulaires |
| compressed gas cylinders (purge, shield, | bouteilles de gaz comprimé (purge, écran, |

| | |
|---|---|
| cutting) | coupage) |
| cordless tools (drills, saws) | outils sans fil (perceuses et scies) |
| gas coring machine | carotteuse à essence |
| crimping tools | outils de sertissage |
| electric drills | perceuses électriques |
| exhaust fans | ventilateurs extracteurs |
| grinders (electric or pneumatic, angle, bench, die, pedestal) | meuleuses (électriques ou pneumatiques, d'angle, d'établi, à rectifier les matrices, sur socle) |
| hammer-drills | perceuses à percussion |
| heat guns | pistolets thermiques |
| impact drivers | visseuses à percussion |
| impact guns | pistolets à percussion |
| impact wrenches | clés à chocs |
| jigsaws | scies sauteuses |
| knockout cutters | outils à emporte-pièce |
| lighting equipment | appareillage d'éclairage |
| nibblers | grignoteuses |
| PEX pipe expanders (power) | outils mécaniques pour agrandir les tuyaux en polyéthylène réticulé |
| portable band saws (hacksaws) | scies à ruban portatives (scies à métaux) |
| powder-actuated tools | outils à charge explosive |
| power pipe threaders | filières à tuyaux mécaniques |
| power threading machines | machines à fileter mécaniques |
| propane tiger torches (preheating) | buses de lance-flammes au propane (préchauffage) |
| reciprocating saws | scies alternatives |
| rotary hammers | marteaux perforateurs rotatifs |
| soldering guns | pistolets à souder |
| tank lifters | chariots de bouteille de gaz |
| transfer pumps | pompes de transfert |
| vacuum cleaners (high-efficiency particulate air [HEPA]) | aspirateurs à filtre HEPA |
| welding equipment (Metal Inert Gas [MIG], Tungsten Inert Gas [TIG]) | matériel de soudage (MIG, TIG) |

## Technical Instruments and Testers/Instruments techniques et matériel d'essai

| | |
|---|---|
| alignment tools | outils d'alignement |
| atmosphere testers | appareils de contrôle de la qualité de l'air |
| calculators | calculatrices |
| calipers | étriers |
| capacitor testers | capacimètres |
| clamp-on ammeters | pinces ampèremétriques |
| combustion analyzers | analyseurs de combustion |
| computers | ordinateurs |
| data recorders | enregistreurs de données |
| dial indicators | indicateurs à cadran |
| differential pressure gauges and sight tubes | manomètres différentiels et tubes de regard |
| digital recordings | enregistrements de données |
| digital tachometers | tachymètres numériques |
| draft gauges | indicateurs de tirage |
| drafting equipment | équipement de dessin |
| electronic leak detectors | détecteurs de fuites électroniques |
| ground resistance testers | pinces de contrôle de la résistance de terre |
| hand pumps and accessories | pompes manuelles et accessoires |

| | |
|---|---|
| hydrostatic pumps and gauges (manual and power) | pompes et jauges hydrostatiques (à main et mécaniques) |
| manometers | manomètres |
| manufacturer-specific diagnostic equipment | équipement de diagnostic propre au fabricant |
| megohmmeters | mégohmmètres |
| micrometers | micromètres |
| multimeters (voltage, amperage, resistance) | multimètres (tension, intensité, résistance) |
| ohmmeters | ohmmètres |
| rotameters | rotamètres |
| rulers | règles |
| scale rulers | règles graduées |
| squares (standard 24 in. combination, flange, straightedge) | équerres (normales de 24 pouces, combinées, à bride, de précision) |
| string lines | cordeaux |
| temperature testers | appareils d'essai de la température |
| thermocouple testers | testeurs de thermocouple |
| thermometers (infrared, electronic, mechanical) | thermomètres (à infrarouges, électroniques, mécaniques) |
| true RMS meters | multimètres à valeur efficace vraie (RMS) |
| velocity meters | compteurs de vitesse |

## Access Equipment/Équipement d'accès

| | |
|---|---|
| ladders (combination, extension, step) | échelles (transformables, coulissantes, escabeaux) |
| mobile elevated work platforms (electrical, hydraulic, pneumatic, hand and power winch, one-person, platform, scissor lift, articulating boom) | plateformes de travail élévatrices mobiles (électriques, hydrauliques, pneumatiques, treuils à main, treuils à moteur, plateformes, nacelles, plateformes élévatrices à ciseaux, nacelles articulées) |
| scaffolding | échafaudages |

## Lifting, Rigging and Hoisting Equipment/Équipement de levage, de gréage et de hissage

| | |
|---|---|
| chokers | attaches à étranglement |
| eye bolts | boulons à œil |
| portable wire rope winches | treuils portables à câble en acier |
| rigging tools (blocks, come-alongs, snatch block, handlines and pulleys) | outils de gréage (moufles, palans manuels, poulies à chape ouvrante, cordes de service, poulies) |
| ropes/cables (wire, nylon [synthetic]) | cordes et câbles en acier ou en nylon (synthétique) |
| shackles (varying sizes) | manilles (tailles variées) |
| spreader beams | palonniers |
| slings | élingues |

# Appendix C
# Glossary/Glossaire

Note: a list of definitions can be referred to in all CSA codes for clarification and meaning of terms and items used in the trade.

| | | | |
|---|---|---|---|
| **accessory** | part capable of performing an independent function and contributing to the operation of the appliance or gas piping system that it serves | **accessoire** | pièce capable de remplir une fonction indépendante et de contribuer au fonctionnement de l'appareil ou de la tuyauterie de gaz qu'elle dessert |
| **building as a system** | building is made up of components that work together to form an integrated system | **bâtiment en tant que système** | bâtiment constitué de composants adaptés les uns aux autres pour former un système intégré |
| **forced draft** | a mechanical draft produced by a device upstream form the combustion zone of an appliance producing a positive combustion chamber pressure | **tirage forcé** | tirage mécanique produit par un dispositif en amont de la zone de combustion d'un appareil produisant une pression positive dans la chambre de combustion |
| **induced draft** | a mechanical draft produced by a device downstream form the combustion zone of an appliance producing a negative combustion chamber pressure | **tirage induit** | tirage mécanique produit par un dispositif en aval de la zone de combustion d'un appareil produisant une pression négative dans la chambre de combustion |
| **spool sheet** | pipe fabrication details | **schéma de raccordement** | plan détaillé de la fabrication de la tuyauterie |