PROGRAM PROGRAMME
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Red Seal Occupational Standard

Plumber

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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 Plumber 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
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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 Plumber Trade: an overview of the trade's duties, work environment, job requirements, similar occupations and career progression

Trends in the Plumber 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

Harmonization of Apprenticeship Training: the aspects of apprenticeship training that participating provinces and territories have agreed upon to substantively align apprenticeship systems across Canada

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.

Harmonization of Apprenticeship Training

An analysis of all provinces' and territories' apprenticeship programs is performed and recommendations are made on harmonizing the name of the trade, the hours of training required and the number of levels of training. Provinces and territories consult with their respective industry stakeholders on these elements and revisions are discussed until consensus is reached. Following the development of the workshop draft of the RSOS, participants discuss and come to consensus on the sequence of training topics, as expressed in the new standard. Their sequencing recommendations are reviewed by stakeholders in participating provinces and territories and further discussions are convened to reach consensus and to identify any exceptions.

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 Plumber Trade

“Plumber” is this trade’s official Red Seal occupational title approved by the CCDA. This standard covers tasks performed by plumbers.

Plumbers plan, install, test and service plumbing fixtures and systems such as water, hydronic, drain, waste and vent (DWV), low pressure steam, residential fire, chemical and irrigation. They also install specialized systems such as medical gas, process piping, compressed air, water conditioners, fuel piping, sewage and water treatment, and storage and flow equipment. Plumbers interpret drawings, refer to layouts of existing services, and review applicable codes and specifications to determine work details and procedures. They locate and mark positions for fixtures, pipe connections and sleeves, and cut openings to accommodate pipe and fittings.

Plumbers may be employed by plumbing/mechanical contractors, service companies, and maintenance departments of manufacturing, commercial, health care and educational facilities. They may also be self-employed. Plumbers install piping and equipment in residential, commercial, institutional and industrial buildings and sites.

Plumbers use a variety of tools and equipment such as hand and power tools, welding and soldering/brazing equipment, and hoisting and lifting equipment to perform the tasks in their trade. To perform some tasks or use some equipment, specific certification may be required. Plumbers work with a variety of piping materials such as copper, steel, plastic, glass, cast iron, cement, fibreglass and specialty materials. Before assembling pipe, tubing and fittings, the pipes must be measured, cut, cleaned, bent and supported. Joining pipe may be done by various means, such as threading, using mechanical joints, welding, soldering/brazing, crimping, using compression, using press fittings and using fastening materials and compounds. Plumbers install supports for piping and equipment. When servicing appliances, components and systems plumbers work with low voltage equipment. Plumbers test and commission systems to ensure proper operation. They perform scheduled, unscheduled and emergency maintenance and repair.

Safety awareness is essential for plumbers. They may work indoors or outdoors, and working conditions vary from one job to another. The work of plumbers can be physically demanding. Plumbers often need to lift and carry heavy materials and equipment. While performing their duties, plumbers are also required to do considerable standing, climbing and kneeling. They may work at heights and in confined spaces. Special precautions may have to be taken when working with fluids, gases, steam and hazardous elements. Plumbers need to assess the systems and the environment to identify possible dangers.

Key attributes for people entering this trade are good mechanical, mathematical and spatial visualization skills. Plumbers also need good communication skills to communicate with co-workers, clients, architects, engineers and building officials. Analytical/problem solving skills are required to interpret building plans, inspect piping systems and diagnose system faults and malfunctions.

This standard recognizes some similarities or overlaps with the work of gasfitters, steamfitters/pipefitters, refrigeration and air conditioning mechanics and sprinkler fitters.

With experience, plumbers act as mentors and trainers to apprentices in the trade. They may also move into other positions such as instructors, inspectors, estimators and project managers.

Trends in the Plumber Trade

Technology

There is an increase of necessary training in technology and computer-based equipment such as GPS for pipe layouts and modelling, smart phones/tablets for accessing online resources and video calling for off-site technical help. 3-D drawings are increasingly being used in the trade and require additional training. Technology continues to improve digital documentation.

Plumbers are increasingly expected to understand the complete low voltage system of any heating or cooling appliance and plumbing fixtures.

Health and Safety

There continues to be a greater focus on physical and mental health and safety. There has been an increased awareness since COVID-19 concerning air-borne viruses. Additional PPE may be required when working in sewage pits, on active drain lines and in occupied residences. There is an increase in awareness and support of equity, diversity and inclusion in the workplace.

Tools and Equipment

Most tools and equipment have become cordless for less power dependency and tripping hazards on site. Many tools are constantly changing and improving such as press/fusion tools for pipe joining.

Tablets and computers are being used onsite by all workers. Tablets are used to organize drawings, construct emails and requests for information (RFI). They also allow for multiple projects to be monitored at one time from any location. Communication with plumbers and apprentices can be done remotely. Engineers, owners and project managers can transfer changes or alterations to plumbers quickly. This allows for a more accurate and less wasteful piping installation.

Products/Materials

Plumbing products are moving towards plastic and cold weld applications. Materials are also constantly changing and improving such as press fittings being used instead of solder for many jobs. Press fitting technology is being used more often. It has now been approved for gas installations and is being used in the field.

There are often unforeseen effects of new products in the field that continue to drive innovation and improvement. This is the case now with the introduction of high efficiency fixtures and equipment.

Environmental

Industry has become conscious of energy usage and efficiency of equipment and systems, resulting in a higher expectation from building owners and clients to meet the standards of programs such as Leadership in Energy and Environmental Design (LEED) and Energy Star. Plumbers must be more aware of the impact the trade has on the environment, the emerging requirements of these programs and the specific site requirements that are critical to projects. Many buildings are being built to environmental standards that require new products and systems. This may include systems such as rainwater harvesting, grey water, solar thermal, geothermal, heat recovery and biomass.

There is an increased awareness of environmental issues related to plumbing. This might include sewage treatment to recyclable piping products. Specific knowledge and training are growing in this area. There are increased requirements for more green piping installation. This includes insulation around pipes and equipment. Energy efficiencies are increasing in equipment. Safer products are being used for various applications. Construction sites are increasing recycling by separating waste products.

Legislative and Regulatory

Plumbing requires paperwork and permits. Plumbers must be aware of constantly evolving procedures and codes. Awareness of the responsibility of the individual worker is a key factor when installing piping systems. Plumbers and their apprentices require a good understanding of codes, regulations, and standards as well as a knowledge of record keeping and legal responsibilities. Modern training programs are focusing on these details much better than before.

Other

The trade continues to expand its workforce through innovation and inclusion.

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

Plumbers require strong reading skills to consult installation procedures, reference manuals, Safety Data Sheets (SDS), the National Plumbing Code (NPC) and industry standards and safety requirements when installing, repairing and maintaining plumbing fixtures and systems. They also refer to project specifications and work orders when planning a job.

Document Use

Document use is important in the work of plumbers. Plumbers use the NPC to ensure compliance with regulatory standards. They interpret specifications, diagrams, schematics and working drawings when planning the installation of piping systems. Plumbers read assembly drawings to install fixtures and appliances. They prepare sketches and drawings to plan a job.

Writing

Writing skills are used by plumbers to perform tasks such as preparing estimates, writing lists of materials required for a job, completing order forms to request materials, and keeping daily logs to track work status and reminders. When required, they must write incident or accident reports. They may be required to communicate in writing to other trade professionals such as engineers and architects.

Oral Communication

Plumbers require good oral communication skills to interact with colleagues, apprentices, supervisors, suppliers, inspectors, clients and other tradespersons when co-ordinating work, resolving problems and ensuring safety.

Numeracy

Plumbers work in both imperial and metric systems of measurement. They locate and mark positions for pipe connections. They perform a variety of calculations such as offsets, drain line fall, hydraulic load, and temperature and pressure calculations depending on the type of piping system being installed. Plumbers estimate materials and supplies needed to complete a project. They may estimate labour requirements and prepare quotations and invoices.

Thinking Skills

Plumbers diagnose and solve problems. They decide on work priorities and plan and organize their work accordingly. Plumbers may determine the most cost-effective way to use materials and supplies when installing plumbing and heating systems.

Working with Others

During the course of a work day, plumbers must interact with others such as co-workers, suppliers, clients and other tradespeople.

Digital Technology

Plumbers use computers and other digital devices to access resource information, communication and cost reporting. They are also used as a tool for design, layout, research, system diagnosis and estimating.

Continuous Learning

Changes to the NPC occur periodically to modify procedures and methods for the design and installation of piping systems. Advances in technology are also changing the design, applications, materials, and tools and equipment used in the installation of systems. There is an increased emphasis on worker health and safety. All these changes mean that related training and certification is often mandatory for both apprentices and journeypersons.

Roles and Opportunities for Skilled Trades in a Sustainable Future

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

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

For example:

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

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

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

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

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

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

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

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

- the Montreal Protocol for phasing out R22 refrigerants.

- energy efficiency programs such as ENERGY STAR.

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

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

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

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

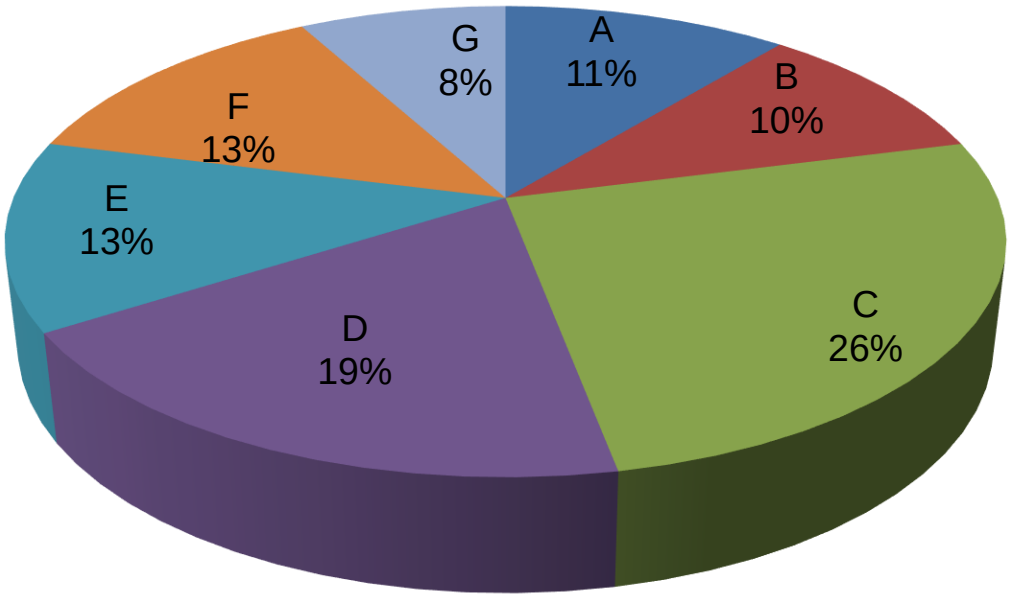
Industry Expected Performance

All tasks must be performed according to the applicable jurisdictional codes and standards. All health and safety 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, clients and quality 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 as well as languages of instruction in apprenticeship programs.

Pie Chart of Red Seal Examination Weightings



MWA A	Performs common occupational skills	11%
MWA B	Prepares and assembles tube, tubing and pipe	10%
MWA C	Installs, tests and services sewers, sewage treatment systems and drainage, waste, vents (DWV) systems	26%
MWA D	Installs, tests and services water service and distribution	19%
MWA E	Installs, tests and services fixtures, appliances and water treatment systems	13%
MWA F	Installs, tests and services low-pressure steam and hydronic systems	13%
MWA G	Installs, tests and services specialized systems	8%

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 125 questions.

Plumber
Task Matrix and Weightings

A – Performs common occupational skills — 11%

Task A-1 **Performs safety-related functions** **19%**	**A-1.01 Maintains safe work environment**	**A-1.02 Uses personal protective equipment (PPE) and safety equipment**	**A-1.03 Performs lock-out and tag-out (LOTO) procedures**
Task A-2 **Uses and maintains tools and equipment** **23%**	**A-2.01 Uses common tools and equipment**	**A-2.02 Uses access equipment**	**A-2.03 Uses rigging, hoisting, lifting and positioning equipment**
	A-2.04 Rigs loads for cranes	**A-2.05 Uses welding equipment**	**A-2.06 Uses soldering and brazing equipment**
Task A-3 **Organizes work** **20%**	**A-3.01 Organizes project tasks and procedures**	**A-3.02 Organizes materials and supplies**	**A-3.03 Uses documentation**
Task A-4 **Performs routine trade activities** **34%**	**A-4.01 Plans layout for piping systems**	**A-4.02 Calculates tube, tubing and pipe lengths**	**A-4.03 Installs piping supports**
	A-4.04 Installs piping sleeves	**A-4.05 Commissions systems**	**A-4.06 Protects piping systems, equipment and structure from damage**
	A-4.07 Coordinates excavation and backfilling of trenches	**A-4.08 Installs fire stopping devices and materials**	
Task A-5 **Uses communication and mentoring techniques** **4%**	**A-5.01 Uses communication techniques**	**A-5.02 Uses mentoring techniques**	

B – Prepares and assembles tube, tubing and pipe — 10%

Task B-6 **Prepares tube, tubing and pipe** **46%**	**B-6.01 Inspects tube, tubing, pipe and fittings before installation**	**B-6.02 Cuts tube, tubing and pipe**	**B-6.03 Bends tube, tubing and pipe**
	B-6.04 Prepares tube, tubing and pipe connections		
Task B-7 **Joins tube, tubing and pipe** **54%**	**B-7.01 Joins copper tube, tubing and pipe**	**B-7.02 Joins plastic tube, tubing and pipe**	**B-7.03 Joins steel tube, tubing and pipe**
	B-7.04 Joins cast iron pipe	**B-7.05 Joins specialized tube, tubing and pipe**	

C – Installs, tests and services sewers, sewage treatment systems and drainage, waste and vent (DWV) systems — 26%

Task C-8 **Installs, tests and services sewers** **20%**	**C-8.01 Plans layout and sizes piping for sewers**	**C-8.02 Installs maintenance holes and catch basins**	**C-8.03 Installs piping for sewers**
	C-8.04 Tests maintenance holes, catch basins and piping for sewers	**C-8.05 Services maintenance holes, catch basins and piping for sewers**	
Task C-9 **Installs, tests and services sewage treatment systems** **17%**	**C-9.01 Plans installation of sewage treatment systems**	**C-9.02 Installs components for sewage treatment systems**	**C-9.03 Tests sewage treatment systems**
	C-9.04 Services sewage treatment systems		

Task C-10 **Installs, tests and services interior drainage, waste and vent (DWV) systems** **63%**	**C-10.01 Plans layout and sizes piping for interior drainage, waste and vent (DWV) systems**	**C-10.02 Installs underground piping and components for interior drainage, waste and vent (DWV) systems**	**C-10.03 Installs above-ground piping and components for interior drainage, waste and vent (DWV) systems**
	C-10.04 Tests interior drainage, waste and vent (DWV) systems	**C-10.05 Services interior drainage, waste and vent (DWV) systems**	

D – Installs, tests and services water service and distribution — 19%

Task D-11 **Installs, tests and services water service** **24%**	**D-11.01 Plans layout and sizes piping and components for water service**	**D-11.02 Installs piping for water service**	**D-11.03 Installs components for water service**
	D-11.04 Tests water service piping and components	**D-11.05 Services water service piping and components**	
Task D-12 **Installs, tests and services potable water distribution systems** **49%**	**D-12.01 Plans layout and sizes piping and components for potable water distribution systems**	**D-12.02 Installs piping for potable water distribution systems**	**D-12.03 Installs components for potable water distribution systems**
	D-12.04 Installs cross connection controls	**D-12.05 Tests potable water distribution systems**	**D-12.06 Services potable water distribution systems**
Task D-13 **Installs, tests and services private water pressure systems** **27%**	**D-13.01 Plans layout and sizes piping and components for private water pressure systems**	**D-13.02 Installs piping for private water pressure systems**	**D-13.03 Installs components for private water pressure systems**
	D-13.04 Tests private water pressure systems	**D-13.05 Services private water pressure systems**	

E – Installs, tests and services fixtures, appliances and water treatment systems

13%

Task E-14 **Installs, tests and services plumbing fixtures and appliances** **63%**	**E-14.01 Installs fixture supports**	**E-14.02 Installs plumbing fixtures and appliances**	**E-14.03 Tests plumbing fixtures and appliances**
	E-14.04 Services plumbing fixtures and appliances		
Task E-15 **Installs, tests and services water treatment systems** **37%**	**E-15.01 Sizes water treatment systems**	**E-15.02 Installs water treatment systems**	**E-15.03 Tests water treatment systems**
	E-15.04 Services water treatment systems		

F – Installs, tests and services low-pressure steam and hydronic systems

13%

Task F-16 **Installs, tests and services low-pressure steam systems - Not Common Core** **0%**	**F-16.01 Plans layout and sizes piping and components for low-pressure steam systems- Not Common Core**	**F-16.02 Installs piping and components for low-pressure steam systems- Not Common Core**	**F-16.03 Tests low-pressure steam systems- Not Common Core**
	F-16.04 Services low-pressure steam systems- Not Common Core		
Task F-17 **Installs, tests and services piping and components for hydronic systems** **58%**	**F-17.01 Plans layout and sizes piping and components for hydronic systems**	**F-17.02 Installs piping and components for hydronic systems**	**F-17.03 Tests hydronic systems**
	F-17.04 Services hydronic systems		

Task F-18 **Installs, tests and services hydronic heating and cooling equipment** **42%**	**F-18.01 Installs hydronic heating equipment**	**F-18.02 Installs hydronic cooling equipment**	**F-18.03 Tests hydronic heating and cooling equipment**
	F-18.04 Services hydronic heating and cooling equipment		

G– Installs, tests and services specialized systems — 8%

Task G-19 **Installs, tests and services process piping systems** **51%**	**G-19.01 Plans layout and sizes piping and components for process piping systems**	**G-19.02 Installs piping for process piping systems**	**G-19.03 Installs components for process piping systems**
	G-19.04 Tests process piping systems	**G-19.05 Services process piping systems**	
Task G-20 **Installs, tests and services potable water fire protection systems - Not Common Core** **0%**	**G-20.01 Plans layout and sizes piping for potable water fire protection systems - Not Common Core**	**G-20.02 Installs potable water fire protection systems - Not Common Core**	**G-20.03 Tests potable water fire protection systems - Not Common Core**
	G-20.04 Services potable water fire protection systems – Not Common Core		
Task G-21 **Installs, tests and services other specialized systems** **49%**	**G-21.01 Plans layout and sizes piping, components and equipment for other specialized systems**	**G-21.02 Installs piping and components for other specialized systems**	**G-21.03 Installs equipment for other specialized systems**
	G-21.04 Tests other specialized systems	**G-21.05 Services other specialized systems**	

Harmonization of Apprenticeship Training

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

1. Trade name

The official Red Seal name for this trade is Plumber.

2. Number of Levels of Apprenticeship

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

3. Total Training Hours During Apprenticeship Training

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

4. Sequencing Topics and Related Sub-tasks

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

Level 1	Level 2	Level 3	Level 4
	In Context	**In Context**	**In Context**
	Tools and Equipment	Tools and Equipment	Tools and Equipment
	Organizes Work	Organizes Work	Organizes Work
		Routine Trade Activities	Routine Trade Activities
	Communication Techniques	Communication Techniques	Communication Techniques
	Tube, Tubing, Pipe (Preparation)	Tube, Tubing, Pipe (Preparation)	Tube, Tubing, Pipe (Preparation)
	Tube, Tubing, Pipe (Join)	Tube, Tubing, Pipe (Join)	Tube, Tubing, Pipe (Join)
			Interior Drainage, Waste and Vent (DMV) Systems
			Water Services
			Potable Water Distribution
			Hydronic Systems
		Plumbing Fixtures and Appliances	Plumbing Fixtures and Appliances

Safety-Related Functions

1.01 Maintains safe work environment

1.02 Uses personal protective equipment (PPE) and safety equipment

1.03 Performs lock-out and tag-out (LOTO) procedures

Level 1	Level 2	Level 3	Level 4
Tools and Equipment 2.01 Uses common tools and equipment 2.02 Uses access equipment 2.03 Uses rigging, hoisting, lifting and positioning equipment 2.04 Rigs loads for cranes 2.05 Uses welding equipment 2.06 Uses soldering and brazing equipment			
Organizes Work 3.01 Organizes project tasks and procedures 3.02 Organizes materials and supplies 3.03 Uses documentation			

Level 1	Level 2	Level 3	Level 4
Routine Trade Activities 4.01 Plans layout for piping systems 4.02 Calculates tube, tubing and pipe lengths 4.03 Installs piping supports 4.04 Installs piping sleeves 4.05 Commissions systems (Introduction) 4.06 Protects piping systems, equipment and structure from damage 4.07 Coordinates excavation and backfilling of trenches 4.08 Installs fire stopping devices and materials	**Routine Trade Activities** 4.01 Plans layout for piping systems 4.02 Calculates tube, tubing and pipe lengths 4.03 Installs piping supports 4.04 Installs piping sleeves 4.05 Commissions systems 4.06 Protects piping systems, equipment and structure from damage 4.07 Coordinates excavation and backfilling of trenches 4.08 Installs fire stopping devices and materials		
Communication Techniques 5.01 Uses communication techniques		**Mentoring Techniques** 5.02 Uses mentoring techniques	**Mentoring Techniques** 5.02 Uses mentoring techniques
Tube, Tubing and Pipe Preparation 6.01 Inspects tube, tubing, pipe and fittings before installation 6.02 Cuts tube, tubing and pipe 6.03 Bends tube, tubing and pipe 6.04 Prepares tube, tubing and pipe connections			

Level 1	Level 2	Level 3	Level 4
Tube, Tubing and Pipe (Join) 7.01 Joins copper tube, tubing and pipe 7.02 Joins plastic tube, tubing and pipe 7.03 Joins steel tube, tubing and pipe 7.04 Joins cast iron pipe 7.05 Joins specialized tube, tubing and pipe			
		Sewers 8.01 Plans layout and sizes piping for sewers 8.02 Installs maintenance holes and catch basins 8.03 Installs piping for sewers 8.04 Tests maintenance holes, catch basins and piping for sewers 8.05 Services maintenance holes, catch basins and piping for sewers	
			Sewage Treatment Systems 9.01 Plans installation of sewage treatment systems 9.02 Installs components for sewage treatment systems 9.03 Tests sewage treatment systems 9.04 Services sewage treatment systems

Level 1	Level 2	Level 3	Level 4
Interior Drainage, Waste and Vent (DWV) Systems (Introduction) 10.01 Plans layout and sizes piping for interior drainage waste and vent (DWV) systems 10.02 Installs underground piping and components for interior drainage, waste and vent (DWV) systems 10.03 Installs above-ground piping and components for interior drainage, waste and vent (DWV) systems 10.04 Tests interior drainage, waste and vent (DWV) systems 10.05 Services interior drainage, waste and vent (DWV) systems	**Interior Drainage, Waste and Vent (DWV) Systems** 10.01 Plans layout and sizes piping for interior drainage waste and vent (DWV) systems 10.02 Installs underground piping and components for interior drainage, waste and vent (DWV) systems 10.03 Installs above-ground piping and components for interior drainage, waste and vent (DWV) systems 10.04 Tests interior drainage, waste and vent (DWV) systems 10.05 Services interior drainage, waste and vent (DWV) systems	**Interior Drainage, Waste and Vent (DWV) Systems** 10.01 Plans layout and sizes piping for interior drainage waste and vent (DWV) systems 10.02 Installs underground piping and components for interior drainage, waste and vent (DWV) systems 10.03 Installs above-ground piping and components for interior drainage, waste and vent (DWV) systems 10.04 Tests interior drainage, waste and vent (DWV) systems 10.05 Services interior drainage, waste and vent (DWV) systems	
		Water Services 11.01 Plans layout and sizes piping and components for water service 11.02 Installs piping for water service 11.03 Installs components for water service 11.04 Tests water service piping and components 11.05 Services water service piping and components	

Level 1	Level 2	Level 3	Level 4
		Potable Water Distribution 12.01 Plans layout and sizes piping and components for potable water distribution systems 12.02 Installs piping for potable water distribution systems. 12.03 Installs components for potable water distribution systems 12.04 Installs cross connection controls 12.05 Tests potable water distribution systems 12.06 Services potable water distribution systems	
			Private Water Pressure Systems 13.01 Plans layout and sizes piping and components for private water pressure systems 13.02 Installs piping for private water pressure systems 13.03 Installs components for private water pressure systems 13.04 Tests private water pressure systems 13.05 Services private water pressure systems

Level 1	Level 2	Level 3	Level 4
	Plumbing Fixtures and Appliances 14.01 Installs fixture supports 14.02 Installs plumbing fixtures and appliances 14.03 Tests plumbing fixtures and appliances 14.04 Services plumbing fixtures and appliances		
			Water Treatment Systems* 15.01 Sizes water treatment systems 15.02 Installs water treatment systems 15.03 Tests water treatment systems 15.04 Services water treatment systems
Task 16 – Not Common Core			
	Piping and Components for Hydronic Systems 17.01 Plans layout and sizes piping and components for hydronic systems 17.02 Installs piping and components for hydronic systems 17.03 Tests hydronic systems 17.04 Services hydronic systems	**Piping and Components for Hydronic Systems** 17.01 Plans layout and sizes piping and components for hydronic systems 17.02 Installs piping and components for hydronic systems 17.03 Tests hydronic systems 17.04 Services hydronic systems	

Level 1	Level 2	Level 3	Level 4
	Hydronic Heating and Cooling Equipment 18.01 Installs hydronic heating equipment 18.02 Installs hydronic cooling equipment 18.03 Tests hydronic heating and cooling equipment 18.04 Services hydronic heating and cooling equipment	**Hydronic Heating and Cooling Equipment** 18.01 Installs hydronic heating equipment 18.02 Installs hydronic cooling equipment 18.03 Tests hydronic heating and cooling equipment 18.04 Services hydronic heating and cooling equipment	
			Process Piping** 19.01 Plans layout and sizes piping and components for process piping systems 19.02 Installs piping for process piping systems 19.03 Installs components for process piping systems 19.04 Tests process piping systems 19.05 Services process piping systems
Task 20 – Not Common Core			

Level 1	Level 2	Level 3	Level 4
		Other Specialized Systems 21.01 Plans layout and sizes piping, components and equipment for other specialized systems 21.02 Installs piping and components for other specialized systems 21.03 Installs equipment for other specialized systems 21.04 Tests other specialized systems 21.05 Services other specialized systems	**Other Specialized Systems** 21.01 Plans layout and sizes piping, components and equipment for other specialized systems 21.02 Installs piping and components for other specialized systems 21.03 Installs equipment for other specialized systems 21.04 Tests other specialized systems 21.05 Services other specialized systems

* While formal delivery of training for **Water Treatment Systems** may occur in Level 4, an introduction to the concepts and importance of **Water Treatment Systems**, especially in rural and remote communities, may be covered in conjunction with delivery of other topics and on the job.

** Additional credentials such as gas licensing, fire protection (NCC) and other credentials are considered to **meet and exceed** the topics sequenced in this document.

NOTE - Trade related Math, Science and Electrical Theory/Safety are integral to the Plumber trade. While not a specific occupational training topic in this document, training providers may include Math and Science and Electrical Theory/Safety training as required to perform activities outlined in the RSOS. Components in the RSOS that may inform such training are knowledge and skill elements and range of variables.

Major Work Activity A
Performs common occupational skills

Task A-1 Performs safety-related functions

Task Descriptor

Safety is integral to every aspect of the plumber trade. Plumbers maintain a safe work environment to prevent and correct any potential or immediate hazards, address an incident or accident, and follow up to ensure the safety and wellness of every person on the work site. Additional site-specific safety practices and procedures may be required. The use and maintenance of personal protective equipment (PPE) and safety equipment are essential to every job. It is also very important to be proficient in the use of safety documentation. Lock-out of equipment and piping is important before working on systems to prevent negative impacts on the environment, spills, property damage, personal injury, and fatalities. Each plumber is responsible for their own lock-out and tag-out (LOTO) equipment. Canada has aligned the Workplace Hazardous Materials Information System (WHMIS) with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). For the purpose of this document this will be indicated as WHMIS (GHS).

A-1.01 Maintains safe work environment

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-1.01.01P	participate in toolbox meetings	documentation of participation and understanding in meetings is signed off
A-1.01.02P	plan job hazard analysis (JHA) before performing each task	pre-hazard assessment plan is in place and task is completed without incident
A-1.01.03P	reference ***safety regulations***	***safety regulations*** are being followed by workers on site
A-1.01.04P	recognize, handle, store and document ***hazardous materials***	***hazardous materials*** are recognized, handled, stored and documented according to Workplace Hazardous Materials Information System (WHMIS (GHS)) and controlled products regulations
A-1.01.05P	locate and interpret ***WHMIS (GHS) materials***	directions on safety data sheets (SDS) are verified and followed (use of PPE and ventilation)
A-1.01.06P	recognize and report unsafe conditions and ***worksite hazards***	conditions are brought to the attention of supervisor and documented

A-1.01.07P	address or correct ***worksite hazard***	***worksite hazard*** is mitigated or eliminated, and information is documented and communicated to supervisor and Health and Safety representative immediately
A-1.01.08P	communicate hazards to co-workers and general public	hazards are communicated to co-workers and general public using various ***methods*** and they are aware of hazards
A-1.01.09P	keep workplace tidy and organized (housekeeping)	workplace is free of debris and clutter

Range of Variables

safety regulations include: lock-out and tag-out (LOTO) regulations, jurisdictional health and safety regulations, site-specific regulations, Transportation of Dangerous Goods (TDG)

hazardous materials include: thread sealant, cutting oil, glycol, solvents, compressed gas cylinders, additives

WHMIS (GHS) materials are: SDS, labels

worksite hazards include: poor housekeeping, overhead hazards, tripping hazards, trenching and shoring hazards, electrical hazards, confined space hazards, hot work hazards, silica and asbestos hazards, noise hazards, environmental hazards, vibration hazards, air quality hazards, falling hazards

methods include: verbally, safety meetings, sirens, air horns, radios, warning lights, flagging off the area, putting up signage, digital

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-1.01.01L	demonstrate knowledge of safe work practices and procedures	identify ***work site hazards*** and describe safe work practices and procedures
		describe components of ***professional conduct***
		identify environmentally friendly products that promote a healthy work site
A-1.01.02L	demonstrate knowledge of regulatory requirements pertaining to workplace safety	describe federal, jurisdictional and local ***safety regulations***
		describe federal, jurisdictional and local regulations and practices related to safe disposal of hazardous products
		describe company or jurisdictional procedures for emergency response
		identify responsibilities regarding site-specific safety policies and procedures
A-1.01.03L	demonstrate knowledge of emerging technologies and practices pertaining to safe work practices	identify jurisdictional mandates that contribute to net zero and carbon neutral commitments
		identify developing technologies pertaining to less toxic and environmentally friendly products

Range of Variables

worksite hazards include: poor housekeeping, overhead hazards, tripping hazards, trenching and shoring hazards, electrical hazards, confined space hazards, hot work hazards, silica and asbestos hazards, noise hazards, environmental hazards, vibration hazards, air quality hazards, falling hazards

professional conduct includes: no horseplay or roughhousing, no drug and alcohol use (either at work or prior to coming to work), no harassment, appropriate work attire

safety regulations include: lock-out and tag-out (LOTO) regulations, jurisdictional health and safety regulations, site-specific regulations, Transportation of Dangerous Goods (TDG)

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

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-1.02.01P	select ***PPE*** and ***safety equipment***	***PPE*** and ***safety equipment*** are selected according to company policies, authority having jurisdiction (AHJ) and ***application requirements***
A-1.02.02P	maintain ***PPE*** and ***safety equipment***	***PPE*** and ***safety equipment*** are maintained by cleaning and ensuring they are in safe working condition according to specifications
A-1.02.03P	identify and replace worn, damaged or defective ***PPE*** and ***safety equipment***	worn, damaged or defective ***PPE*** and ***safety equipment*** are tagged, reported to supervisor and removed from service according to specifications
A-1.02.04P	inspect ***PPE*** and ***safety equipment***	***PPE*** and ***safety equipment*** are inspected for function, expiration date and fit, deficiencies are identified, and defective equipment is tagged, reported to supervisor and removed from service
A-1.02.05P	store ***PPE*** and ***safety equipment***	***PPE*** and ***safety equipment*** are organized and stored to prevent damage
A-1.02.06P	complete ***training and certification***	***training and certification*** for use of ***PPE*** and ***safety equipment*** is completed and certifications are achieved according to AHJ, and site requirements and conditions
A-1.02.07P	inspect, connect, tie or hook fall-protection and fall-arrest equipment	connection of fall-protection and fall-arrest equipment is performed in a manner that restricts user's free fall movement

A-1.02.08P	ensure fall-protection and fall-arrest equipment is recertified	fall-protection and fall-arrest equipment is certified according to manufacturers' information, jurisdictional codes, standards and regulations
A-1.02.09P	use ***PPE*** and ***safety equipment***	***PPE*** and ***safety equipment*** is used according to manufacturers' information, company policies and procedures, and jurisdictional guidelines
A-1.02.10P	complete documentation	documentation is completed according to company policies

Range of Variables

PPE includes: respirators, steel toed boots, hardhats, safety glasses, hearing protection, gloves, face shields, face masks, protective wristlets, fire-retardant clothing, high-visibility clothing

safety equipment includes: fall-arrest systems, fire extinguishers, first aid kits, smoke and fume extractors

application requirements include: fit, specific work hazards, conditions

training and certification include: first aid, confined space, fall-arrest, aerial work platform use

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-1.02.01L	demonstrate knowledge of ***PPE*** and ***safety equipment***, and their characteristics and applications	identify types of ***PPE*** and ***safety equipment***, and describe their characteristics and applications
A-1.02.02L	demonstrate knowledge of procedures to use ***PPE*** and ***safety equipment***	describe procedures to use ***PPE*** and ***safety equipment***
		describe procedures to maintain ***PPE*** and ***safety equipment***
		identify ***hazards*** and describe safe work practices pertaining to use of ***PPE*** and ***safety equipment***
A-1.02.03L	demonstrate knowledge of training and certification requirements for ***PPE*** and ***safety equipment***	identify training required by jurisdictional codes, standards and regulations, and site-specific regulations
A-1.02.04L	demonstrate knowledge of regulatory requirements pertaining to use of ***PPE*** and ***safety equipment***	identify regulations and safety documentation pertaining to use of ***PPE*** and ***safety equipment***
A-1.02.05L	demonstrate knowledge of emerging technologies, procedures and practices pertaining to ***safety equipment***	identify technologies that contribute to safe work practices

Range of Variables

PPE includes: respirators, steel toed boots, hardhats, safety glasses, hearing protection, gloves, face shields, face masks, protective wristlets, fire-retardant clothing, high-visibility clothing

safety equipment includes: fall-arrest systems, fire extinguishers, first aid kits, smoke and fume extractors

hazards include: poor housekeeping, overhead hazards, tripping hazards, trenching and shoring hazards, electrical hazards, confined space hazards, hot work hazards, silica and asbestos hazards, noise hazards, environmental hazards, vibration hazards, air quality hazards, falling ***application***

A-1.03 Performs lock-out and tag-out (LOTO) procedures

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-1.03.01P	determine LOTO requirements for ***system components***	LOTO requirements for ***system components*** are determined according to local AHJ, site requirements and conditions, and company policies and procedures
A-1.03.02P	obtain and install designated ***LOTO equipment***	***LOTO equipment*** is installed in required location according to documentation from owner's representative
A-1.03.03P	complete ***documentation***	***documentation*** for LOTO is signed off by installing personnel according to company policies and procedures
A-1.03.04P	apply ***isolation methods***	isolation methods are applied to system being locked out and system is at a zero-energy state
A-1.03.05P	remove lock-out equipment	lock-out equipment is removed according to ***procedural guidelines***
A-1.03.06P	apply reinstatement methods and procedures	reinstatement methods and procedures are applied to system being re-energized to a full energy state

Range of Variables

system components include: pumps, valves, electrical panels, HVAC systems

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

documentation includes: LOTO permits, tool box meeting reports, sign-in and sign-out sheets

isolation methods include: double-block-and-bleed, blinding, breaker locks, opening low point valves, checking gauges and switches, inspecting sight glasses

procedural guidelines include: tag-in and tag-out, sign-in and sign-out, company-specific policies

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-1.03.01L	demonstrate knowledge of ***LOTO equipment***, and their characteristics and applications	identify ***LOTO equipment***, and describe their characteristics and applications
		identify types of documentation related to company LOTO policies and procedures
A-1.03.02L	demonstrate knowledge of ***LOTO equipment***	identify tools and equipment used to LOTO, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to use of ***LOTO equipment***
		describe procedures to LOTO piping systems
		describe ***isolation methods***
		identify situations and ***system components*** that require lock-out
A-1.03.03L	demonstrate knowledge of training and certification requirements to LOTO	identify training and certification requirements to LOTO
A-1.03.04L	demonstrate knowledge of regulatory requirements pertaining to LOTO	identify safety regulations pertaining to locking out ***system components***
		identify codes, standards and regulations pertaining to LOTO
A-1.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***LOTO equipment*** and procedures	identify emerging technologies that enhance ***LOTO equipment*** and procedures

Range of Variables

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

hazards include: electrocution, chemical burns, crushing, pinching, sudden release of energy

isolation methods include: double-block-and-bleed, blinding, breaker locks, opening low point valves, checking gauges and switches, inspecting sight glasses

system components include: pumps, valves, electrical panels, HVAC systems

Task A-2 Uses and maintains tools and equipment

Task Descriptor

Tools and equipment should be used in a safe manner and for the purpose that they are intended. All tools and equipment must be used, monitored, maintained and stored according to safe work practices and procedures to complete all tasks of the trade, and to prevent injuries and damage to materials and property. Plumbers are expected to keep tools and equipment organized and in good working order so that work can be done efficiently and without down time due to tool and equipment failure.

A-2.01 Uses common tools and equipment

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.01.01P	maintain tools and equipment	tools and equipment are maintained according to specifications, and safety practices and procedures
A-2.01.02P	perform visual inspection	***deficiencies or defects*** are identified according to visual inspection before using tools and equipment
A-2.01.03P	remove worn, damaged or defective tools and equipment	worn, damaged or defective tools and equipment are tagged using ***identification markings***, reported to supervisor and removed from service
A-2.01.04P	organize tools and equipment	tools and equipment are organized and stored according to specifications and company policies and procedures to prevent damage
A-2.01.05P	follow scheduled servicing procedures for tools and equipment	scheduled servicing procedures documentation is completed for maintenance of tools and equipment
A-2.01.06P	select tools and equipment	tools and equipment are selected according to application and materials
A-2.01.07P	set up tools and equipment	tools and equipment are set up according to applications and safe work practices
A-2.01.08P	protect equipment and flammable materials while operating equipment	flammable materials are protected or removed from vicinity of work and equipment is protected

Range of Variables

deficiencies or defects include: worn, bent, broken, damaged and inoperable tools
identification markings include: tape, colour codes, markings, tags

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.01.01L	demonstrate knowledge of tools and equipment, their applications, maintenance and procedures for use	identify ***hazards*** and describe safe work practices pertaining to use of tools and equipment
		identify types of hand tools, and describe their procedures for use
		identify types of power tools, and describe their procedures for use
		identify types of measuring tools and equipment, and describe their procedures for use
		identify types of powder-actuated tools, and describe their applications
		identify types of pipe cutting and joining equipment, and describe their procedures for use
		identify types of ***oxy-fuel equipment*** and describe their procedures for use
		identify oxy-fuel gauges, torches and tips, and describe their procedures for use
		identify flammable materials related to ***oxy-fuel equipment***
A-2.01.02L	demonstrate knowledge of procedures to inspect, maintain and store tools and equipment	describe procedures to inspect, maintain and store tools and equipment
A-2.01.03L	demonstrate knowledge of training and certification requirements pertaining to use of tools and equipment	identify training and certification required by AHJ and manufacturer pertaining to use of tools and equipment
A-2.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to use of tools and equipment	identify technologies that contribute to efficient use of tools and equipment

Range of Variables

hazards include: electrocution, cuts, pinches, burns, debris, embedded objects, projectiles, slip and fall, fumes, kickback

oxy-fuel equipment includes: flashback arrestors, regulators, hoses, strikers, tanks, torch tips and handles

A-2.02 Uses access equipment

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.02.01P	select ***ladders***	***ladders*** are selected according to application requirements
A-2.02.02P	select ***work platforms***	***work platforms*** are selected according to application requirements
A-2.02.03P	perform visual inspection of ***ladders, work platforms*** and ***motorized aerial work platforms***	visual inspection of ***ladders, work platforms*** and ***motorized aerial work platforms*** is completed prior to and during use, and safety documentation is completed
A-2.02.04P	secure ***ladders***, ***work platforms*** and ***motorized aerial work platforms***	***ladders***, ***work platforms*** and ***motorized aerial work platforms*** are secured according to safety codes, jurisdictional guidelines and site-specific requirements
A-2.02.05P	identify, tag and remove worn, damaged or defective ***ladders***, ***work platforms*** and ***motorized aerial work platforms***	***ladders***, ***work platforms*** and ***motorized aerial work platforms*** are tagged, reported to supervisor and removed from service
A-2.02.06P	store ***ladders***, ***work platforms*** and ***motorized aerial work platforms***	***ladders***, ***work platforms*** and ***motorized aerial work platforms*** are organized and stored to prevent damage
A-2.02.07P	verify certification dates for ***ladders***, ***work platforms*** and ***motorized aerial work platforms***	***ladders***, ***work platforms*** and ***motorized aerial work platforms*** certifications are current according to documentation
A-2.02.08P	obtain ***motorized aerial work platform*** training	***motorized aerial work platform*** training is completed according to company policy and jurisdictional regulations

Range of Variables

ladders include: stepladders, extension ladders, platform ladders
work platforms include: scaffolding, tube and clamp
motorized aerial work platforms include: scissor lift, articulated boom, personnel basket

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.02.01L	demonstrate knowledge of ***ladders***, ***work platforms*** and ***motorized aerial work platforms***, their characteristics, applications and limitations	identify types of ***ladders***, and describe their characteristics, applications and limitations
		identify types of ***work platforms***, and describe their characteristics, applications and limitations
		identify types of ***motorized aerial work platforms***, and describe their characteristics, applications and limitations
A-2.02.02L	demonstrate knowledge of procedures to use access equipment	describe procedures to erect and dismantle ***ladders, work platforms*** and ***motorized aerial work platforms***
		identify ***hazards*** and describe safe work practices pertaining to ***ladders, work platforms*** and ***motorized aerial work platforms***
A-2.02.03L	demonstrate knowledge of training and certification requirements to use access equipment	identify access equipment training and certification requirements
A-2.02.04L	demonstrate knowledge of regulatory requirements to use access equipment	identify ***jurisdictional regulations and site-specific requirements*** pertaining to access equipment
A-2.02.05L	demonstrate knowledge of emerging technologies pertaining to access equipment	identify emerging technologies that contribute to work efficiency

Range of Variables

ladders include: stepladders, extension ladders, platform ladders

work platforms include: scaffolding, tube and clamp

motorized aerial work platforms include: scissor lift, articulated boom, personnel basket

hazards include: pinch points, slip and fall, falling objects, lack of supervision, missing safety accessories, tipping, excessive load, electrocution or shock, uneven surfaces

jurisdictional regulations and site-specific requirements include: personnel training/certification, equipment certification requirements, proper use and limitations of equipment

A-2.03 Uses rigging, hoisting, lifting and positioning equipment

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.03.01P	plans lift	lift plan strategy and ***procedures to communicate*** are implemented according to job requirements and site conditions
A-2.03.02P	identify new and existing ***hazards*** and ***elements***	***hazards*** and ***elements*** are identified and recorded, and hazard assessment forms are completed according to AHJ, and company policies and procedures
A-2.03.03P	verify ***rigging, hoisting, lifting and positioning equipment*** is suitable for ***load requirements***	***rigging, hoisting, lifting and positioning equipment*** is verified according to AHJ and safe work policies and procedures to meet working load limit (WLL) requirements
A-2.03.04P	inspect ***rigging, hoisting, lifting and positioning equipment***	***rigging, hoisting, lifting and positioning equipment*** is inspected physically and visually for ***equipment faults***
A-2.03.05P	assess, report, tag and remove damaged ***rigging, hoisting, lifting and positioning equipment*** from service	damaged ***rigging, hoisting, lifting and positioning equipment*** is tagged, reported, and removed from service
A-2.03.06P	communicate lift plan to others	all personnel are advised of lift plan
A-2.03.07P	restrict access to lift area and path of travel	access to lift area and path of travel are restricted using barricades, signage and barrier tape
A-2.03.08P	select and attach ***rigging, hoisting, lifting and positioning equipment***	***rigging, hoisting, lifting and positioning equipment*** is selected according to lift plan
A-2.03.09P	inspect ***knots, hitches and bends***	***knots, hitches and bends*** are visually inspected
A-2.03.10P	place load and secure in location	various ***methods for securing load*** without damage to personnel and property are used according to lift plan
A-2.03.11P	clean and lubricate ***rigging, hoisting, lifting and positioning equipment***	***rigging, hoisting, lifting and positioning equipment*** is cleaned, lubricated and maintained according to specifications

Range of Variables

procedures to communicate include: electronic communications (audible), hand signals (visual)

hazards include: blind spots, overhead piping, live equipment, power lines, site-specific hazards, shock loading, equipment fatigue, uneven surfaces

elements include: weather, temperature

rigging, hoisting, lifting and positioning equipment includes: block and tackle, chain block, come-along, snatch blocks, tugger (power), winch, forklift, grip hoist, wire rope, shackles, slings, softeners, rope, rollers, chain falls, jacks, cable grip hoists, cranes

load requirements include: WLL, final location of load

equipment faults include: rips, tears, cracks, bird-caging, frayed wire rope, frayed synthetic slings, worn shackles, hydraulic oil leaks, missing rating tags, non-CSA approved equipment

knots, hitches and bends include: bowline, cat's paw, clove hitch, half-hitch

methods for securing load include: bolting, lashing, site-specific methods

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.03.01L	demonstrate knowledge of ***rigging, hoisting, lifting and positioning equipment***, their characteristics, applications and limitations	identify types of ***rigging, hoisting, lifting and positioning equipment***, and their accessories, and describe their applications and load capacity
		identify types of equipment used to secure lift area
		identify types of ***knots, hitches and bends***, and describe their characteristics and applications
		identify ***factors*** to consider when selecting ***rigging, hoisting, lifting and positioning equipment***
A-2.03.02L	demonstrate knowledge of calculations required when performing hoisting, lifting and positioning operations	explain how to calculate load weight
		explain ***sling angles*** when preparing for hoisting and lifting operation
		explain correlation of ***sling angles*** to sling capacities
		identify equipment derating criteria based on specifications and load demands
A-2.03.03L	demonstrate knowledge of inspection, maintenance and storage procedures for ***rigging, hoisting, lifting and positioning equipment***	identify ***hazards*** and describe safe work practices pertaining to rigging, hoisting, lifting and positioning
		describe procedures to inspect, maintain and store ***rigging, hoisting, lifting and positioning equipment***
		describe procedures for inspecting ***knots, hitches and bends***

A-2.03.04L	demonstrate knowledge of procedures to use ***rigging, hoisting, lifting and positioning equipment***	identify tools and equipment used for ***rigging, hoisting, lifting and positioning equipment***, and describe their procedures for use
		identify ***hazards***, and describe safe work policies and procedures pertaining to hoisting, lifting, rigging and positioning
		describe ***procedures to ensure work area*** is safe for rigging, hoisting, lifting and positioning
		describe ***procedures to communicate*** during rigging, hoisting, lifting and positioning operations
		identify elements in lift plan, and describe requirements and procedures used for attaching rigging equipment to load
		describe procedures to rig material and equipment for lifting, hoisting and positioning
		describe procedures to tie ***knots, hitches and bends***
A-2.03.05L	demonstrate knowledge of training and certification requirements for ***rigging, hoisting, lifting and positioning equipment***	identify training and certification requirements for ***rigging, hoisting, lifting and positioning equipment***
A-2.03.06L	demonstrate knowledge of regulatory requirements to use ***rigging, hoisting, lifting and positioning equipment***	identify codes, standards and regulations to use ***rigging, hoisting, lifting and positioning equipment***

Range of Variables

rigging, hoisting, lifting and positioning equipment includes: block and tackle, chain block, come-along, snatch blocks, tugger (power), winch, forklift, grip hoist, wire rope, shackles, slings, softeners, rope, rollers, chain falls, jacks, cable grip hoists, cranes

knots, hitches and bends include: bowline, cat's paw, clove hitch, half-hitch

factors include: load characteristics, rigging inspection, work environment, safety factors, sling angles

sling angles include: 45°, 60°

hazards include: blind spots, overhead piping, live equipment, power lines, site-specific hazards, shock loading, equipment fatigue, uneven surfaces

procedures to ensure a safe work area include: supervision of lift, securing work area, communication

procedures to communicate include: electronic communications (audible), hand signals (visual)

A-2.04 Rigs loads for cranes

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.04.01P	plans lift	lift plan strategy and ***procedures to communicate*** are implemented according to job requirements and site conditions
A-2.04.02P	identify new and existing ***hazards*** and ***elements***	***hazards*** and ***elements*** are identified and recorded, and hazard assessment forms are completed according to AHJ, and company policies and procedures
A-2.04.03P	assist to determine ***load requirements*** for lift	***load requirements*** are determined and rigging, hoisting, lifting and positioning equipment is verified to ensure a safe lift
A-2.04.04P	perform physical and visual inspection	***rigging, hoisting, lifting and positioning equipment*** is inspected physically and visually, and ***faults*** are detected and documented
A-2.04.05P	inspect line for ***knots, hitches and bends***	lines are inspected and are removed from service when ***knots, hitches and bends*** are faulty
A-2.04.06P	communicate lift plan to personnel	personnel are advised of lift plan
A-2.04.07P	identify swing radius and potential obstructions and ***hazards***	equipment is positioned to clear obstructions and ***hazards***
A-2.04.08P	restrict access to lift area and path of travel	access to lift area and path of travel are restricted using barricades, signage and barrier tape
A-2.04.09P	assist in inspection of ***rigging, hoisting, lifting and positioning equipment***	***rigging, hoisting, lifting and positioning equipment*** is visually and physically inspected according to safe work practices
A-2.04.10P	tie ***knots***, ***hitches and bends***	***knots, hitches and bends*** are tied and visually inspected
A-2.04.11P	use tag line to orientate and stabilize lift	tag line is secured to load and load is under control at all times
A-2.04.12P	transfer load to ***other rigging equipment*** for final placement of load as required	***method of securing load*** to transfer without damage to material, equipment or personnel is used
A-2.04.13P	place load and secure in location	load is placed and secured using various methods according to job requirements

Range of Variables

procedures to communicate include: electronic communications, signaler, horns, sirens (audible), hand signals (visual)

hazards include: blind spots, power lines, overhead piping, live equipment, site-specific hazards, weather, shock-loading

elements include: weather, temperature

load requirements include: WLL, final location of load

rigging, hoisting, lifting and positioning equipment includes: wire rope, shackles, slings, softeners, tag lines, spreader bars, chokers, boom trucks, overhead cranes, telescopic forklifts, mobile cranes, tower cranes

faults include: rips, tears, cracks, bird-caging, frayed wire rope, frayed slings, worn shackles, hydraulic oil leaks, missing rating tags

knots, ***hitches and bends*** include: bowline, cat's paw, clove hitch, half-hitch

other rigging equipment includes: boom truck, mobile crane, forklift, tower crane

methods for securing load include: bolting, lashing, site-specific methods

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.04.01L	demonstrate knowledge of ***rigging, hoisting, lifting and positioning equipment***, their characteristics, applications and limitations	identify types of ***rigging, hoisting, lifting and positioning equipment*** and accessories, and describe their characteristics, applications and limitations
		identify types of ***knots, hitches and bends***, and describe their characteristics and applications
A-2.04.02L	demonstrate knowledge of procedures to rig loads using ***rigging, hoisting, lifting and positioning equipment***	identify tools and equipment used to rig loads using ***rigging, hoisting, lifting and positioning equipment***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to rigging, hoisting, lifting and positioning
		describe procedures to use ***rigging, hoisting, lifting and positioning equipment***
		describe ***procedures to ensure a safe work area*** for rigging, hoisting, lifting and positioning
		describe methods used for attaching rigging equipment to load
		describe procedures to rig material and equipment for lifting, hoisting and positioning
		describe ***procedures to communicate*** during rigging, hoisting, lifting and positioning operations
		describe ***procedures to communicate*** during set up operations

		describe procedures to tie ***knots, hitches and bends***
A-2.04.03L	demonstrate knowledge of training and certification requirements for ***rigging, hoisting, lifting and positioning equipment***	identify training and certification requirements for ***rigging, hoisting, lifting and positioning equipment***
A-2.04.04L	demonstrate knowledge of regulatory requirements to use ***rigging, hoisting, lifting and positioning equipment***	identify codes, standards and regulations to use ***rigging, hoisting, lifting and positioning equipment***
		identify jurisdictional regulations and site requirements pertaining to rigging for cranes

Range of Variables

rigging, hoisting, lifting and positioning equipment includes: wire rope, shackles, slings, softeners, tag lines, spreader bars, chokers, boom trucks, overhead cranes, telescopic forklifts, mobile cranes, tower cranes

knots, ***hitches and bends*** include: bowline, cat's paw, clove hitch, half-hitch

hazards include: blind spots, power lines, overhead piping, live equipment, site-specific hazards, weather, shock-loading

procedures to ensure a safe work area include: supervision of lift, securing work area, communication

procedures to communicate include: electronic communications, signaler, horns, sirens (audible), hand signals (visual)

A-2.05 Uses welding equipment

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.05.01P	assist in selection of ***welding equipment***	***welding equipment*** is selected according to application and materials
A-2.05.02P	handle ***welding consumables***	handling of ***welding consumables*** is performed according to quality control requirements
A-2.05.03P	assist in matching alloys to specific components to be welded	alloy selected matches specifications
A-2.05.04P	assist in setting up ***welding equipment***	***welding equipment*** is set up according to application
A-2.05.05P	protect surrounding equipment and flammable materials while welding	flammable materials are protected or removed from vicinity of welding work, and equipment is protected
A-2.05.06P	assist in performing tack welding	tack welds are performed within jurisdictional limitations

A-2.05.07P	assist in performing visual inspections to maintain welding equipment	all defects in welding equipment are identified
A-2.05.08P	assist in identifying, tagging and replacing worn, damaged or defective welding equipment	worn, damaged or defective welding equipment is identified, tagged, reported to supervisor and replaced, and is in safe and operable condition
A-2.05.09P	ensure work area location is disarmed within ***safety monitoring system***	work area location is disarmed by building operator and ***safety monitoring system*** procedures are followed according to building policy

Range of Variables

welding equipment includes: Shielded Metal Arc Welding (SMAW) equipment, Gas Tungsten Arc Welding (GTAW) equipment, Gas Metal Arc Welding (GMAW) equipment, heat fusion welding equipment, plasma welding equipment, laser welding equipment

welding consumables include: welding rods, flux, grinding discs, shielding gases

safety monitoring system includes: a system that assists locating fire, smoke and health hazards in a building and alerting first responders

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.05.01L	demonstrate knowledge of ***welding equipment***, their characteristics and applications	identify types of ***welding equipment***, and describe their characteristics and applications
		identify different ***welding processes*** and their applications
		identify ***welding consumables***, and describe their characteristics and applications
		identify materials that can be reconditioned, reused or recycled
A-2.05.02L	demonstrate knowledge of procedures to perform non-pressure and non-structural welds	identify ***welding equipment*** used to perform non-pressure and non-structural welds, and describe their procedures for use
		identify ***hazards***, and describe safety practices pertaining to welding
		describe procedures to perform non-pressure and non-structural welds
		describe procedures to inspect, maintain and store ***welding equipment*** and ***welding consumables***
		describe energy-saving equipment

A-2.05.03L	demonstrate knowledge of training and certification requirements to use ***welding equipment***	identify training and certification requirements to use ***welding equipment***
A-2.05.04L	demonstrate knowledge of regulatory requirements to use ***welding equipment***	identify codes, standards, and regulations to use ***welding equipment***
A-2.05.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***welding equipment***	identify emerging technologies such as laser welding

Range of Variables

welding equipment includes: Shielded Metal Arc Welding (SMAW) equipment, Gas Tungsten Arc Welding (GTAW) equipment, Gas Metal Arc Welding (GMAW) equipment, heat fusion welding equipment, plasma welding equipment, laser welding equipment

welding processes include: SMAW, GTAW, GMAW, laser welding

welding consumables include: welding rods, flux, grinding discs, shielding gases

hazards include: electrocution, fumes, sparks, flash, burns

A-2.06 Uses soldering and brazing equipment

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-2.06.01P	select ***soldering and brazing equipment***	***soldering and brazing equipment*** is selected according to application and materials
A-2.06.02P	set up ***soldering and brazing equipment***	***soldering and brazing equipment*** is set up according to application
A-2.06.03P	match alloys to specific components to be soldered or brazed	alloy selected matches specifications
A-2.06.04P	select flux and solder	flux and solder are selected according to application and codes, and meets requirements of weld procedures and quality control
A-2.06.05P	join piping fittings and components	piping fittings and components are joined according to procedures for brazed or soldered materials
A-2.06.06P	purge and flush piping and tubing	piping and tubing are purged and flushed ensuring system remains a closed system to prevent contamination
A-2.06.07P	protect equipment and flammable materials while soldering and brazing	flammable materials are protected or removed from vicinity of soldering and brazing work, and equipment is protected
A-2.06.08P	maintain ***soldering and brazing equipment***	***soldering and brazing equipment*** is maintained according to specifications, and is in safe and operable condition

A-2.06.09P	identify, tag and replace worn, damaged or defective ***soldering and brazing equipment***	worn, damaged or defective ***soldering and brazing equipment*** is identified, tagged, reported to supervisor and replaced
A-2.06.10P	store ***soldering and brazing equipment*** and ***consumables***	***soldering and brazing equipment*** and ***consumables*** are organized and stored to prevent damage and according to specifications
A-2.06.11P	ensure work area location is disarmed within ***safety monitoring system***	work area location is disarmed by building operator and ***safety monitoring system*** procedures are followed according to building policy

Range of Variables

soldering and brazing equipment includes: oxy-fuel and air-fuel torches, attachments (strikers, methylacetylene-propadiene propane [MAPP] gas cylinders, torch heads)

soldering and brazing consumables include: silver solder, flux, soft solder, brazing rod, sand cloth, gases (nitrogen, carbon dioxide, oxygen, acetylene, MAPP, propane, argon)

safety monitoring system includes: a system that assists locating fire, smoke and heat hazards in a building and alerting first responders

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-2.06.01L	demonstrate knowledge of ***soldering and brazing equipment***, their characteristics and applications	identify types of ***soldering and brazing equipment***, and describe their characteristics and applications
		identify different soldering and brazing processes, and describe their characteristics and applications
		identify ***flush and purge procedures*** required for soldering and brazing
		identify ***soldering and brazing consumables***
		identify fittings and piping that can be reused
A-2.06.02L	demonstrate knowledge of disarming work area location within ***safety monitoring system***	describe procedure to isolate specific area of ***safety monitoring system***
A-2.06.03L	demonstrate knowledge of soldering and brazing procedures	identify ***soldering and brazing equipment*** used for soldering and brazing, and describe their procedures for use
		identify ***hazards***, and describe safety procedures pertaining to soldering and brazing
		describe soldering and brazing procedures
		describe procedures to inspect, maintain and store soldering and brazing equipment

A-2.06.04L	demonstrate knowledge of training and certification requirements for soldering and brazing	identify training and certification requirements for soldering and brazing
A-2.06.05L	demonstrate knowledge of regulatory requirements for soldering and brazing	identify codes, standards and regulations for soldering and brazing
A-2.06.06L	demonstrate knowledge of lead-reduction practices pertaining to soldering and brazing	identify technologies that contribute to lead-reduction

Range of Variables

soldering and brazing equipment includes: oxy-fuel and air-fuel torches, attachments (strikers, methylacetylene-propadiene propane [MAPP] gas cylinders, torch heads)

flush and purge procedures include: valve isolation, monitoring pressures, monitoring flow rates

soldering and brazing consumables include: silver solder, flux, soft solder, brazing rod, sand cloth, gases (nitrogen, carbon dioxide, oxygen, acetylene, MAPP, propane, argon)

safety monitoring system includes: a system that assists locating fire, smoke and heat hazards in a building and alerting first responders

hazards include: fumes, sparks, flash, burns, cuts, fire

Task A-3 Organizes work

Task Descriptor

Plumbers participate in organizing jobs, planning the work, generating material lists and managing their time to meet project deadlines. They ensure the plumbing systems are assembled correctly, through quality control practices, by following regulations and specifications. Plumbers use drawings and specifications to determine scope of work, and materials and methods to be used for specific installations. Drawings are also used to communicate detailed construction information such as dimensions, materials used, joining methods and templates, which are used in the layout and fabrication of piping systems.

It is very important for plumbers to develop a strong understanding of costing, work efficiencies, safe work practices and procedures, regulations and codes.

A-3.01 Organizes project tasks and procedures

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-3.01.01P	identify task and sequence of tasks	task planning is done by completing construction sequence according to schedule
A-3.01.02P	identify tools, piping, equipment and materials required for task	required tools, piping, equipment and materials are identified according to application

A-3.01.03P	estimate time and labour requirements to complete tasks	productivity and progress reports reflect estimates
A-3.01.04P	coordinate schedule and work with other trades	work practices are tracked in progress reports and work schedules
A-3.01.05P	verify that required permits are in place before commencing work	required documentation is filed according to task requirements and AHJ
A-3.01.06P	adapt to changing ***environmental conditions***	accommodate for unexpected ***environmental conditions***
A-3.01.07P	organize ***work area requirements***	***work area requirements*** are met, and work practices are tracked in productivity reports and work schedule
A-3.01.08P	perform ***hazard*** assessments	***hazard*** assessments are completed according to safe work practices and procedures
A-3.01.09P	coordinate for all necessary tools, piping, equipment, materials and spool pieces to be at installation location when needed	all necessary tools, piping, equipment, materials and spool pieces are at installation location when needed

Range of Variables

environmental conditions include: site-specific, weather, air quality, asbestos abatement, flooding

work area requirements include: installing temporary shelters, platforms, heaters, waste disposal, lunch rooms, specific site safety requirements

hazards include: asbestos, trip hazards, overhead hazards, other trade activities, electrical hazards, silica dust

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-3.01.01L	demonstrate knowledge of procedures to plan and organize work	identify ***sources of information*** relevant to work planning
		describe ***considerations*** for determining job requirements
		describe ***planning procedures***
		describe procedures to organize and maintain inventory
		describe Leadership in Energy and Environmental Design (LEED) procedures
A-3.01.02L	demonstrate knowledge of project costs and efficient trade practices	calculate labour and time costs
		calculate material costs and wastage
		identify work methods and planning to maximize most efficient practices while maintaining commitment to safety

A-3.01.03L	demonstrate knowledge of job-specific technology	identify digital devices to plan and organize tasks and schedules
		describe procedures for using digital devices to plan and organize tasks and schedules
		identify technologies including software and modelling practices pertaining to material and labour savings

Range of Variables

sources of information include: documentation, drawings, related professionals, clients, Internet
considerations include: safety, site layout, crane requirements, excavation, access
planning procedures include: scheduling, estimating, job costing

A-3.02 Organizes materials and supplies

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-3.02.01P	estimate material and supplies required	materials and supplies for the task are estimated according to drawings and specifications, and are in place to prevent cost overruns and to enable smooth operation of project
A-3.02.02P	select and order material and equipment for task	material and equipment for task is selected and ordered according to specifications and site requirements
A-3.02.03P	schedule use of material and supplies throughout project	use of material and supplies is scheduled, and sufficient materials and supplies are available
A-3.02.04P	organize and store materials and supplies	materials and supplies are organized and stored to prevent theft and damage, and to ensure availability

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-3.02.01L	demonstrate knowledge of procedures to organize and maintain materials and supplies	identify sources of information relevant to organizing materials and supplies
		describe ***considerations*** for determining material and supply requirements
		describe procedures to organize and maintain inventory
		describe LEED procedures
A-3.02.02L	demonstrate knowledge of job-specific technology	identify technologies including software and modelling practices pertaining to material savings

Range of Variables

considerations include: plans, specifications, drawings, environment, codes, AHJ

A-3.03 Uses documentation

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-3.03.01P	interpret ***technical documents***	***technical documents*** are interpreted to determine tasks to be performed
A-3.03.02P	use ***documentation***	***documentation*** is used according to task, company policies and procedures
A-3.03.03P	interpret symbols, dimensions and specifications	symbols, dimensions and specifications are interpreted
A-3.03.04P	perform metric/imperial conversions	metric/imperial conversions are performed
A-3.03.05P	measure dimensions	dimensions are measured according to ***technical documents***
A-3.03.06P	sketch modifications of repairs and ***installations***	modifications of repairs and ***installations*** are sketched according to specifications
A-3.03.07P	document work	work is documented according to company policies and procedures
A-3.03.08P	document alterations	alterations are documented by modifying plans, schematics and drawings to reflect changes and additions made to original design

A-3.03.09P	communicate status of task and LOTO to personnel	status of task and LOTO are communicated to personnel according to facility policies
A-3.03.10P	compile maintenance manuals from installed equipment specifications	product data sheets for installed equipment are included in maintenance manuals
A-3.03.11P	submit final documentation, including revisions to facility manager	final documentation including revisions are submitted to facility manager according to specifications

Range of Variables

technical documents include: AFC, as-built, schematics, diagrams, flow charts, specifications

documentation includes: work orders, estimating guides, service or repair guides, meeting records, specifications, as-built drawings (civil/site, architectural, mechanical, structural, shop, electrical, single line), sketches, logic diagram

installations include: piping systems, fixtures, equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-3.03.01L	demonstrate knowledge of ***documentation***, its purpose, application and use	describe and identify types of ***documentation*** developed from tasks
		describe procedures for finalizing ***documentation***
		identify materials that can be reconditioned, reused or recycled
A-3.03.02L	demonstrate knowledge of ***technical documents*** and ***documentation***, their characteristics and applications	identify terminology associated with ***technical documents*** and ***documentation***
		identify types of ***technical documents*** and ***documentation***, and describe their characteristics and applications
		identify common mechanical and electrical symbols
		describe metric/imperial systems and conversions
A-3.03.03L	demonstrate knowledge of procedures to use and interpret ***technical documents*** and ***documentation***	describe procedures to use and interpret ***technical documents*** and ***documentation***

Range of Variables

documentation includes: work orders, estimating guides, service or repair guides, meeting records, specifications, as-built drawings (civil/site, architectural, mechanical, structural, shop, electrical, single line), sketches, logic diagram

technical documents include: AFC, as-built, schematics, diagrams, flow charts, specifications

Task A-4 Performs routine trade activities

Task Descriptor

Routine trade activities are performed on a regular basis. These activities include performing piping system layout and related calculations, installing piping supports and sleeves, protecting piping systems, coordinating excavation and commissioning systems. Additional training and certification may be required, for example testing of cross connection devices.

A-4.01 Plans layout for piping systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.01.01P	lay out final position of ***fixtures***, ***appliances***, pipe and ***pipe fittings***	final positions of ***fixtures***, ***appliances***, pipe and ***pipe fittings*** are laid out according to drawings, codes, ***specifications***, AHJ and site conditions
A-4.01.02P	select and use ***tools and equipment***	required ***tools and equipment*** are selected and used according to type of ***piping material*** and used according to ***specifications***
A-4.01.03P	coordinate layout with other trades to avoid interferences with other ***systems***	final piping layout does not interfere with other ***systems***

Range of Variables

fixtures include: water closets, sinks, tub/showers, basins

appliances include: water heaters, dishwashers, water treatment equipment, disposal unit, washing machines

pipe fittings include: tees, elbows, valves, devices

specifications include: engineered drawings, manufacturers' requirements, job specifications, standards, shop drawings

tools and equipment include: levels, builders' levels, measuring tapes, lasers, marking tools, wraparound, software and modeling technologies

piping material includes: plastic, copper, steel, cast iron

systems include: ventilation, electrical, sprinkler

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.01.01L	demonstrate knowledge of various ***piping*** and ***component*** layouts and their applications	interpret blueprints, specification documentation and job site instructions
		identify ***components*** used with various ***piping*** systems, and describe their characteristics and applications
		describe requirements of various piping systems
A-4.01.02L	demonstrate knowledge of procedures to lay out piping systems	identify ***tools and equipment*** required for layout, and describe their procedures for use
		describe procedures to lay out piping systems
		identify practices that promote labour savings
A-4.01.03L	demonstrate knowledge of training and certification requirements to lay out piping systems	identify training and certification requirements to lay out piping systems
A-4.01.04L	demonstrate knowledge of regulatory requirements to lay out piping systems	identify codes, standards and regulations to lay out piping systems
A-4.01.05L	demonstrate knowledge of emerging technologies and practices pertaining to laying out piping systems	identify technologies including software and modelling practices pertaining to material and labour savings

Range of Variables

piping includes: pipe and pipe fittings

components include: appliances, fixtures and control devices

tools and equipment include: levels, builders' levels, measuring tapes, lasers, marking tools, wraparound, software and modeling technologies

A-4.02 Calculates tube, tubing and pipe lengths

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.02.01P	select and use ***tools***	***tools*** to complete tube, tubing and pipe length calculations are selected and used according to application
A-4.02.02P	calculate materials required	tube, tubing and pipe materials are calculated using appropriate ***tools***
A-4.02.03P	calculate ***cut length*** of tube, tubing and pipe	***cut length*** of tube, tubing and pipe is calculated using fitting allowances, gaps, measurements and expansion rates

Range of Variables

tools include: measuring tapes, scale rulers, calculators
cut length includes: end-to-end, centre-to-centre, centre-to-end

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.02.01L	demonstrate knowledge of tube, tubing and pipe, their characteristics and applications	identify tube, tubing and pipe, and describe their characteristics and applications
		interpret linear expansion and contraction tables in codes and ***specifications***
		describe types of ***fitting allowances*** and their applications
		identify and create materials list
		identify materials that can be reused or recycled
A-4.02.02L	demonstrate knowledge of procedures to calculate tube, tubing and pipe lengths	identify ***tools*** and equipment used to calculate tube, tubing, pipe and offsets length, and describe their procedures for use
		describe procedures to calculate ***cut length***
		describe procedures to calculate offsets
		identify practices that reduce material waste

A-4.02.03L	demonstrate knowledge of regulatory requirements pertaining to tube, tubing, pipe and offsets length	identify codes, standards and regulations pertaining to tube, tubing, pipe and offsets length
A-4.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to pipe, tube, tubing and offsets length	identify technologies including software and modelling practices pertaining to material and labour savings

Range of Variables

specifications include: engineered drawings, manufacturers' requirements, job specifications, shop drawings

fitting allowances include: face-to-centre, end-to-centre, thread engagement, insertion depth

tools include: measuring tapes, scale rulers, calculators

cut length includes: end-to-end, centre-to-centre, centre-to-end

A-4.03 Installs piping supports

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.03.01P	select hangers	hangers are selected according to ***specifications***, pipe size, contents and pipe material, and ensure adequate support and prevent damage to piping and ***structural members***
A-4.03.02P	select supports for seismic restraint	supports for seismic restraints are selected according to jurisdictional regulations and ***specifications***
A-4.03.03P	place supports and hanger systems	supports and hanger systems are placed according to codes and ***specifications***
A-4.03.04P	assemble supports and hangers	supports and hangers are assembled according to ***specifications***
A-4.03.05P	attach supports and hangers to ***structural members***	supports and hangers are attached according to ***specifications*** and codes
A-4.03.06P	select and use ***tools and equipment***	***tools and equipment*** for installing hangers and supports are selected according to application
A-4.03.07P	install ***support components***	***support components*** are installed according to ***specifications***

Range of Variables

specifications include: engineered drawings, manufacturers' requirements, job specifications, shop drawings

structural members include: concrete, wood and steel beams, joist systems

tools and equipment include: powder-actuated tools, hammer drills, chop saws

support components include: anchors, guides, threaded rods

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.03.01L	demonstrate knowledge of piping supports and hangers, their characteristics and applications	identify piping supports and hangers for various types and sizes of pipe, and describe their characteristics and applications
A-4.03.02L	demonstrate knowledge of procedures to install piping supports and hangers	identify ***tools and equipment*** used to install piping supports and hangers, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of piping supports and hangers
		describe procedures to install piping supports and hangers
		identify practices that reduce material waste
A-4.03.03L	demonstrate knowledge of training and certification requirements to install piping supports and hangers	identify training and certification requirements to install piping supports and hangers
A-4.03.04L	demonstrate knowledge of regulatory requirements to install piping supports and hangers	identify codes, standards and regulations to install piping supports and hangers
A-4.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to installing piping supports and hangers	identify technologies including software and modelling practices pertaining to material and labour savings

Range of Variables

tools and equipment include: powder-actuated tools, hammer drills, chop saws

hazards include: pinch points, cuts, lifting, elevated work, falling materials, debris, auditory and vision hazards

A-4.04 Installs piping sleeves

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.04.01P	lay out piping sleeves	piping sleeve is laid out according to measurements taken from drawings
A-4.04.02P	select piping sleeves	piping sleeves are selected according to ***specifications*** and pipe size, and provide adequate space for insulation and fire stopping
A-4.04.03P	fabricate piping sleeves	piping sleeves are fabricated from ***material*** required for application and according to ***specifications***
A-4.04.04P	select and use ***tools and equipment***	***tools and equipment*** for installing piping sleeves are selected and used according to installation
A-4.04.05P	cut hole to receive piping sleeve	hole is cut to accommodate piping sleeve size using ***piping sleeve cutting methods***
A-4.04.06P	fasten piping sleeves to ***structures***	piping sleeves are aligned and securely fastened to ***structures***
A-4.04.07P	protect piping sleeves	piping sleeves are protected from blockage and misalignment during concrete pour

Range of Variables

specifications include: engineered drawings, manufacturers' requirements, job specifications, shop drawings

material includes: plastic pipe, metal pipe, firestop sleeves, sheet metal

tools and equipment include: coring drills, tin snips, grinders, hole saws

piping sleeve cutting methods include: coring, drilling, cutting

structures include: metal decking, formwork, block wall

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.04.01L	demonstrate knowledge of piping sleeves, their characteristics and applications	identify types of materials used for piping sleeves, and describe their characteristics and applications
		identify piping sleeves for various sizes of pipe, and describe their characteristics and applications
		identify ***specifications*** for determining piping sleeves and clearances
		identify materials that can be reconditioned, reused or recycled
A-4.04.02L	demonstrate knowledge of procedures to install piping sleeves	identify ***tools and equipment*** used to install piping sleeves, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of piping sleeves
		describe procedures to install piping sleeves
		determine proper location of piping sleeves
		identify practices that reduce material waste
A-4.04.03L	demonstrate knowledge of training and certification requirements to install piping sleeves	identify training and certification requirements to install piping sleeves
A-4.04.04L	demonstrate knowledge of regulatory requirements to install piping sleeves	identify codes, standards and regulations to install piping sleeves
A-4.04.05L	demonstrate knowledge of emerging technologies and practices pertaining to installing piping sleeves	identify technologies including software and modelling practices pertaining to material and labour savings

Range of Variables

specifications include: engineered drawings, manufacturers' requirements, job specifications, shop drawings

tools and equipment include: coring drills, tin snips, grinders, hole saws

hazards include: pinch points, cuts, lifting, elevated work, falling materials, debris, auditory and vision hazards

A-4.05 Commissions systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.05.01P	flush and degrease lines and clean strainers prior to commissioning system to remove ***foreign matter***	lines are flushed, degreased and ***foreign matter*** is removed so that plumbing system is ready for commissioning
A-4.05.02P	purge air and fill system to operating levels and pressures	air is purged from system, and operating levels and pressures are set according to ***specifications***
A-4.05.03P	add ***chemicals*** for prevention of freezing and deterioration	***chemicals*** are added according to ***specifications***
A-4.05.04P	start system to verify operation	system operates safely according to ***specifications*** and system requirements
A-4.05.05P	adjust ***components*** to ensure operation of system	components are adjusted according to ***specifications***, and system and safety requirements
A-4.05.06P	clean, flush and sanitize potable water systems	potable water systems are sanitized according to ***specifications*** and before occupancy
A-4.05.07P	document and forward ***commissioning information***	***commission documents*** are completed according to specifications and AHJ, and provided to ***building authority***

Range of Variables

foreign matter includes: debris, scale

specifications include: engineered drawings, manufacturers' requirements, job specifications, as-built drawings, approved shop drawings

chemicals include: glycol, inhibitors

components include: sensors, mechanical and electrical controls

commissioning information includes: chemicals added, date of commissioning, pressure readings

commission documents include: manufacturers' instructions, engineering specifications

building authority includes***:*** building owner/occupant, engineer, architect, maintenance staff

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.05.01L	demonstrate knowledge of commissioning	identify systems and equipment that require commissioning
		describe ***sources of information*** pertaining to commissioning systems
A-4.05.02L	demonstrate knowledge of procedures to commission systems	identify ***tools and equipment*** to commission systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to commissioning
		describe ***procedures*** to commission systems
A-4.05.03L	demonstrate knowledge of training and certification requirements to commission systems	identify training and certification requirements to commission systems
A-4.05.04L	demonstrate knowledge of regulatory requirements pertaining to commissioning systems	identify codes, standards and regulations pertaining to commissioning systems

Range of Variables

sources of information include: specifications, codes, standards and regulations, operation and maintenance manuals, quality assurance and quality control documentation, as-built drawings, approved shop drawings

tools and equipment include: pumps, glycol meter, gauges, multimeters

hazards include: pressure, explosions, burns, electrocution, flying debris, silica hazards, auditory and visual hazards

procedures include: marking and labelling system components (valves, equipment, pipes), providing turnover instructions, coordinating system start-up

A-4.06 Protects piping systems, equipment and structure from damage

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.06.01P	make penetrations through building envelope	penetrations through building envelope are secured and watertight using ***materials*** according to ***specifications***
A-4.06.02P	install galvanic protection where dissimilar metals come into contact	galvanic protection is installed according to industry piping practice to prevent electrolysis where required
A-4.06.03P	install heat tracing and insulation	heat tracing and insulation materials are installed according to ***specifications*** to prevent freezing of piping contents

A-4.06.04P	install ***components*** that protect against vibration and movement	piping and equipment are protected from damage from vibration or other movement
A-4.06.05P	install expansion joints in piping systems	expansion joints are installed according to ***specifications*** to allow for thermal expansion and contraction, and settling of structures
A-4.06.06P	lay out housekeeping pads for pumps and equipment	housekeeping pads for pumps and equipment are placed according to ***specifications***
A-4.06.07P	install water hammer arrestors	water hammer arrestors are installed according to codes, AHJ and ***specifications*** to protect systems from water hammer
A-4.06.08P	protect embedded components	embedded components are protected according to ***specifications***, AHJ and site requirements
A-4.06.09P	install backwater valves	backwater valves are installed according to codes, ***specifications*** and AHJ to protect structure from backflow

Range of Variables

materials include: flashings, vent terminations, caulking, guards, link seal

specifications include: engineered drawings, manufacturers' requirements, job specifications, approved shop drawings

components include: spring hangers, isolators, flex connectors, seismic restraints

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.06.01L	demonstrate knowledge of methods used to protect piping systems, equipment and structure from damage	identify ***components***, and describe applications used to protect against vibration and movement
		identify types of potential damage
		describe dielectric fittings and applications used to prevent electrolysis
		describe heat trace and insulation, and applications used to prevent freezing of pipe contents
		describe expansion tanks and applications used to accommodate thermal expansion
		describe water hammer arrestors and applications used to prevent water hammer
		describe devices used to prevent backflow in piping systems

A-4.06.02L	demonstrate knowledge of procedures to protect piping systems, equipment and structure from damage	identify tools and equipment used to protect piping systems, equipment and structure from damage, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to protecting piping systems, equipment and structure from damage
		describe procedures to protect piping systems, equipment and structure from damage
A-4.06.03L	demonstrate knowledge of training and certification requirements to protect piping systems, equipment and structure from damage	identify training and certification requirements to protect piping systems, equipment and structure from damage
A-4.06.04L	demonstrate knowledge of regulatory requirements to protect piping systems, equipment and structure from damage	identify codes, standards and regulations to protect piping systems, equipment and structure from damage

Range of Variables

components include: spring hangers, isolators, flex connectors, seismic restraints

hazards include: pinch points, cuts, lifting, elevated work, falling materials, debris, auditory and vision hazards

A-4.07 Coordinates excavation and backfilling of trenches

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.07.01P	obtain permits	permits required by AHJ are obtained according to ***specifications*** and scope of work
A-4.07.02P	lay out and mark excavation route	excavation route is marked according to ***specifications***
A-4.07.03P	coordinate with utility companies to locate underground utilities	all utilities are located and marked to avoid ***consequences***
A-4.07.04P	determine ***excavation requirements*** and document	***excavation requirements*** are determined according to ***specifications*** and site conditions

A-4.07.05P	schedule ***equipment*** for excavation	required ***equipment*** is available for excavation
A-4.07.06P	verify backfill material	backfill materials are verified according to codes, ***specifications***, AHJ and site conditions
A-4.07.07P	supervise backfilling and compaction	backfilling and compaction procedures are completed according to ***specifications***, AHJ, and site conditions and requirements

Range of Variables

specifications include: engineered drawings, manufacturers' requirements, job specifications, approved shop drawings

consequences include: damage to utilities, injuries to personnel

excavation requirements include: depth, grade, bedding

equipment includes: backhoes, jackhammers, tampers, shovels

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.07.01L	demonstrate knowledge excavating, backfilling and compacting trenches	identify types of backfill materials, and describe their characteristics and applications
		describe considerations to excavate, backfill and compact trenches
		calculate amount of grade and elevation required using fractions, ratios and percentages
		identify materials that can be reconditioned, reused or recycled
A-4.07.02L	demonstrate knowledge of procedures to excavate, backfill and compact trenches	identify tools and ***equipment*** used to excavate, backfill and compact trenches, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to excavating, shoring and backfilling trenches
		describe procedures to excavate, backfill and compact trenches
		identify practices that reduce material waste

A-4.07.03L	demonstrate knowledge of training and certification requirements pertaining to excavating, backfilling and compacting trenches	identify training and certification requirements pertaining to excavating, backfilling and compacting trenches
A-4.07.04L	demonstrate knowledge of regulatory requirements pertaining to excavating, backfilling and compacting trenches	interpret codes, regulations, standards and specifications pertaining to excavating, backfilling and compacting trenches
A-4.07.05L	demonstrate knowledge of emerging technologies and practices pertaining to excavating, backfilling and compacting trenches	identify technologies that contribute to work efficiencies

Range of Variables

equipment includes: backhoes, jackhammers, tampers, shovels
hazards include: crushing, buried by backfill, electrocution, flooding, drowning

A-4.08 Installs fire stopping devices and materials

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-4.08.01P	identify locations where ***fire stopping devices and materials*** are required	locations where ***fire stopping devices and materials*** are required to prevent potential spread of fire and smoke are identified according to ***specifications***
A-4.08.02P	select ***fire stopping devices and materials***	***fire stopping devices and materials*** are selected according to ***specifications***
A-4.08.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
A-4.08.04P	anchor fire stopping devices to building structure	fire stopping devices are firmly attached to building structure using approved ***methods***
A-4.08.05P	apply fire stopping material to fill gaps and cavities around penetrations in walls and floors	all gaps and cavities around penetrations are filled using fire stopping material according to specifications and AHJ
A-4.08.06P	secure fire stopping material to pipe	fire stopping material is secured to pipe according to ***specifications***

Range of Variables

fire stopping devices and materials include: collars, straps, caulking, insulating materials
specifications include: manufacturer specifications, engineered listings, building code requirements
tools and equipment include: screw guns, caulking guns, hammer drills
methods include: screwing, wrapping, pinning

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-4.08.01L	demonstrate knowledge of ***fire stopping devices and materials***, their characteristics, applications and operation	identify ***fire stopping devices and materials***, and describe their characteristics and applications
		describe operating principles of ***fire stopping devices and materials***
		identify ***systems requiring fire stopping***
		identify materials that can be reconditioned, reused or recycled
A-4.08.02L	demonstrate knowledge of procedures to install ***fire stopping devices and materials***	identify ***tools and equipment*** used to install ***fire stopping devices and materials***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of ***fire stopping devices and materials***
		describe procedures to install ***fire stopping devices and materials***
A-4.08.03L	demonstrate knowledge of training and certification requirements to install ***fire stopping devices and materials***	identify training and certification requirements to install ***fire stopping devices and materials***
A-4.08.04L	demonstrate knowledge of regulatory requirements to install ***fire stopping devices and materials***	identify codes, standards and regulations pertaining to fire stopping
A-4.08.05L	demonstrate knowledge of emerging technologies and practices pertaining to the installation of ***fire stopping devices and materials***	identify technologies that contribute to product installation efficiencies

Range of Variables

fire stopping devices and materials include: collars, straps, caulking, insulating materials

systems requiring fire stopping include: sanitary drainage systems, venting systems, storm drainage systems, potable water distribution systems, hot water heating systems, specialty systems

tools and equipment include: screw guns, caulking guns, hammer drills

hazards include: auditory hazards, vision hazards, burns, cuts, respiratory damage, pinch points

Task A-5 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-5.01 Uses communication techniques

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-5.01.01P	demonstrate communication practices with individuals or in a group	instructions and messages are interpreted by all parties involved in communication
A-5.01.02P	listen using ***active listening*** practices	***active listening*** practices are used
A-5.01.03P	speak clearly using correct industry terminology to ensure understanding	understanding of message is confirmed by both parties
A-5.01.04P	receive and respond to instructions	response to instructions indicates understanding
A-5.01.05P	receive and respond to feedback on work completed or performed	response to feedback indicates understanding and corrective measures are taken
A-5.01.06P	explain and provide feedback	explanation and feedback are provided and task is carried out as directed
A-5.01.07P	use questions to improve communication	questions enhance understanding, on-the-job training and goal setting
A-5.01.08P	participate in safety and information meetings	meetings are attended, information is relayed to workforce, and is applied
A-5.01.09P	send and receive ***electronic messages***	***electronic messages*** are sent and received using professionalism, plain language and clear expressions according to company policy

Range of Variables

active listening includes: hearing, interpreting, reflecting, responding, paraphrasing
electronic messages include: email, text messages

	Knowledge	
	Learning Outcomes	**Learning Objectives**
A-5.01.01L	demonstrate knowledge of trade terminology	define terminology used in trade
A-5.01.02L	demonstrate knowledge of effective communication practices	describe importance of using effective verbal and non-verbal communication with ***people in the workplace***
		identify ***sources of information*** to effectively communicate
		identify communication and ***learning styles***
		describe effective listening and speaking skills
		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, clients, jurisdictional representatives, manufacturers

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

learning styles include: visual, auditory, reading, writing, 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-5.02 Uses mentoring techniques

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
A-5.02.01P	identify and communicate learning objective and point of lesson	apprentice or learner can explain objective and point of lesson
A-5.02.02P	link lesson to other lessons and project	lesson order and unplanned learning opportunities are defined
A-5.02.03P	demonstrate performance of a skill to an apprentice or learner	***steps required to demonstrate a skill*** are performed
A-5.02.04P	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-5.02.05P	assess apprentice or learner's ability to perform tasks with increasing independence	performance of apprentice or learner improves with practice to a point where skill can be done with little supervision
A-5.02.06P	give supportive and corrective feedback	apprentice or learner adopts best practice after having been given supportive or corrective feedback
A-5.02.07P	support apprentices or learners in pursuing technical training opportunities	technical training is completed within timeframe prescribed by apprenticeship authority
A-5.02.08P	support anti-***harassment*** and anti-***discrimination*** practices in workplace	workplace is ***harassment-*** and ***discrimination***-free
A-5.02.09P	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 the 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 include: 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-5.02.01L	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-5.02.02L	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) include: reading, document use, writing, oral communication, numeracy, thinking, working with others, digital technology, continuous learning

learning styles include: visual, auditory, reading, writing, kinesthetic

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

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

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

Major Work Activity B
Prepares and assembles tube, tubing and pipe

Task B-6 Prepares tube, tubing and pipe

Task Descriptor

Plumbers prepare tube, tubing and pipe for proper installation and trouble-free operation of the plumbing system. Preparation of tube, tubing and pipe includes many different techniques such as inspection, measuring, cutting, reaming, threading, grooving and bending. Pipe and tube are measured by nominal inside diameter (ID) and type, while some types of tubing are measured by outside diameter (OD) and wall thickness. Plumbers are responsible for the preparation of tube, tubing and pipe for applications such as DWV, water distribution, pressure systems and other product conveyance such as chemicals and gases.

B-6.01 Inspects tube, tubing, pipe and fittings before installation

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.01.01P	perform ***sensory inspection***	***sensory inspection*** is performed to detect ***faults***
B-6.01.02P	confirm certification	certifications are obtained according to codes, specifications and AHJ, and approval markings are recorded
B-6.01.03P	confirm materials	correct tube, tubing, pipe and fittings are verified according to site requirements

Range of Variables

sensory inspection includes: visual, auditory, tactile (sounding cast iron pipe, checking threads, confirming groove depth)

faults include: damage, cracks, debris

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.01.01L	demonstrate knowledge of tube, tubing, pipe and fittings, their ***accessories***, characteristics and applications	identify ***types of tube, tubing and pipe***, and describe their characteristics and applications
		identify tube, tubing and pipe ***accessories***, and describe their characteristics and applications
		identify fittings used with tube, tubing and pipe, and describe their characteristics and applications
		interpret information pertaining to tube, tubing, pipe and fittings, and their ***accessories*** found on drawings and specifications
		describe manufacturers' identification systems and methods for tube, tubing, pipe and fittings, and their ***accessories***
		identify materials that can be reconditioned, reused or recycled
B-6.01.02L	demonstrate knowledge of procedures to measure tube, tubing, pipe and fittings	explain ***systems of measurement*** for tube, tubing, pipe, and fittings
		describe procedures to measure tube, tubing, pipe and fittings
		perform ***calculations*** to determine tube, tubing and pipe lengths
B-6.01.03L	demonstrate knowledge of procedures to inspect tube, tubing, pipe, fittings and ***accessories***	identify tools and equipment used to inspect tube, tubing, pipe, fittings and ***accessories***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to tube, tubing, pipe, fittings and ***accessories***
		describe procedures to inspect tube, tubing, pipe, fittings and ***accessories***
		describe procedures to perform ***sensory inspection***
		identify practices that reduce material waste
		describe energy-saving practices
B-6.01.04L	demonstrate knowledge of regulatory requirements pertaining to tube, tubing, pipe, fittings and ***accessories***	identify codes, standards and regulations pertaining to tube, tubing, pipe, fittings and ***accessories***

Range of Variables

accessories include: supports, hangers, sleeves

types of tube, tubing and pipe include: steel, copper, plastic, cast iron, asbestos cement

systems of measurement include: dimension, length, wall thickness

calculations include: fitting allowances, centre-to-centre, end-to-end, offsets

hazards include: weight, cuts, pinch points

sensory inspection includes: visual, auditory, tactile (sounding cast iron pipe, checking threads, confirming groove depth)

B-6.02 Cuts tube, tubing and pipe

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
B-6.02.02P	select tube, tubing and pipe	tube, tubing and pipe are selected according to codes, specifications, AHJ and site requirements
B-6.02.03P	inspect tube, tubing and pipe for damage	tube, tubing and pipe are inspected for damage after each cut using ***sensory inspections***
B-6.02.04P	measure tube, tubing and pipe	tube, tubing and pipe are measured according to drawings and site requirements to determine length and location of cut
B-6.02.05P	support and secure tube, tubing and pipe	tube, tubing and pipe are supported and secured for cutting

Range of Variables

tools and equipment include: pipe and tubing cutters, saws, reamers, grinders, measuring tapes, cutting guides (contour wraparounds)

sensory inspection includes: visual, auditory, tactile (sounding cast iron pipe, checking threads, confirming groove depth)

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.02.01L	demonstrate knowledge of tube, tubing, pipe and fittings, and their characteristics and applications	identify tube, tubing, pipe and fittings, and describe their characteristics and applications
		explain ***systems of measurement*** for tube, tubing and pipe
		identify cutting guides, and describe their applications
		identify manufacturers' information that must be maintained on tube, tubing and pipe
		identify materials that can be reconditioned, reused or recycled
B-6.02.02L	demonstrate knowledge of procedures to measure and cut tube, tubing and pipe	identify ***tools and equipment*** used to measure and cut tube, tubing and pipe, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to tube, tubing and piping
		describe procedures to measure tube, tubing and pipe
		perform ***calculations*** to determine tube, tubing and pipe lengths
		describe procedures to inspect tube, tubing and pipe cuts
		describe procedures to cut tube, tubing and pipe
		identify practices that reduce material waste
B-6.02.03L	demonstrate knowledge of regulatory requirements pertaining to tube, tubing and pipe	identify codes, standards and regulations pertaining to tube, tubing and pipe
B-6.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to tube, tubing and pipe	identify emerging technologies for cutting tube, tubing and pipe

Range of Variables

systems of measurement include: dimension, length, wall thickness

tools and equipment include: pipe and tubing cutters, saws, reamers, grinders, measuring tapes, cutting guides (contour wraparounds)

hazards include: weight, cuts, pinch points, burns, flying debris

calculations include: fitting allowances, centre-to-centre, end-to-end, offsets

B-6.03 Bends tube, tubing and pipe

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.03.01P	identify tube, tubing and pipe	tube, tubing and pipe are identified according to codes, specifications, AHJ and site requirements
B-6.03.02P	select tube, tubing and pipe ***bender***	***bender*** is selected according to type and size of tube, tubing and pipe
B-6.03.03P	determine increments on bending tool	increments on bending tools are determined to achieve required angle
B-6.03.04P	determine location and angle of offsets or bends	location and angle of offsets or bends are determined according to site requirements
B-6.03.05P	measure and calculate distances	distances between offsets and bends are measured and calculated
B-6.03.06P	inspect tube, tubing and pipe	tube, tubing and pipe are inspected after bending for ***distortions***

Range of Variables

bender includes: pneumatic, hydraulic, manual, electric
distortions include: kinks, ripples

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.03.01L	demonstrate knowledge of tube, tubing, pipe and fittings, and their accessories, characteristics and applications	identify ***types of tube, tubing, pipe*** and fittings, and their accessories, and describe their characteristics and applications
		interpret information pertaining to bending tube, tubing and pipe found on drawings and specifications
		identify materials that can be reconditioned, reused or recycled
B-6.03.02L	demonstrate knowledge of procedures to bend tube, tubing and pipe	identify tools and equipment used to bend tube, tubing and pipe, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to bending tube, tubing and pipe
		identify ***bender*** used to bend tube, tubing and pipe, and describe their procedures for use

		describe procedures to bend tube, tubing and pipe
		identify practices that reduce material waste
B-6.03.03L	demonstrate knowledge of regulatory requirements to bend tube, tubing and pipe	identify codes, standards and regulations pertaining to bending tube, tubing and piping
B-6.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to bending tube, tubing and pipe	identify emerging technologies for bending tube, tubing and pipe

Range of Variables

types of tube, tubing and pipe include: soft, semi-soft (partially annealed), rigid
hazards include: weight, cuts, pinch points, strains
bender includes: pneumatic, hydraulic, manual, electric

B-6.04 Prepares tube, tubing and pipe connections

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-6.04.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
B-6.04.02P	ream and thread pipe	pipe is reamed and threaded according to codes, specifications and industry standards
B-6.04.03P	flare tube and tubing	tube and tubing are flared according to specifications and application
B-6.04.04P	***clean*** tube, tubing and pipe	tube, tubing and pipe are cleaned according to code requirements and specifications
B-6.04.05P	bevel or groove pipe	pipe is bevelled or grooved according to pipe specification and application
B-6.04.06P	inspect tube, tubing and pipe	tube, tubing and pipe are inspected using ***sensory inspections*** to detect ***faults*** prior to connection

Range of Variables

tools and equipment include: threading tools, grooving tools, bevelling tools, cutting tools
clean includes: deburred, sanded, degreased
sensory inspection includes: visual, auditory, tactile (sounding cast iron pipe, checking threads, confirming groove depth)
faults include: damage, cracks, debris

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-6.04.01L	demonstrate knowledge of tube, tubing, pipe and fittings, and their ***accessories***, characteristics and applications	identify tube, tubing, pipe and fittings, and their ***accessories***, and describe their characteristics and applications
		interpret information pertaining to preparing tube, tubing, pipe and fittings, and their ***accessories*** found in drawings and specifications
		identify fittings used for tube, tubing and pipe connections, and describe their characteristics and applications
		explain ***systems of measurement*** for tube, tubing and pipe
		identify potential environmental and health impacts involved during preparing tube, tubing and pipe, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
B-6.04.02L	demonstrate knowledge of procedures to prepare tube, tubing and pipe	identify ***tools and equipment*** to prepare tube, tubing and pipe connections, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to preparing tube, tubing and pipe connections
		describe procedures to ***clean*** tube, tubing and pipe connections
		identify ***techniques*** to prepare tube, tubing and pipe connections
		describe procedures to inspect tube, tubing and pipe for ***faults***
B-6.04.04L	demonstrate knowledge of regulatory requirements pertaining to preparing tube, tubing and pipe connections	identify codes, standards and regulations pertaining to preparing tube, tubing and pipe connections
B-6.04.05L	demonstrate knowledge of emerging technologies and practices pertaining to preparing tube, tubing and pipe connections	identify emerging technologies for preparing tube, tubing and pipe connections

Range of Variables

accessories include: lubricants, sealants, cleaners, primers

systems of measurement include: dimension, length, wall thickness

tools and equipment include: threading tools, grooving tools, bevelling tools, cutting tools

hazards include: weight, cuts, pinch points, strains

clean includes: deburred, sanded, degreased

techniques include: reaming, bevelling, filing, grinding, cleaning, sanding, priming, flaring, grooving, threading

faults include: damage, cracks, debris

Task B-7 Joins tube, tubing and pipe

Task Descriptor

Plumbers join tube, tubing and pipe to ensure trouble-free operation of systems. They use materials such as copper, plastic, steel, cast iron as well as specialized materials such as glass and fibreglass.

Copper may be used for potable water systems, DWV and specialized systems.

Steel is one of the most widely used piping materials installed by plumbers in heating and process applications. Some examples of systems using steel pipe are hydronic heating, fuel piping, air lines and low-pressure steam lines.

Plastic provides an alternative to other types of pipe.

Cast iron has proven qualities that continue to make it a reliable material for drainage of sanitary and storm waste. Ductile iron is widely used for water service and process piping.

Glass is commonly used in laboratories, hospitals and chemical plants for corrosive materials. Small bore glass pipe is commonly used for such items as sight glasses.

B-7.01 Joins copper tube, tubing and pipe

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.01.01P	determine types of fittings, ***methods to join*** and materials to be used	types of fittings, ***methods to join*** and materials are determined according to codes, AHJ, industry standards, specifications and site requirements
B-7.01.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to fittings and joining methods
B-7.01.03P	connect flared tube and tubing ends	flared tube and tubing ends are connected and tightened according to specifications to ensure proper seal on fitting
B-7.01.04P	connect swaged fittings to pipe	swaged fittings are connected to pipe according to specifications
B-7.01.05P	connect grooved pipe ends	grooved pipe ends are connected according to specifications
B-7.01.06P	clean and lubricate grooved mechanical joints	grooved mechanical joints are cleaned and lubricated according to specifications to avoid pinching and to allow for proper tightening
B-7.01.07P	select soldering and brazing materials	soldering and brazing materials are selected according to application

B-7.01.08P	purge pipe	brazed piping systems are purged with inert gas during brazing process according to industry procedures to prevent oxidization of interior of pipe
B-7.01.09P	solder tube, tubing and pipe, and fittings	tube, tubing and pipe, and fittings are soldered according to industry procedures, achieving adequate temperature to obtain required flow and capillary action of filler metal
B-7.01.10P	assemble and install corporation, compression or push-fit fittings	corporation, compression or push-fit fittings are assembled and installed according to required depth and to specifications

Range of Variables

methods to join include: press-fit, soldered, brazed, grooved, flanged, flared, compression, swaged, corporation, push-fit

tools and equipment include: pipe and tubing cutters, flaring tools, grooving tools, soldering and brazing equipment, swaging tools, press-fit

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.01.01L	demonstrate knowledge of copper tube, tubing and pipe, and their fittings, ***accessories***, characteristics and applications	identify types of copper tube, tubing and pipe, and describe their characteristics and applications
		identify fittings used with copper tube, tubing and pipe, and describe their characteristics and applications
		identify ***pipe and tubing accessories***, and describe their characteristics and applications
		interpret information pertaining to copper tube, tubing and pipe found on drawings and specifications
		describe identification systems and methods for copper tube, tubing and pipe
		identify ***adaptors*** required to join dissimilar materials to prevent galvanic action
		identify potential environmental and health impacts of joining copper tube, tubing and pipe, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled

B-7.01.02L	demonstrate knowledge of procedures to join copper tube, tubing and pipe	identify ***tools and equipment*** used to join copper tube, tubing and pipe, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to copper tube, tubing and pipe
		identify ***methods to join*** copper tube, tubing and pipe, and describe their associated procedures
		describe procedures to install fittings and ***accessories*** for copper tube, tubing and pipe
B-7.01.03L	demonstrate knowledge of training and certification requirements pertaining to copper tube, tubing and pipe	identify training and certification requirements pertaining to copper tube, tubing and pipe
B-7.01.04L	demonstrate knowledge of regulatory requirements pertaining to copper tube, tubing and pipe	identify codes, standards and regulations pertaining to copper tube, tubing and pipe

Range of Variables

accessories include: lubricants, sealants, cleaners, primers

pipe and tubing accessories include: supports, expansion joints, hangers, sleeves

adaptors include: dielectric unions, brass, insulated unions

tools and equipment include: pipe and tubing cutters, flaring tools, grooving tools, soldering and brazing equipment, swaging tools, press-fit

hazards include: fire, cuts, burns

methods to join include: press-fit, soldered, brazed, grooved, flanged, flared, compression, swaged, corporation, push-fit

B-7.02 Joins plastic tube, tubing and pipe

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.02.01P	determine types of fittings, ***methods to join*** and materials to be used	types of fittings, ***methods to join*** and materials are determined according to codes, specifications, AHJ, industry standards, and site requirements
B-7.02.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
B-7.02.03P	select solvents and primers	solvents and primers are selected according to codes and specifications
B-7.02.04P	solvent weld plastic tube, tubing and pipe joints	plastic tube, tubing and pipe joints are solvent welded according to type of pipe, codes and specifications

B-7.02.05P	groove plastic pipe	plastic pipes are grooved to proper depth according to specifications
B-7.02.06P	clean and lubricate grooved mechanical joints	grooved mechanical joints are cleaned and lubricated according to specifications to avoid pinching and to allow for tightening
B-7.02.07P	connect and tighten mechanical joints	mechanical joints are connected and tightened to required specifications
B-7.02.08P	perform ***plastic welding techniques***	***plastic welding techniques*** are performed according to type of pipe and specifications
B-7.02.09P	crimp or expand cross-linked polyethylene (PEX) pipe and tubing	PEX pipe and tubing are crimped or expanded to create a joint according to specifications
B-7.02.10P	prepare hub and spigot joints	hub and spigot joints are prepared by chamfering pipe ends and applying lubricant on pipe and gasket according to specifications
B-7.02.11P	assemble hub and spigot joints	hub and spigot joints are assembled for pressure water and drainage systems according to specifications
B-7.02.12P	assemble and install compression and push-fit fittings	compression and push-fit fittings are assembled and installed according to required depth and to specifications
B-7.02.13P	select and thread pipe	pipe is selected and threaded according to application and specifications
B-7.02.14P	assemble components for flanged connections	components for flanged connections are assembled according to specifications

Range of Variables

methods to join include: heat fusion welding, threading, tapping, solvent welding, compression fittings, mechanical joints, gasket, flanged, crimped, expansion, grooved, push-fit

tools and equipment include: crimping tools, expanders, heat plates and timer, cutters, hot-air tools, threading machines, chamfer tools, reaming tools, groovers, torque ratchets, electrofusion machines

plastic welding techniques include: hot air welding, socket fusion, butt fusion

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.02.01L	demonstrate knowledge of plastic tube, tubing and pipe, and their fittings, accessories, characteristics and applications	identify ***types of plastic tube, tubing and pipe***, and describe their characteristics and applications
		interpret information pertaining to plastic tube, tubing and pipe found on drawings and specifications
		describe identification systems and methods for plastic tube, tubing and pipe

		identify fittings used with plastic tube, tubing and pipe, and describe their characteristics and applications
		identify plastic tube, tubing and pipe ***accessories***, and describe their characteristics and applications
		identify ***adaptors*** required for transitions
		identify ***types of joints***, and describe their characteristics and applications
		identify potential environmental and health impacts of joining plastic tube, tubing and pipe, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
B-7.02.02L	demonstrate knowledge of procedures to join plastic tube, tubing and pipe	identify ***tools and equipment*** used to join plastic tube, tubing and pipe, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to plastic tube, tubing and pipe
		identify ***methods to join*** plastic tube, tubing and pipe, and describe their associated procedures
B-7.02.03L	demonstrate knowledge of training and certification requirements pertaining to plastic tube, tubing and pipe	identify training and certification requirements pertaining to plastic tube, tubing and pipe
B-7.02.04L	demonstrate knowledge of regulatory requirements pertaining to joining plastic tube, tubing and pipe	identify codes, standards and regulations pertaining to plastic tube, tubing and pipe

Range of Variables

types of plastic tube, tubing and pipe include: PVC, chlorinated polyvinyl chloride (CPVC), acrylonitrile butadiene styrene (ABS), high-density polyethylene (HDPE), PEX, PEX-Aluminum-PEX (PEX-AL-PEX), Polyethylene (PE)

accessories include: supports, expansion joints, hangers, sleeves

adaptors include: male, female, mechanical joints

types of joints include: welded, threaded, flanged, cut-grooved, crimped, expanded, push-fit, compression, mechanical, gasket, transition

tools and equipment include: crimping tools, expanders, heat plates and timer, cutters, hot-air tools, threading machines, chamfer tools, reaming tools, groovers, torque ratchets, electrofusion machines

hazards include: pinch points, burning, chemicals, cuts, strains, confined spaces, fume inhalation

methods to join include: heat fusion welding, threading, tapping, solvent welding, compression fittings, mechanical joints, gasket, flanged, crimped, expansion, grooved, push-fit

B-7.03 Joins steel tube, tubing and pipe

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.03.01P	determine types of fittings, ***joints*** and materials to be used	types of fittings, ***joints*** and materials are determined according to codes, specifications, AHJ, industry standards, and site requirements
B-7.03.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to type of materials, fittings and joining methods
B-7.03.03P	support and align tube, tubing and pipe, and fittings	tube, tubing and pipe, and fittings are supported and aligned prior to connection
B-7.03.04P	thread steel pipe	steel pipe is threaded using lubricants and power or hand threader, and ensuring proper taper and length of threads
B-7.03.05P	groove steel pipe	steel pipe is grooved to proper depth according to specifications
B-7.03.06P	clean and lubricate grooved mechanical joints	grooved mechanical joints are cleaned and lubricated according to specifications to avoid pinching and to allow for tightening
B-7.03.07P	connect and tighten mechanical joints	mechanical joints are connected and tightened according to specifications
B-7.03.08P	install gaskets and tighten bolts	gasket and bolt tightening pattern is used for flanged joints according to specifications

Range of Variables

joints include: welded, threaded, flanged, grooved, press-fit, mechanical

tools and equipment include: hand and power tools, grinders, threaders, press-fit tools, cutters, groovers, oxy-acetylene equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.03.01L	demonstrate knowledge of steel tube, tubing and pipe and their fittings, ***accessories***, characteristics and applications	identify ***types of steel tube, tubing and pipe***, and describe their characteristics and applications
		identify steel tube, tubing and pipe systems and describe their characteristics and applications
		identify fittings used with steel tube, tubing and pipe and describe their characteristics and applications
		identify steel tube, tubing and pipe ***accessories***, and describe their characteristics and applications
		interpret information pertaining to steel tube, tubing and pipe found on drawings and specifications
		describe identification systems and methods used for steel tube, tubing and pipe
		identify potential environmental and health impacts of joining steel piping, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
B-7.03.02L	demonstrate knowledge of procedures to join steel tube, tubing and pipe	identify ***tools and equipment*** used to join steel tube, tubing and pipe, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to steel tube, tubing and pipe
		identify ***joints*** used for joining steel tube, tubing and pipe, and describe their associated procedures
B-7.03.03L	demonstrate knowledge of training and certification requirements pertaining to steel tube, tubing and pipe	identify training and certification requirements pertaining to steel tube, tubing and pipe
B-7.03.04L	demonstrate knowledge of regulatory requirements pertaining to steel tube, tubing and pipe	identify codes, standards and regulations pertaining to steel tube, tubing and pipe

Range of Variables

accessories include: supports, hangers, sleeves

types of steel tube, tubing and pipe include: carbon steel, galvanized, stainless steel

tools and equipment include: hand and power tools, grinders, threaders, press-fit tools, cutters, groovers, oxy-acetylene equipment

hazards include: pinch points, burns, fire, cuts, electrical shock, strains, dangerous projectiles

joints include: welded, threaded, flanged, grooved, press-fit, mechanical

B-7.04 Joins cast iron pipe

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.04.01P	determine types of ***joints***, fittings, and materials to be used	types of ***joints***, fittings, materials to be used are determined according to codes, specifications, AHJ, industry standards, and site requirements
B-7.04.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to fittings and joining methods
B-7.04.03P	align pipe and fittings	pipe and fittings are aligned and assembled using ***joints*** according to specifications and application
B-7.04.04P	identify locations	locations are identified where mechanical restraints are required
B-7.04.05P	install ***mechanical restraints***	***mechanical restraints*** are installed for cast iron pipe
B-7.04.06P	torque mechanical coupling	mechanical coupling is torqued to specifications
B-7.04.07P	join hub and spigot connections	hub and spigot connections are joined according to codes and specifications

Range of Variables

joints include: mechanical joint clamps, oakum and cold caulking compound, gasket joints
tools and equipment include: hand and power tools, snap cutters, come-alongs
mechanical restraints include: riser clamps, thrust blocks, rodding

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.04.01L	demonstrate knowledge of cast iron piping, and their fittings, accessories, characteristics and applications	identify ***types of cast iron piping***, and describe their characteristics and applications
		identify fittings used with cast iron piping, and describe their characteristics and applications
		identify cast iron piping ***accessories***, and describe their characteristics and applications
		interpret information pertaining to cast iron piping found on drawings and specifications

		describe identification systems and methods for cast iron piping
		identify materials that can be reconditioned, reused or recycled
B-7.04.02L	demonstrate knowledge of procedures to join cast iron piping	identify ***tools and equipment*** used to join cast iron piping and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to cast iron piping
		identify ***joints*** used for joining cast iron piping and describe their associated procedures
B-7.04.03L	demonstrate knowledge of regulatory requirements pertaining to cast iron piping	identify codes, standards and regulations pertaining to cast iron piping

Range of Variables

types of cast iron piping include: soil, duriron, ductile iron
accessories include: supports, hangers, sleeves, flanges, mechanical restraints
tools and equipment include: hand and power tools, snap cutters, come-alongs
hazards include: biohazards, lead (in old piping systems), pinch points, strains
joints include: mechanical joint clamps, oakum and cold caulking compound, gasket joints

B-7.05 Joins specialized tube, tubing and pipe

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
B-7.05.01P	determine types of ***joints***, fittings, materials to be used	types of ***joints***, fittings, materials to be used are determined according to codes, specifications, AHJ, industry standards (for specialized materials) and site requirements
B-7.05.02P	select and use tools and equipment	tools and equipment are selected and used according to fittings, joining methods, and type of tube, tubing and pipe
B-7.05.03P	position fittings, tube, tubing and pipe	fittings, tube, tubing and pipe are selected and installed according to codes, specifications, AHJ, industry standards (for specialized materials), and site requirements

B-7.05.04P	select and install transition fittings	transition fittings are selected and installed to connect different materials according to codes, AHJ, industry standards (for specialized materials), specifications and site requirements
B-7.05.05P	align and assemble tube, tubing, pipe and fittings	tube, tubing, pipe and fittings are aligned and assembled using ***joints*** according to codes, AHJ, industry standards (for specialized materials) and site requirements

Range of Variables

joints include: compression joints, mechanical joint clamps, welded, threaded, flanged, grooved, press-fit, heat fusion welding, solvent welding, gasket, crimped and expansion, push-fit, transition, brazing, soldering, flaring, swaged, corporation, wrapped

	Knowledge	
	Learning Outcomes	**Learning Objectives**
B-7.05.01L	demonstrate knowledge of specialized tube, tubing, pipe and fittings, and their ***accessories***, characteristics and applications	identify ***types of specialized tube, tubing and pipe***, and describe their characteristics and applications
		identify fittings used with specialized tube, tubing and pipe, and describe their characteristics and applications
		identify specialized tube, tubing and pipe ***accessories***, and describe their characteristics and applications
		interpret information pertaining to specialized tube, tubing and pipe found on drawings and specifications
		describe identification systems and methods for specialized tube, tubing and pipe
		identify potential environmental and health impacts of joining specialized tube, tubing and pipe, and fittings and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled

B-7.05.02L	demonstrate knowledge of procedures to join specialized tube, tubing and pipe, their fittings and ***accessories***	identify tools and equipment used to join specialized tube, tubing and pipe, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to specialized piping
		identify ***joints*** used for joining specialized tube, tubing and pipe and describe their associated procedures
		describe procedures to install fittings and ***accessories*** for specialized tube, tubing and pipe
		describe disposal requirements for hazardous materials
B-7.05.03L	demonstrate knowledge of training and certification requirements pertaining to specialized tube, tubing and pipe	identify training and certification requirements pertaining to specialized tube, tubing and pipe
B-7.05.04L	demonstrate knowledge of regulatory requirements pertaining to specialized tube, tubing and pipe	identify codes, standards and regulations pertaining to specialized tube, tubing and pipe

Range of Variables

accessories include: supports, hangers, sleeves

types of specialized tube, tubing and pipe include: glass, asbestos cement, lead, concrete, historical piping, fibreglass

hazards include: asbestos, lead, slivers, burns, cuts, strains

joints include: compression joints, mechanical joint clamps, welded, threaded, flanged, grooved, press-fit, heat fusion welding, solvent welding, gasket, crimped and expansion, push-fit, transition, brazing, soldering, flaring, swaged, corporation, wrapped

Major Work Activity C
Installs, tests and services sewers, sewage treatment systems and drainage, waste and vent (DWV) systems

Task C-8 Installs, tests and services sewers

Task Descriptor

Plumbers install both sanitary and storm sewers. They may be responsible for the sizing of the sewer as well as installing maintenance holes (formerly known as manholes), catch basins and piping. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

C-8.01 Plans layout and sizes piping for sewers

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-8.01.01P	identify ***fixtures and equipment***	***fixtures and equipment*** are identified for hydraulic load according to drawings and specifications
C-8.01.02P	identify roofs and paved surfaces	roofs and paved surfaces are identified for hydraulic load to be calculated
C-8.01.03P	calculate total hydraulic load of building	total hydraulic load of building is calculated according to tables in NPC
C-8.01.04P	design piping layout	piping layout is designed according to codes, specifications, AHJ and site conditions
C-8.01.05P	determine size of sewer piping	size of sewer piping is determined according to sewer sizing tables in NPC
C-8.01.06P	select piping material	piping material is selected according to codes, specifications, AHJ and site requirements
C-8.01.07P	identify benchmark	benchmark is identified to set grade or offset for piping
C-8.01.08P	coordinate work with other tradespeople	work with other tradespeople is coordinated according to schedule and spacing requirements

Range of Variables

fixtures and equipment include: condensate drains, sump pumps, sinks, water closets, lavatories, showers, bathtubs

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-8.01.01L	demonstrate knowledge of sanitary drainage systems, their ***components***, characteristics and applications	identify sanitary drainage systems and their ***components***, and describe their characteristics and applications
		interpret information pertaining to sanitary drainage systems found on drawings and specifications
		identify ***factors*** to consider when sizing ***sanitary drainage system components***
		identify sewer sizing tables in NPC
C-8.01.02L	demonstrate knowledge of storm and combination drainage systems, their ***components***, characteristics and applications	identify storm and combination drainage systems and their ***components***, and describe their characteristics and applications
		interpret information pertaining to storm and combination drainage systems found on drawings and specifications
		identify ***factors*** to consider when sizing ***storm and combination drainage system components***
C-8.01.03L	demonstrate knowledge of procedures to plan layout and size piping for sewers	describe procedures to plan layout and size piping for sewers
		describe safe work practices to size piping for sewers
		identify ***procedures to determine hydraulic load*** on sanitary drainage systems, and storm and combination drainage systems
		describe procedures to determine and transfer grade and elevation measurements for sanitary drainage systems, and storm and combination drainage systems
		identify practices that reduce material waste
C-8.01.04L	demonstrate knowledge of regulatory requirements pertaining to sanitary drainage systems, and storm and combination drainage systems	identify codes, standards and regulations pertaining to sanitary drainage systems
		identify codes, standards and jurisdictional regulations pertaining to storm and combination drainage systems

Range of Variables

sanitary drainage system components include: piping, fixtures, drains, traps, cleanouts, joints and connections, backwater valves, fire stopping, sewage sumps, macerating toilet systems, expansion joints

factors include: hydraulic load, code requirements, grade

storm and combination drainage system components include: piping, roof drains, area drains, fire stopping, expansion joints, storm water management devices, backwater valves

procedures to determine hydraulic load include: conversion factors, code requirements

C-8.02 Installs maintenance holes and catch basins

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-8.02.01P	locate and size maintenance holes and catch basins	maintenance holes and catch basins are located and sized according to drawings, codes, AHJ and specifications
C-8.02.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used to ensure base is level and stable
C-8.02.03P	channel bottom of maintenance hole	bottom of maintenance hole is channelled to direct waste
C-8.02.04P	select, lubricate and place gaskets	gaskets are selected, lubricated and placed to ensure maintenance holes and catch basins are watertight and to avoid damage or reaction between lubricant and gaskets
C-8.02.05P	modify maintenance holes and catch basins for new laterals	maintenance holes and catch basins are modified for new laterals by making additional penetrations while maintaining structural integrity
C-8.02.06P	seal penetration points	penetration points are sealed to ensure water tightness

Range of Variables

tools and equipment include: tripod, life line, full body harness, oxygen level sensor, levels, compactors, rigging, hoisting and lifting equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-8.02.01L	demonstrate knowledge of maintenance holes and catch basins, their components, characteristics and applications	identify types of maintenance holes and catch basins, and describe their components, characteristics and applications
		interpret information pertaining to maintenance holes and catch basins found on drawings and specifications
		identify potential environmental and health impacts involved during installation of maintenance holes and catch basins, and describe associated prevention measures
C-8.02.02L	demonstrate knowledge of procedures to lay out and install maintenance holes and catch basins	identify ***tools and equipment*** used to lay out and install maintenance holes and catch basins, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to maintenance holes and catch basins
		describe ***procedures to install*** maintenance holes and catch basins
		describe ***procedures to protect*** maintenance holes and catch basins
		describe procedures to determine and transfer grade and elevation measurements for maintenance holes and catch basins
		identify practices that reduce material waste
C-8.02.03L	demonstrate knowledge of regulatory requirements pertaining to maintenance holes and catch basins	identify codes, standards and regulations pertaining to maintenance holes and catch basins

Range of Variables

tools and equipment include: tripod, life line, full body harness, oxygen level sensor, levels, compactors, rigging, hoisting and lifting equipment

hazards include: trenching, confined spaces, pinch points, hoists, oxygen quality

procedures to install include: locating, identifying, excavating, backfilling

procedures to protect include: insulating, supporting, backfilling

C-8.03 Installs piping for sewers

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-8.03.01P	grade pipe	pipe is graded according to codes, specifications and AHJ
C-8.03.02P	verify pipe grade	pipe grade is verified using ***tools and equipment***
C-8.03.03P	lay out piping, ***fixtures and equipment***	piping, ***fixtures and equipment*** are laid out according to codes, AHJ, drawings, specifications, and site requirements and conditions
C-8.03.04P	select and install cleanouts	cleanouts are selected and installed according to codes, specifications, AHJ and site requirements
C-8.03.05P	verify that no cross connection is present	presence of no cross connection is verified between storm and sanitary sewers using ***methods***
C-8.03.06P	compact soil	soil is compacted using backfill material to ensure stable base and to prevent damage to piping according to codes, specifications and AHJ

Range of Variables

tools and equipment include: laser levels, builder's levels, total stations

fixtures and equipment include: condensate drains, sump pumps, sinks, water closets, lavatories, showers, bathtubs

methods include: dye tests, visual inspections

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-8.03.01L	demonstrate knowledge of sewers, their components, characteristics and applications	identify ***types of sewers***, and describe their characteristics and applications
		identify piping for sewers, and describe their characteristics and applications
		interpret information pertaining to sewers found on drawings and specifications
		identify potential environmental and health impacts involved during installation of sewers, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled

C-8.03.02L	demonstrate knowledge of procedures to install piping for sewers	identify ***tools and equipment*** used to install piping for sewers, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of sewers
		describe procedures to rough-in piping for sewers
		describe ***procedures to install*** piping for sewers
		describe ***procedures to protect*** piping for sewers according to mechanical specifications
		describe procedures to grade piping for sewers
		calculate elevations and inverts for sewers
		describe procedures to determine and transfer grade and elevation measurements for sewers
C-8.03.03L	demonstrate knowledge of regulatory requirements pertaining to sewers	identify codes, standards, AHJ and regulations pertaining to sewers
C-8.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to sewers	identify technologies that contribute to net zero and carbon neutral commitments

Range of Variables

types of sewers include: storm, sanitary, combined

tools and equipment include: laser levels, builder's levels, total stations

hazards include: trenching, confined spaces, pinch points, hoists, oxygen quality, biological matter

procedures to install include: safety considerations (trenching, confined space, points of access), support, protection

procedures to protect include: insulating, supporting, backfilling

C-8.04 Tests maintenance holes, catch basins and piping for sewers

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

Skills

	Performance Criteria	Evidence of Attainment
C-8.04.01P	select and use ***testing equipment***	***testing equipment*** is selected and used to detect ***faults*** and to confirm operation of sewer
C-8.04.02P	perform ***sensory inspection***	***sensory inspection*** is performed to detect plumbing system problems
C-8.04.03P	perform pressure test in sewer	pressure test in sewer is performed according to codes and AHJ
C-8.04.04P	perform test on maintenance holes and catch basins	maintenance holes and catch basins are tested using ***methods*** to ensure watertight seal according to specifications and AHJ

Range of Variables

testing equipment include: ball, inflatable test balls, test plugs, mandrel
faults include: cracks, corrosion, inadequate flow, leaks
sensory inspection includes: auditory, visual
methods include: hydrostatic, smoke and air test, mandrel test

Knowledge

	Learning Outcomes	Learning Objectives
C-8.04.01L	demonstrate knowledge of maintenance holes, catch basins and piping for sewers, their characteristics and applications	identify types of maintenance holes, catch basins and piping for sewers, and describe their characteristics and applications
		identify potential problems and ***faults*** with maintenance holes, catch basins and piping for sewers
C-8.04.02L	demonstrate knowledge of procedures to test maintenance holes, catch basins and piping for sewers	identify ***testing equipment*** used to test maintenance holes, catch basins and piping for sewers, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to testing maintenance holes, catch basins and piping for sewers

		describe procedures to inspect maintenance holes, catch basins and piping for sewers
		describe procedures to test and troubleshoot maintenance holes, catch basins and piping for sewers
C-8.04.03L	demonstrate knowledge of regulatory requirements to test maintenance holes, catch basins and piping for sewers	identify codes, standards and regulations to test maintenance holes, catch basins and piping for sewers

Range of Variables

faults include: cracks, corrosion, inadequate flow, leaks
testing equipment include: ball, inflatable test balls, test plugs, mandrel
hazards include: confined spaces, heights, oxygen quality

C-8.05 Services maintenance holes, catch basins and piping for sewers

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-8.05.01P	select and use tools and equipment	tools and equipment are selected and used according to application
C-8.05.02P	perform scheduled service of systems	scheduled servicing of system is performed according to type of design and AHJ
C-8.05.03P	verify operation of maintenance holes, catch basins and piping for sewers	operation of maintenance holes, catch basins and piping for sewers is verified according to AHJ
C-8.05.04P	inspect maintenance holes, catch basins and piping for sewers	maintenance holes, catch basins and piping for sewers are inspected for ***conditions requiring service***
C-8.05.05P	determine whether ***components*** require replacement or repair	***components*** are determined to be in need of replacement or repair according to industry standards
C-8.05.06P	determine required isolation of system	isolation of system is determined according to servicing required
C-8.05.07P	notify client of need to isolate and execute isolation	client is notified and isolation is executed
C-8.05.08P	clean ***components***	***components*** are cleaned according to AHJ and company policies and procedures to prolong life of system and adequate flow
C-8.05.09P	replace ***components***	***components*** are replaced according to codes, specifications and AHJ

C-8.05.10P	repair ***components***	***components*** are repaired according to codes, specifications and AHJ
C-8.05.11P	complete required ***documentation***	***documentation*** is completed according to AHJ and company policies
C-8.05.12P	return system to service and verify system operation	system is returned to service and system operation is verified according to system design

Range of Variables

conditions requiring service includes: wear, noise, leaks, corrosion
components include: backwater valves, compression seals, covers, grates, gaskets
documentation includes: service reports, maintenance reports

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-8.05.01L	demonstrate knowledge of maintenance holes, catch basins and piping for sewers, their ***components***, characteristics and applications	identify types of maintenance holes, catch basins and piping for sewers, and their ***components***, and describe their characteristics and applications
		interpret information pertaining to maintenance holes, catch basins and piping for sewers found on drawings and specifications
		identify ***factors to consider when servicing*** maintenance holes, catch basins and piping for sewers
		identify potential environmental and health impacts involved during servicing maintenance holes, catch basins and piping for sewers, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
C-8.05.02L	demonstrate knowledge of procedures to service maintenance holes, catch basins and piping for sewers	identify tools and equipment used for servicing maintenance holes, catch basins and piping for sewers, and describe their procedures for use
		identify ***hazards*** and describe ***safe work practices*** pertaining to maintenance holes, catch basins and piping for sewers
		describe procedures to replace maintenance holes, catch basins and piping for sewers
		describe procedures to protect maintenance holes, catch basins and piping for sewers
		describe procedures to maintain and repair maintenance holes, catch basins and piping for sewers

		describe procedures to troubleshoot maintenance holes, catch basins and piping for sewers
C-8.05.03L	demonstrate knowledge of regulatory requirements pertaining to maintenance holes, catch basins and piping for sewers	identify codes, standards and regulations pertaining to maintenance holes, catch basins and piping for sewers
C-8.05.04L	demonstrate knowledge of emerging technologies and practices pertaining to maintenance holes, catch basins and piping for sewers	identify emerging technologies pertaining to maintenance holes, catch basins and piping for sewers

Range of Variables

components include: backwater valves, compression seals, covers, grates, gaskets

factors to consider when servicing include: specifications, condition of maintenance holes, catch basins and piping for sewers

hazards include: trenching, confined spaces, pinch points, hoists, oxygen quality, biological matter

safe work practices include: confined space, point of access, shoring, lock-out procedures

Task C-9 Installs, tests and services sewage treatment systems

Task Descriptor

Sewage treatment systems may encompass holding and septic tanks, absorption fields and sewage treatment plants. Regulations concerning the installation of sewage treatment systems may vary by jurisdiction. This may be considered a specialized area of work and additional certification may be required in some jurisdictions to allow plumbers to plan and install these systems. Plumbers may be required to maintain and repair these systems and must have basic knowledge of how they are planned, installed and operated. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

C-9.01 Plans installation of sewage treatment systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-9.01.01P	determine type of system required	type of system required is determined by performing percolation tests and by identifying ***factors*** according to AHJ
C-9.01.02P	prepare and submit site plan to AHJ	site plan is prepared and submitted to AHJ in order to obtain permits
C-9.01.03P	select and size ***private sewage treatment system components***	***private sewage treatment system components*** are selected and sized according to AHJ

C-9.01.04P	determine proper depth of piping and components	proper depth of piping and components are determined according to AHJ
C-9.01.05P	confirm that adequate bedding material is present	presence of adequate bedding material is confirmed according to type of system and AHJ

Range of Variables

factors include: location (system position, clearances, relation to water table, sensitive areas), soil conditions/properties (percolation test, soil test), expected daily volume of sewage

private sewage treatment system components include: leaching beds, distribution box, septic tank, holding tanks, effluent filter, pumps, alarms, sensors

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-9.01.01L	demonstrate knowledge of private sewage treatment systems, their ***components***, characteristics, applications and operation	identify ***types of private sewage treatment systems*** and their ***components***, and describe their characteristics and applications
		describe operating principles of private sewage treatment systems
		identify ***factors*** to consider when planning and sizing private sewage treatment systems
		interpret information pertaining to private sewage treatment systems found on drawings and specifications
		identify potential environmental, biohazard and health impacts involved during installation of private and public sewage treatment systems, and describe associated prevention measures
C-9.01.02L	demonstrate knowledge of procedures to plan installation of private sewage treatment systems	identify tools and equipment used for installation of private sewage treatment systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of private sewage treatment systems
		describe procedures to size and plan installation of private sewage treatment system components
C-9.01.03L	demonstrate knowledge of training and certification requirements pertaining to private sewage treatment systems	identify training and certification requirements pertaining to private sewage treatment systems
C-9.01.04L	demonstrate knowledge of regulatory requirements pertaining to private sewage treatment systems	identify codes, standards and regulations pertaining to private sewage treatment systems

C-9.01.05L	demonstrate knowledge of public sewage treatment systems, their ***components***, characteristics and applications	identify ***types of public sewage treatment systems*** and their ***components***, and describe their characteristics and applications
		describe operating principles of public sewage treatment systems
		interpret information pertaining to public sewage treatment systems found on drawings and specifications
C-9.01.06L	demonstrate knowledge of procedures to plan installation of public sewage treatment systems	identify tools and equipment used for installation of public sewage treatment systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of public sewage treatment systems
		describe procedures to plan installation of public sewage treatment systems
C-9.01.07L	demonstrate knowledge of training and certification requirements pertaining to public sewage treatment systems	identify training and certification requirements pertaining to public sewage treatment systems
C-9.01.08L	demonstrate knowledge of regulatory requirements pertaining to public sewage treatment systems	identify codes, standards and regulations pertaining to public sewage treatment systems
C-9.01.09L	demonstrate knowledge of emerging technologies and practices pertaining to private and public sewage treatment systems	identify emerging technologies pertaining to private and public sewage treatment systems

Range of Variables

private sewage treatment system components include: leaching beds, distribution box, septic tank, holding tanks, effluent filter, pumps, alarms, sensors

types of private sewage treatment systems include: raised, slope and sand, pumped

factors include: location (system position, clearances, relation to water table, sensitive areas), soil conditions/properties (percolation test, soil test), expected daily volume of sewage

hazards include: identifying existing services, equipment depth, soil conditions, trenching, confined spaces, hoists, oxygen quality, heights, biohazard, health, environmental

public sewage treatment system components include: pumps, septic tanks, absorption fields, alarms, sensors

types of public sewage treatment systems include: lagoon, plant

C-9.02 Installs components for sewage treatment systems

NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
yes	yes	NV	yes	yes	yes	yes	yes	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 application
C-9.02.02P	determine elevation and position of piping and ***components***	elevation and position of piping and ***components*** are determined according to specifications, AHJ and ***site conditions***
C-9.02.03P	install and secure tanks	tanks are installed and secured according to specifications, AHJ and ***site conditions***
C-9.02.04P	lubricate and place ***gaskets***	***gaskets*** are lubricated and placed to ensure tanks and components are watertight
C-9.02.05P	assemble, lay out and install piping and ***components***	piping and ***components*** are assembled, laid out and installed according to codes, specifications and AHJ

Range of Variables

tools and equipment include: rigging, hoisting and lifting equipment, excavation machinery

components include: pumps, siphons, filters, ejectors, tanks (septic, holding), controls, distribution box, strainers, lift stations, leaching beds, backwater valves, compression seals, covers, grates, alarms, sensors

site conditions include: high water table, limiting layer, terrain contour

gaskets include: rubber O-rings, butyl rubber seals

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-9.02.01L	demonstrate knowledge of sewage treatment systems, their ***components***, characteristics, applications and operation	identify types of sewage treatment systems, and describe their characteristics and applications
		identify private sewage treatment system ***components***, and describe their characteristics and applications
		identify public sewage treatment system ***components***, and describe their characteristics and applications
		describe operating principles of sewage treatment systems and their ***components***
		interpret information pertaining to sewage treatment systems found on drawings and specifications

		identify ***factors*** to consider when installing sewage treatment system ***components***
		identify potential environmental and health impacts involved during installation of sewage treatment systems, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
C-9.02.02L	demonstrate knowledge of procedures to install sewage treatment system ***components***	identify ***tools and equipment*** used to install sewage treatment systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to sewage treatment systems
		describe procedures to install sewage treatment system ***components***
		describe procedures to protect sewage treatment system ***components***
		describe procedures to determine grade and elevation for piping and ***components***
C-9.02.03L	demonstrate knowledge of training and certification requirements pertaining to sewage treatment systems	identify training and certification requirements pertaining to sewage treatment systems
C-9.02.04L	demonstrate knowledge of regulatory requirements pertaining to sewage treatment systems	identify codes, standards and regulations pertaining to sewage treatment systems

Range of Variables

components include: pumps, siphons, filters, ejectors, tanks (septic, holding), controls, distribution box, strainers, lift stations, leaching beds, backwater valves, compression seals, covers, grates, alarms, sensors

factors include: location (system position, clearances, relation to water table, sensitive areas), soil conditions/properties (percolation test, soil test), expected daily volume of sewage

tools and equipment include: rigging, hoisting and lifting equipment, excavation machinery

hazards include: identifying existing services, equipment depth, soil conditions, trenching, confined spaces, hoists, oxygen quality, heights, health, environmental

C-9.03 Tests sewage treatment systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-9.03.01P	select and use ***testing equipment***	***testing equipment*** is selected according to specifications and AHJ, and used to detect ***faults*** and confirm operation of sewage treatment system
C-9.03.02P	perform systems check to analyze performance	systems check is performed to analyze performance according to design specifications and AHJ
C-9.03.03P	perform ***tests***	***tests*** are performed according to ***specifications*** and AHJ

Range of Variables

testing equipment include: flange blanks, test plugs, sewer camera
faults include: leaks, inadequate grade, corrosion, malfunctioning alarms and sensors
tests include: pressure, visual inspection
specifications include: manufacturers', job site, contractual requirements

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-9.03.01L	demonstrate knowledge of sewage treatment systems, their characteristics, applications and operation	identify types of sewage treatment systems, and describe their characteristics and applications
		describe operating principles of sewage treatment systems
C-9.03.02L	demonstrate knowledge of procedures to test sewage treatment systems	identify ***testing equipment*** used to test sewage treatment systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to testing sewage treatment systems
		describe procedures to inspect sewage treatment systems
		describe procedures to test sewage treatment systems
C-9.03.03L	demonstrate knowledge of training and certification requirements pertaining to sewage treatment systems	identify training and certification requirements pertaining to sewage treatment systems
C-9.03.04L	demonstrate knowledge of regulatory requirements pertaining to sewage treatment systems	identify codes, standards and regulations pertaining to sewage treatment systems

Range of Variables

testing equipment include: flange blanks, test plugs, sewer camera
hazards include: confined spaces, hoists, oxygen quality, heights, health, environmental

C-9.04 Services sewage treatment systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-9.04.01P	inspect piping and ***components***	piping and ***components*** are inspected for ***conditions requiring service***
C-9.04.02P	interpret client information	client information is interpreted to assist in diagnostic process
C-9.04.03P	select and use tools and equipment	tools and equipment are selected and used according to application
C-9.04.04P	perform scheduled servicing of system	scheduled servicing of system is performed according to system specifications and AHJ
C-9.04.05P	verify operation of sewage treatment system	operation of sewage treatment system is verified according to system design
C-9.04.06P	determine whether ***components*** require replacement or repair	***components*** are determined to be in need of replacement or repair
C-9.04.07P	determine required isolation of system	isolation of system is determined according to service required
C-9.04.08P	notify client of need to isolate and execute isolation	client is notified and isolation is executed
C-9.04.09P	clean ***components***	***components*** are cleaned according to maintenance schedule, AHJ and company policies to prolong life of system and adequate flow
C-9.04.10P	replace ***components***	***components*** are replaced according to specifications and AHJ
C-9.04.11P	repair ***components***	***components*** are repaired according to specifications and AHJ
C-9.04.12P	complete required ***documentation***	***documentation*** is completed according to AHJ and company policies
C-9.04.13P	return system to service and verify system operation	system is returned to service and system operation is verified according to system design

Range of Variables

components include: pumps, siphons, filters, ejectors, tanks (septic, holding), controls, distribution box, strainers, lift stations, leaching chambers, backwater valves, compression seals, covers, grates, alarms, sensors

conditions requiring service include: wear, noise, leaks, corrosion

documentation includes: service reports, maintenance reports

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-9.04.01L	demonstrate knowledge of sewage treatment systems, their ***components***, characteristics, applications and operation	identify types of sewage treatment systems, and their ***components*** and describe their characteristics and applications
		describe operating principles of sewage treatment systems
		interpret information pertaining to sewage treatment systems found on drawings and specifications
		identify ***factors*** to consider when servicing sewage treatment systems
		describe importance of filling out service ***documentation*** related to maintenance and repair
		identify potential environmental and health impacts involved during servicing of sewage treatment systems, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
C-9.04.02L	demonstrate knowledge of procedures to service sewage treatment systems	identify tools and equipment used to service sewage treatment systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to servicing sewage treatment systems
		describe procedures to inspect sewage treatment systems and their ***components***
		describe procedures to replace sewage treatment systems and their ***components***
		describe procedures to repair sewage treatment systems and their ***components***

		describe procedures to protect sewage treatment systems and their ***components***
		describe procedures to maintain sewage treatment systems and their ***components***
		describe procedures to troubleshoot sewage treatment systems and their ***components***
C-9.04.03L	demonstrate knowledge of regulatory requirements pertaining to sewage treatment systems	identify codes, standards and regulations pertaining to sewage treatment systems

Range of Variables

components include: pumps, siphons, filters, ejectors, tanks (septic, holding), controls, distribution box, strainers, lift stations, leaching chambers, backwater valves, compression seals, covers, grates, alarms, sensors

factors include: AHJ, maintenance schedule, specifications, condition of sewage treatment system

documentation includes: service reports, maintenance reports

hazards include: identifying existing services, equipment depth, soil conditions, trenching, confined spaces, hoists, oxygen quality, heights, health, environmental

Task C-10 Installs, tests and services interior drainage, waste and vent (DWV) systems

Task Descriptor

Plumbers install both underground and above-ground piping and components for DWV systems. Underground systems are defined as piping systems in direct contact with the earth. Embedded components are encased in concrete or other materials. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

C-10.01 Plans layout and sizes piping for interior drainage, waste and vent (DWV) systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-10.01.01P	identify ***fixtures and equipment***	***fixtures and equipment*** are identified for hydraulic load using drawings and specifications
C-10.01.02P	select piping material	piping material is selected according to codes, specifications, AHJ and site requirements

C-10.01.03P	design piping layout	piping layout is designed according to codes, specifications, AHJ and site conditions
C-10.01.04P	coordinate work with other tradespeople	work with other tradespeople is coordinated according to schedule and spacing requirements
C-10.01.05P	identify roofs and paved surfaces	roofs and paved surfaces are identified for hydraulic load calculated
C-10.01.06P	calculate total hydraulic load of building	total hydraulic load of building is calculated according to tables in codes
C-10.01.07P	size sanitary drainage system and associated vent piping	sanitary drainage system and associated vent piping are sized by calculating total hydraulic load according to codes and AHJ
C-10.01.08P	size storm drainage system	storm drainage system is sized by calculating total hydraulic load according to codes and AHJ

Range of Variables

fixtures and equipment include: condensate drains, sump pumps, sinks, water closets, lavatories, showers, bathtubs

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-10.01.01L	demonstrate knowledge of interior DWV systems, their piping arrangements, purposes, characteristics and applications	identify interior DWV systems and their piping arrangements, and describe their purposes, characteristics and applications
		identify ***fixtures and equipment***, and describe their characteristics and applications
		identify ***storm system components***, and describe their characteristics and applications
		interpret information pertaining to interior DWV systems found on drawings and specifications
C-10.01.02L	demonstrate knowledge of procedures to plan layout and size piping for interior DWV systems	describe procedures to plan layout of interior DWV systems relating to location of structural penetrations and supports
		describe safe work practices to size interior DWV systems
		describe procedures to size piping for interior DWV systems
		describe ***procedures to determine hydraulic load*** on sanitary DWV systems
		describe ***procedures to determine hydraulic load*** on storm systems
		describe procedures to grade piping for interior DWV systems

		describe procedures to determine and transfer grade and elevation measurements for interior DWV systems
		identify practices that reduce material waste
C-10.01.03L	demonstrate knowledge of regulatory requirements pertaining to interior DWV systems	identify codes, standards and regulations pertaining to interior DWV systems
C-10.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to interior DWV systems	identify technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies that reduce environmental impacts

Range of Variables

fixtures and equipment include: condensate drains, sump pumps, sinks, water closets, lavatories, showers, bathtubs

storm system components include: piping, roof drains, area drains, fire stopping, expansion joints

procedures to determine hydraulic load include: conversion factors, code requirements

C-10.02 Installs underground piping and components for interior drainage, waste and vent (DWV) systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-10.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
C-10.02.02P	identify benchmark	benchmark is identified to set grade or offset for piping
C-10.02.03P	lay out piping and ***components***	piping and ***components*** are laid out according to drawings, codes, specifications, AHJ, and site requirements and conditions
C-10.02.04P	calculate required grade of piping	required grade of piping is calculated according to codes and AHJ
C-10.02.05P	ensure excavation and compaction of trench	excavation and compaction of trench is ensured to prevent settling of piping and ***components***
C-10.02.06P	install required pipe and ***components*** to proper grade	required pipe and ***components*** are installed to proper grade according to codes and AHJ

C-10.02.07P	determine elevation and set ***components***	elevation of ***components*** is determined and set in relation to finished floor
C-10.02.08P	protect and prepare pipe and ***components***	pipe and ***components*** are protected and prepared for backfill
C-10.02.09P	backfill trench	trench is backfilled once testing is complete using appropriate material and ensuring adequate protection of piping according to codes and AHJ

Range of Variables

tools and equipment include: tampers, jackhammers, levels (laser, builder's), excavation equipment

components include: drains, sumps, trap seal primer (TSP), compression seals, cleanouts, pipes, interceptors

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-10.02.01L	demonstrate knowledge of interior DWV systems, their ***components***, purposes, characteristics, applications and operation	identify interior DWV systems and their ***components***, and describe their purposes, characteristics and applications
		describe operating principles of interior DWV systems
		interpret information pertaining to interior DWV systems found on drawings and specifications
		identify ***methods of backflow protection*** used in interior DWV systems
		identify ***factors*** to consider when installing interior DWV system ***components***
		identify potential environmental, biohazard and health impacts involved during installation of interior DWV systems, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
C-10.02.02L	demonstrate knowledge of procedures to lay out and install underground piping and ***components*** for interior DWV systems	identify ***tools and equipment*** used to lay out and install underground piping and ***components*** for interior DWV systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of underground piping and ***components*** for interior DWV systems
		describe procedures to lay out and install underground piping and ***components*** for interior DWV systems
		describe procedures to protect underground piping and ***components*** for interior DWV systems

		describe procedures to determine and transfer grade and elevation for underground piping and ***components*** for interior DWV systems
		describe ***procedures to install*** underground piping and ***components*** for interior DWV systems in trenches
		describe procedures to grade piping for underground interior DWV systems
		identify practices that reduce material waste
C-10.02.03L	demonstrate knowledge of regulatory requirements pertaining to interior DWV systems	identify codes, standards and regulations pertaining to interior DWV systems

Range of Variables

components include: drains, sumps, trap seal primer (TSP), compression seals, cleanouts, pipes, interceptors

methods of backflow protection include: backwater valves, gate valves

factors include: hydraulic load, code requirements

tools and equipment include: tampers, jackhammers, levels (laser, builder's), excavation equipment

hazards include: identifying existing services, equipment depth, soil conditions, trenching, confined spaces, hoists, oxygen quality, chemical fumes from glues, environmental

procedures to install include: safety considerations, support, protection

C-10.03 Installs above-ground piping and components for interior drainage, waste and vent (DWV) systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-10.03.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
C-10.03.02P	select piping material	piping material is selected according to codes, specifications, AHJ and site requirements
C-10.03.03P	lay out piping and ***components***	piping and ***components*** are laid out according to drawings, codes, specifications, AHJ, and site requirements and conditions
C-10.03.04P	calculate required grade of piping	required grade of piping is calculated according to codes

C-10.03.05P	install supports and hangers	supports and hangers are installed according to drawings, codes, specifications and AHJ
C-10.03.06P	prepare and protect piping and ***components***	piping and ***components*** are prepared for testing and protected from site conditions and thermal expansion
C-10.03.07P	install piping and ***components***	piping and ***components*** are installed to grade according to codes, specifications and AHJ

Range of Variables

tools and equipment include: torches, tubing cutters, hand and power saws, snap cutters

components include: drains, trap seal primer (TSP), cleanouts, pipes, interceptors, carriers, roof drains, area drains, fire stopping, expansion joints, wall plates, hangers, supports

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-10.03.01L	demonstrate knowledge of interior DWV systems, their ***components***, purposes, characteristics, applications and operation	identify interior DWV systems and their ***components***, and describe their purposes, characteristics and applications
		describe operating principles of interior DWV systems
		interpret information pertaining to interior DWV systems found on drawings and specifications
		identify ***methods of backflow protection*** used in interior DWV systems
		identify ***factors*** to consider when installing interior DWV system ***components***
		identify types of hangers and supports used to install interior DWV systems
		identify potential environmental and health impacts involved during installation of interior DWV systems, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
C-10.03.02L	demonstrate knowledge of procedures to lay out and install above-ground piping and ***components*** for interior DWV systems	identify ***tools and equipment*** used to layout and install above-ground piping and ***components*** for interior DWV systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to interior DWV systems
		describe procedures to install above-ground piping and ***components*** for interior DWV systems

		describe procedures to install hangers and supports for interior DWV systems
		describe procedures to protect above-ground piping and ***components*** for interior DWV systems
		describe procedures to determine and transfer grade and elevation for above-ground piping in interior DWV systems
		describe procedures to grade piping for interior DWV systems
		identify practices that reduce material waste
C-10.03.03L	demonstrate knowledge of regulatory requirements pertaining to interior DWV systems	identify codes, standards and regulations pertaining to interior DWV systems

Range of Variables

components include: drains, trap seal primer (TSP), cleanouts, pipes, interceptors, carriers, roof drains, area drains, fire stopping, expansion joints, wall plates, hangers, supports

methods of backflow protection include: backwater valves, gate valves, air breaks

factors include: hydraulic load, code requirements, AHJ

tools and equipment include: torches, tubing cutters, hand and power saws, snap cutters

hazards include: identifying existing services, confined spaces, hoists, oxygen quality, heights, chemical fumes, environmental

C-10.04 Tests interior drainage, waste and vent (DWV) systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-10.04.01P	select and use ***testing equipment***	***testing equipment*** is selected and used to detect ***faults*** and confirm operation of interior DWV system
C-10.04.02P	perform systems check to analyze performance	systems check is performed to analyze performance according to system design and AHJ
C-10.04.03P	perform ***pressure test***	***pressure test*** is performed according to codes and AHJ
C-10.04.04P	perform ***final test***	***final test*** is performed using required ***testing equipment***

Range of Variables

testing equipment includes: inflatable test balls, mechanical test plugs, gauge, smoke generating machine, compressor, test can

faults include: leaks, inadequate grade

pressure tests include: hydrostatic test, pneumatic test

final tests include: smoke test, 25-mm water column (WC) test

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-10.04.01L	demonstrate knowledge of interior DWV systems, their purposes, characteristics, applications and operation	identify types of interior DWV systems, and describe their purposes, characteristics and applications
		describe operating principles of interior DWV systems
C-10.04.02L	demonstrate knowledge of procedures used for testing interior DWV systems	identify ***testing equipment*** used to test interior DWV systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to interior DWV systems
		describe procedures to inspect interior DWV systems
		describe procedures to test interior DWV systems
C-10.04.03L	demonstrate knowledge of regulatory requirements pertaining to interior DWV systems	identify codes, standards and regulations pertaining to interior DWV systems

Range of Variables

testing equipment includes: inflatable test balls, mechanical test plugs, gauge, smoke generating machine, compressor, test can

hazards include: flooding, confined spaces, hoists, oxygen quality, heights, health, environmental

C-10.05 Services interior drainage, waste and vent (DWV) systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
C-10.05.01P	interpret client information	client information is interpreted to assist in diagnostic process
C-10.05.02P	inspect piping and ***components***	piping and ***components*** are inspected for ***conditions requiring service***
C-10.05.03P	select and use tools and equipment	tools and equipment are selected and used according to application
C-10.05.04P	perform scheduled servicing of systems	scheduled servicing of system is performed according to system design and AHJ
C-10.05.05P	verify operation of DWV system	operation of DWV system is verified according to system design
C-10.05.06P	determine whether pipes and ***components*** require replacement or repair	pipes and ***components*** are determined to be in need of replacement or repair
C-10.05.07P	determine required isolation of system	isolation of system is determined according to service requirements
C-10.05.08P	notify client of need to isolate and execute isolation	client is notified and isolation is executed
C-10.05.09P	clean pipe and ***components***	pipe and ***components*** are cleaned according to AHJ to prolong life of system and ensure adequate flow
C-10.05.10P	replace pipe and ***components***	pipe and ***components*** are replaced according to specifications
C-10.05.11P	repair pipe and ***components***	pipe and ***components*** are repaired according to specifications
C-10.05.12P	complete required ***documentation***	***documentation*** is completed according to AHJ, company policies and building authority
C-10.05.13P	return system to service and verify system operation	system is returned to service and system operation is verified according to system design

Range of Variables

components include: fittings, pipe, valves, sewage sumps, sewage lift, interceptors, specialty traps, expansion joints, backwater valves, trap seal primers (TSP)

conditions requiring service include: wear, noise, leaks, corrosion, blockage, sewer gas

documentation includes: service reports, maintenance reports

	Knowledge	
	Learning Outcomes	**Learning Objectives**
C-10.05.01L	demonstrate knowledge of interior DWV systems, their ***components***, purposes, characteristics, applications and operation	identify types of interior DWV systems and their ***components***, and describe their purposes, characteristics and applications
		describe operating principles of interior DWV systems
		identify ***conditions requiring service***
		identify potential environmental and health impacts involved during servicing of interior DWV systems, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
C-10.05.02L	demonstrate knowledge of procedures to service interior DWV systems	identify tools and equipment used to service interior DWV systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to interior DWV systems
		describe procedures to inspect interior DWV systems
		describe procedures to service interior DWV systems
		describe procedures and ***components used to protect*** interior DWV systems and buildings
C-10.05.03L	demonstrate knowledge of regulatory requirements pertaining to interior DWV systems	identify codes, standards and regulations pertaining to interior DWV systems

Range of Variables

components include: fittings, pipe, valves, sewage sumps, sewage lift, interceptors, specialty traps, expansion joints, backwater valves, trap seal primers (TSP)

conditions requiring service include: wear, noise, leaks, corrosion, blockage, sewer gas

hazards include: flooding, identifying existing services, equipment depth, soil conditions, trenching, confined spaces, hoists, oxygen quality, heights, health, environmental

components used to protect include: expansion joints, wall plates, fire stopping, insulation, thrust blocks

Major Work Activity D
Installs, tests and services water service and distribution

Task D-11 Installs, tests and services water service

Task Descriptor

By connecting piping from the municipal or private water supply to the water distribution system, plumbers make water available for use. Plumbers determine water demand in order to be able to size and install piping and equipment. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

D-11.01 Plans layout and sizes piping and components for water service

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-11.01.01P	identify demand flow requirements	demand flow requirements are identified according to codes, specifications and AHJ
D-11.01.02P	calculate required peak demand flow for water service	peak demand flow is calculated considering fire protection requirements for residential/commercial/industrial applications and system demand according to specifications and AHJ
D-11.01.03P	design piping layout	piping layout is designed according to codes, specifications, AHJ and site conditions
D-11.01.04P	determine size of water service pipe	size of water service pipe is determined according to ***factors to consider for sizing piping***, water service tables in codes, specifications and AHJ

Range of Variables

factors to consider for sizing pipe include: total number of fixture units, types of fixtures being served, developed length of pipe, type of pipe, most remote outlet, difference in elevation, available system pressure, flow velocity

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-11.01.01L	demonstrate knowledge of water service piping, their components, characteristics and applications	identify ***types of water service*** and describe their characteristics and applications
		identify ***factors to consider for sizing pipe*** for water service
		interpret information pertaining to water service found on drawings and specifications
		calculate piping size requirements for water service based on peak flow demand
		identify water service tables in codes
		identify materials that can be reconditioned, reused or recycled
D-11.01.02L	demonstrate knowledge of procedures to size pipe for water service	describe procedures to determine elevation, friction loss, velocity and required pressure for water service
		describe procedures to size pipe for water service
D-11.01.03L	demonstrate knowledge of regulatory requirements pertaining to sizing pipe for water service	identify codes, standards and regulations pertaining to sizing pipe for water service

Range of Variables

types of water service include: rural, residential, commercial, industrial, remote

factors to consider for sizing pipe include: total number of fixture units, types of fixtures being served, developed length of pipe, type of pipe, most remote outlet, difference in elevation, available system pressure, flow velocity

D-11.02 Installs piping for water service

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-11.02.01P	select piping materials, fittings and water service ***components*** for water service installation	piping materials, fittings and water service ***components*** are selected according to codes, specifications, AHJ and site requirements
D-11.02.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application

D-11.02.03P	lay out location and elevation of water service	location and elevation of water service is laid out according to drawings, specifications, AHJ and site requirements
D-11.02.04P	lay out piping and ***components***	piping and ***components*** are laid out according to codes, specifications, AHJ and site conditions
D-11.02.05P	verify pipe elevation	pipe elevation is verified according to codes, specifications, AHJ and site requirements
D-11.02.06P	select and coordinate placement of bedding and backfilling material	bedding and backfilling material are selected and placed according to codes, specifications and AHJ
D-11.02.07P	align piping and fittings	piping and fittings are aligned to facilitate joint assembly
D-11.02.08P	install fittings	fittings are installed according to codes, specifications and AHJ
D-11.02.09P	install ***restraints and supports***	***restraints and supports*** are installed according to codes and AHJ
D-11.02.10P	install heat tracing and insulation	heat tracing and insulation is installed according to drawings, codes, specifications, AHJ and site requirements

Range of Variables

components include: corporation main stop, expansion loop, curb stop, meters, main shut-off, cathodic protection, backflow prevention

tools and equipment include: wrenches, saws, pipe cutters, excavation equipment, brazing equipment, levels, measuring tape, hot tapping machine, transit levels, thermal fusion equipment

restraints and supports include: thrust blocks, mechanical restraints, anchors, rods, tie rods

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-11.02.01L	demonstrate knowledge of water service piping and ***components***, their characteristics and applications	identify water service piping and ***components,*** and describe their characteristics and applications
		identify factors to consider in determining elevation for water service piping
		identify materials that can be reconditioned, reused or recycled
D-11.02.02L	demonstrate knowledge of procedures to install water service piping and ***components***	identify ***tools and equipment*** to install water service piping and ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of water services
		describe procedures to lay out and install water service piping in trenches
		describe procedures to install water service piping and their associated ***restraints and supports***

		describe ***procedures to protect*** water service piping
		describe procedures to install water service piping and ***components***
		identify practices that reduce material waste
D-11.02.03L	demonstrate knowledge of regulatory requirements pertaining to water services in residential and ICI applications	identify codes, standards and regulations pertaining to water services in residential and ICI applications
D-11.02.04L	demonstrate knowledge of ***emerging technologies*** and practices pertaining to water services	identify ***emerging technologies*** pertaining to water services

Range of Variables

components include: corporation main stop, expansion loop, curb stop, meters, main shut-off, cathodic protection, backflow prevention

tools and equipment include: wrenches, saws, pipe cutters, excavation equipment, brazing equipment, levels, measuring tape, hot tapping machine, transit levels, thermal fusion equipment

hazards include: trenching, confined work space, electrical hazards, weather, machinery, falling/tripping hazards

restraints and supports include: thrust blocks, mechanical restraints, anchors, rods, tie rods

procedures to protect include: insulating, supporting, backfilling, identification, heat tracing, cathodic protection

emerging technologies include: remote wireless meters

D-11.03 Installs components for water service

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-11.03.01P	select and assemble water service ***components***	water service ***components*** are selected and assembled according to codes, specifications, AHJ and site requirements
D-11.03.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-11.03.03P	connect water service ***components***	water service ***components*** are connected to water service according to codes, specifications, AHJ and site requirements

Range of Variables

components include: water meters, isolation valves, cross connection control devices, check valves, expansion devices, pumps, pressure-reducing valves

tools and equipment include: ratchets, jointing equipment, wrenches, levels, measuring tape, cutters, hoisting and lifting equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-11.03.01L	demonstrate knowledge of water service ***components***, their characteristics, applications and operation	identify types of water service ***components*** and describe their characteristics and applications
		describe operating principles of water service ***components***
		identify potential environmental and health impacts of installing water service ***components***, and describe prevention of cross-contamination
		identify materials that can be reconditioned, reused or recycled
D-11.03.02L	demonstrate knowledge of procedures to install water service ***components***	identify ***tools and equipment*** used to install water service ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of water service ***equipment components***
		describe procedures to install water service ***components***
		describe ***procedures to protect*** water service ***components***
D-11.03.03L	demonstrate knowledge of training and certification requirements pertaining to installation of water service ***components***	identify training and certification requirements pertaining to installation of water service ***components***
D-11.03.04L	demonstrate knowledge of regulatory requirements pertaining to installation of water service ***components***	identify codes, standards and regulations pertaining to installation of water service ***components***
D-11.03.05L	demonstrate knowledge of ***emerging technologies*** and practices pertaining to installation of water service ***components***	identify ***emerging technologies*** pertaining to installation of water service ***components***

Range of Variables

components include: water meters, isolation valves, cross connection control devices, check valves, expansion devices, pumps, pressure-reducing valves

tools and equipment include: ratchets, jointing equipment, wrenches, levels, measuring tape, cutters, hoisting and lifting equipment

hazards include: blowouts, heavy and unbalanced objects, insufficient equipment supports

procedures to protect include: frost box installation, backfilling, heat tracing, insulating

emerging technologies include: wireless remote meters, modulating pumps

D-11.04 Tests water service piping and components

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

Skills

	Performance Criteria	Evidence of Attainment
D-11.04.01P	perform hydrostatic test	hydrostatic test is performed to determine leaks and operation according to codes and AHJ
D-11.04.02P	perform sensory inspection	sensory inspection is performed to detect water service leaks
D-11.04.03P	document test results and commission system	test results are documented using digital equipment or by written report according to AHJ, and system is commissioned

Knowledge

	Learning Outcomes	Learning Objectives
D-11.04.01L	demonstrate knowledge of water service piping and ***components***, their characteristics and applications	identify types of water service piping and ***components***, and describe their characteristics and applications
		describe operating principles of water service ***components***
		identify potential environmental and health impacts of testing water service piping and ***components***, and describe associated prevention measures
D-11.04.02L	demonstrate knowledge of procedures used for testing water service piping and ***components***	identify tools and equipment used to test water service piping and ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to testing water service piping and ***components***
		describe procedures to inspect water service piping and ***components***
		describe procedures to test water service piping and ***components***
D-11.04.03L	demonstrate knowledge of training and certification requirements pertaining to water service piping and ***components***	identify training and certification requirements pertaining to water service piping and ***components***
D-11.04.04L	demonstrate knowledge of regulatory requirements pertaining to water service piping and ***components***	identify codes, standards and regulations pertaining to water service piping and ***components***

Range of Variables

components include: water meters, isolation valves, cross connection control devices, check valves, expansion devices, pumps, pressure-reducing valves

hazards include: sudden release of energy, flooding, electrical hazards

D-11.05 Services water service piping and components

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-11.05.01P	interpret client information	client information is interpreted to assist in diagnostic process
D-11.05.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-11.05.03P	inspect water service piping and ***components***	water service piping and ***components*** is inspected for ***conditions requiring service***
D-11.05.04P	determine whether water service piping and ***components*** require replacement or repair	water service piping and ***components*** are determined to be in need of replacement or repair according to industry standards
D-11.05.05P	clean water service piping and ***components***	water service piping and ***components*** are ***cleaned*** to prolong life of system and to ensure adequate flow according to specifications, industry standards and drinking water quality standards
D-11.05.06P	replace water service piping and ***components***	water service piping and ***components*** are replaced according to codes, specifications and AHJ
D-11.05.07P	repair water service piping and ***components***	water service piping and ***components*** are repaired according to codes, specifications and AHJ
D-11.05.08P	complete required ***documentation***	***documentation*** is completed according to AHJ, company policies and building authority
D-11.05.09P	return system to service and verify operation	system is returned to service and operation is verified according to specifications and AHJ

Range of Variables

tools and equipment include: wrenches, saws, pipe cutters, excavation equipment, soldering and brazing equipment

components include: water meters, isolation valves, cross connection control devices, check valves, expansion devices, pumps, pressure-reducing valves

conditions requiring service includes: wear, leaks, corrosion, damage

cleaned includes: chlorination (for private water services), flushing, swabbing

documentation includes: service reports, maintenance reports, checklists

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-11.05.01L	demonstrate knowledge of water services and ***components***, their characteristics, applications and operation	identify ***types of water service***, and describe their characteristics and applications
		identify water service piping and ***components***, and describe their characteristics and applications
		describe operating principles of water services
		identify ***conditions requiring service***
		identify potential environmental and health impacts involved during servicing, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
D-11.05.02L	demonstrate knowledge of procedures to service water services	identify ***tools and equipment*** used to service water service systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to servicing water services
		describe procedures to inspect water service piping and ***components***
		describe procedures to maintain water service piping and ***components***
		describe ***procedures to protect*** water service piping and ***components***
D-11.05.03L	demonstrate knowledge of training and certification requirements pertaining to servicing water services	identify training and certification requirements pertaining to servicing water services
D-11.05.04L	demonstrate knowledge of regulatory requirements pertaining to water services	identify codes, standards and regulations pertaining to water services
D-11.05.05L	demonstrate knowledge of ***emerging technologies*** and practices pertaining to water services	identify ***emerging technologies*** pertaining to servicing water services

Range of Variables

components include: water meters, isolation valves, cross connection control devices, check valves, expansion devices, pumps, pressure-reducing valves

types of water service include: rural, residential, commercial, industrial, remote

conditions requiring service includes: wear, leaks, corrosion, damage

tools and equipment include: wrenches, saws, pipe cutters, excavation equipment, soldering and brazing equipment

hazards include: electrical hazards, cave-ins, confined spaces, chemical hazards, burns

procedures to protect include: frost box installation, backfilling, shoring, heat tracing, insulating, thrust blocks

emerging technologies include: re-lining water services, inspecting and locating equipment, infrared leak detection equipment, freeze packs

Task D-12 Installs, tests and services potable water distribution systems

Task Descriptor

Plumbers install potable water distribution systems by connecting the piping from the water service to equipment and fixtures. Plumbers must select the appropriate materials and properly size the system to deliver adequate water supply. By installing cross connection devices, the water supply is protected from contamination. In some jurisdictions plumbers may be required to attain additional training to install and certify cross connection devices. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

D-12.01 Plans layout and sizes piping and components for potable water distribution systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-12.01.01P	identify peak demand flow requirements	peak demand flow requirements are identified according to codes and AHJ
D-12.01.02P	calculate required peak demand flow for potable water distribution system	peak demand flow is calculated considering fixtures, potable water distribution ***components*** and other system demands according to codes, AHJ, NFPA and specifications
D-12.01.03P	determine size of water distribution pipe and ***components***	size of water distribution pipe and ***components*** is determined according to ***site considerations***, water distribution tables in codes, specifications and AHJ
D-12.01.04P	design piping layout	piping layout is designed according to codes, specifications, AHJ and site conditions

Range of Variables

components include: pumps, pressure reducing valves, hot water tanks, tempering valves, cross connection devices, pressure tanks, water treatment equipment, flow controls

site considerations include: total number of fixture units, developed length of pipe, most remote outlet, difference in elevation, velocity, available system pressure, type of fixture, type of pipe, friction loss

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-12.01.01L	demonstrate knowledge of potable water distribution systems and ***components***, their characteristics and applications	identify ***types of potable water distribution systems***, and describe their characteristics and applications
		identify potable water distribution ***components***, and describe their characteristics and applications
		identify ***site considerations*** and ***components*** for potable water distribution systems
		interpret information pertaining to potable water distribution system found on drawings and specifications
		identify materials that can be reconditioned, reused or recycled
D-12.01.02L	demonstrate knowledge of procedures to size piping and ***components*** for potable water distribution systems	describe procedures to size piping and ***components*** for potable water distribution systems
		describe procedures to determine elevation, friction loss and required pressure for potable water distribution systems
D-12.01.03L	demonstrate knowledge of regulatory requirements pertaining to sizing piping and ***components*** for potable water distribution systems	identify codes, standards and regulations pertaining to sizing piping and ***components*** for potable water distribution systems

Range of Variables

types of potable water distribution systems include: public, private, residential, ICI

components include: pumps, pressure reducing valves, hot water tanks, tempering valves, cross connection devices, pressure tanks, water treatment equipment, flow controls

site considerations include: total number of fixture units, developed length of pipe, most remote outlet, difference in elevation, velocity, available system pressure, type of fixture, type of pipe, friction loss

D-12.02 Installs piping for potable water distribution systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-12.02.01P	select piping materials and fittings for potable water distribution system	piping materials and fittings for potable water distribution system are selected according to codes, specifications, AHJ and site requirements
D-12.02.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-12.02.03P	lay out piping and ***components***	piping and ***components*** are laid out according to codes, specifications, AHJ and site conditions
D-12.02.04P	drill, cut and sleeve adequately sized holes for piping	holes for piping are drilled, cut and sleeved according to specifications
D-12.02.05P	install piping ***components***	piping ***components*** are installed according to codes, specifications and AHJ
D-12.02.06P	install ***supports***	***supports*** are installed according to codes and AHJ
D-12.02.07P	insulate distribution system	distribution system is insulated according to drawings, codes, specifications, AHJ and site requirements
D-12.02.08P	label and stencil pipe	pipe is labelled and stenciled for pipe identification according to AHJ and site requirements

Range of Variables

tools and equipment include: soldering and brazing equipment, crimping tools, solvents, cutters, expansion tools, compression tools, measuring tape, levels, grooving tools

components include: piping, fittings, valves, shock arrestors, cross connection devices, expansion tanks, flow controls

supports include: riser clamps, hangers

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-12.02.01L	demonstrate knowledge of potable water distribution piping and ***components***	identify potable water distribution piping and ***components***, and describe their characteristics and applications
		identify locations for potable water distribution piping and ***components***
		interpret information pertaining to piping for potable water distribution found on drawings and specifications

		identify potential environmental and health impacts of incorrect installation of potable water distribution piping and ***components*** and associated prevention measures
		identify materials that can be reconditioned, reused or recycled
D-12.02.02L	demonstrate knowledge of procedures to install potable water distribution piping and ***components*** for potable water distribution systems	identify ***tools and equipment*** used to install potable water distribution piping and ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of piping and ***components*** for potable water distribution systems
		describe procedures to lay out potable water distribution piping and ***components***
		describe procedures to install potable water distribution piping and ***components***
		describe ***procedures to protect*** potable water distribution piping and ***components***
D-12.02.03L	demonstrate knowledge of regulatory requirements pertaining to piping for potable water distribution	identify codes, standards and regulations pertaining to piping for potable water distribution

Range of Variables

components include: piping, fittings, valves, shock arrestors, cross connection devices, expansion tanks, flow controls

tools and equipment include: soldering and brazing equipment, crimping tools, solvents, cutters, expansion tools, compression tools, measuring tape, levels, grooving tools

hazards include: confined spaces, working at heights, noxious fumes, biohazards

procedures to protect include: installing shock arrestors and expansion joints, insulating

D-12.03 Installs components for potable water distribution systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-12.03.01P	select potable water distribution ***components***	potable water distribution ***components*** are selected according to codes, specifications and AHJ
D-12.03.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-12.03.03P	connect potable water distribution ***components***	potable water distribution ***components*** are connected according to codes, specifications and AHJ

Range of Variables

components include: isolation valves, supply connectors, check valves, couplings, unions, flanges, shock arrestors, expansion joints (bellows), flow controls, pumps, pressure reducing valves, hot water tanks, tempering valves, cross connection devices, pressure tanks, water treatment equipment, on-demand hot water system

tools and equipment include: pipe wrenches, adjustable wrenches, soldering and brazing equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-12.03.01L	demonstrate knowledge of potable water distribution equipment and ***components***, their characteristics, applications and operation	identify potable water distribution equipment and ***components***, and describe their characteristics and applications
		describe operating principles of potable water distribution ***components***
		interpret information pertaining to potable water distribution ***components*** found on drawings and specifications
		explain water hammer, its causes and methods of prevention or control
		identify potential environmental and health impacts of installing potable water distribution ***components***, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
D-12.03.02L	demonstrate knowledge of procedures to install potable water distribution ***components***	identify ***tools and equipment*** used to install potable water distribution equipment and ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation potable water distribution ***components***
		describe procedures to install potable water distribution ***components***
D-12.03.03L	demonstrate knowledge of expansion calculations	perform expansion calculations
D-12.03.04L	demonstrate knowledge of regulatory requirements to install potable water distribution ***components***	identify codes, standards and regulations to install potable water distribution ***components***
D-12.03.05L	demonstrate knowledge of ***emerging technologies*** and practices pertaining to installing potable water distribution ***components***	identify ***emerging technologies*** pertaining to installing potable water distribution ***components***

Range of Variables

components include: isolation valves, supply connectors, check valves, couplings, unions, flanges, shock arrestors, expansion joints (bellows), flow controls, pumps, pressure reducing valves, hot water tanks, tempering valves, cross connection devices, pressure tanks, water treatment equipment, on-demand hot water system

tools and equipment include: pipe wrenches, adjustable wrenches, soldering and brazing equipment

hazards include: burns, working at heights, confined spaces, cross connections

emerging technologies include: drain water heat recovery units, alternative water heating systems (solar, geothermal)

D-12.04 Installs cross connection controls

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-12.04.01P	determine ***level of hazard*** and select ***cross connection controls***	***level of hazard*** is determined, and ***cross connection controls*** are selected for hazard according to ***standards***, codes and AHJ
D-12.04.02P	determine location of ***cross connection controls***	location of ***cross connection controls*** is determined to allow for accessibility for servicing and testing, and according to ***level of hazard***, ***standards***, codes and AHJ
D-12.04.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-12.04.04P	connect ***cross connection control*** devices to piping	***cross connection control*** devices are connected to piping according to ***standards***, codes, specifications and AHJ
D-12.04.05P	arrange for testing and commissioning of ***cross connection controls***	testing and commissioning of ***cross connection controls*** are arranged according to ***standards*** and AHJ

Range of Variables

levels of hazard are: low (minor), moderate, severe

cross connection controls include: reduced pressure backflow preventer (RPBP), double check valve assembly, dual check valve, air break, air gap, barometric loop

standards include: American Water Works Association (AWWA),CSA-B64.10, American Society of Sanitary Engineering (ASSE)

tools and equipment include: wrenches, soldering and brazing equipment, rigging and hoisting equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-12.04.01L	demonstrate knowledge of ***cross-connection controls***, their characteristics, applications and operation	identify types of ***cross connection controls***, and describe their characteristics and applications
		describe operating principles of ***cross-connection controls***
		identify ***levels of hazard*** related to ***cross connection controls***
		interpret information pertaining to ***cross connection controls*** found on drawings, specifications and AHJ
		explain back siphonage and back pressure and their causes
		identify potential environmental and health impacts related to ***cross connection controls***, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
D-12.04.02L	demonstrate knowledge of procedures to install ***cross connection controls***	identify ***tools and equipment*** to install and use ***cross connection controls***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of ***cross connection controls***
		describe procedures to install ***cross connection controls***
D-12.04.03L	demonstrate knowledge of training and certification requirements pertaining to ***cross connection controls***	identify training and certification requirements pertaining to ***cross connection controls***
D-12.04.04L	demonstrate knowledge of regulatory requirements pertaining to ***cross connection controls***	identify codes, ***standards*** and regulations pertaining to ***cross connection controls***

Range of Variables

cross connection controls include: reduced pressure backflow preventer (RPBP), double check valve assembly, dual check valve, air break, air gap, barometric loop

levels of hazard are: low (minor), moderate, severe

tools and equipment include: wrenches, soldering and brazing equipment, rigging and hoisting equipment

hazards include: heavy loads, working at heights, burns

standards include: American Water Works Association (AWWA),CSA-B64.10, American Society of Sanitary Engineering (ASSE)

D-12.05 Tests potable water distribution systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-12.05.01P	select and use ***testing equipment***	***testing equipment*** is selected and used to detect ***faults*** and confirm operation of potable water distribution system according to ***standards***, codes and AHJ
D-12.05.02P	perform sensory inspection	sensory inspection is performed to detect potable water distribution system ***faults***
D-12.05.03P	perform systems check	systems check is performed to analyze system performance
D-12.05.04P	check, set and adjust pressures	pressures are checked to detect system problems, and set and adjusted to correct operating pressures
D-12.05.05P	arrange for testing and commissioning of ***cross connection controls***	testing and commissioning of ***cross connection controls*** are arranged according to ***standards*** and AHJ

Range of Variables

testing equipment includes: gauges, pumps, air compressors

faults include: ruptures, leaks, manufacturers' imperfections

standards include: AWWA, CSA-B64.10, ASSE

cross connection control devices include: RPBP, air break, double check valve assembly, dual check valve

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-12.05.01L	demonstrate knowledge of potable water distribution systems, their ***components***, characteristics, applications and operation	identify potable water distribution systems and ***components***, and describe their characteristics and applications
		describe operating principles of potable water distribution systems
		identify potable water distribution system ***components*** that require testing
		identify ***faults*** in potable water distribution systems
D-12.05.02L	demonstrate knowledge of procedures to test potable water distribution systems	identify ***testing equipment*** for potable water distribution systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to testing potable water distribution systems

		describe procedures to inspect potable water distribution systems
		describe procedures to test potable water distribution systems
D-12.05.03L	demonstrate knowledge of training and certification requirements pertaining to testing potable water distribution systems	identify training and certification requirements pertaining to testing potable water distribution systems
D-12.05.04L	demonstrate knowledge of regulatory requirements pertaining to testing potable water distribution systems	identify codes, ***standards*** and regulations pertaining to testing potable water distribution systems

Range of Variables

components include: pumps, pressure reducing valves, hot water tanks, tempering valves, cross connection devices, relief devices, pressure tanks, water treatment equipment, isolation valves, supply connectors, check valves, couplings, unions, flanges, shock arrestors, expansion joints (bellows), flow controls

faults include: ruptures, leaks, manufacturers' imperfections

testing equipment includes: gauges, pumps, air compressors

hazards include: sudden release of energy, flooding, electrical hazards

standards include: AWWA, CSA-B64.10, ASSE

D-12.06 Services potable water distribution systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-12.06.01P	interpret client information	client information is interpreted to assist in diagnostic process
D-12.06.02P	inspect potable water distribution system	potable water distribution system is inspected for ***conditions requiring service***
D-12.06.03P	select and use ***tools and equipment*** required for repairs	***tools and equipment*** are selected and used according to application
D-12.06.04P	perform sensory inspection	sensory inspection is performed to detect potable water distribution system for ***conditions requiring service***
D-12.06.05P	lubricate pumps and bearings	pumps and bearings are lubricated according to manufacturers' recommendations to prevent wear
D-12.06.06P	clean and change filters and strainers	filters and strainers are cleaned and changed according to manufacturers' recommendations to maintain water quality, prolong life of system and maintain adequate flow

D-12.06.07P	adjust potable water distribution system ***components***	potable water distribution system ***components*** are adjusted according to specifications
D-12.06.08P	determine required isolation of system	isolation of system is determined according to service required
D-12.06.09P	notify client of need to isolate and execute isolation	client is notified and isolation is completed
D-12.06.10P	replace and repair potable water distribution system ***components***	potable water distribution system ***components*** are replaced and repaired
D-12.06.11P	check and adjust pressures	pressures are checked and adjusted to maintain system performance and to detect system problems
D-12.06.12P	sample and check potable ***water conditions***	potable ***water conditions*** are sampled and checked according to AHJ to identify necessary repairs
D-12.06.13P	perform scheduled service of systems	scheduled servicing of system is performed according to specifications
D-12.06.14P	return system to service and verify system operation	system is returned to service and system operation is verified according to specifications
D-12.06.15P	complete required ***documentation***	***documentation*** is completed according to AHJ, company policies and building authority

Range of Variables

conditions requiring service include: leaks, wear, cleanliness, water quality

tools and equipment include: hand and power tools, freeze packs, pipe cutters, torches

components include: pumps, pressure reducing valves, flow controls, expansion tanks, hot water tanks, tempering valves, cross connection devices, relief devices, pressure tanks, water treatment equipment, isolation valves, supply connectors, check valves, couplings, unions, flanges, shock arrestors, expansion joints (bellows)

water conditions include: pH, iron content, bacterial content, H_2S, total dissolved solids (TDS), chlorine content, manganese content

documentation includes: checklists, preventative maintenance documents, workplace hazard assessments, hot work permits, inspection reports

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-12.06.01L	demonstrate knowledge of potable water distribution systems and ***components***, their characteristics, applications and operation	identify types of potable water distribution systems, and describe their characteristics and applications
		identify potable water distribution system ***components***, and describe their characteristics and applications
		describe operating principles of potable water distribution systems

		identify ***water conditions*** of potable water distribution systems that require service
		identify potential environmental and health impacts of service, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
D-12.06.02L	demonstrate knowledge of procedures to service potable water distribution systems	identify ***tools and equipment*** used to service potable water distribution systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to servicing potable water distribution systems
		describe procedures to inspect potable water distribution systems
		describe procedures to service potable water distribution system ***components***
		describe ***procedures to protect*** potable water distribution systems
D-12.06.03L	demonstrate knowledge of procedures to service cross connection control devices	identify ***tools and equipment*** used to service cross connection control devices, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to servicing cross connection control devices
		describe procedures to service cross connection control devices
D-12.06.04L	demonstrate knowledge of training and certification requirements pertaining to servicing potable water distribution systems	identify training and certification requirements pertaining to servicing potable water distribution systems
D-12.06.05L	demonstrate knowledge of regulatory requirements pertaining to servicing potable water distribution system	identify codes, standards and regulations pertaining to servicing potable water distribution system

Range of Variables

components include: pumps, pressure reducing valves, flow controls, expansion tanks, hot water tanks, tempering valves, cross connection devices, relief devices, pressure tanks, water treatment equipment, isolation valves, supply connectors, check valves, couplings, unions, flanges, shock arrestors, expansion joints (bellows)

water conditions include: pH, iron content, bacterial content, H_2S, total dissolved solids (TDS), chlorine content, manganese content

tools and equipment include: hand and power tools, freeze packs, pipe cutters, torches

hazards include: sudden release of energy, flooding, electrical hazards

procedures to protect include: installing frost box, heat tracing, insulation

Task D-13 Installs, tests and services private water pressure systems

Task Descriptor

Plumbers install systems that maintain pressure within private water distribution systems. The pressure system installation requires sizing and installing piping, equipment and other components that reduce or increase pressure as required. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

D-13.01 Plans layout and sizes piping and components for private water pressure systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-13.01.01P	calculate required peak flow demand	peak flow demand is calculated according to codes, specifications, AHJ and site requirements
D-13.01.02P	design piping layout	piping layout is designed according to ***factors***, codes, specifications and AHJ
D-13.01.03P	determine size of piping, and ***pressure system components***	size of piping, and **pressure system *components*** are determined by calculating elevations, distances and fittings
D-13.01.04P	select ***pressure system components***	***pressure system components*** are selected according to elevation and distance calculations
D-13.01.05P	determine sizing of ***private water pressure system*** equipment	sizing of ***private water pressure system*** equipment is determined based on ***water source factors***

Range of Variables

factors include: environmental, number of fixtures, water usage, water source, type of pipe, water treatment equipment, friction loss, site conditions

pressure system components include: pressure tanks, pumps, controls

private water pressure systems include: shallow well, deep well, dugouts, natural freshwater sources (springs, rivers, lakes, ponds), cisterns, artesian well

water source factors include: drawdown, yield, depth, distance

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-13.01.01L	demonstrate knowledge of ***private water pressure systems*** and ***pressure system components***, and their characteristics and applications	identify types of ***private water pressure systems*** and ***pressure system components,*** and describe their characteristics and applications
		identify ***water source factors*** to consider for sizing ***pressure system components***
		interpret information pertaining to ***private water pressure systems*** found on drawings and specifications
D-13.01.02L	demonstrate knowledge of procedures to size ***pressure system components***	describe procedures to size ***pressure system components***
D-13.01.03L	demonstrate knowledge of regulatory requirements pertaining to ***private water pressure systems***	identify codes, standards and regulations pertaining to ***private water pressure systems***
D-13.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to ***private water pressure systems***	identify emerging technologies and practices pertaining to ***private water pressure systems***

Range of Variables

private water pressure systems include: shallow well, deep well, dugouts, natural freshwater sources (springs, rivers, lakes, ponds), cisterns, artesian well

pressure system components include: pressure tanks, pumps, controls

water source factors include: drawdown, yield, depth, distance

D-13.02 Installs piping for private water pressure systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-13.02.01P	determine required piping materials	required piping materials are determined according to codes, specifications, AHJ and site requirements
D-13.02.02P	select and use ***tools and equipment***	***tools and equipment*** are used according to application
D-13.02.03P	lay out piping and ***components***	piping and ***components*** are laid out according to codes, specifications, AHJ and site conditions
D-13.02.04P	connect piping to ***components***	piping is connected to ***components*** according to application

Range of Variables

tools and equipment include: hand and power tools, soldering and brazing equipment

components include: foot valves, clamps, pumps, pressure tanks, controls, relief valves, shut-off valves, air volume controls, drain valves, pitless adapter, torque arrestors, cable guards, pressure switch, water treatment equipment, backflow preventer

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-13.02.01L	demonstrate knowledge of ***private water pressure systems***, their characteristics and applications	identify types of ***private water pressure systems***, and describe their characteristics and applications
		identify private water pressure system ***components***, and describe their characteristics and applications
		interpret information pertaining to ***private water pressure systems*** found on drawings and specifications
		identify potential environmental and health impacts of installing ***private water pressure systems***, and describe associated prevention measures
D-13.02.02L	demonstrate knowledge of procedures to install piping for ***private water pressure systems***	identify ***tools and equipment*** used to install piping for ***private water pressure systems***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of piping for ***private water pressure systems***
		describe procedures to install piping for ***private water pressure systems***
		describe ***procedures to protect*** piping for ***private water pressure systems***
		perform calculations using ***formulas***
D-13.02.03L	demonstrate knowledge of regulatory requirements pertaining to ***private water pressure systems***	identify codes, standards and regulations pertaining to ***private water pressure systems***

Range of Variables

private water pressure systems include: shallow well, deep well, dugouts, natural freshwater sources (springs, rivers, lakes, ponds), cisterns, artesian well

components include: foot valves, clamps, pumps, pressure tanks, controls, relief valves, shut-off valves, air volume controls, drain valves, pitless adapter, torque arrestors, cable guards, pressure switch, water treatment equipment, backflow preventer

tools and equipment include: hand and power tools, soldering and brazing equipment

hazards include: confined space, burns, weather, electrical, excavations

procedures to protect include: backfilling, insulating, sleeving, heat tracing

formulas include: Boyle's Law, volume, flow, total dynamic head (TDH)

D-13.03 Installs components for private water pressure systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-13.03.01P	determine private water pressure system ***components*** required for installation	private water pressure system ***components*** required for installation are determined according to application
D-13.03.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
D-13.03.03P	assemble private water pressure system ***components***	private water pressure system ***components*** are assembled according to codes, AHJ and specifications
D-13.03.04P	attach ***rigging***	***rigging*** is attached to private water pressure system ***components*** to facilitate removal, service and repair
D-13.03.05P	determine and coordinate power and control connection requirements	power and control connection requirements are determined and coordinated according to electrical code

Range of Variables

components include: foot valves, clamps, pumps, pressure tanks, controls, relief valves, shut-off valves, air volume controls, drain valves, pitless adapter, torque arrestors, cable guards, pressure switch, water treatment equipment, backflow preventer

tools and equipment include: hand and power tools, soldering and brazing equipment, rigging and hoisting equipment

rigging includes: rope, chains, cable, shackles

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-13.03.01L	demonstrate knowledge of ***private water pressure systems***, their characteristics and applications	identify types of ***private water pressure systems***, and describe their characteristics and applications
		identify private water pressure system ***components***, and describe their characteristics and applications
		identify ***types of pumps***, and describe their components, characteristics and applications
		describe operating principles of private water pressure system ***components***

		identify potential environmental and health impacts of installing private water pressure system ***components***, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
D-13.03.02L	demonstrate knowledge of procedures to install private water pressure system ***components***	identify ***tools and equipment*** used to install private water pressure system ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of private water pressure system ***components***
		describe procedures to install private water pressure system ***components***
		describe procedures to install pumps for pressures systems
		describe energy-saving practices
D-13.03.03L	demonstrate knowledge of basic concepts of electricity	interpret electrical related information found on drawings and specifications
		describe characteristics and applications of electricity related to pumps and controls
		explain ***basic electrical principles***
D-13.03.04L	demonstrate knowledge of procedures used to test electrical circuits	identify ***electrical testing tools*** used to test electrical circuits, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to testing electrical circuits
		describe procedures to test electrical circuits
D-13.03.05L	demonstrate knowledge of training and certification requirements pertaining to installation of private water pressure system ***components***	identify training and certification requirements pertaining to installation of private water pressure system ***components***
D-13.03.06L	demonstrate knowledge of regulatory requirements pertaining to installation of private water pressure system ***components***	identify codes, standards and regulations pertaining to installation of private water pressure system ***components***
D-13.03.07L	demonstrate knowledge of emerging technologies and practices pertaining to installation of private water pressure system ***components***	identify emerging technologies and practices pertaining to private water pressure system ***components***

Range of Variables

private water pressure systems include: shallow well, deep well, dugouts, natural freshwater sources (springs, rivers, lakes, ponds), cisterns, artesian well

components include: foot valves, clamps, pumps, pressure tanks, controls, relief valves, shut-off valves, air volume controls, drain valves, pitless adapter, torque arrestors, cable guards, pressure switch, water treatment equipment, backflow preventer

types of pumps include: shallow well, deep well, submersible, jet, booster

tools and equipment include: hand and power tools, soldering and brazing equipment, rigging and hoisting equipment

hazards include: electrocution, confined spaces, chemicals, weather, flooding

basic electrical principles include: Ohm's Law, bonding, grounding, phases

electrical testing tools include: multimeters, circuit meters, ohmmeters

D-13.04 Tests private water pressure systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-13.04.01P	charge system and inspect for ***faults***	system is charged and inspected for ***faults***
D-13.04.02P	perform sensory inspection	sensory inspection is performed to detect plumbing ***system problems***
D-13.04.03P	perform systems check	systems check is performed to analyze performance
D-13.04.04P	check and adjust pressures	pressures are checked and adjusted to detect ***system problems***
D-13.04.05P	perform water quality test	water quality test is performed to identify ***properties***

Range of Variables

faults include: debris, leaks, cracks, manufacturers' defects

system problems include: pressure differentials, air lock, cavitation, electrical faults

properties include: manganese, chlorine, bacteria, hydrogen sulfide, hardness, pH

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-13.04.01L	demonstrate knowledge of ***private water pressure systems***, their characteristics and applications	identify types of ***private water pressure systems***, and describe their characteristics and applications
		identify private water pressure system ***components***, and describe their characteristics and applications
		describe operating principles of ***private water pressure systems***
D-13.04.02L	demonstrate knowledge of procedures to test ***private water pressure systems***	identify ***testing equipment*** used for ***private water pressure systems***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to testing private water pressure system ***components***
		describe procedures to inspect private water pressure system ***components***
		describe procedures to test private water pressure system ***components***
D-13.04.03L	demonstrate knowledge of regulatory requirements pertaining to ***private water pressure systems***	identify codes, standards and regulations pertaining to ***private water pressure systems***

Range of Variables

private water pressure systems include: shallow well, deep well, dugouts, natural freshwater sources (springs, rivers, lakes, ponds), cisterns, artesian well

components include: foot valves, clamps, pumps, pressure tanks, controls, relief valves, shut-off valves, air volume controls, drain valves, pitless adapter, torque arrestors, cable guards, pressure switch, water treatment equipment, backflow preventer

testing equipment includes: pressure gauges, multimeters, water quality test kit

hazards include: sudden release of energy, electrocution, confined spaces, chemicals, weather, flooding

D-13.05 Services private water pressure systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
D-13.05.01P	interpret client information	client information is interpreted to assist in diagnostic process
D-13.05.02P	inspect private water pressure system ***components***	private water pressure system ***components*** are inspected for ***conditions requiring service***

D-13.05.03P	perform sensory inspection	sensory inspection is performed to detect ***conditions requiring service*** in ***private water pressure systems***
D-13.05.04P	lubricate pumps and bearings	pumps and bearings are lubricated according to specifications using ***materials*** to prevent wear of components
D-13.05.05P	clean and change filters and strainers	filters and strainers are cleaned and changed according to specifications to maintain water quality, prolong life of system and maintain adequate flow
D-13.05.06P	perform water quality test	water quality test is performed to identify ***properties***
D-13.05.07P	adjust private water pressure system ***components***	private water pressure system ***components*** are adjusted according to specifications
D-13.05.08P	check and adjust pressures	pressures are checked and adjusted as required to maintain system performance and to detect system problems
D-13.05.09P	select and use tools and equipment	tools and equipment are selected and used according to application
D-13.05.10P	determine required isolation of ***private water pressure systems***	isolation of ***private water pressure systems*** is determined according to service requirements
D-13.05.11P	notify client of need to isolate	client is notified and isolation is executed according to repair needs
D-13.05.12P	determine whether private water pressure system ***components*** require replacement or repair	replacement or repair of private water pressure system ***components*** is determined
D-13.05.13P	replace and repair private water pressure system ***components***	private water pressure system ***components*** are replaced or repaired as required
D-13.05.14P	perform scheduled service of systems	scheduled servicing of system is performed according to specifications
D-13.05.15P	return system to service and verify system operation	system is returned to service and system operation is verified according to system design
D-13.05.16P	complete required documentation	documentation is completed according to specifications and company policies

Range of Variables

components include: foot valves, clamps, pumps, pressure tanks, controls, relief valves, shut-off valves, air volume controls, drain valves, pitless adapter, torque arrestors, cable guards, pressure switch, water treatment equipment, backflow preventer

conditions requiring service includes: wear, noise, leaks, corrosion, electrical faults

private water pressure systems include: shallow well, deep well, dugouts, natural freshwater sources (springs, rivers, lakes, ponds), cisterns, artesian well

materials include: graphite, grease, oil, silicone

properties include: manganese, chlorine, bacteria, hydrogen sulfide, hardness, pH

	Knowledge	
	Learning Outcomes	**Learning Objectives**
D-13.05.01L	demonstrate knowledge of ***private water pressure systems*** and ***components***, their characteristics and applications	identify types of ***private water pressure systems***, and describe their characteristics and applications
		identify private water pressure system ***components***, and describe their characteristics and applications
		describe operating principles of ***private water pressure systems***
		identify ***conditions requiring service***
		compare performance data with specifications pertaining to servicing ***private water pressure systems***
		identify potential environmental and health impacts of service, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
D-13.05.02L	demonstrate knowledge of procedures to service ***private water pressure systems***	identify tools and equipment to service ***private water pressure systems***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to servicing ***private water pressure systems***
		describe procedures to inspect ***private water pressure systems***
		describe procedures to service private water pressure system ***components***
D-13.05.03L	demonstrate knowledge of training and certification requirements pertaining to servicing ***private water pressure systems***	identify training and certification requirements pertaining to ***private water pressure systems***
D-13.05.04L	demonstrate knowledge of regulatory requirements pertaining to ***private water pressure systems***	identify codes, standards and regulations pertaining to ***private water pressure systems***
D-13.05.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***private water pressure systems***	identify emerging technologies and practices pertaining to ***private water pressure systems***

Range of Variables

private water pressure systems include: shallow well, deep well, dugouts, natural freshwater sources (springs, rivers, lakes, ponds), cisterns, artesian well

components include: foot valves, clamps, pumps, pressure tanks, controls, relief valves, shut-off valves, air volume controls, drain valves, pitless adapter, torque arrestors, cable guards, pressure switch, water treatment equipment, backflow preventer

conditions requiring service includes: wear, noise, leaks, corrosion, electrical faults

hazards include: sudden release of energy, electrocution, confined spaces, chemicals, weather, flooding

Major Work Activity E
Installs, tests and services fixtures, appliances and water treatment systems

Task E-14 Installs, tests and services plumbing fixtures and appliances

Task Descriptor

Plumbers install fixtures and appliances in a variety of buildings. Plumbers must take care in the installation of fixtures and appliances since this is an important stage of the plumbing installation process.

Plumbing fixtures and appliances are connected to the water and/or drainage and/or electrical or fuel systems.

For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

E-14.01 Installs fixture supports

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-14.01.01P	lay out fixture and mark backing location	fixture is laid out and backing location is marked according to drawings, specifications, codes and AHJ
E-14.01.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
E-14.01.03P	install backing	backing is installed to ensure stability of fixture
E-14.01.04P	assemble ***fixture supports***	***fixture supports*** are assembled according to specifications
E-14.01.05P	mount supports to floor and walls	supports are mounted to floor and walls level and plumb using fasteners
E-14.01.06P	set up a grouping of ***fixture supports***	grouping of ***fixture supports*** are set up to ensure grade, spacing and alignment
E-14.01.07P	complete installation of ***fixture supports***	installation of ***fixture supports*** is completed in coordination with other trades

Range of Variables

tools and equipment include: hand and power tools
fixture supports include: brackets, carriers, wood backing, flanges

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-14.01.01L	demonstrate knowledge of plumbing ***fixture supports***, their characteristics and applications	identify types of plumbing ***fixture supports***, and describe their characteristics and applications
		interpret information pertaining to plumbing ***fixture supports*** found on drawings and specifications
		identify materials that can be reconditioned, reused or recycled
E-14.01.02L	demonstrate knowledge of procedures to install plumbing ***fixture supports***	identify tools and equipment used to install plumbing ***fixture supports***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of ***fixture supports***
		describe procedures to install plumbing ***fixture supports***
E-14.01.03L	demonstrate knowledge of regulatory requirements pertaining to ***fixture supports***	identify codes, standards and regulations pertaining to ***fixture supports***

Range of Variables

fixture supports include: brackets, carriers, wood backing, flanges
hazards include: dust, power tools, pinch points, strains

E-14.02 Installs plumbing fixtures and appliances

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-14.02.01P	select and use ***tools and equipment***	***tools and equipment*** are selected and used to install plumbing ***fixtures*** and ***appliances***
E-14.02.02P	verify rough-ins of carriers, plumbing connections, and ***fixture*** and ***appliance*** dimensions	rough-ins of carriers and plumbing connections are verified to be in appropriate locations, and ***fixture*** and ***appliance*** dimensions are matched according to drawings, codes, specifications and AHJ
E-14.02.03P	complete assembly and adjustment of ***fixture*** and ***appliance*** supports	***fixture*** and ***appliance*** supports are assembled and adjusted to ensure proper installation (off-site and on-site)
E-14.02.04P	select ***fixtures***, ***appliances*** and ***trim***	***fixtures***, ***appliances*** and ***trim*** are selected for specific application according to drawings, codes, specifications and AHJ
E-14.02.05P	install ***fixtures*** and ***appliances***	***fixtures*** and ***appliances*** are installed plumb and level and are secured according to specifications and AHJ
E-14.02.06P	verify operation of ***fixtures*** and ***appliances***	operation of ***fixtures*** and ***appliances*** is verified according to specifications

Range of Variables

tools and equipment include: hand and power tools
fixtures include: showers, water closets, lavatories, urinals, sinks, tubs
appliances include: water heaters, coffee machines, ice makers, dishwashers, sanitizers
trim include: dispensers, cover plates, shower heads, grab bars

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-14.02.01L	demonstrate knowledge of plumbing ***fixtures*** and ***appliances***, their characteristics, applications and operation	identify types of plumbing ***fixtures*** and ***appliances***, and describe their characteristics, applications and operation
		identify fixture and appliance ***trim***, and describe their characteristics and applications
		describe operating principles of plumbing ***fixtures*** and ***appliances***
		interpret information pertaining to plumbing ***fixtures*** and ***appliances***

		identify potential environmental and health impacts of installing plumbing ***fixtures*** and ***appliances*** and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
E-14.02.02L	demonstrate knowledge of procedures to install plumbing ***fixtures*** and ***appliances***	identify ***tools and equipment*** used to install plumbing ***fixtures*** and ***appliances***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation plumbing ***fixtures*** and ***appliances***
		describe procedures to install plumbing ***fixtures*** and ***appliances***
		describe ***energy-saving practices***
E-14.02.03L	demonstrate knowledge of regulatory requirements to install plumbing ***fixtures*** and ***appliances***	identify codes, standards and regulations pertaining to installing plumbing ***fixtures*** and ***appliances***
E-14.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to installing plumbing ***fixtures*** and ***appliances***	identify emerging technologies pertaining to ***fixtures*** and ***appliances***

Range of Variables

fixtures include: showers, water closets, lavatories, urinals, sinks, tubs

appliances include: water heaters, coffee machines, ice makers, dishwashers, sanitizers

trim include: dispensers, cover plates, shower heads, grab bars

tools and equipment include: hand and power tools

hazards include: dust, power tools, pinch points, sharp edges, slivers, strains

energy-saving practices include: low-flow faucets, water closets, metering faucets, mixing valves, recirculating lines

E-14.03 Tests plumbing fixtures and appliances

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-14.03.01P	select and use ***testing tools***	***testing tools*** are selected and used to detect ***faults***
E-14.03.02P	perform sensory inspection	sensory inspection is performed to detect plumbing ***fixture*** and ***appliance faults***
E-14.03.03P	perform systems check	systems check is performed to analyze operation and performance according to codes, specifications and AHJ
E-14.03.04P	adjust plumbing ***fixtures*** and ***appliances***	plumbing ***fixtures*** and ***appliances*** are adjusted for operation according to specifications and AHJ

Range of Variables

testing tools include: thermometers, voltmeters, pressure meters
faults include: leaks, inadequate operation, cracks
fixtures include: showers, water closets, lavatories, urinals, sinks, tubs
appliances include: water heaters, coffee machines, ice makers, dishwashers, sanitizers

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-14.03.01L	demonstrate knowledge of plumbing ***fixtures*** and ***appliances***, their characteristics, applications and operation	identify types of plumbing ***fixtures*** and ***appliances***, and describe their characteristics, applications and operation
		describe operating principles of plumbing ***fixtures*** and ***appliances***
E-14.03.02L	demonstrate knowledge of procedures used for testing plumbing ***fixtures*** and ***appliances***	identify ***testing tools*** used to test plumbing ***fixtures*** and ***appliances***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to plumbing ***fixtures*** and ***appliances***
		describe procedures to inspect and test plumbing ***fixtures*** and ***appliances***
E-14.03.03L	demonstrate knowledge of regulatory requirements pertaining to plumbing ***fixtures*** and ***appliances***	identify codes, standards and regulations pertaining to plumbing ***fixtures*** and ***appliances***

Range of Variables

fixtures include: showers, water closets, lavatories, urinals, sinks, tubs
appliances include: water heaters, coffee machines, ice makers, dishwashers, sanitizers
testing tools include: thermometers, voltmeters, pressure meters
hazards include: sudden release of energy, flooding, electrocution

E-14.04 Services plumbing fixtures and appliances

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-14.04.01P	interpret client information	client information is interpreted to assist in diagnostic process
E-14.04.02P	inspect plumbing ***fixtures*** and ***appliances***	***fixtures*** and ***appliances*** are inspected for ***faults***
E-14.04.03P	perform sensory inspection	sensory inspection is performed to detect faults in plumbing ***fixtures*** and ***appliances***
E-14.04.04P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
E-14.04.05P	perform scheduled servicing of plumbing ***fixtures*** and ***appliances***	scheduled servicing of plumbing ***fixtures*** and ***appliances*** is performed according to specifications and client requests
E-14.04.06P	verify operation of plumbing ***fixtures*** and ***appliances***	operation of plumbing ***fixtures*** and ***appliances*** is verified according to specifications
E-14.04.07P	determine whether components require replacement or repair	components are determined to be in need of replacement or repair according to industry standards
E-14.04.08P	determine required isolation of plumbing ***fixtures*** and ***appliances***	isolation of plumbing ***fixtures*** and ***appliances*** is determined according to service requirements
E-14.04.09P	notify client of need to isolate and execute isolation	client is notified and isolation is executed
E-14.04.10P	clean components	components are cleaned to rectify fault, diagnose operation, prolong life of system and maintain adequate flow

E-14.04.11P	replace components	components are replaced according to specifications
E-14.04.12P	repair components	components are repaired according to specifications
E-14.04.13P	complete required ***documentation***	***documentation*** is completed according to AHJ, company policies and building authority
E-14.04.14P	return plumbing ***fixtures*** and ***appliances*** to service and verify their operation	plumbing ***fixtures*** and ***appliances*** are returned to service and operation is verified

Range of Variables

fixtures include: showers, water closets, lavatories, urinals, sinks, tubs
appliances include: water heaters, coffee machines, ice makers, dishwashers, sanitizers
faults include: leaks, inadequate operation, cracks
tools and equipment include: hand and power tools, testing tools
documentation includes: service reports, maintenance reports

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-14.04.01L	demonstrate knowledge of plumbing ***fixtures*** and ***appliances***, their characteristics, applications and operation	identify types of plumbing ***fixtures*** and ***appliances***, their characteristics, applications and operation
		describe operating principles of plumbing ***fixtures*** and ***appliances***
		identify ***trim*** for plumbing ***fixtures*** and ***appliances***, and describe their characteristics and applications
		identify potential environmental and health impacts of service, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
E-14.04.02L	demonstrate knowledge of procedures to service plumbing ***fixtures*** and ***appliances***	identify ***tools and equipment*** used to service plumbing ***fixtures*** and ***appliances***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to plumbing ***fixtures*** and ***appliances***

		describe procedures to inspect, troubleshoot and diagnose plumbing ***fixtures*** and ***appliances***
		describe procedures to service plumbing ***fixtures*** and ***appliances***
		describe procedures to repair and replace plumbing ***fixtures*** and ***appliances***
E-14.04.03L	demonstrate knowledge of regulatory requirements pertaining to plumbing ***fixtures*** and ***appliances***	identify codes, standards and regulations pertaining to plumbing ***fixtures*** and ***appliances***

Range of Variables

fixtures include: showers, water closets, lavatories, urinals, sinks, tubs
appliances include: water heaters, coffee machines, ice makers, dishwashers, sanitizers
trim includes: dispensers, cover plates, shower heads, grab bars
tools and equipment include: hand and power tools, testing tools
hazards include: biohazards, flooding, cuts, strains, electrocution

Task E-15 Installs, tests and services water treatment systems

Task Descriptor

Water treatment systems are used in residential, commercial and institutional buildings to improve the quality of water. Plumbers may be responsible for sizing and installing these systems. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

E-15.01 Sizes water treatment systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-15.01.01P	collect water sample	water sample is collected according to specifications and AHJ
E-15.01.02P	test and analyze sample	sample is tested and analyzed (on-site or in lab) to determine water quality and ***characteristics***
E-15.01.03P	obtain results and interpret data	results are obtained and data is interpreted to determine type of equipment for water treatment requirements

E-15.01.04P	calculate water demand	water demand is calculated to determine size of equipment and according to specifications
E-15.01.05P	select and size ***water treatment system***	***water treatment system*** is selected and sized according to various ***factors***
E-15.01.06P	design piping layout	piping layout is designed according to codes, specifications, AHJ and site conditions

Range of Variables

characteristics include: chemical (hardness, pH), physical (colour, odour, total dissolved solids (TDS), biological (bacteria, algae)

water treatment systems include: filtering, softening, purifying, chemical feeding, sterilizing (UV), reverse osmosis, de-ionizing, neutralizing, distilling

factors include: test results, demand, specifications, service/regeneration intervals, space constraints

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-15.01.01L	demonstrate knowledge of ***water treatment systems***, their characteristics, applications and operation	identify ***water treatment systems***, and describe their characteristics, applications and operation
		interpret information pertaining to ***water treatment systems*** found on drawings and specifications
		identify ***types of water quality problems***, and describe their characteristics and causes
		interpret information pertaining to water quality test results
		identify potential environmental and health impacts of ***water treatment systems***, and describe associated prevention measures
E-15.01.02L	demonstrate knowledge of procedures to plan layout and size piping and equipment for ***water treatment systems***	describe procedures to lay out and size piping and equipment for ***water treatment systems***
E-15.01.03L	demonstrate knowledge of training and certification requirements for testing water quality	identify training and certification requirements to test water quality
E-15.01.04L	demonstrate knowledge of emerging technologies and practices pertaining to ***water treatment systems***	identify emerging technologies pertaining to ***water treatment systems***

Range of Variables

water treatment systems include: filtering, softening, purifying, chemical feeding, sterilizing (UV), reverse osmosis, de-ionizing, neutralizing, distilling

types of water quality problems include: hardness, minerals, contamination/pollution, pH, taste/odour, turbidity

E-15.02 Installs water treatment systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-15.02.01P	determine location of installation	location of installation is determined according to specifications and service requirements
E-15.02.02P	determine installation sequence for water treatment equipment	installation sequence for water treatment equipment is determined according to specifications
E-15.02.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
E-15.02.04P	assemble water treatment equipment	water treatment equipment is assembled according to specifications
E-15.02.05P	plumb and level water treatment equipment	water treatment equipment is plumb and levelled
E-15.02.06P	secure water treatment equipment	water treatment equipment is secured according to specifications and site conditions
E-15.02.07P	connect water and drainage	water and drainage are connected according to codes and specifications
E-15.02.08P	commission ***water treatment system***	***water treatment system*** is commissioned according to specifications
E-15.02.09P	collect and analyze water sample	water sample is collected and analyzed to ensure equipment is operating

Range of Variables

tools and equipment include: hand and power tools, soldering and brazing equipment

water treatment systems include: filtering, softening, purifying, chemical feeding, sterilizing, reverse osmosis, de-ionizing, neutralizing, distilling

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-15.02.01L	demonstrate knowledge of ***water treatment systems***, their characteristics, applications and operation	identify ***water treatment systems***, and describe their characteristics, applications and operation
		interpret information pertaining to ***water treatment systems*** found on drawings and specifications
		identify ***types of water quality problems***, and describe their characteristics and causes

		interpret information pertaining to water quality test results
		identify equipment used (backflow prevention) to protect potable water system from water treatment system, and describe their characteristics and applications
E-15.02.02L	demonstrate knowledge of procedures to install ***water treatment systems***	identify ***tools and equipment*** used to install water treatment equipment, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of water treatment equipment
		describe procedures to install water treatment ***components***
		describe sequence of installation of multiple water treatment ***components*** and their importance
		describe procedures to protect ***water treatment systems***
		describe ***methods of water treatment***
E-15.02.03L	demonstrate knowledge of regulatory requirements to install ***water treatment systems***	identify codes, standards and regulations pertaining to installing ***water treatment systems***
E-15.02.04L	demonstrate knowledge of emerging technologies and practices pertaining to ***water treatment systems***	identify emerging technologies pertaining to ***water treatment systems***

Range of Variables

water treatment systems include: filtering, softening, purifying, chemical feeding, sterilizing, reverse osmosis, de-ionizing, neutralizing, distilling

types of water quality problems include: hardness, minerals, contamination/pollution, pH, taste/odour, turbidity

tools and equipment include: hand and power tools, soldering and brazing equipment

hazards include: sudden release of energy, chemical burns, fumes, chemical reactions, electrocution, burns, flooding, strains

components include: brine tanks, cylinders, UV treatment bulbs, filters

E-15.03 Tests water treatment systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-15.03.01P	select and use ***testing equipment***	***testing equipment*** is selected and used to assess water quality and confirm operation of ***water treatment system***
E-15.03.02P	perform sensory inspection	sensory inspection is performed to detect ***water treatment system faults***
E-15.03.03P	perform systems check	systems check is performed to analyze operation and performance according to AHJ and specifications
E-15.03.04P	adjust water treatment equipment	water treatment equipment is adjusted for optimal operation according to specifications

Range of Variables

testing equipment includes: pH kit, hardness testing kit

water treatment systems include: filtering, softening, purifying, chemical feeding, sterilizing, reverse osmosis, de-ionizing, neutralizing, distilling

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-15.03.01L	demonstrate knowledge of ***water treatment systems***, their characteristics, applications and operation	identify ***water treatment systems***, and describe their characteristics, applications and operation
		interpret information pertaining to ***water treatment systems*** found on drawings and specifications
		identify ***types of water quality problems***, and describe their characteristics and causes
		interpret information pertaining to water quality test results
		identify potential environmental and health impacts of ***water treatment systems***, and describe associated prevention measures
E-15.03.02L	demonstrate knowledge of testing ***water treatment systems***	identify ***testing equipment*** for ***water treatment systems***, and describe their procedures for use
		identify hazards and describe safe work practices pertaining to testing ***water treatment systems***

		describe procedures to inspect ***water treatment systems***
		describe procedures to test ***water treatment systems***
		interpret results of water tests to determine water treatment requirements
E-15.03.03L	demonstrate knowledge of regulatory requirements to test ***water treatment systems***	identify codes, standards and regulations pertaining to testing ***water treatment systems***
E-15.03.04L	demonstrate knowledge of emerging technologies and practices pertaining to ***water treatment systems***	identify emerging technologies pertaining to ***water treatment systems***

Range of Variables

water treatment systems include: filtering, softening, purifying, chemical feeding, sterilizing, reverse osmosis, de-ionizing, neutralizing, distilling

types of water quality problems include: hardness, minerals, contamination/pollution, pH, taste/odour, turbidity

E-15.04 Services water treatment systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
E-15.04.01P	interpret client information	client information is interpreted to assist in diagnostic process
E-15.04.02P	inspect ***water treatment systems***	***water treatment systems*** are inspected to identify ***conditions requiring service***
E-15.04.03P	perform sensory inspection	sensory inspection is performed to detect ***conditions requiring service*** in ***water treatment systems***
E-15.04.04P	select and use tools and equipment	tools and equipment are selected and used according to application
E-15.04.05P	perform scheduled servicing of ***water treatment systems***	scheduled servicing of ***water treatment systems*** is performed according to service requirements
E-15.04.06P	verify operation of ***water treatment systems***	operation of ***water treatment systems*** is verified according to system design and specifications
E-15.04.07P	determine whether ***components*** require replacement or repair	***components*** are determined to be in need of replacement or repair according to industry standard and specifications
E-15.04.08P	determine required isolation of ***water treatment systems***	isolation of ***water treatment systems*** is determined according to system design

E-15.04.09P	notify client of need to isolate and execute isolation	client is notified and isolation is executed
E-15.04.10P	clean ***components***	***components*** are cleaned according to manufacturers' recommendations to prolong life of system and maintain adequate flow
E-15.04.11P	replace ***components***	***components*** are replaced according to specifications and industry standards
E-15.04.12P	repair ***components***	***components*** are repaired according to specifications and industry standards
E-15.04.13P	complete required ***documentation***	***documentation*** is completed according to company policies and building authority
E-15.04.14P	return ***water treatment systems*** to service and verify system operation	***water treatment systems*** are returned to service and system operation is verified according to system design

Range of Variables

water treatment systems include: filtering, softening, purifying, chemical feeding, sterilizing, reverse osmosis, de-ionizing, neutralizing, distilling

conditions requiring service include: wear, noise, leaks, corrosion, contamination, blockage, loss of pressure

components include: brine tanks, cylinders, UV treatment bulbs, filters

documentation includes: service reports, maintenance reports

	Knowledge	
	Learning Outcomes	**Learning Objectives**
E-15.04.01L	demonstrate knowledge of ***water treatment systems***, their characteristics, applications and operation	identify ***water treatment systems***, and describe their characteristics, applications and operation
		interpret information pertaining to ***water treatment systems*** found on drawings and specifications
		identify ***types of water quality problems***, and describe their characteristics and causes
		identify ***conditions requiring service***
		interpret information pertaining to water quality test results
		identify potential environmental and health impacts of ***water treatment systems***, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled

E-15.04.02L	demonstrate knowledge of procedures to service ***water treatment systems***	identify tools and equipment used to service ***water treatment systems***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to servicing ***water treatment systems***
		describe procedures to troubleshoot, maintain and repair ***water treatment systems*** and components
		describe procedures to inspect ***water treatment systems***
		describe procedures to protect ***water treatment systems***
		identify practices that reduce material waste
E-15.04.03L	demonstrate knowledge of emerging technologies and practices pertaining to ***water treatment systems***	identify emerging technologies pertaining to ***water treatment systems***

Range of Variables

water treatment systems include: filtering, softening, purifying, chemical feeding, sterilizing, reverse osmosis, de-ionizing, neutralizing, distilling

types of water quality problems include: hardness, minerals, contamination/pollution, pH, taste/odour, turbidity

conditions requiring service include: wear, noise, leaks, corrosion, contamination, blockage, loss of pressure

hazards include: flooding, electrical hazards, sudden release of energy, strains, slipping

Major Work Activity F
Installs, tests and services low-pressure steam and hydronic systems

Task F-16 Installs, tests and services low-pressure steam systems – Not Common Core

Task Descriptor

Low pressure steam systems are used for processes such as sterilization, humidification, heat exchange and direct heating. This task includes the sizing, installation and testing of piping and components. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

F-16.01 Plans layout and sizes piping and components for low-pressure steam systems - Not Common Core

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-16.01.01P	identify ***load*** requirements	***load*** requirements are identified according to system being used, heat loss calculations, drawings and specifications
F-16.01.02P	design piping layout	piping layout is designed according to codes, specifications, AHJ and site conditions
F-16.01.03P	select required steam generator	required steam generator is selected for ***load*** according to design, system requirements, specifications and AHJ
F-16.01.04P	determine pipe size	pipe size is determined according to ***load*** and distribution requirements per design
F-16.01.05P	select and position ***components***	***components*** are selected and positioned according to design, system requirements, specifications and AHJ
F-16.01.06P	select and position expansion joints	expansion joints are selected and positioned according to design, system requirements, specifications and AHJ

Range of Variables

load includes: domestic water heating, space heating, humidification

components include: traps, strainers, drip legs, valves, pumps, pressure reducing valve (PRV) station, backflow preventer

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-16.01.01L	demonstrate knowledge of low-pressure steam systems, their ***components***, characteristics, applications and operation	identify low-pressure steam systems, and describe their characteristics and applications
		identify types of pipe and ***components***, and describe their characteristics and applications
		describe operating principles of low-pressure steam systems
		identify ***expansion*** methods, and describe their characteristics and applications
		interpret information pertaining to low-pressure steam systems found on drawings and specifications
		perform heat transfer calculations to determine ***loads***
		identify steam generators, and describe their characteristics and applications
F-16.01.02L	demonstrate knowledge of procedures to size pipe and ***components*** for low-pressure steam systems	describe procedures to size pipe and ***components*** for low-pressure steam systems
		describe procedures to calculate linear expansion
		identify practices that reduce material waste
F-16.01.03L	demonstrate knowledge of training and certification requirements pertaining to low-pressure steam systems	identify training and certification requirements pertaining to low-pressure steam systems
F-16.01.04L	demonstrate knowledge of regulatory requirements pertaining to low-pressure steam systems	identify codes, standards and regulations pertaining to low-pressure steam systems
F-16.01.05L	demonstrate knowledge of emerging technologies and practices pertaining to low-pressure steam systems	identify emerging technologies pertaining to boiler efficiency in low-pressure steam systems
		identify energy saving components
		identify insulation practices that contribute to energy savings

Range of Variables

components include: traps, strainers, drip legs, valves, pumps, pressure reducing valve (PRV) station, backflow preventer

expansion includes: bellows, piston, loop, swing joint, offset

load includes: domestic water heating, space heating, humidification

F-16.02 Installs piping and components for low-pressure steam systems - Not Common Core

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

Skills

	Performance Criteria	Evidence of Attainment
F-16.02.01P	fit piping, ***components*** and accessories	piping, ***components*** and accessories are fitted according to drawings, codes, specifications, AHJ and industry standards
F-16.02.02P	lay out piping and ***components***	piping and ***components*** are laid out according to codes, specifications, AHJ and site conditions
F-16.02.03P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-16.02.04P	assist in setting up welding equipment	welding equipment is set up according to AHJ
F-16.02.05P	install piping	piping is installed plumb, level, straight or graded according to system design, specifications and industry practices
F-16.02.06P	locate and install drip legs	drip legs are located and installed according to system design
F-16.02.07P	install condensate pump	condensate pump is installed according to drawings and specifications
F-16.02.08P	select and install steam traps	steam traps are selected and installed to ensure optimum operation of steam system and according to drawings and specifications
F-16.02.09P	install anchors, guides and expansion joints	anchors, guides and expansion joints are installed to control movement of pipe
F-16.02.10P	label and stencil pipe	pipe is labelled and stencilled for pipe identification according to specifications and AHJ
F-16.02.11P	verify operation of system	system is verified to be operating according to system design
F-16.02.12P	record and transfer heat numbers and weld symbols	heat numbers and weld symbols labelled on pipe are recorded and transferred

Range of Variables

components include: traps, strainers, drip legs, valves, pumps, PRV station

tools and equipment include: threading equipment, cutters, oxy-fuel torches, welding equipment

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-16.02.01L	demonstrate knowledge of low-pressure steam systems, their ***components***, characteristics, applications and operation	identify low-pressure steam systems, and describe their characteristics and applications
		identify piping and ***components***, and describe their characteristics and applications
		describe operating principles of low-pressure steam systems
		identify pipe and associated joining methods for low-pressure steam systems
		interpret drawings and determine path for piping providing allowance for ***interferences***, grade, insulation and fire stopping
		describe purpose and procedure for documenting pipe heat numbers and weld symbols according to AHJ and quality control procedures
		identify steam traps, drip legs and condensate pumps, and describe their characteristics and applications
		identify potential environmental and health impacts involved when installing pipe and ***components*** for low-pressure steam systems, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
F-16.02.02L	demonstrate knowledge of procedures to install pipe and ***components*** for low-pressure steam systems	identify ***tools and equipment*** used to install pipe and ***components*** for low-pressure steam systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of pipe and components for low-pressure steam systems
		describe procedures to install pipe and ***components*** for low-pressure steam systems
		describe procedures to perform linear expansion calculations
		identify practices that reduce material waste

F-16.02.03L	demonstrate knowledge of training requirements pertaining to low-pressure steam systems	identify training requirements pertaining to low-pressure steam systems
F-16.02.04L	demonstrate knowledge of regulatory requirements pertaining to low-pressure steam systems	identify codes, standards and regulations pertaining to low-pressure steam systems
F-16.02.05L	demonstrate knowledge of emerging technologies and practices pertaining to low-pressure steam systems	identify emerging technologies pertaining to boiler efficiency in low-pressure steam systems
		identify energy saving components
		identify insulation practices that contribute to energy savings

Range of Variables

components include: traps, strainers, drip legs, valves, pumps, PRV station
interferences include: duct, structural, electrical, other piping
tools and equipment include: threading equipment, cutters, oxy-fuel torches, welding equipment
hazards include: falls, lifting heavy weight, heights, leaks, welding, threading, burns

F-16.03 Tests low-pressure steam systems - Not Common Core

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-16.03.01P	select and use ***testing equipment***	***testing equipment*** is selected and used to detect ***faults*** and to confirm operation of low-pressure steam system
F-16.03.02P	perform ***sensory inspection***	***sensory inspection*** is performed to detect ***problems***
F-16.03.03P	perform and coordinate ***tests***	***tests*** are performed and coordinated according to specifications and AHJ
F-16.03.04P	performs startup and operational testing	startup and operational testing is performed according to specifications and AHJ
F-16.03.05P	complete documentation	documentation is completed according to client requirements, specifications and company policies

Range of Variables

testing equipment include: infrared thermometer, pneumatic compressor, multimeter including thermal accessories

faults include: cracks, corrosion, steam flash

sensory inspection includes: visual, auditory, tactile

problems include: water hammer, inadequate flow, leaks

tests include: pressure, NDT, temperature

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-16.03.01L	demonstrate knowledge of piping and ***components*** for low-pressure steam systems, their characteristics, applications and operation	identify types of piping and ***components*** for low-pressure steam systems, and describe their characteristics and applications
		describe operating principles of low-pressure steam systems
		identify inspection requirements for low-pressure steam piping and ***components*** in order to meet design specifications
		identify potential ***problems*** and ***faults*** with piping and ***components***
F-16.03.02L	demonstrate knowledge of procedures used for testing piping and ***components*** for low-pressure steam systems	identify ***testing equipment*** used for piping and ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to testing piping and ***components*** for low-pressure steam systems
		describe procedures to inspect piping and ***components*** for low-pressure steam systems
		describe procedures to test piping and ***components*** for low-pressure steam systems
		describe procedure for monitoring system for performance deficiencies
F-16.03.03L	demonstrate knowledge of training requirements pertaining to low-pressure steam systems	identify training requirements pertaining to low-pressure steam systems
F-16.03.04L	demonstrate knowledge of regulatory requirements pertaining to low-pressure steam systems	identify codes, standards and regulations pertaining to low-pressure steam systems
F-16.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to low-pressure steam systems	identify emerging technologies pertaining to boiler efficiency in low-pressure steam systems
		identify energy saving components

Range of Variables

components include: traps, strainers, drip legs, valves, pumps, PRV station

problems include: water hammer, inadequate flow, leaks

faults include: cracks, corrosion, steam flash

testing equipment include: infrared thermometer, pneumatic compressor, multimeter including thermal accessories

hazards include: sudden release of energy, component failure, piping failure, burns

F-16.04 Services low-pressure steam systems - Not Common Core

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

Skills

	Performance Criteria	Evidence of Attainment
F-16.04.01P	select and use tools and equipment	tools and equipment are selected and used according to application
F-16.04.02P	interpret client information	client information is interpreted to assist in diagnostic process
F-16.04.03P	perform scheduled service	scheduled servicing of system is performed according to system requirements, specifications and AHJ
F-16.04.04P	verify operation of piping and ***components***	operation of piping and ***components*** is verified according to system design and specifications
F-16.04.05P	inspect piping and ***components***	piping and ***components*** are inspected using ***sensory inspection*** for ***conditions requiring service*** or replacement according to industry standards
F-16.04.06P	identify strategy for isolation, notify client and perform LOTO procedures	strategy for isolation is identified, client is notified and LOTO procedures performed according to required service
F-16.04.07P	clean ***components***	***components*** are cleaned according to specifications to prolong life of system and maintain adequate flow
F-16.04.08P	replace ***components***	***components*** are replaced according to specifications
F-16.04.09P	repair ***components***	***components*** are repaired according to specifications

F-16.04.10P	verify water quality	water is treated according to system requirements
F-16.04.11P	return system to service and verify system operation	system is returned to service and system operation is verified according to system design
F-16.04.12P	complete ***documentation***	***documentation*** is completed according to client requirements, specifications, AHJ and company policies

Range of Variables

components include: traps, strainers, drip legs, valves, pumps, PRV station
sensory inspection includes: visual, auditory, tactile
conditions requiring service include: wear, noise, leaks, corrosion
documentation includes: service reports, maintenance reports, building logbook

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-16.04.01L	demonstrate knowledge of low-pressure steam systems, their characteristics, applications and operation	identify low-pressure steam systems, and describe their characteristics and applications
		describe operating principles of low-pressure steam systems
		interpret drawings, specifications and equipment manuals required for system service
		identify ***conditions requiring service***
		identify strategy for isolation and associated LOTO procedures
		identify potential environmental and health impacts involved during servicing piping and ***components*** for low-pressure steam systems, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
F-16.04.02L	demonstrate knowledge of procedures to service piping and ***components*** for low-pressure steam systems	identify tools and equipment used to service piping and ***components*** for low-pressure steam systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to servicing piping and ***components*** for low-pressure steam systems
		describe procedures to inspect and diagnose problems with piping and ***components***
		describe procedures to service piping and ***components***

		describe procedures to disassemble problem area of system, replace or repair faulty ***components*** and reassemble system
		describe procedures for reinstating system to operating condition and verifying repair
		describe energy-saving practices
		identify practices that reduce material waste
F-16.04.03L	demonstrate knowledge of documenting service for low-pressure steam system	identify program of scheduled service
		identify ***documentation*** pertaining to servicing low-pressure steam systems
F-16.04.04L	demonstrate knowledge of training requirements pertaining to low-pressure steam systems	identify training requirements pertaining to low-pressure steam systems
F-16.04.05L	demonstrate knowledge of regulatory requirements pertaining to low-pressure steam systems	identify codes, standards and regulations pertaining to low-pressure steam systems
F-16.04.06L	demonstrate knowledge of emerging technologies and practices pertaining to low-pressure steam systems	identify emerging technologies pertaining to boiler efficiency in low-pressure steam systems
		identify insulation practices that contribute to energy savings

Range of Variables

conditions requiring service include: wear, noise, leaks, corrosion
components include: traps, strainers, drip legs, valves, pumps, PRV station
hazards include: sudden release of energy, component failure, piping failure, burns, welding, threading
documentation includes: service reports, maintenance reports, building logbook

Task F-17 Installs, tests and services piping and components for hydronic systems

Task Descriptor

While the temperatures of the contents of these systems are different, the piping principles used in a variety of hydronic systems (conventional hydronic, solar, geothermal/ground source heating and cooling) are similar. High and low temperature systems use various or multiple sources and exchangers to provide or remove heat from transfer units. Controls are used to modulate the distribution of temperature throughout the hydronic system. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs. Additional certification may be required in some jurisdictions to allow plumbers to design and install these systems.

F-17.01 Plans layout and sizes piping and components for hydronic systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-17.01.01P	perform room-by-room heat loss and gain calculation	heat loss and gain calculations are performed according to design, building requirements, drawings and specifications
F-17.01.02P	identify total load requirements	total load requirements are identified according to system being used, design, building requirements, drawings and specifications
F-17.01.03P	design piping layout	piping layout is designed according to codes, specifications, AHJ and site conditions
F-17.01.04P	determine pipe type, size and ***piping system design***	pipe type, size and ***piping system design*** are determined according to friction loss, load and distribution requirements
F-17.01.05P	size, identify and determine location of ***components*** and ***control accessories***	***components*** and ***control accessories*** are sized, identified and locations determined according to system being used, design, building requirements, drawings and specifications
F-17.01.06P	calculate and size ***expansion devices***	***expansion devices*** are sized with consideration to expansion calculations

Range of Variables

piping system design includes: one pipe, two pipe, three pipe, four pipe, reverse return, direct return, primary/secondary, injection

components include: valves, air removal devices, circulators, gauges, thermometers, transfer units (terminal heat pumps, fan coil units, radiators, radiant panels, unit heaters), dirt elimination devices, controls

control accessories include: control modules, thermostats, supply sensors, circulator sensors, outdoor temperature sensors, safety devices

expansion devices include: bladder, diaphragm, conventional air cushion, open tank

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-17.01.01L	demonstrate knowledge of fluid fundamentals, and their characteristics and applications	identify and describe fluid fundamentals and their applications
		explain volumetric coefficient differences between various ***fluids***
		calculate linear and volumetric expansion
		describe effects of viscosity for various ***fluids*** through temperature range
		describe difference between laminar and turbulent flow
		describe how velocity and friction loss affects flow characteristics
F-17.01.02L	demonstrate knowledge of factors that impact design	identify factors that impact design, and describe their characteristics and applications
		identify zoning strategies and how they impact piping
		explain point of no pressure change and importance of its location within piping system
		identify how ***piping system design*** affects pipe sizing
		identify environmental factors that impact design
F-17.01.03L	demonstrate knowledge of hydronic systems, piping and ***components***, their characteristics, applications and operation	identify hydronic systems, and describe their characteristics, applications and operation
		identify piping and ***components***, and describe their characteristics, applications and operation
		describe operating principles of hydronic systems
		interpret information found on drawings, and in specifications and equipment manuals pertaining to hydronic systems, piping and ***components***

		identify ***piping system design***, and describe their characteristics and applications
		identify ***fluids*** used in hydronic systems, and describe their characteristics and applications
		identify ***additives*** used in hydronic systems, and describe their characteristics and applications
		identify hydronic system ***control accessories*** and describe their characteristics, applications and operation
F-17.01.04L	demonstrate knowledge of procedures to size piping and ***components*** for hydronic systems	describe procedures to size piping and ***components*** for hydronic systems
		describe procedures for selecting and sizing ***auxiliary equipment***
		describe procedures to calculate heat loss
		describe energy-saving practices
		identify practices that reduce material waste
F-17.01.05L	demonstrate knowledge of training and certification requirements pertaining to hydronic systems	identify training and certification requirements pertaining to hydronic systems
F-17.01.06L	demonstrate knowledge of regulatory requirements pertaining to hydronic systems	identify codes, standards and regulations pertaining to hydronic systems
F-17.01.07L	demonstrate knowledge of emerging technologies and practices pertaining to hydronic systems	identify emerging technologies pertaining to hydronic systems, and describe their characteristics and applications
		identify technologies that contribute to net zero and carbon neutral commitments
		identify VFDs (variable frequency drives), and heat and cooling recovery, and describe their characteristics and applications
		identify building automation technologies, and describe their characteristics and applications

Range of Variables

fluids include: water, brine solutions, glycol

piping system design includes: one pipe, two pipe, three pipe, four pipe, reverse return, direct return, primary/secondary, injection

components include: valves, air removal devices, circulators, gauges, thermometers, transfer units (terminal heat pumps, fan coil units, radiators, radiant panels, unit heaters), dirt elimination devices, controls

additives include: treatment chemicals, rust inhibitors, cleaners

control accessories include: control modules, thermostats, supply sensors, circulator sensors, outdoor temperature sensors, safety devices

auxiliary equipment includes: indirect fired hot water tank, heat exchangers, make-up tank

F-17.02 Installs piping and components for hydronic systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-17.02.01P	determine routing of piping and placement of ***components***	routing of piping and placement of ***components*** are determined according to drawings, specifications, site conditions and ***interferences***, and equipment and component location
F-17.02.02P	identify high points and low points	high points and low points for piping and ***components*** are identified
F-17.02.03P	select and use tools and equipment	tools and equipment are selected and used according to application
F-17.02.04P	determine and install ***provisions for isolation***	***provisions for isolation*** of ***components*** and ***auxiliary equipment*** are determined and installed according to design, specifications and AHJ
F-17.02.05P	lay out piping and ***components***	piping and ***components*** are laid out according to codes, specifications, AHJ and site conditions
F-17.02.06P	position, connect and install piping and ***components*** and ***auxiliary equipment***	piping and ***components*** and ***auxiliary equipment*** are positioned, connected and installed using ***joining methods*** according to system design, drawings, specifications and industry standards
F-17.02.07P	install provisions for expansion, contraction and vibration	expansion, contraction and vibration provisions are installed according to specifications
F-17.02.08P	install transfer units and their components	transfer units and their components are installed according to drawings, specifications and system requirements

F-17.02.09P	install trim	trim is installed according to type and style of transfer unit
F-17.02.10P	install ***air removal devices***	***air removal devices*** are installed according to system requirements and specifications
F-17.02.11P	label and stencil pipe	pipe is labelled and stencilled for pipe identification according to specifications and AHJ

Range of Variables

components include: valves, air removal devices, circulators, gauges, thermometers, transfer units (terminal heat pumps, fan coil units, radiators, radiant panels, unit heaters), dirt elimination devices, controls

interferences include: duct, structural, electrical, other piping

provisions for isolation include: unions, flanges, valves, blanks

auxiliary equipment includes: indirect hot water tank, heat exchangers, make-up tank

joining methods include: threading, soldering, grooving, welding, press fitting

air removal devices include: manual vents, automatic vents, scoops, separator, traps, scrubber

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-17.02.01L	demonstrate knowledge of hydronic systems, piping and ***components***, their characteristics, applications and operation	identify hydronic systems, and describe their characteristics, applications and operation
		identify piping and ***components***, and describe their characteristics, applications and operation
		describe operating principles of hydronic systems
		interpret information found on drawings, and in specifications and equipment manuals pertaining to hydronic systems, piping and ***components***
		describe effects of trapped air in hydronic systems
		identify control strategies for hydronic systems
		identify types of ***auxiliary equipment*** used with hydronic systems, and describe their characteristics, applications and operation
		identify potential environmental and health impacts involved when installing piping and ***components*** for hydronic systems, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled

F-17.02.02L	demonstrate knowledge of procedures to install piping and ***components*** for hydronic systems	identify tools and equipment used to install piping and ***components*** for hydronic systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of piping and ***components*** for hydronic systems
		describe ***joining methods*** for hydronic systems
		describe procedures to install piping, ***components*** and ***auxiliary equipment*** for hydronic systems
		describe ***procedures to protect*** hydronic system ***components***
		describe procedure to add ***fluids*** used in hydronic systems
		describe procedure to add ***additives*** used in hydronic systems
		describe procedures to pre-clean and flush hydronic systems
		describe procedures to protect piping and ***components*** for hydronic systems
		describe energy-saving practices
		identify practices that reduce material waste
F-17.02.03L	demonstrate knowledge of training and certification requirements pertaining to hydronic systems	identify training and certification requirements pertaining to hydronic systems
F-17.02.04L	demonstrate knowledge of regulatory requirements pertaining to hydronic systems	identify codes, standards and regulations pertaining to hydronic systems
F-17.02.05L	demonstrate knowledge of emerging technologies and practices pertaining to hydronic systems	identify emerging technologies pertaining to hydronic systems, and describe their characteristics and applications
		identify technologies that contribute to net zero and carbon neutral commitments
		identify VFDs (variable frequency drives), and heat and cooling recovery, and describe their characteristics and applications
		identify building automation technologies, and describe their characteristics and applications

Range of Variables

components include: valves, air removal devices, circulators, gauges, thermometers, transfer units (terminal heat pumps, fan coil units, radiators, radiant panels, unit heaters), dirt elimination devices, controls

auxiliary equipment includes: indirect hot water tank, heat exchangers, make-up tank

hazards include: falls, lifting heavy weight, heights, leaks, welding, threading, confined space, burns

joining methods include: threading, soldering, grooving, welding, press fitting

procedures to protect include: vibration isolation, insulating, installation of cover plates

fluids include: water, brine solutions, glycol

additives include: treatment chemicals, rust inhibitors, cleaners

F-17.03 Tests hydronic systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-17.03.01P	perform a visual pre-check inspection	visual pre-check inspection is completed to confirm piping and components are installed according to specifications
F-17.03.02P	determine type of test and test parameters	type of test and test parameters are determined to match system application and requirements according to system design and specifications
F-17.03.03P	perform ***sensory inspection***	***sensory inspection*** is performed to detect problems
F-17.03.04P	pressurize system and inspect for ***faults***	system is pressurized and inspected for ***faults***
F-17.03.05P	install isolation components	isolation components are installed and ***sensitive equipment*** is protected or removed from test pressures
F-17.03.06P	perform tests	hydronic system is tested according to specifications and AHJ
F-17.03.07P	verify operation of ***components***	hydronic system ***components*** operate according to system design and specifications
F-17.03.08P	check and adjust pressures	pressures are checked and adjusted according to system design
F-17.03.09P	program, calibrate and adjust ***components***	***components*** are programed, calibrated and adjusted according to system design and specifications
F-17.03.10P	complete documentation	documentation is completed according to client requirements, specifications and company policies

Range of Variables

sensory inspection includes: visual, auditory, tactile

faults include: cracks, corrosion, inadequate flow, air lock, leaks, manufacturers' defects, blockages

sensitive equipment includes: safety valves, air vents, gauges

components include: valves, air removal devices, circulators, gauges, thermometers, transfer units (terminal heat pumps, fan coil units, radiators, radiant panels, unit heaters), dirt elimination devices, controls

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-17.03.01L	demonstrate knowledge of hydronic systems, piping and ***components***, their characteristics, applications and operation	identify hydronic systems, and describe their characteristics, applications and operation
		identify hydronic system piping and ***components***, and describe their characteristics, applications and operation
		describe operating principles of hydronic systems
		interpret information found on drawings, and in specifications and equipment manuals pertaining to hydronic systems, piping and ***components***
		explain effect of elevation and temperature on pressure when testing hydronic systems
		explain effects trapped air in a hydronic system will have on testing and describe procedures to prevent or correct it
		identify potential problems and ***faults*** with piping, ***components*** and ***auxiliary equipment***
		identify materials that can be reconditioned, reused or recycled
F-17.03.02L	demonstrate knowledge of procedures used for testing piping and ***components*** for hydronic systems	identify ***testing equipment*** for piping, ***components*** and ***auxiliary equipment***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to testing piping and ***components***
		describe procedures to inspect piping, ***components*** and ***auxiliary equipment***
		describe procedures to test piping, ***components*** and ***auxiliary equipment***
		identify method of filling, adding, draining or purging ***fluids*** or ***additives***
		describe procedures to set and adjust hydronic system ***components***
		describe procedure for start-up of ***components***

		describe procedures to monitor system for performance deficiencies
		describe energy-saving practices
		identify practices that reduce material waste
F-17.03.03L	demonstrate knowledge of training and certification requirements to test piping and ***components*** for hydronic systems	identify training and certification requirements to test piping and ***components*** for hydronic systems
F-17.03.04L	demonstrate knowledge of regulatory requirements pertaining to testing piping and ***components*** for hydronic systems	identify codes, standards and regulations pertaining to testing piping and ***components*** for hydronic systems
F-17.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to hydronic systems	identify technologies that contribute to net zero and carbon neutral commitments
		identify VFDs (variable frequency drives), and heat and cooling recovery, and describe their characteristics and applications
		identify building automation technologies, and describe their characteristics and applications

Range of Variables

components include: valves, air removal devices, circulators, gauges, thermometers, transfer units (terminal heat pumps, fan coil units, radiators, radiant panels, unit heaters), dirt elimination devices, controls

faults include: cracks, corrosion, inadequate flow, air lock, leaks, manufacturers' defects, blockages

auxiliary equipment includes: indirect fired hot water tank, heat exchangers, make-up tank

testing equipment includes: control modules, digital technology (scanners, scopes), multimeter (including thermal accessories), gauges

hazards include: sudden release of energy, component failure, piping failure, burns, confined space, heights, cross-contamination, electrical, spillage

fluids include: water, brine solutions, glycol

additives include: treatment chemicals, rust inhibitors, cleaners

F-17.04 Services hydronic systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-17.04.01P	select and use tools and equipment	tools and equipment are selected and used according to application
F-17.04.02P	interpret client information	client information is interpreted to assist in diagnostic process

F-17.04.03P	perform scheduled service	scheduled servicing of system is performed according to system requirements, AHJ and specifications
F-17.04.04P	verify operation of piping and ***components***	operation of piping and ***components*** is verified according to system design and specifications
F-17.04.05P	inspect piping and ***components***	piping and ***components*** are inspected using ***sensory inspection*** for ***conditions requiring service*** or replacement according to industry standard
F-17.04.07P	identify strategy for isolation, notify client and perform LOTO procedures	strategy for isolation is identified, client is notified and LOTO procedures performed according to required service
F-17.04.08P	clean ***components***	***components*** are cleaned according to system requirements and specifications to prolong life of system and maintain design flow
F-17.04.09P	replace ***components***	***components*** are replaced according to specifications
F-17.04.10P	repair ***components***	***components*** are repaired according to specifications
F-17.04.11P	verify ***fluid*** quality	***fluid*** is treated according to system requirements and specifications
F-17.04.12P	return system to service and verify system operation	system is returned to service and system operation is verified according to system design
F-17.04.13P	complete ***documentation***	***documentation*** is completed according to client requirements, specifications, AHJ and company policies

Range of Variables

components include: valves, air removal devices, circulators, gauges, thermometers, transfer units (terminal heat pumps, fan coil units, radiators, radiant panels, unit heaters), dirt elimination devices, controls

sensory inspection includes: visual, auditory, tactile

conditions requiring service include: wear, noise, leaks, corrosion, no flow, air lock, fluid temperatures

fluid includes: water, brine solutions, glycol

documentation includes: service reports, maintenance reports, building logbook

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-17.04.01L	demonstrate knowledge of hydronic systems, piping and ***components***, their characteristics, applications and operation	identify hydronic systems, and describe their characteristics, applications and operation
		identify hydronic system piping and ***components***, and describe their characteristics, applications and operation
		describe operating principles of hydronic systems

		interpret drawings, specifications and equipment manuals pertaining to hydronic systems, piping and ***components***
		identify ***conditions requiring service***
		identify strategy for isolation and associated LOTO procedures
		identify potential environmental and health impacts involved during servicing piping and ***components*** for hydronic systems, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
		identify problems and ***faults*** with piping, ***components*** and ***auxiliary equipment***
F-17.04.02L	demonstrate knowledge of procedures to service piping and ***components*** for hydronic systems	identify tools and equipment used to service piping and ***components*** for hydronic systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to servicing piping and ***components*** for hydronic systems
		describe procedures to inspect and diagnose problems with piping and ***components*** for hydronic systems
		describe procedures to service piping and ***components***
		describe procedures to disassemble problem area of system, replace or repair faulty ***components*** and reassemble system
		describe procedures for reinstating system to operating condition and verifying repair
		describe energy-saving practices
		identify practices that reduce material waste
F-17.04.03L	demonstrate knowledge of documenting service for hydronic systems	identify program of scheduled service
		identify ***documentation*** pertaining to servicing hydronic systems
F-17.04.04L	demonstrate knowledge of training and certification requirements to service piping and ***components*** for hydronic systems	identify training and certification requirements to service piping and ***components*** for hydronic systems
F-17.04.05L	demonstrate knowledge of regulatory requirements pertaining to servicing piping and ***components*** for hydronic systems	identify codes, standards and regulations pertaining to servicing piping and ***components*** for hydronic systems

F-17.04.06L	demonstrate knowledge of emerging technologies and practices pertaining to hydronic systems	identify technologies that contribute to net zero and carbon neutral commitments
		identify VFDs (variable frequency drives), and heat and cooling recovery, and describe their characteristics and applications
		identify building automation technologies, and describe their characteristics and applications

Range of Variables

components include: valves, air removal devices, circulators, gauges, thermometers, transfer units (terminal heat pumps, fan coil units, radiators, radiant panels, unit heaters), dirt elimination devices, controls

conditions requiring service include: wear, noise, leaks, corrosion, no flow, air lock, fluid temperatures

faults include: cracks, corrosion, inadequate flow, air lock, leaks, manufacturers' defects, blockages

auxiliary equipment includes: indirect fired hot water tank, heat exchangers, make-up tank

hazards include: sudden release of energy, component failure, piping failure, burns, confined space, heights, cross-contamination, electrocution, spillage

documentation includes: service reports, maintenance reports, building logbook

Task F-18 Installs, tests and services hydronic heating and cooling equipment

Task Descriptor

Hydronic heating equipment keeps heat transfer fluid at an elevated temperature for purposes such as perimeter heating, fan-coils, in-floor heating and domestic hot water. Heating systems use equipment such as heat exchangers, heat pumps, solar panels, and high and low mass boilers.

Hydronic cooling equipment is used to keep the heat transfer fluid at a constant temperature for cooling. Cooling systems use equipment such as heat exchangers, heat pumps, solar panels, cooling towers and chillers. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs. Additional certification may be required in some jurisdictions to allow plumbers to install, test and service these systems.

F-18.01 Installs hydronic heating equipment

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-18.01.01P	select and assemble hydronic heating equipment	hydronic heating equipment is selected and assembled according to building requirements, drawings, specifications and AHJ
F-18.01.02P	determine location and placement of hydronic heating equipment	location and placement of hydronic heating equipment are determined according to drawings, specifications, AHJ and site conditions
F-18.01.03P	determine housekeeping pad	housekeeping pad for protection of hydronic heating equipment is determined according to drawings, specifications, AHJ and site conditions
F-18.01.04P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-18.01.05P	install vibration isolation for hydronic heating equipment	vibration isolation is installed according to drawings, specifications and site conditions
F-18.01.07P	install hydronic heating equipment	hydronic heating equipment is installed according to drawings, specifications and site conditions

F-18.01.08P	install ***heat source*** piping and ***trim***	***heat source*** piping and ***trim*** are installed according to drawings, specifications, AHJ and site conditions
F-18.01.09P	install connections for flue gas condensation	connections for flue gas condensation are installed according to drawings, specifications and AHJ
F-18.01.10P	select and install treatment equipment for corrosive condensation	treatment equipment for corrosive condensation is selected and installed according to drawings, specifications, AHJ and site conditions

Range of Variables

tools and equipment include: come-alongs, chain falls, forklifts, pallet jacks, slings, cranes

heat source includes: high and low mass boilers, heat pumps, solar thermal panels, biomass boilers, water heater

trim includes: low water cutoff, feed water control, safety relief device, flow switch, operating control

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-18.01.01L	demonstrate knowledge of hydronic heating equipment, their characteristics, applications and operation	identify types of hydronic heating equipment, and describe their characteristics and applications
		identify hydronic heating equipment ***components***, and describe their characteristics and applications
		describe operating principles of hydronic heating equipment
		interpret information found on drawings and specifications pertaining to hydronic heating equipment
		identify ***sources of energy*** used by hydronic heating equipment, and describe their characteristics and applications
		identify ***heat sources*** used by hydronic heating equipment, and describe their characteristics and applications
		describe ***principles of heat transfer***
		explain ***variables*** that impact pipe and tubing in hydronic systems and their associated calculations
		identify ***heat transfer fluids*** used in hydronic systems, and describe their characteristics and applications
		identify additives used in hydronic systems, and describe their characteristics and applications

		identify potential environmental and health impacts involved during installing hydronic heating equipment, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
F-18.01.02L	demonstrate knowledge of procedures to install hydronic heating equipment	identify ***tools and equipment*** used to install hydronic heating equipment, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to hydronic heating equipment
		describe procedures to install hydronic heating equipment
		describe energy-saving practices
		identify practices that reduce material waste
F-18.01.03L	demonstrate knowledge of training and certification requirements pertaining to hydronic heating equipment	identify training and certification requirements pertaining to hydronic heating equipment
F-18.01.04L	demonstrate knowledge of regulatory requirements pertaining to hydronic heating equipment	identify codes, standards and regulations pertaining to hydronic heating equipment
F-18.01.05L	demonstrate knowledge of emerging technologies and practices pertaining to hydronic heating equipment	identify hydronic heating equipment technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies and practices pertaining to hydronic heating equipment, and describe their characteristics and applications

Range of Variables

components include: boiler trim, heat pumps, expansion tanks, heat exchangers, circulating pumps, mixing components, valves

sources of energy include: oil, gas, solid fuel, geothermal, solar, electric, air

heat source includes: high and low mass boilers, heat pumps, solar thermal panels, biomass boilers, water heater

principles of heat transfer include: radiation, conduction, convection

variables include: thermal expansion, thermal contraction, weight, friction loss, turbulence, galvanic action

heat transfer fluids include: water, glycol, methyl hydrate, methanol

tools and equipment include: come-alongs, chain falls, forklifts, pallet jacks, slings, cranes

hazards include: falls, lifting heavy weight, heights, leaks, welding, threading, confined space, burns, toxic fumes, gases

F-18.02 Installs hydronic cooling equipment

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-18.02.01P	select and assemble hydronic cooling equipment	hydronic cooling equipment is selected and assembled according to building requirements, drawings, specifications, and AHJ
F-18.02.02P	determine location and placement of hydronic cooling equipment	location and placement of hydronic cooling equipment are determined according to drawings, specifications, AHJ and site conditions
F-18.02.03P	determine housekeeping pad	housekeeping pad for protection of hydronic cooling equipment is determined according to drawings, specifications, AHJ and site conditions
F-18.02.04P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-18.02.05P	install vibration isolation for hydronic cooling equipment	vibration isolation is installed according to drawings, specifications and site conditions
F-18.02.06P	install hydronic cooling equipment	hydronic cooling equipment is installed according to drawings, specifications and site conditions
F-18.02.07P	install ***cooling source*** piping and ***trim***	***cooling source*** piping and trim are installed according to drawings, specifications, AHJ and site conditions
F-18.02.08P	install connections for condensation	connections for condensation are installed according to specifications and AHJ
F-18.02.09P	select and install treatment equipment for corrosive condensation	treatment equipment for corrosive condensation is selected and installed according to drawings, specifications, AHJ and site conditions

Range of Variables

tools and equipment include: come-alongs, chain falls, forklifts and pallet jacks, slings, cranes
cooling source includes: heat pumps, cooling towers, fluid coolers, chillers
trim includes: feed water control, safety relief device, flow switch, operating control

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-18.02.01L	demonstrate knowledge of hydronic cooling equipment, their characteristics, applications and operation	identify types of hydronic cooling equipment, and describe their characteristics and applications
		identify hydronic cooling equipment ***components***, and describe their characteristics and applications
		describe operating principles of hydronic cooling equipment
		interpret information found on drawings and specifications pertaining to hydronic cooling equipment
		identify ***sources of energy*** used by hydronic cooling equipment, and describe their characteristics and applications
		identify ***cooling sources*** used by hydronic cooling equipment, and describe their characteristics and operation
		describe ***principles of heat transfer***
		explain ***variables*** that impact pipe and tubing in hydronic systems and their associated calculations
		identify ***fluids*** used in hydronic cooling equipment, and describe their characteristics and applications
		identify ***additives*** used in hydronic cooling equipment, and describe their characteristics and applications
		explain difference between latent and sensible heat removal in hydronic cooling equipment
		identify potential environmental and health impacts involved during installing hydronic cooling equipment, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
F-18.02.02L	demonstrate knowledge of procedures to install hydronic cooling equipment	identify ***tools and equipment*** used to install hydronic cooling equipment, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to hydronic cooling equipment
		describe procedures to install hydronic cooling equipment
		describe energy-saving practices
		identify practices that reduce material waste

F-18.02.03L	demonstrate knowledge of training and certification requirements pertaining to hydronic cooling equipment	identify training and certification requirements pertaining to hydronic cooling equipment
F-18.02.04L	demonstrate knowledge of regulatory requirements pertaining to hydronic cooling equipment	identify codes, standards and regulations pertaining to hydronic cooling equipment
F-18.02.05L	demonstrate knowledge of emerging technologies and practices pertaining to hydronic cooling equipment	identify hydronic cooling equipment technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies and practices pertaining to hydronic cooling equipment, and describe their characteristics and applications

Range of Variables

components include: expansion tanks, heat exchangers, circulating pumps, mixing components, valves
sources of energy include: gas, geothermal, solar, electric, air
cooling source includes: heat pumps, cooling towers, fluid coolers, chillers
principles of heat transfer include: radiation, conduction, convection
variables include: thermal expansion, thermal contraction, weight, friction loss, turbulence, galvanic action
fluids include: water, brine solutions
additives include: methyl hydrate, glycol
tools and equipment include: come-alongs, chain falls, forklifts and pallet jacks, slings, cranes
hazards include: falls, lifting heavy weight, heights, leaks, welding, threading, confined space

F-18.03 Tests hydronic heating and cooling equipment

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

Skills

	Performance Criteria	Evidence of Attainment
F-18.03.01P	conduct ***pressure test***	***pressure test*** is performed according to specifications and AHJ
F-18.03.02P	select and use ***tools and equipment***	***tools and equipment*** are selected and used according to application
F-18.03.03P	verify sequence of operations	sequence of operations are verified according to specifications
F-18.03.04P	test ***safeties*** and ***controls***	***safeties*** and ***controls*** are tested to ensure operation according to specifications and AHJ
F-18.03.05P	verify flow rate	flow rate is verified and adjusted according to design and specifications
F-18.03.06P	conduct ***fuel*** combustion analysis	***fuel*** combustion analysis is conducted according to specifications and AHJ

F-18.03.07P	adjust and set manifold pressures	manifold pressures are adjusted and set according to specifications and AHJ
F-18.03.08P	conduct ***fluid tests***	***fluid tests*** are conducted according to specifications
F-18.03.09P	complete ***documentation***	***documentation*** is completed according to client requirements, specifications and company policies

Range of Variables

pressure test includes: hydrostatic, pneumatic

tools and equipment include: multimeter with thermal attachments, manometer, thermal scanner, combustion analysis equipment

safeties include: electronic, mechanical

controls include: electronic, mechanical

fuel include: oil, gas, biomass, coal, wood

fluid tests include: pH, TDS, glycol strength, supply and return temperatures

documentation includes: testing reports, commission report, maintenance manual, as-builts

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-18.03.01L	demonstrate knowledge of ***hydronic heating and cooling equipment***, their characteristics, applications and operation	identify ***hydronic heating and cooling equipment***, and describe their characteristics and applications
		describe operating principles of ***hydronic heating and cooling equipment***
		identify ***safeties***, and describe their characteristics and applications
		identify ***controls***, and describe their characteristics, applications and operation
F-18.03.02L	demonstrate knowledge of procedures to test ***hydronic heating and cooling equipment***	identify ***tools and equipment*** used to test ***hydronic heating and cooling equipment***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to ***hydronic heating and cooling equipment***
		describe procedures to test hydronic heating and cooling equipment
		describe energy-saving practices
		identify practices that reduce material waste
F-18.03.03L	demonstrate knowledge of training and certification requirements pertaining to ***hydronic heating and cooling equipment***	identify training and certification requirements pertaining to ***hydronic heating and cooling equipment***

F-18.03.04L	demonstrate knowledge of regulatory requirements pertaining to ***hydronic heating and cooling equipment***	identify codes, standards and regulations pertaining to ***hydronic heating and cooling equipment***
F-18.03.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***hydronic heating and cooling equipment***	identify ***hydronic heating and cooling equipment*** technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies pertaining to hydronic cooling generating systems, and describe their characteristics and applications

Range of Variables

hydronic heating and cooling equipment includes: boilers, cooling towers, heat pumps, chillers, fluid coolers, solar thermal panels

safeties include: electronic, mechanical

controls include: electronic, mechanical

tools and equipment include: multimeter with thermal attachments, manometer, thermal scanner, combustion analysis equipment

hazards include: sudden release of energy, component failure, piping failure, burns, confined space, heights, cross-contamination, electrical, spillage

F-18.04 Services hydronic heating and cooling equipment

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
F-18.04.01P	select and use tools and equipment	tools and equipment are selected and used according to application
F-18.04.02P	interpret client information	client information is interpreted to assist in diagnostic process
F-18.04.03P	perform scheduled service of ***hydronic heating and cooling equipment***	scheduled servicing of ***hydronic heating and cooling equipment*** is performed according to building requirements and specifications
F-18.04.04P	verify operation of ***hydronic heating and cooling equipment***, piping and ***components***	operation of ***hydronic heating and cooling equipment***, piping and ***components*** is verified according to specifications
F-18.04.05P	inspect ***hydronic heating and cooling equipment***, piping and ***components***	***hydronic heating and cooling equipment***, piping and ***components*** are inspected for ***conditions requiring service***

F-18.04.06P	determine whether ***components*** require replacement or repair	***components*** are determined to be in need of replacement or repair according to specifications and industry standards
F-18.04.07P	identify strategy for isolation, notify client and perform LOTO procedures	strategy for isolation is identified, client is notified and LOTO procedures are performed according to required service
F-18.04.08P	clean ***hydronic heating and cooling equipment*** and ***trim***	***hydronic heating and cooling equipment*** and ***trim*** are cleaned according to specifications and system requirements to prolong life of system and maintain design flow
F-18.04.09P	replace ***hydronic heating and cooling equipment*** and ***trim***	***hydronic heating and cooling equipment*** and ***trim*** are replaced according to specifications and system requirements
F-18.04.10P	repair ***hydronic heating and cooling equipment*** and ***trim***	***hydronic heating and cooling equipment*** and ***trim*** are repaired according to specifications and system requirements
F-18.04.11P	verify ***fluid*** quality and quantity	***fluid*** is treated and volume adjusted according to system requirements and specifications
F-18.04.12P	complete ***documentation***	***documentation*** is completed according to client requirements, specifications, AHJ and company policies
F-18.04.13P	return system to service and verify system operation	system is returned to service and system operation is verified according to system design

Range of Variables

hydronic heating and cooling equipment includes: boilers, cooling towers, heat pumps, chillers, fluid coolers, solar thermal panels

components include: expansion tanks, heat exchangers, circulating pumps, mixing components, valves

conditions requiring service include: wear, noise, leaks, corrosion, no flow, air lock, fluid temperatures

trim includes: low water cutoff, feed water control, safety relief device, flow switch, operating control

fluid includes: water, brine solutions, glycol, oil

documentation includes: service reports, maintenance reports, building logbook

	Knowledge	
	Learning Outcomes	**Learning Objectives**
F-18.04.01L	demonstrate knowledge of ***hydronic heating and cooling equipment***, their characteristics, applications and operation	identify types of ***hydronic heating and cooling equipment***, and describe their characteristics, applications and operation
		describe operating principles of ***hydronic heating and cooling equipment***
		interpret drawings, specifications and equipment manuals required for system service

		identify ***conditions requiring service*** in ***hydronic heating and cooling equipment***
		identify strategy for isolation and associated LOTO procedures
		identify potential environmental and health impacts involved during servicing ***hydronic heating and cooling equipment***, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
F-18.04.02L	demonstrate knowledge of procedures to service ***hydronic heating and cooling equipment***	identify tools and equipment used to service ***hydronic heating and cooling equipment***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to ***hydronic heating and cooling equipment***
		describe procedures to inspect and diagnose problems with ***hydronic heating and cooling equipment*** and ***trim***
		describe procedures to service ***hydronic heating and cooling equipment*** and ***trim***
		describe procedures to disassemble problem area of system, replace or repair faulty ***components*** and reassemble system
		describe procedures for reinstating system to operating condition and verifying repair
		describe energy-saving practices
		identify practices that reduce material waste
F-18.04.03L	demonstrate knowledge of documenting service for ***hydronic heating and cooling equipment***	describe program of scheduled service
		identify required ***documentation*** pertaining to servicing ***hydronic heating and cooling equipment***
F-18.04.04L	demonstrate knowledge of training and certification requirements pertaining to ***hydronic heating and cooling equipment***	identify training and certification requirements pertaining to ***hydronic heating and cooling equipment***

F-18.04.05L	demonstrate knowledge of regulatory requirements pertaining to ***hydronic heating and cooling equipment***	identify codes, standards and regulations pertaining to ***hydronic heating and cooling equipment***
F-18.04.06L	demonstrate knowledge of emerging technologies and practices pertaining to ***hydronic heating and cooling equipment***	identify ***hydronic heating and cooling equipment*** technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies pertaining to ***hydronic heating and cooling equipment***, and describe their characteristics and applications

Range of Variables

hydronic heating and cooling equipment includes: boilers, cooling towers, heat pumps, chillers, fluid coolers, solar thermal panels

conditions requiring service include: wear, noise, leaks, corrosion, no flow, air lock, fluid temperatures

hazards include: sudden release of energy, component failure, piping failure, burns, confined space, heights, cross-contamination, electrical, spillage, Legionnaires disease (anywhere cooling towers are used)

trim includes: low water cutoff, feed water control, safety relief device, flow switch, operating control

components include: expansion tanks, heat exchangers, circulating pumps, mixing components, valves

documentation includes: service reports, maintenance reports, building logbook

Major Work Activity G
Installs, tests and services specialized systems

Task G-19 Installs, tests and services process piping systems

Task Descriptor

Process piping allows for a wide variety of applications. These piping systems may convey materials or fluids for applications such as manufacturing or treatment processes. These systems are installed in locations ranging from small businesses to large factories. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

G-19.01 Plans layout and sizes piping and components for process piping systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-19.01.01P	confirm materials required to install piping	materials required to install piping are confirmed according to codes, ***specifications*** and AHJ
G-19.01.02P	design piping layout	piping layout is designed according to codes, specifications, AHJ and site conditions
G-19.01.03P	size piping and ***components***	piping and ***components*** are sized according to codes, specifications, AHJ, site conditions and equipment location
G-19.01.04P	determine routing of piping	routing of piping is determined according to codes, specifications, AHJ, site conditions and equipment location
G-19.01.05P	select and use tools and equipment	tools and equipment are selected and used according to application

Range of Variables

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

components include: flexible connectors, vibration isolators, expansion joints

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-19.01.01L	demonstrate knowledge of ***process piping systems***, their ***components***, characteristics, applications and operation	identify types of ***process piping systems*** and their ***components***, and describe their characteristics and applications
		describe operating principles of ***process piping systems***
		interpret information pertaining to ***process piping systems*** found in ***specifications***
G-19.01.02L	demonstrate knowledge of procedures to plan layout and size piping for ***process piping systems***	describe procedures to plan layout and size piping for ***process piping systems***
		identify ***hazards*** and describe safe work practices pertain ing to sizing piping for ***process piping systems***
G-19.01.03L	demonstrate knowledge of training and certification requirements pertaining to ***process piping systems***	identify training and certification requirements pertaining to ***process piping systems***
G-19.01.04L	demonstrate knowledge of regulatory requirements pertaining to ***process piping systems***	identify codes, standards and regulations pertaining to ***process piping systems***
G-19.01.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***process piping systems***	identify technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies that reduce environmental impacts

Range of Variables

process piping systems include: food processing (food grade, non-food grade), reverse-osmosis, high purity water, water treatment plant, waste water treatment plant, non-potable water (reclaim), manufacturing plant, laboratories

components include: flexible connectors, vibration isolators, expansion joints

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, health

G-19.02 Installs piping for process piping systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-19.02.01P	confirm materials required to install piping	materials required to install piping are confirmed according to codes, ***specifications*** and AHJ
G-19.02.02P	select and use tools and equipment	tools and equipment are selected and used according to application
G-19.02.03P	lay out piping	piping is laid out according to codes, ***specifications***, AHJ and site conditions
G-19.02.04P	plumb and level or grade piping	piping is plumbed and levelled or graded according to codes, ***specifications*** and AHJ
G-19.02.05P	install, label and identify approved ***components***	approved ***components*** are installed, labelled and identified according to codes, ***specifications*** and AHJ

Range of Variables

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

components include: flexible connectors, vibration isolators, expansion joints, valves, cross-connection controls

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-19.02.01L	demonstrate knowledge of ***process piping systems***, their ***components***, characteristics, applications and operation	identify types of ***process piping systems*** and their ***components,*** and describe their characteristics and applications
		describe operating principles of ***process piping systems***
		interpret information pertaining to ***process piping systems*** found in ***specifications***
		identify potential environmental and health impacts involved during installation of ***process piping systems***, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled

G-19.02.02L	demonstrate knowledge of procedures to install piping for ***process piping systems***	identify tools and equipment to install ***process piping systems***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installing piping for ***process piping systems***
		describe procedures to install piping for ***process piping systems***
		describe ***procedures to protect*** piping for ***process piping systems***
		identify practices that reduce material waste
G-19.02.03L	demonstrate knowledge of training and certification requirements pertaining to ***process piping systems***	identify training and certification requirements pertaining to ***process piping systems***
G-19.02.04L	demonstrate knowledge of regulatory requirements pertaining to ***process piping systems***	identify codes, standards and regulations pertaining to ***process piping systems***
G-19.02.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***process piping systems***	identify technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies that reduce environmental impacts

Range of Variables

process piping systems include: food processing (food grade, non-food grade), reverse-osmosis, high purity water, water treatment plant, waste water treatment plant, non-potable water (reclaim), manufacturing plant, laboratories

components include: flexible connectors, vibration isolators, expansion joints, valves, cross-connection controls

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, health

procedures to protect include: installing guards, installing anchor points, installing expansion joints, installing vibration dampering, installing specialty coatings

G-19.03 Installs components for process piping systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-19.03.01P	confirm materials required to install ***components***	materials required to install ***components*** are confirmed according to codes, ***specifications*** and AHJ
G-19.03.02P	lay out ***components***	***components*** are laid out according to codes, ***specifications*** and AHJ
G-19.03.03P	select and use tools and equipment	tools and equipment are selected and used according to application
G-19.03.04P	secure ***components***	***components*** are secured according to codes, ***specifications*** and AHJ
G-19.03.05P	install ***materials*** to compensate for movement and vibration	***materials*** are installed to compensate for the movement or vibration of ***components***
G-19.03.06P	connect piping to ***components***	***components*** are connected to piping according to codes, ***specifications*** and AHJ

Range of Variables

components include: tanks, pumps, specialty valves, valve boxes, pressure gauges, backflow preventers

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

materials include: housekeeping pads, spring isolators, flexible connections

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-19.03.01L	demonstrate knowledge of ***process piping systems***, their ***components***, characteristics, applications and operation	identify ***process piping systems***, and describe their characteristics and applications
		identify process piping ***components***, and describe their characteristics and applications
		describe operating principles of ***process piping systems*** and their ***components***
		interpret information pertaining to process piping ***components*** found in ***specifications***
		identify potential environmental and health impacts involved during installation of ***process piping systems***, and describe associated prevention measures

		identify materials that can be reconditioned, reused or recycled
G-19.03.02L	demonstrate knowledge of procedures to install process piping ***components***	identify tools and equipment used to install process piping ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of process piping ***components***
		describe procedures to install process piping ***components***
		identify practices that reduce material waste
G-19.03.03L	demonstrate knowledge of procedures to handle, store and transport process piping ***components***	describe procedures to handle, store and transport process piping ***components***
G-19.03.04L	demonstrate knowledge of training and certification requirements pertaining to process piping ***components***	identify training and certification requirements pertaining to process piping ***components***
G-19.03.05L	demonstrate knowledge of regulatory requirements pertaining to process piping ***components***	identify codes, standards and regulations pertaining to process piping ***components***
G-19.03.06L	demonstrate knowledge of emerging technologies and practices pertaining to process piping ***components***	identify technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies that reduce environmental impacts

Range of Variables

process piping systems include: food processing (food grade, non-food grade), reverse-osmosis, high purity water, water treatment plant, waste water treatment plant, non-potable water (reclaim), manufacturing plant, laboratories

components include: tanks, pumps, specialty valves, valve boxes, compensate, pressure gauges, backflow preventers

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, health

G-19.04 Tests process piping systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-19.04.01P	select and use ***testing equipment***	***testing equipment*** is selected and used to detect ***faults*** and to confirm operation of process piping systems
G-19.04.02P	inspect ***process piping system***	***process piping system*** is inspected to detect problems
G-19.04.03P	verify operation of ***process piping system***	operation of ***process piping system*** is verified according to codes, ***specifications*** and AHJ
G-19.04.04P	***isolate*** piping and sensitive components	sensitive components not required in advance of test are ***isolated*** to prevent damage
G-19.04.05P	perform ***tests***	***tests*** are performed according to codes, ***specifications*** and AHJ
G-19.04.06P	document ***test*** results upon completion	***test*** results are verified and documented according to codes, ***specifications*** and AHJ

Range of Variables

testing equipment includes: inflatable test balls, test plugs, compressors, blank flanges, mandrels, x-ray equipment, cameras, high-pressure cylinders

faults include: cracks, corrosion, inadequate flow, vibration

process piping systems include: food processing (food grade, non-food grade), reverse-osmosis, high purity water, water treatment plant, waste water treatment plant, non-potable water (reclaim), manufacturing plant, laboratories

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

isolation includes: LOTO, valves in closed position, caps, plugs, blanks

tests include: hydrostatic, smoke, bending test, dye test, nitrogen test, air test

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-19.04.01L	demonstrate knowledge of ***process piping systems***, their characteristics, applications and operation	identify ***process piping systems***, and describe their characteristics and applications
		describe operating principles of ***process piping systems***
		interpret information pertaining to ***process piping systems*** found in ***specifications***

		identify potential problems and ***faults*** of ***process piping systems***
G-19.04.02L	demonstrate knowledge of procedures to test ***process piping systems***	identify ***testing equipment*** used for ***process piping systems***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to testing ***process piping systems***
		describe procedures to inspect ***process piping systems***
		describe procedures to test and troubleshoot ***process piping systems***
G-19.04.03L	demonstrate knowledge of training and certification requirements pertaining to ***process piping systems***	identify training and certification requirements pertaining to ***process piping systems***
G-19.04.04L	demonstrate knowledge of regulatory requirements pertaining to ***process piping systems***	identify ***codes***, standards and regulations pertaining to ***process piping systems***

Range of Variables

process piping systems include: food processing (food grade, non-food grade), reverse-osmosis, high purity water, water treatment plant, waste water treatment plant, non-potable water (reclaim), manufacturing plant, laboratories

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

faults include: cracks, corrosion, inadequate flow, vibration

testing equipment includes: inflatable test balls, test plugs, compressors, blank flanges, mandrels, x-ray equipment, cameras, high-pressure cylinders

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, health, sudden release of energy

G-19.05 Services process piping systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-19.05.01P	interpret client information	client information is interpreted to assist in diagnostic process
G-19.05.02P	inspect piping and ***components***, and operation of system	piping and ***components***, and operation of system is inspected to determine ***servicing required***
G-19.05.03P	clean, lubricate, repair or replace ***components***	***components*** are cleaned, lubricated repaired or replaced according to codes, ***specifications*** and AHJ

G-19.05.04P	check and adjust levels and conditions of ***media***	levels and conditions of ***media*** are adjusted according to codes, ***specifications*** and AHJ
G-19.05.05P	check and adjust ***components***	***components*** are checked and adjusted according to codes, ***specifications*** and AHJ to maintain system performance
G-19.05.06P	complete service and maintenance records	service and maintenance records are completed according to codes, ***specifications***, AHJ, company policies and building authority to indicate status of current system and follow-up actions required
G-19.05.07P	verify operation of safety devices	operation of safety devices is verified according to codes, ***specifications*** and AHJ
G-19.05.08P	select and use tools and equipment	tools and equipment are selected and used according to application
G-19.05.09P	perform scheduled service of system	scheduled servicing of system is performed according to schedule, codes, ***specifications*** and AHJ
G-19.05.10P	notify building occupants and isolate system	building occupants are notified and system is isolated according to application, codes, ***specifications*** and AHJ
G-19.05.11P	return system to service and verify system operation	system is returned to service and system operation is verified

Range of Variables

components include: tanks, pumps, specialty valves, valve boxes, zone valves, pressure gauges, backflow preventers

servicing required includes: wear, noise, leaks, corrosion, failure, maintenance schedule

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

media includes: glycol, pulp, chemicals, food and beverage

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-19.05.01L	demonstrate knowledge of ***process piping systems***, their ***components***, characteristics, applications and operation	identify ***process piping systems*** and their ***components***, and describe their characteristics and applications
		describe operating principles of ***process piping systems*** and their ***components***
		interpret information pertaining to ***process piping systems*** found in ***specifications***
		identify potential environmental and health impacts involved during servicing of service ***process piping systems***, and describe associated prevention measures

		identify materials that can be reconditioned, reused or recycled
G-19.05.02L	demonstrate knowledge of procedures to service ***process piping systems*** and their ***components***	identify tools and equipment used to service ***process piping systems*** and their ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to ***process piping systems***
		describe procedures to service ***process piping systems***, and their ***components***
		identify ***servicing required***
G-19.05.03L	demonstrate knowledge of training and certification requirements pertaining to ***process piping systems***	identify training and certification requirements pertaining to ***process piping systems***
G-19.05.04L	demonstrate knowledge of regulatory requirements pertaining to ***process piping systems***	identify codes, standards and regulations pertaining to servicing ***process piping systems***
G-19.05.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***process piping systems***	identify technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies that reduce environmental impacts

Range of Variables

process piping systems include: food processing (food grade, non-food grade), reverse-osmosis, high purity water, water treatment plant, waste water treatment plant, non-potable water (reclaim), manufacturing plant, laboratories

components include: tanks, pumps, specialty valves, valve boxes, zone valves, pressure gauges, backflow preventers

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, health

servicing required includes: wear, noise, leaks, corrosion, failure, maintenance schedule

Task G-20 Installs, tests and services potable water fire protection systems - Not Common Core

Task Descriptor

Fire protection systems help save lives and ensure minimal fire damage to structures. Jurisdictional regulations determine the scope of the work that plumbers can perform in installing fire protection systems. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repairs.

G-20.01 Plans layout and sizes piping for potable water fire protection systems - Not Common Core

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-20.01.01P	confirm type, location and installation sequence of ***components***	type, location and installation sequence of ***components*** are confirmed according to codes, ***specifications***, AHJ and site conditions
G-20.01.02P	confirm piping and ***components*** are suitable for potable water systems	piping and ***components*** are confirmed suitable for potable water systems according to codes, ***specifications*** and AHJ
G-20.01.03P	select and use tools and equipment	tools and equipment are selected and used according to application
G-20.01.04P	size piping of potable water fire protection systems	piping of potable water fire protection systems is sized according to codes, ***specifications*** and AHJ

Range of Variables

components include: supervisory valves, sprinkler heads, flow switches, cross connection devices

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-20.01.01L	demonstrate knowledge of potable water fire protection systems, their piping, ***components***, characteristics, applications and operation	identify types of potable water fire protection systems and their piping and ***components***, and describe their characteristics and applications
		describe operating principles of potable water fire protection systems and their piping and ***components***

		interpret information pertaining to potable water fire protection systems found in codes and ***specifications***
G-20.01.02L	demonstrate knowledge of procedures to plan layout and size piping for potable water fire protection systems	identify tools and equipment required for layout and sizing of piping for potable water fire protection systems, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to potable water fire protection systems and their piping and components
		describe procedures to plan layout and size piping for potable water fire protection systems
G-20.01.03L	demonstrate knowledge of training and certification requirements pertaining to potable water fire protection systems	identify training and certification requirements pertaining to potable water fire protection systems
G-20.01.04L	demonstrate knowledge of regulatory requirements pertaining to potable water fire protection systems	identify codes, standards and regulations pertaining to potable water fire protection systems

Range of Variables

components include: supervisory valves, sprinkler heads, flow switches, cross connection devices

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

hazards include: heights, confined spaces, health, environmental

G-20.02 Installs potable water fire protection systems - Not Common Core

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

Skills

	Performance Criteria	Evidence of Attainment
G-20.02.01P	confirm type, location and installation sequence of ***components***	type, location and installation sequence of ***components*** are confirmed according to ***codes***, specifications, AHJ and site conditions
G-20.02.02P	select and use tools and equipment	tools and equipment are selected and used according to application
G-20.02.03P	lay out piping and ***components***	piping and ***components*** are laid out according to codes, specifications, AHJ and site conditions
G-20.02.04P	level, plumb, secure and protect ***components***	***components*** are levelled, plumbed, secured and protected according to ***codes***, specifications, AHJ and site conditions

G-20.02.05P	connect piping and ***components***	connections are made to ensure water remains potable
G-20.02.06P	compensate for expansion and contraction of system	compensation for expansion and contraction has been provided to prevent damage to piping and structure

Range of Variables

components include: supervisory valves, sprinkler heads, flow switches, cross connection devices
codes include: plumbing, building, NFPA, CSA, ASSE

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-20.02.01L	demonstrate knowledge of potable water fire protection systems, their piping, ***components***, characteristics, applications and operation	identify types of potable water fire protection systems and their piping and ***components***, and describe their characteristics and applications
		describe operating principles of potable water fire protection systems and their piping and ***components***
		interpret information pertaining to potable water fire protection systems found in ***specifications***
		identify materials that can be reconditioned, reused or recycled
G-20.02.02L	demonstrate knowledge of procedures to install potable water fire protection systems and their piping and ***components***	identify tools and equipment used to install potable water fire protection systems and their piping and ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to potable water fire protection systems
		describe procedures to install potable water fire protection systems and their piping and ***components***
G-20.02.03L	demonstrate knowledge of training and certification requirements pertaining to potable water fire protection systems	identify training and certification requirements pertaining to potable water fire protection systems
G-20.02.04L	demonstrate knowledge of regulatory requirements pertaining to potable water fire protection systems	identify ***codes***, standards and regulations pertaining to potable water fire protection systems

Range of Variables

components include: supervisory valves, sprinkler heads, flow switches, cross connection devices
specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings
hazards include: heights, confined spaces, health, environmental

G-20.03 Tests potable water fire protection systems - Not Common Core

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

Skills

	Performance Criteria	Evidence of Attainment
G-20.03.01P	select and use ***testing equipment***	***testing equipment*** is selected and used to detect ***faults*** and to confirm operation of potable water fire protection system
G-20.03.02P	perform visual inspection of sprinkler head coverage	visual inspection of sprinkler head coverage is performed according to codes, ***specifications*** and AHJ
G-20.03.03P	perform ***tests***	***tests*** are performed according to codes and ***specifications*** to confirm operation and performance
G-20.03.04P	document test results upon completion	test results are verified and documented according to codes, ***specifications*** and AHJ

Range of Variables

testing equipment includes: compressor, hydrostatic pump, gauges

faults include: inadequate flow, leaks, malfunctioning alarm

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

tests include: flow, pressure, capacity, acceptance

Knowledge

	Learning Outcomes	Learning Objectives
G-20.03.01L	demonstrate knowledge of potable water fire protection systems, their piping, ***components***, characteristics, applications and operation	identify types of potable water protection systems and their piping and ***components***, and describe their characteristics and applications
		describe operating principles of potable water fire protection systems and their piping and ***components***
		interpret information pertaining to potable water fire protection systems found in ***specifications***
G-20.03.02L	demonstrate knowledge of procedures to test potable water fire protection systems and their piping and ***components***	identify ***testing equipment*** used to test potable water fire protection systems and their piping and ***components***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to potable water fire protection systems and their piping and ***components***

		describe procedures to inspect potable water fire protection systems and their piping and ***components***
		describe ***procedures to test*** potable water fire protection systems and their piping and ***components***
G-20.03.03L	demonstrate knowledge of training and certification requirements pertaining to potable water fire protection systems	identify training and certification requirements pertaining to potable water fire protection systems
G-20.03.04L	demonstrate knowledge of regulatory requirements pertaining to potable water fire protection systems	identify codes, standards and regulations pertaining to potable water fire protection systems

Range of Variables

components include: supervisory valves, sprinkler heads, flow switches, cross connection devices

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

testing equipment includes: compressor, hydrostatic pump, gauges

hazards include: heights, confined spaces, health, environmental, sudden release of energy

procedures to test include: pneumatic, hydrostatic

G-20.04 Services potable water fire protection systems - Not Common Core

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-20.04.01P	interpret client information	client information is interpreted to assist in diagnostic process
G-20.04.02P	check and adjust pressures	pressures are checked and adjusted to maintain system performance and to detect system problems
G-20.04.03P	perform scheduled service of system	scheduled servicing of system is performed and documented
G-20.04.04P	determine whether ***components*** require replacement or repair	***components*** are replaced or repaired considering ***factors for replacement or repair***
G-20.04.05P	select and use tools and equipment	tools and equipment are selected and used according to application
G-20.04.06P	return system to service and verify correct system operation	system is returned to service and correct system operation is verified
G-20.04.07P	complete required documentation	documentation is completed according to ***specifications***, AHJ and building authority

Range of Variables

components include: supervisory valves, sprinkler heads, flow switches, cross connection devices

factors for replacement or repair include: leaks, damaged sprinkler heads

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-20.04.01L	demonstrate knowledge of potable water fire protection systems, their ***components***, characteristics and applications	identify types of potable water fire protection systems and ***components***, and describe their characteristics and applications
		describe operating principles of potable water fire protection systems and their ***components*** and equipment
		interpret information pertaining to potable water fire protection systems found in ***specifications***
		identify materials that can be reconditioned, reused or recycled
G-20.04.02L	demonstrate knowledge of procedures to service potable water fire protection systems and their ***components*** and equipment	identify tools and equipment used to service potable water fire protection systems and their ***components*** and equipment, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to potable water fire protection systems
		describe procedures to service potable water fire protection systems and their ***components*** and equipment
		describe procedures to repair potable water fire protection system and their ***components*** and equipment
G-20.04.03L	demonstrate knowledge of training and certification requirements pertaining to potable water fire protection systems	identify training and certification requirements pertaining to potable water fire protection systems
G-20.04.04L	demonstrate knowledge of regulatory requirements pertaining to potable water fire protection systems	identify codes, standards and regulations pertaining to potable water fire protection systems

Range of Variables

components include: supervisory valves, sprinkler heads, flow switches, cross connection devices

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

hazards include: heights, confined spaces, health, environmental, sudden release of energy

Task G-21 Installs, tests and services other specialized systems

Task Descriptor

There are a number of specialized systems that, depending on the provincial jurisdictional regulations, may be worked on in the plumbing trade.

Natural gas, liquefied petroleum gas (LPG) and petroleum products are specialized piping installations. Plumbers install the piping from point of supply to the appliance isolation valve.

Plumbers install specialized piping and related equipment to provide medical gases in institutions such as hospitals, dental offices and clinics.

Residential irrigation systems provide water to lawns, gardens and flowerbeds. Commercial applications may include high volume installations for large areas such as farms, municipal parks and other public green spaces.

Ground source loops are essential components of a ground source heat pump system (geothermal). De-superheaters are components of the heat pump, used to provide heat supplementation to the domestic hot water supply.

Radon mitigation to systems are installed to prevent the entry of harmful radon gas into buildings.

Solar thermal systems are used to transfer heat for potable water and space heating supplementation as well as pool heating. Industrial installations also apply and may include low and high temperature applications.

Drain pipe heat recovery systems reclaim otherwise lost heat content from drains such as shower, sink and lavatory drains.

Compressed air systems provide filtered and dry compressed air for a variety of purposes.

Non-potable water systems would include green initiative items like grey water reuse and rainwater harvesting applications for irrigation and firefighting purposes. Plumbers would install collection and distribution piping and equipment for these systems. For the purpose of this standard, service includes troubleshooting, diagnosing, maintenance and repair.

Additional certification may be required in some jurisdictions to allow plumbers to install, test and service these systems.

G-21.01 Plans layout and sizes piping, components and equipment for other specialized systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-21.01.01P	confirm materials, components and equipment required to install piping	materials, components and equipment required to install piping are confirmed according to ***codes***, AHJ and ***specifications***
G-21.01.02P	design piping, components and equipment layout	piping, components and equipment layout is designed according to ***codes***, ***specifications***, AHJ and site conditions

G-21.01.03P	size piping, components and equipment	piping, components and equipment are sized according to ***codes***, ***specifications***, AHJ and site conditions
G-21.01.04P	select and use tools and equipment	tools and equipment are selected and used according to application

Range of Variables

codes include: plumbing codes, building codes, CSA, American Society of Mechanical Engineers (ASME), ASSE

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-21.01.01L	demonstrate knowledge of ***specialized systems***, their piping, components, equipment, properties, characteristics, applications and operation	identify types of ***specialized systems*** and their piping, components and equipment, and describe their properties, characteristics and applications
		describe operating principles of ***specialized systems*** and their piping, components and equipment
		interpret information pertaining to ***specialized systems*** found in ***specifications***
		identify factors to consider for determining pipe sizing in ***specialized systems***
		identify potential environmental and health impacts involved during installation of piping, components and equipment for ***specialized systems***, and describe associated prevention measures
G-21.01.02L	demonstrate knowledge of procedures to plan layout and size piping, components and equipment for ***specialized systems***	identify ***hazards*** and describe safe work practices pertaining to installation of piping for ***specialized systems***
		describe procedures to lay out and size piping, components and equipment for ***specialized systems***
G-21.01.03L	demonstrate knowledge of training and certification requirements pertaining to ***specialized systems***	identify training and certification requirements pertaining to ***specialized systems***
G-21.01.04L	demonstrate knowledge of regulatory requirements pertaining to ***specialized systems***	identify ***codes***, standards and regulations pertaining to ***specialized systems***
G-21.01.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***specialized systems***	identify technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies that reduce environmental impacts

Range of Variables

specialized systems include: compressed air, natural gas, propane, inert gas, medical gas, utility, process, radon mitigation, medical vacuum, residential irrigation, ground source loops, de-superheaters, solar thermal, drain pipe heat recovery, non-potable water (e.g., grey water reuse, rainwater harvesting)

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, health, explosions, leaks, flammability of gases and fuels

G-21.02 Installs piping and components for other specialized systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-21.02.01P	confirm materials required to install piping and components	materials required to install piping and components are confirmed according to codes, ***specifications*** and AHJ
G-21.02.02P	select and use tools and equipment	tools and equipment are selected and used according to application
G-21.02.03P	lay out piping and components	piping and components are laid out and assembled according to codes, ***specifications***, AHJ and site conditions
G-21.02.04P	plumb and level or grade piping and components	piping and components are plumbed and levelled or graded according to codes and AHJ
G-21.02.05P	install piping and components	piping and components are installed according to codes, ***specifications*** and AHJ

Range of Variables

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications and shop drawings

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-21.02.01L	demonstrate knowledge of ***specialized systems***, their piping, components, properties, characteristics, applications and operation	identify types of ***specialized systems*** and their piping and components, and describe their properties, characteristics and applications
		describe operating principles of ***specialized systems*** and their piping and components

		interpret information pertaining to ***specialized systems*** found in ***specifications***
		identify materials that can be reconditioned, reused or recycled
G-21.02.02L	demonstrate knowledge of procedures to install piping and components for ***specialized systems***	identify tools and equipment used to install piping and components for ***specialized systems***, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of piping and components for ***specialized systems***
		describe procedures to install piping and components for ***specialized systems***
G-21.02.03L	demonstrate knowledge of training and certification requirements pertaining to ***specialized systems***	identify training and certification requirements pertaining to ***specialized systems***
G-21.02.04L	demonstrate knowledge of regulatory requirements pertaining to ***specialized systems***	identify codes, standards and regulations pertaining to ***specialized systems***
G-21.02.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***specialized systems***	identify technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies that reduce environmental impacts

Range of Variables

specialized systems include: compressed air, natural gas, propane, inert gas, medical gas, utility, process, radon mitigation, medical vacuum, residential irrigation, ground source loops, de-superheaters, solar thermal, drain pipe heat recovery, non-potable water (e.g., grey water reuse, rainwater harvesting)

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications and shop drawings

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, explosions, leaks, flammability of gases and fuels

G-21.03 Installs equipment for other specialized systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-21.03.01P	confirm materials required to install equipment	materials required to install equipment is confirmed according to codes, ***specifications*** and AHJ
G-21.03.02P	confirm location and installation sequence of equipment	location and installation sequence of equipment is confirmed according to codes, ***specifications*** and AHJ
G-21.03.03P	select and use tools and equipment	tools and equipment are selected and used according to application
G-21.03.04P	lay out and secure equipment	equipment is laid out and secured according to codes, ***specifications*** and AHJ to compensate for movement and vibration
G-21.03.05P	verify type of liquid or gas and supply pressure/vacuum	type of liquid or gas being used, and supply pressure/vacuum are verified according to codes, ***specifications*** and AHJ
G-21.03.06P	connect piping to equipment	equipment is connected to piping according to codes, ***specifications*** and AHJ

Range of Variables

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-21.03.01L	demonstrate knowledge of ***specialized systems***, their equipment, characteristics, applications and operation	identify types of ***specialized systems*** and their equipment, and describe their characteristics and applications
		describe operating principles of ***specialized systems*** and their equipment
		interpret information found in ***specifications*** for ***specialized systems*** and their equipment and components
		identify potential environmental and health impacts involved during installation of equipment and components for ***specialized systems***, and describe associated prevention measures

		identify materials that can be reconditioned, reused or recycled
G-21.03.02L	demonstrate knowledge of procedures to install equipment for ***specialized systems***	identify tools and equipment used to install equipment for ***specialized systems*** and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to installation of equipment for ***specialized systems***
		describe procedures to install equipment for ***specialized systems***
		identify practices that reduce material waste
G-21.03.03L	demonstrate knowledge of procedures to handle, store and transport equipment for ***specialized systems***	describe procedures to handle, store and transport equipment for ***specialized systems***
G-21.03.04L	demonstrate knowledge of training and certification requirements pertaining to ***specialized systems***	identify training and certification requirements pertaining to ***specialized systems***
G-21.03.05L	demonstrate knowledge of regulatory requirements pertaining to ***specialized systems***	identify codes, standards and regulations pertaining to ***specialized systems***
G-21.03.06L	demonstrate knowledge of emerging technologies and practices pertaining to ***specialized systems***	identify technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies that reduce environmental impacts

Range of Variables

specialized systems include: compressed air, natural gas, propane, inert gas, medical gas, utility, process, radon mitigation, medical vacuum, residential irrigation, ground source loops, de-superheaters, solar thermal, drain pipe heat recovery, non-potable water (e.g., grey water reuse, rainwater harvesting)

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, explosions, leaks, flammability of gases and fuels

G-21.04 Tests other specialized systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-21.04.01P	select and use ***testing equipment***	***testing equipment*** is selected and used to detect ***faults*** and to confirm operation of ***specialized system***
G-21.04.02P	inspect ***specialized systems***	***specialized systems*** are inspected to identify ***faults***
G-21.04.03P	***isolate*** piping from ***sensitive components and equipment***	piping is ***isolated*** from ***sensitive components and equipment*** to prevent damage
G-21.04.04P	perform ***tests***	***tests*** are performed according to codes, ***specifications*** and AHJ
G-21.04.05P	verify integrity of piping, components and equipment for ***specialized systems***	integrity of piping, components and equipment is verified according to codes, ***specifications*** and AHJ
G-21.04.06P	document test results upon completion	test results are verified and documented according to codes, ***specifications***, AHJ and building authority

Range of Variables

testing equipment includes: manometers, flue gas analyzer, compressors, hydrostatic pumps, high pressure nitrogen cylinders, O_2 analyzers

faults include: cracks, corrosion, inadequate flow, leaks

specialized systems include: compressed air, natural gas, propane, inert gas, medical gas, utility, process, radon mitigation, medical vacuum, residential irrigation, ground source loops, de-superheaters, solar thermal, drain pipe heat recovery, non-potable water (e.g., grey water reuse, rainwater harvesting)

isolation includes: LOTO, valves in closed position, caps, plugs, blanks

sensitive components and equipment include: regulators, gauges, pressure switches, flow switches

tests include: hydrostatic, smoke, dye, nitrogen, air, cross connection, particulate, leak

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings, standards

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-21.04.01L	demonstrate knowledge of ***specialized systems***, their piping, components, equipment, characteristics, applications and operation	identify ***specialized systems*** and their piping, components and equipment, and describe their characteristics and applications
		describe operating principles of ***specialized systems*** and their piping, components and equipment

		identify potential ***faults*** in ***specialized systems***
G-21.04.02L	demonstrate knowledge of procedures to test ***specialized systems*** and their piping, components and equipment	identify ***testing equipment*** used to test ***specialized systems*** and their piping, components and equipment, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to ***specialized systems***
		describe procedures to inspect ***specialized systems*** and their piping, components and equipment
		identify ***tests*** associated with ***specialized systems***, and describe their procedures
G-21.04.03L	demonstrate knowledge of training and certification requirements pertaining to ***specialized systems***	identify training and certification requirements pertaining to ***specialized systems***
G-21.04.04L	demonstrate knowledge of regulatory requirements pertaining to ***specialized systems***	identify codes, standards and regulations pertaining to ***specialized systems***

Range of Variables

specialized systems include: compressed air, natural gas, propane, inert gas, medical gas, utility, process, radon mitigation, medical vacuum, residential irrigation, ground source loops, de-superheaters, solar thermal, drain pipe heat recovery, non-potable water (e.g., grey water reuse, rainwater harvesting)

faults include: cracks, corrosion, inadequate flow, leaks

testing equipment includes: manometers, flue gas analyzer, compressors, hydrostatic pumps, high pressure nitrogen cylinders, O_2 analyzers

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, explosions, leaks, flammability of gases and fuels, sudden release of energy

G-21.05 Services other specialized systems

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

	Skills	
	Performance Criteria	**Evidence of Attainment**
G-21.05.01P	interpret client information	client information is interpreted to assist in diagnostic process
G-21.05.02P	inspect piping, components, equipment, and operation of ***specialized system***	piping, components, equipment and operation of ***specialized system*** are inspected to determine ***conditions requiring service***

G-21.05.03P	clean, lubricate, repair or replace piping, components and equipment	piping, components and equipment are cleaned, lubricated, repaired or replaced according to codes, ***specifications*** and AHJ
G-21.05.04P	calibrate components and equipment	components and equipment are calibrated according to codes, ***specifications*** and AHJ
G-21.05.05P	check and adjust levels and conditions of ***media***	levels and conditions of ***media*** are checked and adjusted according to codes, ***specifications*** and AHJ
G-21.05.06P	check and adjust pressures	pressures are checked and adjusted according to codes, ***specifications*** and AHJ to maintain system performance
G-21.05.07P	complete service and maintenance records	service and maintenance records are completed according to codes, ***specifications***, AHJ and company policies to indicate status of current system and follow-up actions required
G-21.05.08P	verify operation of safety devices	operation of safety devices is verified according to codes, ***specifications*** and AHJ
G-21.05.09P	select and use tools and equipment	tools and equipment are selected and used according to application
G-21.05.10P	perform scheduled service of system	scheduled servicing of system is performed according to schedule, codes, ***specifications*** and AHJ
G-21.05.11P	isolate system and notify client and building occupants	system is isolated according to application codes, ***specifications*** and AHJ and client and building occupants are notified
G-21.05.12P	return system to service and verify system operation	system is returned to service and operation is verified

Range of Variables

specialized systems include: compressed air, natural gas, propane, inert gas, medical gas, utility, process, radon mitigation, medical vacuum, residential irrigation, ground source loops, de-superheaters, solar thermal, drain pipe heat recovery, non-potable water (e.g., grey water reuse, rainwater harvesting)

conditions requiring service include: wear, noise, leaks, corrosion, failure

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

media includes: glycol, medical gas, fuel gas, heating oil, inert gas

	Knowledge	
	Learning Outcomes	**Learning Objectives**
G-21.05.01L	demonstrate knowledge of ***specialized systems***, their piping, components, equipment, characteristics, applications and operation	identify ***specialized systems*** and their piping, equipment and components, and describe their characteristics and applications
		describe operating principles of ***specialized systems*** their piping, equipment and components

		interpret information pertaining to ***specialized systems*** found in ***specifications***
		identify potential environmental and health impacts involved during servicing of ***specialized systems***, and describe associated prevention measures
		identify materials that can be reconditioned, reused or recycled
G-21.05.02L	demonstrate knowledge of procedures to service ***specialized systems*** and their piping, equipment and components	identify tools and equipment used to service ***specialized systems*** and their piping, equipment and components, and describe their procedures for use
		identify ***hazards*** and describe safe work practices pertaining to ***specialized systems***
		describe procedures to service ***specialized systems*** and their piping, equipment and components
		describe procedures to repair ***specialized systems***, and their piping, equipment and components
G-21.05.03L	demonstrate knowledge of training and certification requirements pertaining to ***specialized systems***	identify training and certification requirements pertaining to ***specialized systems***
G-21.05.04L	demonstrate knowledge of regulatory requirements pertaining to ***specialized systems***	identify codes, standards and regulations pertaining to ***specialized systems***
G-21.05.05L	demonstrate knowledge of emerging technologies and practices pertaining to ***specialized systems***	identify technologies that contribute to net zero and carbon neutral commitments
		identify emerging technologies that reduce environmental impacts

Range of Variables

specialized systems include: compressed air, natural gas, propane, inert gas, medical gas, utility, process, radon mitigation, medical vacuum, residential irrigation, ground source loops, de-superheaters, solar thermal, drain pipe heat recovery, non-potable water (e.g., grey water reuse, rainwater harvesting)

specifications include: engineered drawings, manufacturers' requirements, system requirements, job specifications, shop drawings

hazards include: chemicals, machinery, equipment, heights, electrocution, confined spaces, environmental, explosions, leaks, flammability of gases and fuels, sudden release of energy

Appendix A
Acronyms

ABS	acrylonitrile-Butadiene-Styrene
AHJ	Authority Having Jurisdiction
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
AWWA	American Water Works Association
CFDA	Canadian Food and Drugs Act
CPVC	chlorinated polyvinyl chloride
CSA	Canadian Standards Association
DISS	Diameter Index Safety System
DWV	drainage, waste and vent
GHS	Globally Harmonized System of Classification and Labelling of Chemicals
JHA	job hazard analysis
GMAW	Gas Metal Arc Welding
GPS	global positioning system
GTAW	Gas Tungsten Arc Welding
HDPE,	high-density polyethylene
ICI	industrial/commercial/institutional
ID	inside diameter
LEED	Leadership in Energy and Environmental Design
LOTO	lock-out and tag-out
LPG	liquefied petroleum gas
MAPP	methylacetylene-propadiene propane
NBC	National Building Code
NFPA	National Fire Protection Association
NPC	National Plumbing Code
OD	outside diameter
PE	polyethylene
PEX	cross-linked polyethylene
PEX-AL-PEX	PEX-Aluminum-PEX
PPE	personal protective equipment
PRV	pressure reducing valve
PVC	polyvinyl chloride
RFI	request for information
RPBP	reduced pressure backflow preventer
SDS	Safety Data Sheets
SMAW	Shielded Metal Arc Welding
TDG	Transportation of Dangerous Goods

TDH	total dynamic head
TDS	total dissolved solids
TSP	trap seal primer
UV	ultraviolet
VFD	variable frequency drive
WC	water column
WHMIS	Workplace Hazardous Materials Information System
WLL	working load limit

Appendix B
Tools and Equipment / Outils et équipement

Personal Protective and Safety Equipment/Équipement de protection individuelle

air quality tester	testeurs de qualité de l’air
arc flash protection	protecteurs contre les éclairs d’arcs électriques
barricades and caution tape	barrières et ruban d’avertissement
confined space equipment	équipement pour les espaces clos
eye wash kit	douches oculaires
face shield	écrans faciaux
fire blanket	couvertures ignifuges
fire extinguisher	extincteurs
fire resistant clothing	vêtements résistants au feu
first aid kit	trousses de premiers soins
gloves (industrial, rubber)	gants (industriels, en caoutchouc)
ground fault circuit interrupter	disjoncteurs de fuite de terre
hard hat	casques de sécurité
health care and infectious control equipment	équipement de soins de santé et de contrôle des infections
hearing protection	protecteurs auditifs
kneepads	genouillères
lock-out/tag out devices	dispositifs de cadenassage et d’étiquetage
reflective vests	gilets réflecteurs
respiratory mask	masques respiratoires
rubber boots (CSA)	bottes en caoutchouc de sécurité (CSA)
safety boots (CSA)	bottes de sécurité (CSA)
safety glasses/goggles (CSA)	lunettes de sécurité (CSA)
safety harness, lanyard and lifeline (CSA)	harnais et cordage de sécurité (CSA)
tripod	trépieds

Hand Tools/Outils à main

adjustable wrench	clés réglables
ball-peen hammer	marteaux à panne ronde
basin wrench	clés à robinet de montée
bolt cutter	coupe-boulons
broom	balais
caulking gun	pistolets à calfeutrer
chalk line	cordeaux à tracer
chisel	ciseaux
cistern pump (hand operated-diaphragm)	pompes à citerne (manuelles – à membrane)
claw hammer	marteaux à panne fendue

combination wrench	clés mixtes
diaphragm pump (hand operated)	pompes à membrane (manuelles)
drywall saw	scies pour cloisons sèches
faucet seat wrench	clés à siège de robinet
file	limes
flashlight	lampes de poche
hacksaw	scies à métaux
hand groover	fraises manuelles à rainer
hand saw	scies à main
hand threader	filières à main
hex keys (set)	clés hexagonales (jeu)
hole saws	scies emporte-pièce
knife	couteaux
level	niveaux
locking pliers	pince étaux
nut drivers	tourne-écrou
pick	pioches
pipe wrenches	clés à tuyaux
pliers (lineman, needle nose, water pump, groove lock)	pinces (de monteur, à bec effilé, pour pompe à eau, multiprises)
plumb bob	fils à plomb
plunger	débouchoir à ventouse
pry bars	leviers
punch	poinçons
ratchet	rochets
reamer	alésoirs
rubber mallet	maillets en caoutchouc
scratch awl	pointes à tracer
screwdrivers (complete set)	tournevis (jeu complet)
shovel	pelles
sledgehammer	masses
socket set (imperial and metric)	jeux de douilles (systèmes impérial et métrique)
spud wrench	clés à mâchoires
square	équerres
strap wrench	clés à sangle
striker	percuteurs
stud finder	localisateurs de montants
stud punch	chasse-goujons
swage	outils à emboîture
t square	équerres en t
tap and die sets	jeux de tarauds et filières
tin snips (set)	cisailles de ferblantier (jeu)
toilet auger	débouchoir rotatif pour tuyauterie

torque wrench	clés dynamométriques
transfer pump (hand-operated)	pompes de transfert (à main)
tri square	équerres à coulisse
utility brushes	brosses à usages multiples
wire brushes	brosses métalliques

Power Tools and Equipment/Outils et équipement électriques

air compressor and accessories	compresseur d’air et accessoires
band saw	scie à ruban
bench grinder	meuleuse d’établi
booster pump	pompe de surpression
chain saw	scie à chaîne
chop saw	scie à tronçonner
circular saw	scie circulaire
compaction equipment	matériel de compactage
concrete cutter	coupe-béton
coring machines	carotteuses
cryogenic equipment	équipement cryogénique
die grinder	meule à rectifier les matrices
drain cleaning equipment	matériel de débouchage
drill press	perceuse à colonne
drills	perceuses
generator	générateur
heat gun	pistolet thermique
heat lamp	lampe infrarouge
impact wrench	clé à choc
inspection cameras	caméras d’inspection
mini-grinder	mini-meuleuse
mini-excavator	mini-excavateur
oscillating multi-tool	outil oscillant polyvalent
portable band saw (hack saw)	scie à ruban portative (scie à métaux)
powder-actuated tools	outils à charge explosive
power hole saw	mèches emporte-pièce utilisées sur une perceuse
reciprocating saw	scie alternative
rotary hammer	perceuse à percussion
sewer auger (snake)	dégorgeoir mécanique (sonde spirale)
steamer	vaporisateur
task lighting equipment	matériel d’éclairage des aires de travail
telescopic boom	flèche télescopique
transfer pump (electric and pneumatic)	pompe de transfert (électrique et pneumatique)

Pipe Cutting and Joining Equipment/Équipement de coupe et de raccordement de tuyaux

copper tube cutter	outils de coupe pour les tubes en cuivre
crimpers	pinces à sertir
files (set)	limes (jeu)
flaring tools	outils à évaser
fusion tools	outils de fusion
gas cylinders, and soldering and brazing equipment	bouteilles à gaz et matériel de brasage
gas powered cut-off	tronçonneuses à essence
grooving machine	rainureuses
hand-operated oiler	graisseurs manuels
hot air gun (welder)	pistolets à air chaud (soudage)
hot tap equipment	équipement de piquage sur conduite en charge
hydraulic pipe cutter	coupe-tuyaux hydrauliques
mechanical crimper	sertisseuses mécaniques
PEX crimper	sertisseuses en polyéthylène réticulé
PEX pipe expander (manual and power)	évaseurs de tuyaux en polyéthylène réticulé (manuels et mécaniques)
pipe cutter	coupe-tuyaux
pipe groover	rainureuses à tuyaux
pipe reamer	alésoirs à tuyaux
pipe roller	supports à rouleau pour tuyaux
pipe stand	supports de tuyaux
pipe threader	filières à tuyaux
pipe vise	étaux à tuyaux
plastic tube cutters (set)	outils de coupe pour les tubes en plastique (jeu)
power vise press tool	étaux électriques
ratchet cutter	coupe-tuyaux à rochet
snap cutter	coupe-tuyaux à chaîne
specialized assembly tools and equipment	outils et matériel d’assemblage spéciaux
T-extracting tool	extracteurs en T
torch	chalumeaux
tube bender	cintreuses
tube cutter	coupe-tubes
welding equipment	équipement de soudage

Testing, Measuring and Communication Equipment/Équipement d’essai, de mesure et de communication

builder’s level	niveaux de bâtisseur
calculator	calculatrices
calliper	compas d’épaisseur
communication devices	dispositifs de communication

computer	ordinateurs
crimp gauge	jauges à sertissures
differential pressure gauge and sight tube	manomètres différentiels et visiverres
drafting equipment	matériel de traçage
electronic leak detector	détecteurs de fuites électroniques
gauges	jauges
GPS	GPS
groove depth tape	ruban à profondeur de rainure
hand pump and accessories (bicycle pump)	pompes à main et accessoires (pompes à bicyclettes)
hydrostatic pump and gauge (manual and power)	pompes hydrostatiques et manomètres (à main ou mécaniques)
infrared thermometer	thermomètres à infrarouges
laser layout tools	outils de traçage à laser
manometer	manomètres
markers	marqueurs
measuring tape	ruban à mesurer
micrometer	micromètres
multimeter	multimètres
pipe locator	localisateur de conduits
refractometer	réfractomètres
scale rule	règles graduées
scanning equipment	équipement de balayage
test strips and kits	bandes et trousses d’essai
thermal imager	imageurs thermiques
thermometer	thermomètres
two-way radios	radios émetteurs-récepteurs

Hoisting, Rigging and Access Tools and Equipment/Outils et équipement de hissage, de gréage et d’accès

beam trolleys	chariots à poutres
block and tackles	palans
boom truck	camions à flèche
bridles	guide-câbles
chain block hoist (endless chain)	palans à chaîne (chaîne sans fin)
come-along and grip hoist	palans à levier et palans à levier à course illimitée du câble
crane	grues
dolly	socles roulants
equalizer beam	balancier
forklift	chariots élévateurs à fourche
ladders	échelles
lifting eyes	anneaux de levage
pallet jack	transpalettes à main

person/material lift (manual and power)	monte-personnes/monte-charges (manuels et électriques)
pipe dolly	chariot à tuyau
rope/cable	cordes et câbles
scaffolding	échafaudages
scissor lifts	plateformes élévatrices à ciseaux
shackles (varying sizes)	manilles de diverses grandeurs
skid steer loader	chargeurs à direction à glissement
slings and chokers	élingues et étrangleurs
snatch blocks	poulies à chape ouvrante
spreader bar	barres d’écartement
stair cart	chariots pour escaliers
telescopic forklift	chariots élévateurs à fourche télescopique
tuggers (power)	chariots tracteurs
winches	treuils
wire, synthetic, or natural fibre rope	cordes métalliques ou synthétique

Appendix C
Glossary / Glossaire

appliance	piece of equipment which may require connection to a plumbing system	**appareil**	pièce d'équipement qui peut demander un branchement à une installation de plomberie
backflow	flowing back or reversal of the normal direction of the flow	**refoulement**	inversion du sens normal d'écoulement de l'eau
backflow preventer	a device used to prevent backflow due to back pressure or back siphonage	**dispositif antirefoulement**	dispositif utilisé pour empêcher le refoulement causé par la contrepression ou la rentrée d'eau
backing	a layer of material that forms, protects and strengthens the supports for plumbing fixtures and equipment	**pièce de renfort**	couche de matériau qui façonne, protège et renforce le support des appareils et de l'équipement sanitaires
backwater valve	check valve designed for use in a gravity drainage system, permitting flow in only one direction	**clapet antiretour**	clapet de retenue conçu pour un réseau d'évacuation par gravité, permettant un écoulement dans une seule direction
benchmark	predetermined elevation used as a reference point	**repère**	élévation préétablie utilisée comme point de référence
check valve	valve that permits flow in only one direction	**clapet de retenue**	dispositif ne permettant l'écoulement que dans un sens
cleanout	access provided in drainage and venting systems to provide for cleaning and inspection services	**regard de nettoyage**	accès prévu dans un réseau d'évacuation ou de ventilation pour en permettre le nettoyage et l'inspection
cross connection	a connection between a potable water source to a non-potable water source	**raccordement croisé**	raccordement entre une source d'eau potable et une source d'eau non potable
developed length	length along the centre line of the pipe and fitting	**longueur développée**	longueur d'un tuyau mesurée le long de l'axe du tuyau et de ses raccords
Diameter Index Safety System (DISS)	index system used for medical gases which defines the properties of the access points (diameter and configuration) allowing only specific connection devices to connect to corresponding gas access point	**raccord de sécurité à diamètres correspondants**	système utilisé pour les gaz médicaux qui définit les propriétés des points d'accès (diamètre et configuration) et permet seulement de brancher les dispositifs de raccordement spécifiques au point d'accès au gaz qui convient
dielectric protection	a method isolating dissimilar metals to prevent electrolysis (ion transfer) and galvanic corrosion	**protection diélectrique**	méthode visant à isoler les métaux dissemblables afin d'empêcher l'électrolyse (transfert d'ions) et la corrosion

			galvanique
drainage system	assembly of pipes, fittings, fixtures, traps and appurtenances that is used to convey sewage, clear-water waste or storm water to a public sewer or a private sewage disposal system, but does not include subsoil drainage pipes	**réseau d'évacuation**	ensemble de tuyaux, de raccords, d'appareils sanitaires, de siphons et d'accessoires utilisés pour l'acheminement des eaux usées, des eaux nettes ou des eaux pluviales à un égout public ou à une installation individuelle d'assainissement, à l'exclusion des tuyaux de drainage souterrains
embedded components	components of a plumbing system that are encased in concrete or other materials	**composants enfouis**	composants d'une tuyauterie enfermés dans du béton ou d'autres matériaux
expansion tank	device used to accept expansion of water in a closed system	**réservoir d'expansion**	dispositif conçu pour recueillir l'augmentation du volume d'eau dans un système fermé
fire monitoring system	a system that assists locating fire hazard in a building and alerting first responders	**système de surveillance des incendies**	système qui permet de localiser les risques d'incendie dans un bâtiment et d'alerter les premiers intervenants
fire separation / fire stopping	construction assembly that acts as a barrier against the spread of fire and smoke	**séparation coupe-feu/dispositif coupe-feu**	construction destinée à retarder la propagation du feu et de la fumée
fixture	receptacle, appliance, apparatus or other device that discharges sewage or clear-water waste, includes a floor drain	**appareil sanitaire**	réceptacle, appareil ou dispositif, y compris un avaloir de sol, qui évacue des eaux usées ou des eaux nettes
fixture unit – drainage systems	unit of measure based on the rate of discharge, time of operation and frequency of use of a fixture that expresses the hydraulic load that is imposed by that fixture on the drainage system	**facteur d'évacuation (en parlant d'un réseau d'évacuation)**	unité de mesure fondée sur le débit d'écoulement, le temps de fonctionnement et la fréquence d'utilisation d'un appareil sanitaire, et qui exprime la charge hydraulique imposée au réseau d'évacuation par cet appareil
fixture unit – water distribution systems	unit of measure based on the rate of supply, time of operation and frequency of use of a fixture or outlet that expresses the hydraulic load that is imposed by that fixture or outlet on the water supply system	**facteur d'alimentation (en parlant d'un réseau de distribution d'eau)**	unité de mesure fondée sur le débit d'alimentation, le temps de fonctionnement et la fréquence d'utilisation d'un appareil sanitaire ou d'un point de sortie, et qui exprime la charge hydraulique imposée au réseau de distribution d'eau par cet appareil ou ce point de sortie
flashing	component made of rubber, sheet metal or lead used to seal around exterior pipe penetrations	**solin**	composant fait de caoutchouc, de tôle métallique ou de plomb, utilisé pour empêcher l'infiltration d'eau aux pénétrations de tuyaux

			extérieurs
flex connector	device used to isolate vibration and allow for expansion and movement of appliances, equipment and piping	**connecteur souple**	dispositif utilisé pour protéger des vibrations et pour permettre la dilatation et le mouvement d'un appareil, de matériel ou de la tuyauterie
heat tracing	an electrical resistance cable, hydronic or steam piping that prevents the freezing of systems	**dispositif de réchauffage de tuyaux**	tuyauterie à câble à résistance électrique, à eau chaude ou à vapeur qui empêche le gel des tuyaux
maintenance hole	an opening to a confined space to allow access to underground piping for inspection, maintenance and system upgrades (formerly known as a manhole)	**bouche d'égout**	Un acces a un espace restraint pour fair l'inspection, la maintenance et faire l'amelioiration au tuyaux sousterrain.
offset	a piping that connects the ends of two pipes that are parallel or perpendicular	**déviation**	tuyauterie reliant les extrémités de deux tuyaux parallèles ou perpendiculaires
pitless adaptor	fitting that allows the connection and removal of a pump without the use of tools or entering a confined space	**coulisseau de raccordement**	dispositif qui permet de raccorder et de retirer une pompe sans devoir utiliser d'outils ou pénétrer dans un espace clos
plumbing system	drainage system, a venting system and a water system or parts thereof	**installation de plomberie**	réseau d'évacuation, réseau de ventilation, réseau d'alimentation en eau ou toute partie de ceux-ci
potable	safe for human consumption	**eau potable**	eau propre à la consommation humaine
potable water fire protection systems	any fire protection system connected to potable water piping downstream of the building control valve	**systèmes de gicleurs et de canalisations d'incendie raccordés sur le réseau d'eau potable**	tout système de protection contre les incendies raccordé aux tuyauteries d'eau potable
private sewage treatment system	privately owned plant for the treatment and disposal of sewage (such as a septic tank with an absorption field)	**installation individuelle d'assainissement**	installation individuelle de traitement et d'évacuation des eaux usées (par exemple, une fosse septique avec champ d'épuration)
private water supply system	assembly of pipes, fittings, valves, equipment and appurtenances that supplies water from a private source to a water distribution system	**installation individuelle d'alimentation en eau**	ensemble de tuyaux, de raccords, d'appareils de robinetterie, d'équipement et d'accessoires utilisés pour acheminer l'eau d'une source individuelle à un réseau de distribution d'eau
purge	to pass inert gas inside of pipe to displace oxygen or flammable gas and prevent	**purger**	action de faire passer du gaz inerte à l'intérieur d'un tuyau afin de déplacer de l'oxygène et

	oxidation during brazing and welding operations and gas piping modification		empêcher l'oxydation pendant les opérations de brasage et de soudage
roof drain	fitting or device that is installed in the roof to permit storm water to discharge into a leader	**avaloir de toit**	raccord ou dispositif installé sur le toit pour diriger les eaux pluviales vers une descente pluviale
rough-in	placement of pipes to allow for future installation of fixtures and equipment	**plomberie brute**	positionnement de tuyaux pour permettre l'installation éventuelle d'appareils sanitaires et de matériel
sanitary sewer	sewer that conducts sewage	**égout sanitaire**	égout acheminant des eaux usées
sensory inspection	inspection using one or more of the following: sight, taste, touch, smell, auditory	**inspection sensorielle**	inspection faite à partir d'un ou plusieurs des cinq sens, c'est-à-dire la vue, le goût, le toucher, l'odorat ou l'ouïe
sewage	any liquid water other than clear-water waste or storm water	**eaux usées**	eau de rejet autre que les eaux nettes (eaux de rejet dont la teneur en impuretés n'est pas dangereuse pour la santé) et les eaux pluviales
sleeve	a component used to create a penetration through walls, floors and ceilings prior to the installation of piping	**manchon**	composant destiné à créer une voie de pénétration dans des murs, des planchers ou des plafonds avant l'installation de tuyauterie
soil-or-waste pipe	pipe in a sanitary drainage system	**tuyau d'évacuation d'eaux usées**	tuyau faisant partie d'un réseau sanitaire d'évacuation
sounding	a method of detecting cracks in cast iron pipe and fitting	**sondage**	méthode utilisée pour détecter des fissures dans des tuyaux ou des raccords en fonte
storm sewer	sewer that conveys storm water	**égout pluvial**	égout acheminant des eaux pluviales
swing joint	piping arrangement to allow for movement without putting strain on piping	**joint articulé**	disposition de la tuyauterie permettant le mouvement sans imposer de tension à la tuyauterie
thrust blocks	a formed concrete block used to prevent movement of a fitting at a change of direction in a buried piping system	**massif d'ancrage**	bloc de béton moulé utilisé pour empêcher le mouvement d'un raccord où une tuyauterie enfouie change de direction
torque arrestor	device installed on a pipe in a well casing which prevents the pipe from spinning	**cale anticouple**	dispositif installé sur un tuyau placé dans un tubage de puits pour empêcher le tuyau de tourner
trap	fitting or device that is designed to hold a liquid seal that will prevent the	**siphon**	dispositif obturateur hydraulique empêchant le passage des gaz sans gêner l'écoulement des

	passage of gas but will not materially affect the flow of a liquid		liquides
tube	measured by inside diameter	**tube**	tuyau mesuré selon son diamètre intérieur
tubing	measured by OD and wall thickness	**tubulure**	tuyau mesuré selon son diamètre extérieur et l'épaisseur de la paroi
vent piping	pipe that is part of a venting system	**tuyauterie de ventilation**	tuyau faisant partie d'un réseau de ventilation
venting system	assembly of pipes and fittings that connects a drainage system with outside air for circulation of air and the protection of trap seals in the drainage system	**réseau de ventilation**	ensemble de tuyaux et de raccords mettant un réseau d'évacuation en communication avec l'air extérieur et assurant la circulation d'air et le maintien des gardes d'eau dans ce réseau
water distribution system	assembly of pipes, fittings, valves and appurtenances that conveys water from the water service pipe or private water supply system to water supply outlets, fixtures, appliances and devices	**réseau de distribution d'eau**	ensemble de tuyaux, de raccords, d'appareils de robinetterie et d'accessoires acheminant l'eau d'un branchement d'eau général ou d'une installation individuelle d'alimentation en eau aux sorties d'eau, aux appareils sanitaires, aux appareils et aux autres dispositifs
water heater	device for heating water for plumbing services	**chauffe-eau**	dispositif servant à chauffer l'eau circulant dans les installations de plomberie
water service pipe	pipe that conveys water from a public water main or private water source to the inside of a building up to and including the main isolation valve	**branchement d'eau général**	tuyau acheminant l'eau d'une canalisation publique d'alimentation principale en eau ou d'une source d'eau individuelle vers l'intérieur d'un bâtiment, jusqu'au robinet d'isolement principal inclusivement
water system	private water supply system, a water service pipe, a water distribution system or parts thereof	**réseau d'alimentation en eau**	installation individuelle d'alimentation en eau, branchement d'eau général, réseau de distribution d'eau ou toute partie de ceux-ci