PROGRAM PROGRAMME
EXCELLENCE
RED SEAL · SCEAU ROUGE

CURRICULUM OUTLINE

Steamfitter/Pipefitter

2015

INTERPROVINCIAL STANDARD
CANADA
NORME INTERPROVINCIALE

red-seal.ca
sceau-rouge.ca

Employment and Social Development Canada
Emploi et Développement social Canada

Canada

PROGRAM PROGRAMME
EXCELLENCE
RED SEAL · SCEAU ROUGE

STEAMFITTER/PIPEFITTER
CURRICULUM OUTLINE

INTERPROVINCIAL STANDARD
CANADA
NORME INTERPROVINCIALE

STRUCTURE OF THE CURRICULUM OUTLINE

To facilitate development of apprenticeship technical training, this guide contains the following sections:

Description of the Steamfitter / Pipefitter trade: An overview of the trade's duties, work environment, job requirements, similar occupations and career progression

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

Trends in the Steamfitter / Pipefitter trade: Some of the trends identified by industry as being the most important for workers in this trade

Task Matrix and Recommended Training Levels: a chart which outlines graphically the Major Work Activities, Tasks and Sub tasks and their the recommended training levels for each of the sub-tasks

Sequencing of Apprenticeship Training and Subtasks: A chart which outlines the model for apprenticeship training sequencing and a cross-reference of the sub-tasks covered by each topic.

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

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

Task Descriptor: a general description of the task

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

Essential Skills: the three most important essential skills that are used in this sub-task

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

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

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

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

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

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

A complete version of the occupational standard, which provides additional detail for the trade activities, skills and knowledge can be found at www.red-seal.ca

ACKNOWLEDGEMENTS

The CCDA and ESDC wish to express sincere appreciation for the contribution of the many tradespersons, industrial establishments, professional associations, labour organizations, provincial and territorial government departments and agencies, and all others who contributed to this publication.

Acknowledgement is extended by ESDC and the CCDA to the National Industry Advisory Committee for this project, co-chaired by Larry Slaney of the United Association and by Richard McKeagan of the Mechanical Contractors Association of Canada.

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

Glen Aspen	United Association
Michael Battye	Ontario
Philip Craig	Nova Scotia
Jon Dalton	Canadian Standards Association
Paul Dupont	Quebec
Stephen Evecsyn	Manitoba
Tim Furlong	Manitoba
Bruce Gillingham	Newfoundland and Labrador
Anthony Iannucci	Ontario
Corey Kelly	Newfoundland and Labrador
Vince Koeman	British Columbia
Wade MacFadyen	New Brunswick
Andrew Nalesso	Prince Edward Island
Ron Perkin	British Columbia
Al Philips	British Columbia
Bruce Power	United Association
Dustin Saccucci	Saskatchewan
Brian Thompson	Alberta
John Topple	Nova Scotia
Alan Vanderploeg	Ontario

This standard was prepared by the Labour Market Integration Directorate of ESDC. The coordinating, facilitating and processing of this analysis were undertaken by employees of the standards development team of the Trades and Apprenticeship Division and of Apprenticeship New Brunswick. The host jurisdiction of British Columbia also participated in the development of this standard.

DESCRIPTION OF THE STEAMFITTER/PIPEFITTER TRADE

"Steamfitter/Pipefitter" is this trade's official Red Seal occupational title approved by the CCDA. This standard covers tasks performed by a Steamfitter/Pipefitter whose occupational title has been identified by some provinces and territories of Canada under the following names:

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
Pipefitter - Heating System Installer Specialty (Construction)					■								
Steamfitter						■							
Steamfitter – Pipefitter							■		■				
Steamfitter/Pipefitter	■	■	■	■				■		■	■	■	■

Steamfitters/Pipefitters lay out, assemble, fabricate, maintain, repair and service equipment and piping systems carrying water, steam, fluids, gases, chemicals and fuel in various systems such as heating, cooling, lubricating and process piping systems. They read and interpret drawings, specifications and codes to determine layout, type and size of pipe, and tools to use. They measure, cut, thread, groove, bend, solder, braze, assemble and install metal, plastic and fiberglass pipes, valves and fittings. As well, they must be able to join and secure pipe sections of related equipment. They check systems for leaks. Steamfitters/Pipefitters also do general maintenance work including replacement of worn components.

Steamfitters/Pipefitters must carry out quality control checks on work performed. The system must be tested and commissioned to verify the quality of work and to confirm that the system is functioning to design specifications. They use welding, cutting, shaping, soldering, threading and brazing equipment to join pipes and fabricate sections of piping systems.

Areas of specialization in this trade include maintenance, quality control, rigging, fabrication and installation of various types of systems and specialty piping.

Safety practices are of utmost importance in this trade. Steamfitters/Pipefitters work both indoors and outdoors at physically demanding tasks that often require working at heights. There is some risk of injury when working in and around trenches, on work platforms, and with power tools and heavy equipment. The piping systems may carry dangerous substances. Safety practices and training are emphasized in order to minimize risks.

Steamfitters/Pipefitters must have mechanical aptitude, manual dexterity, mathematical skills, an ability to read and understand complex instructions and an ability to do careful and exacting work. They sometimes work in uncomfortable or cramped positions. The work can also be physically demanding. In aspects of layout, work organization, project planning and supervisory tasks, steamfitters/pipefitters may also make use of many digital tools and applications.

With experience, steamfitters/pipefitters may advance to positions such as foreman, contractor, owner, superintendent and instructor.

ESSENTIAL SKILLS SUMMARY

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

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

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

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

The tools are available online or for order at: www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml

The application of these skills may be described throughout this document within the skills and knowledge which support each sub-task of the trade. The most important essential skills for each sub-task have also been identified. The following are summaries of the requirements in each of the essential skills, taken from the essential skills profile. A link to the complete essential skills profile can be found at www.red-seal.ca.

READING

Steamfitters/Pipefitters require strong reading skills to refer to and interpret manufacturers' manuals and instructions including diagrams, charts and graphs. They also need to consult multiple professional codes concerning industry standards and safety requirements.

DOCUMENT USE

Steamfitters/Pipefitters must be comfortable in document use to interpret work schedules. They consult reference manuals on measurement, materials and pipe sizing, pressures and mathematical formulas for calculations. They interpret information from mechanical drawings, schematic diagrams and architectural plans to ensure proper installation of piping. They also use quality control documentation which records information such as heat numbers, weld mapping and material identification.

WRITING

Writing skills are used by steamfitters/pipefitters to write lists of materials and fittings needed for a job, complete forms to request materials and keep daily logs to record measurements and reminders. When required, they must write incident or accident reports.

ORAL COMMUNICATION

Steamfitters/Pipefitters require good oral communication skills to interact with colleagues, supervisors and other tradespersons when co-ordinating work, resolving problems and ensuring safety. They interact with apprentices to provide mentorship and speak with vendors to order materials.

NUMERACY

Numeracy skills are very important in the everyday work of steamfitters/pipefitters. They frequently take or calculate measurements of temperature, pressure and volume. They verify conformity with manufacturers' recommendations and operating practices. The work requires a strong understanding of mathematical calculations and trigonometry. The ability to estimate the quantity of piping material required and to convert between imperial and metric systems of measurement is also important.

THINKING SKILLS

Steamfitters/Pipefitters identify the steps and develop a plan to accomplish a task and coordinate the work. They must decide how to configure and relocate pipes. The ability to problem solve during testing or when a pipe or system failure is encountered is important. Decision making is important when considering job safety and risk prevention. Steamfitters/Pipefitters must also be able to find information they need in multiple sources such as blueprints, code documents, reference manuals and product catalogues.

WORKING WITH OTHERS

Steamfitters/Pipefitters liaise with supervisors, colleagues and other trades to coordinate multiple tasks. They may work with trades such as welders, pipe insulators and electricians. They supervise others and mentor apprentices, offering both practical training and safety information. Additionally, the conduct, behaviour, appearance and attitude of a steamfitter/pipefitter are essential to the success of a job or project.

DIGITAL TECHNOLOGY

Steamfitters/Pipefitters may use communications software for e-mail or use the Internet to look up material and trade-related information, to order materials online or to access training. They may use a spreadsheet to keep track of the status of materials ordered. They may also use CAD software to input measurements taken on the job site, to generate drawings and for referencing purposes. The use of digital equipment for the trade such as smart phones, laser and digital layout equipment such as total station, building information modeling and GPS technology is increasingly important for trade activities.

CONTINUOUS LEARNING

Steamfitters/Pipefitters may pursue refresher courses or specialty certifications and attend supplier seminars. Continuous learning is essential as they must keep up-to-date with the regulatory requirements and the various codes that are periodically revised. Also, they must keep abreast of technological advances in their field to select the most appropriate equipment, tools and materials and be able to perform a proper installation.

TRENDS IN THE STEAMFITTER/PIPEFITTER TRADE

Steam systems are being installed less frequently in office and commercial facilities. However, these systems are still prevalent in facilities utilizing central heating plants such as hospitals and college/university campuses.

Steamfitters/Pipefitters work in many sectors including pipelines, nuclear energy, mining, petro-chemical, natural gas, sawmills, offshore oil and gas, shipbuilding, automotive, pulp and paper, and commercial and institutional. In some jurisdictions, steamfitting/pipefitting work is increasing in certain sectors, such as gas plants and shipbuilding. Due to changing demands on the industry and an aging workforce, there may be a requirement for more steamfitter/pipefitters in Canada.

Plastic pipe is increasingly being used in residential, commercial and institutional sectors for certain applications. In industries such as pulp and paper, shipbuilding, mining and chemical, there is an increase in the use of specialized materials. New materials are becoming economically feasible, driving changes in structural design, especially in industrial and institutional sectors. The movement to more specialized materials will require more training for steamfitters/pipefitters. This will also require a more in-depth knowledge of quality control procedures.

Renewable energy systems such as geo-exchange, geothermal, solar, radiant, refrigeration, heat recovery and central cooling plants are becoming more prevalent. There is new technology for water-heating such as low-mass boilers, on-demand (flow-through) hot water systems, condensing boilers, biomass, high efficiency boilers and co-generation boilers. Heating and cooling systems are becoming increasingly hybridized making it less clear where one system ends and the other begins.

Steamfitters/Pipefitters must keep current on a large number of regulations and codes. Governments continue to pass more stringent safety, health and environmental regulations. Leadership in Energy and Environmental Design (LEED) standards are becoming more common in many jurisdictions. These promote increased energy efficiency and environmentally friendly building practices.

Steamfitters/Pipefitters are expected to obtain and maintain a high level of safety knowledge and training. There is an increase in the use of hydraulic/pneumatic/electric cutting and bevelling tools for pipe-end preparation. Hydraulic/pneumatic/electric tensioning and torquing equipment are also becoming more common in the trade. There is an increase in the use of flame-free pipe press-connection technology, which increases efficiency and safety.

There is an ongoing trend towards the use of computers for reports, schedules, ordering material, completion of forms, rendering drawings (computer-aided design or CAD), system analysis and service, and control of heating/cooling systems. The use of digital equipment for the trade such as smart phones, laser and digital layout equipment such as total station and GPS technology is increasingly important for trade activities.

Modularization and pre-fabrication is becoming more common and installation of these materials requires less field runs.

In some jurisdictions, steamfitters/pipefitters require specialty licenses such as gas, fuel and oil licences or other special endorsements for working with materials such as medical gas. Certification may also be required for performing welding, tacking processes and backflow prevention. Licensing and certifications for aerial work platforms, zoom booms, articulated fork-lifts and scissor lifts are becoming essential for operating these pieces of equipment. Hoisting and rigging certification is becoming increasingly necessary in some jurisdictions.

With regulations becoming more stringent, steamfitters/pipefitters may be held liable for their actions when performing rigging, hoisting, lifting and positioning activities. It is the responsibility of steamfitters/pipefitters to be aware of changes in regulations.

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.

SEQUENCING OF APPRENTICESHIP TRAINING TOPICS AND RELATED SUBTASKS

These Topic Titles are accompanied by the subtasks and their reference number contained in this Curriculum Outline. The topics in the shaded cells represent those that are covered “in context” with other training.

Level 1	Level 2	Level 3	Level 4
Organizes Job 3.01 Plans work. 3.02 Generates drawings. 3.03 Interprets drawings and specifications. 3.04 Develops piping templates. 3.05 Performs preliminary quality control functions.	**Organizes Job** 3.01 Plans work. 3.02 Generates drawings. 3.03 Interprets drawings and specifications. 3.04 Develops piping templates. 3.05 Performs preliminary quality control functions.	**Organizes Job** 3.01 Plans work. 3.02 Generates drawings. 3.03 Interprets drawings and specifications. 3.04 Develops piping templates. 3.05 Performs preliminary quality control functions.	**Organizes Job** 3.01 Plans work. 3.02 Generates drawings. 3.03 Interprets drawings and specifications. 3.04 Develops piping templates. 3.05 Performs preliminary quality control functions.
	Rigging, Hoisting, Lifting	**Rigging, Hoisting, Lifting**	
		Fabrication	**Fabrication**
		Layout	**Layout**
	Valves	**Valves**	**Valves**
			Heat Tracing Systems
			Industrial Water Treatment Equipment
	Steam Systems		
			Fuel Systems
	Commissions Systems	**Commissions Systems**	
Safety 1.01 Maintains safe work environment. 1.02 Selects, inspects and uses personal protective equipment (PPE) and safety equipment. 1.03 Follows lock-out 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 welding equipment 2.04 Uses soldering and brazing equipment.	**Tools and Equipment** 2.03 Uses welding equipment 2.05 Uses oxy-fuel equipment. 8.06 Sets up rigging, hoisting, lifting and positioning equipment.		
Rigging, Hoisting, Lifting 8.01 Determines load. 8.02 Prepares lift plan(s). 8.03 Selects rigging, hoisting, lifting and positioning equipment. 8.04 Inspects rigging, hoisting, lifting and positioning equipment. 8.05 Secures lift area. 8.06 Sets up rigging, hoisting, lifting and positioning equipment 8.07 Performs lift and positioning. 8.08 Maintains and stores rigging, joisting, lifting and positioning equipment.			**Complex Rigging** 9.01 Prepares lift plan for complex and critical rigging, hoisting, lifting and positioning. 9.02 Performs calculations for complex and critical rigging, hoisting, lifting and positioning. 9.03 Selects rigging, hoisting, lifting and positioning equipment for complex and critical lifts. 9.04 Sets up rigging, hoisting, lifting and positioning equipment for complex and critical lifts. 9.05 Performs complex and critical lifts and positioning.
Fabrication 4.02 Fabricates brackets, supports, hangers, guides and anchors.	**Fabrication** 4.01 Fabricates piping system components.		
Layout 5.01 Lays out, identifies and installs copper piping, tubing, fittings and related components. 5.02 Lays out, identifies and installs plastic piping, tubing, fittings and related components. 5.03 Lays out, identifies and installs carbon steel piping, tubing, fittings and related components. 5.04 Lays out, identifies and installs stainless steel piping, tubing, fittings and related components.	**Layout** 5.05 Lays out, identifies and installs fibreglass piping, fittings and related components. 5.06 Lays out, identifies and installs specialty piping, fittings and related components.		
Valves 6.01 Installs valves. 6.02 Maintains, troubleshoots, repairs and tests valves.			
	Heat Tracing Systems (Liquid) 7.03 Installs liquid-filled tracing systems. 7.04 Maintains, troubleshoots, repairs and tests liquid-filled tracing systems.	**Heat Tracing Systems (Steam)** 7.01 Installs steam tracing systems. 7.02 Maintains, troubleshoots, repairs and tests steam tracing systems.	

Level 1	Level 2	Level 3	Level 4
			Process Piping 13.01 Installs equipment for process piping systems. 13.02 Installs piping for process piping systems. 13.03 Tests process piping systems. 13.04 Maintains, troubleshoots and repairs process piping systems.
			Hydraulic Systems 15.01 Installs equipment for hydraulic systems. 15.02 Installs piping, tubing and hoses for hydraulic systems. 15.03 Tests hydraulic systems. 15.04 Maintains, troubleshoots and repairs hydraulic systems.
			Air and Pneumatic Systems 19.01 Installs equipment for compressed air and pneumatic systems. 19.02 Installs piping and tubing for compressed air and pneumatic systems. 19.03 Tests compressed air and pneumatic systems. 19.04 Maintains, troubleshoots and repairs compressed air and pneumatic systems.
		Industrial Water Treatment Equipment 14.01 Installs equipment for industrial water and waste treatment systems. 14.02 Installs piping for industrial water and waste treatment systems. 14.03 Tests industrial water and waste treatment systems. 14.04 Maintains, troubleshoots and repairs industrial water and waste treatment systems.	
	Hydronic Systems 12.01 Installs equipment for hydronic systems. 12.02 Installs piping for hydronic systems. 12.03 Tests hydronic systems. 12.04 Maintains, troubleshoots and repairs hydronic systems.	**Hydronic Systems (Controls)** 12.01 Installs equipment for hydronic systems. 12.02 Installs piping for hydronic systems. 12.03 Tests hydronic systems. 12.04 Maintains, troubleshoots and repairs hydronic systems.	

Level 1	Level 2	Level 3	Level 4
		Steam Systems (Low Pressure) 10.01 Installs equipment for low pressure steam and condensate systems. 10.02 Installs piping for low pressure steam and condensate systems. 10.03 Tests low pressure steam and condensate systems. 10.04 Maintains, troubleshoots and repairs low pressure steam and condensate systems.	**Steam Systems (High Pressure)** 11.01 Installs equipment for high pressure steam and condensate systems. 11.02 Installs piping for high pressure steam and condensate systems. 11.03 Tests high pressure steam and condensate systems. 11.04 Maintains, troubleshoots and repairs high pressure steam and condensate systems.
			HVACR 16.01 Installs equipment for HVACR systems. 16.02 Installs hydronic piping and refrigeration tubing for HVACR systems. 16.03 Tests associated components of HVACR systems. 16.04 Maintains, troubleshoots and repairs associated components of HVACR systems.
		Fuel Systems 17.01 Installs equipment for fuel systems. 17.02 Installs piping and tubing for fuel systems. 17.03 Tests fuel systems. 17.04 Maintains, troubleshoots and repairs fuel systems.	
		Medical Gas 18.01 Installs equipment for medical gas systems. 18.02 Installs piping and tubing for medical gas systems. 18.03 Tests medical gas systems. 18.04 Maintains, troubleshoots and repairs medical gas systems.	
			Heat Recovery Systems 23.01 Installs equipment for heat recovery systems. 23.02 Installs piping for heat recovery systems. 23.03 Tests heat recovery systems. 23.04 Maintains, troubleshoots and repairs heat recovery systems.

Level 1	Level 2	Level 3	Level 4

Geothermal Systems
Solar Heating Systems

21.01 Installs equipment for geo-exchange and geothermal systems.
21.02 Installs piping for geo-exchange and geothermal systems.
21.03 Tests geo-exchange and geothermal systems.
21.04 Maintains, troubleshoots and repairs geo-exchange and geothermal systems.
22.01 Installs equipment for solar heating systems.
22.02 Installs piping for solar heating systems.
22.03 Tests solar heating systems.
22.04 Maintains, troubleshoots and repairs solar heating systems.

Commissions System

24.01 Flushes system.
24.02 Chemically treats system.
24.03 Pre-checks system for commissioning.
24.04 Selects and connects commissioning equipment.
25.01 Secures commissioning area.
25.02 Pressurizes system.
25.03 Inspects system
25.04 Corrects faulty conditions.
25.05 Participates in start-up and turnover

STEAMFITTER/PIPEFITTER TASK MATRIX AND RECOMMENDED TRAINING LEVELS

A – PERFORMS COMMON OCCUPATIONAL SKILLS

Task A-1 **Performs safety-related functions.**	**A-1.01 Maintains safe work environment.** 1	**A-1.02 Selects, inspects and uses personal protective equipment (PPE) and safety equipment.** 1	**A-1.03 Follows lock-out procedures.** 1
Task A-2 **Uses and maintains tools and equipment.**	**A-2.01 Uses common tools and equipment.** 1	**A-2.02 Uses access equipment.** 1	**A-2.03 Uses welding equipment.** 1,2
	A-2.04 Uses soldering and brazing equipment. 1	**A-2.05 Uses oxy-fuel equipment.** 2	
Task A-3 **Organizes job.**	**A-3.01 Plans work.** 1,2,3,4	**A-3.02 Generates drawings.** 1,2,3,4	**A-3.03 Interprets drawings and specifications.** 1,2,3,4
	A-3.04 Develops piping templates. 1,2,3,4	**A-3.05 Performs preliminary quality control functions.** 1,2,3,4	

B – PERFORMS LAYOUT, FABRICATION AND PIPING INSTALLATION

Task B-4 **Performs fabrication.**	**B-4.01 Fabricates piping system components.** 2	**B-4.02 Fabricates brackets, supports, hangers, guides and anchors.** 1	
Task B-5 **Lays out, identifies and installs piping, tubing, fittings and related components.**	**B-5.01. Lays out, identifies and installs copper piping, tubing, fittings and related components.** 1	**B-5.02 Lays out, identifies and installs plastic piping, tubing, fittings and related components.** 1	**B-5.03 Lays out, identifies and installs carbon steel piping, tubing, fittings and related components.** 1
	B-5.04. Lays out, identifies and installs stainless steel piping, tubing, fittings and related components. 1	**B-5.05 Lays out, identifies and installs fibreglass piping, fittings and related components.** 2	**B-5.06 Lays out, identifies and installs specialty piping, fittings and related components.** 2
Task B-6 **Installs, maintains, troubleshoots, repairs and tests valves.**	**B-6.01 Installs valves.** 1	**B-6.02 Maintains, troubleshoots, repairs and tests valves.** 1	
Task B-7 **Installs, tests, maintains, troubleshoots and repairs heat tracing systems.**	**B-7.01 Installs steam tracing systems.** 3	**B-7.02 Maintains, troubleshoots, repairs and tests steam tracing systems.** 3	**B-7.03 Installs liquid-filled tracing systems.** 2
	B-7.04. Maintains, troubleshoots, repairs and tests liquid-filled tracing systems. 2		

C – PERFORMS RIGGING, HOISTING, LIFTING AND POSITIONING

Task C-8 **Performs common rigging, hoisting, lifting and positioning.**	**C-8.01 Determines load.** 1	**C-8.02. Prepares lift plan(s).** 1	**C-8.03 Selects rigging, hoisting, lifting and positioning equipment.** 1
	C-8.04 Inspects rigging, hoisting, lifting and positioning equipment. 1	**C-8.05 Secures lift area.** 1	**C-8.06 Sets up rigging, hoisting, lifting and positioning equipment.** 1,2
	C-8.07 Performs lift and positioning. 1	**C-8.08 Maintains and stores rigging, hoisting, lifting and positioning equipment.** 1	
Task C-9 **Performs complex and critical rigging, hoisting, lifting and positioning.**	**C-9.01 Prepares lift plan for complex and critical rigging, hoisting, lifting and positioning.** 4	**C-9.02 Performs calculations for complex and critical rigging, hoisting, lifting and positioning.** 4	**C-9.03 Selects rigging, hoisting, lifting and positioning equipment for complex and critical lifts.** 4
	C-9.04 Sets up rigging, hoisting, lifting and positioning equipment for complex and critical lifts. 4	**C-9.05 Performs complex and critical lifts and positioning.** 4	

D – INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS LOW AND HIGH PRESSURE STEAM AND CONDENSATE SYSTEMS

Task D-10 **Installs, tests, maintains, troubleshoots and repairs low pressure steam and condensate systems.**	**D-10.01 Installs equipment for low pressure steam and condensate systems.** 3	**D-10.02 Installs piping for low pressure steam and condensate systems.** 3	**D-10.03 Tests low pressure steam and condensate systems.** 3
	D-10.04 Maintains, troubleshoots and repairs low pressure steam and condensate systems. 3		
Task D-11 **Installs, tests, maintains, troubleshoots and repairs high pressure steam and condensate systems.**	**D-11.01 Installs equipment for high pressure steam and condensate systems.** 4	**D-11.02 Installs piping for high pressure steam and condensate systems.** 4	**D-11.03 Tests high pressure steam and condensate systems.** 4
	D-11.04 Maintains, troubleshoots and repairs high pressure steam and condensate systems. 4		

E – INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS HEATING, COOLING AND PROCESS PIPING SYSTEMS

Task E-12 **Installs, tests, maintains, troubleshoots and repairs hydronic systems.**	**E-12.01 Installs equipment for hydronic systems.** 2,3	**E-12.02 Installs piping for hydronic systems.** 2,3	**E-12.03 Tests hydronic systems.** 2,3
	E-12.04 Maintains, troubleshoots and repairs hydronic systems. 2,3		
Task E-13 **Installs, tests, maintains, troubleshoots and repairs process piping systems.**	**E-13.01 Installs equipment for process piping systems.** 4	**E-13.02 Installs piping for process piping systems.** 4	**E-13.03 Tests process piping systems.** 4
	E-13.04 Maintains, troubleshoots and repairs process piping systems. 4		
Task E-14 **Installs, tests, maintains, troubleshoots and repairs industrial water and waste treatment systems.**	**E-14.01 Installs equipment for industrial water and waste treatment systems.** 3	**E-14.02 Installs piping for industrial water and waste treatment systems.** 3	**E-14.03 Tests industrial water and waste treatment systems.** 3
	E-14.04 Maintains, troubleshoots and repairs industrial water and waste treatment systems. 3		
Task E-15 **Installs, tests, maintains, troubleshoots and repairs hydraulic systems.**	**E-15.01 Installs equipment for hydraulic systems** 4	**E-15.02 Installs piping, tubing and hoses for hydraulic systems.** 4	**E-15.03 Tests hydraulic systems.** 4
	E-15.04 Maintains, troubleshoots and repairs hydraulic systems. 4		

Task E-16 **Installs, tests, maintains, troubleshoots and repairs heating, ventilation, air conditioning and refrigeration (HVACR) systems.**	**E-16.01 Installs equipment for HVACR systems.** 4	**E-16.02 Installs hydronic piping and refrigeration tubing for HVACR systems.** 4	**E-16.03 Tests associated components of HVACR systems.** 4
	E-16.04 Maintains, troubleshoots and repairs associated components of HVACR systems. 4		
Task E-17 **Installs, tests, maintains, troubleshoots and repairs fuel systems.**	**E-17.01 Installs equipment for fuel systems.** 3	**E-17.02 Installs piping and tubing for fuel systems.** 3	**E-17.03 Tests fuel systems.** 3
	E-17.04 Maintains, troubleshoots and repairs fuel systems. 3		
Task E-18 **Installs, tests, maintains, troubleshoots and repairs medical gas systems.**	**E-18.01 Installs equipment for medical gas systems.** 3	**E-18.02 Installs piping and tubing for medical gas systems.** 3	**E-18.03 Tests medical gas systems.** 3
	E-18.04 Maintains, troubleshoots and repairs medical gas systems. 3		
Task E-19 **Installs, tests, maintains, troubleshoots and repairs compressed air and pneumatic systems.**	**E-19.01 Installs equipment for compressed air and pneumatic systems.** 4	**E-19.02 Installs piping and tubing for compressed air and pneumatic systems.** 4	**E-19.03 Tests compressed air and pneumatic systems.** 4
	E-19.04 Maintains, troubleshoots and repairs compressed air and pneumatic systems. 4		
Task E-20 **Installs and tests fire protection systems.** **(NOT COMMON CORE)**	**E-20.01 Installs equipment for fire protection systems.** **(NOT COMMON CORE)**	**E-20.02 Installs piping for fire protection systems.** **(NOT COMMON CORE)**	**E-20.03 Tests fire protection systems.** **(NOT COMMON CORE)**

F – INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS RENEWABLE ENERGY SYSTEMS

Task F-21 **Installs, tests, maintains, troubleshoots and repairs geo-exchange and geothermal systems.**	**F-21.01 Installs equipment for geo-exchange and geothermal systems.** 4	**F-21.02 Installs piping for geo-exchange and geo-thermal systems.** 4	**F-21.03 Tests geo-exchange and geothermal systems.** 4
	F-21.04 Maintains, troubleshoots and repairs geo-exchange and geothermal systems. 4		
Task F-22 **Installs, tests, maintains, troubleshoots and repairs solar heating systems.**	**F-22.01 Installs equipment for solar heating systems.** 4	**F-22.02 Installs piping for solar heating systems.** 4	**F-22.03 Tests solar heating systems.** 4
	F-22.04 Maintains, troubleshoots and repairs solar heating systems. 4		
Task F-23 **Installs, tests, maintains, troubleshoots and repairs heat recovery systems.**	**F-23.01 Installs equipment for heat recovery systems.** 4	**F-23.02 Installs piping for heat recovery systems.** 4	**F-23.03 Tests heat recovery systems.** 4
	F-23.04 Maintains, troubleshoots and repairs heat recovery systems. 4		

G – PERFORMS COMMISSIONING, START-UP AND TURNOVER

Task G-24 **Prepares system for commissioning, start-up and turnover.**	**G-24.01 Flushes system.** 4	**G-24.02 Chemically treats system.** 4	**G-24.03 Pre-checks system for commissioning.** 4
	G-24.04 Selects and connects commissioning equipment. 4		
Task G-25 **Commissions systems.**	**G-25.01 Secures commissioning area.** 4	**G-25.02 Pressurizes system.** 4	**G-25.03 Inspects system.** 4
	G-25.04 Corrects faulty conditions. 4	**G-25.05 Participates in start-up and turnover procedures.** 4	

MAJOR WORK ACTIVITY A
PERFORMS COMMON OCCUPATIONAL SKILLS

TASK A-1 Performs safety-related functions.

TASK DESCRIPTOR

Safety is integral to any and every aspect of the steamfitter/pipefitter trade. Steamfitters/Pipefitters maintain a safe work environment in order to prevent and correct any potential or immediate hazard, address an incident or accident, and follow up to ensure the safety and wellness of every person on the work site. 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 spills, property damage, personal injury and fatalities. Each steamfitter/pipefitter is responsible for their own lock-out and tag-out equipment.

A-1.01 Maintains safe work environment.

Essential Skills	Oral Communication, Thinking Skills, Reading

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-1.01.01K	demonstrate knowledge of safe work practices	identify ***hazards*** and describe safe work practices
A-1.01.02K	demonstrate knowledge of regulatory requirements pertaining to workplace safety	identify and describe local and jurisdictional laws and requirements
		identify and describe company or jurisdictional procedures for emergency response

RANGE OF VARIABLES

work site hazards include: poor housekeeping, overhead hazards, confined space hazards, hot work hazards, asbestos, noise hazards, environmental hazards, vibration hazards, air quality

A-1.02 Selects, inspects and uses personal protective equipment (PPE) and safety equipment.

Essential Skills	Document Use, Thinking Skills, Continuous Learning

	KNOWLEDGE	
	Learning Outcomes	Learning Objectives
A-1.02.01K	demonstrate knowledge of ***PPE*** and ***safety equipment***, its applications, maintenance and procedures for use	identify types of ***PPE*** and safety equipment and describe their applications, limitations and procedures for use
		describe procedures used to care for, maintain and store PPE and ***safety equipment***
A-1.02.02K	demonstrate knowledge of regulatory requirements pertaining to PPE and safety equipment	identify training required by jurisdictional codes and regulations, and site-specific regulations
		identify regulations and safety documentation pertaining to the use of PPE and safety equipment

RANGE OF VARIABLES

PPE includes: fall arrest systems, respirators and face shields, steel toed boots, hardhats, safety glasses, hearing protection, gloves, face shields, protective wristlets, fire-retardant clothing

safety equipment includes: fire extinguishers, hand rails, first aid kits, smoke and fume extractors

A-1.03 Follows lock-out procedures.

Essential Skills	Document Use, Reading, Thinking Skills

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-1.03.01K	demonstrate knowledge of applications and procedures for ***locking out equipment***	identify situations that require lock-out
		describe procedures for locking out equipment and piping
		identify safety regulations pertaining to locking out electrical equipment, piping equipment and piping

RANGE OF VARIABLES

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

TASK A-2 Uses and maintains tools and equipment.

TASK DESCRIPTOR

Tools and equipment must be used, maintained and stored in a safe manner to complete all tasks of the steamfitter/pipefitter trade. Ladders and work platforms are often required to access job locations. Steamfitters/Pipefitters use various tools and equipment to assemble piping systems. Steamfitter/Pipefitter tasks include welding, soldering, bolting, grooving, threading, fusion and crimping. Steamfitters/Pipefitters perform welding and soldering tasks including orbital welding, oxy-fuel welding and heat fusion welding. They also assist certified welders with electric arc welding, gas tungsten arc welding (GTAW), shielded metal arc welding (SMAW) and gas metal arc welding (GMAW) processes. They must be knowledgeable in setting up the welding, soldering, brazing and oxy-fuel equipment, in welding practices, pipe preparation and cure times.

A-2.01 Uses common tools and equipment.

Essential Skills	Thinking Skills, Document Use, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.01.01K	demonstrate knowledge of tools and equipment, their applications, maintenance and procedures for use	identify types of ***hand tools*** and describe their applications and procedures for use
		identify types of ***power tools*** and describe their applications and procedures for use
		identify types of ***measuring tools*** and equipment and describe their applications and procedures for use
		identify types of powder-actuated tools and describe their applications
		describe the procedures used to inspect, maintain and store tools and equipment
		demonstrate proper use of tools and equipment

RANGE OF VARIABLES

hand tools include: pipe wrenches, combination wrenches, spacers, wedges, squares, levels
power tools include: electrical, pneumatic, hydraulic
measuring tools include: measuring tape, ruler, manometer

A-2.02 Uses access equipment.

Essential Skills	Document Use, Thinking Skills, Continuous Learning

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.02.01K	demonstrate knowledge of ladders, scaffolding and motorized work platforms, their applications, limitations and procedures for use	identify hazards and describe safe work practices pertaining to ladders, scaffolding and motorized work platforms
		identify ***jurisdictional regulations and site specific requirements*** pertaining to ladders, scaffolding and motorized work platforms
		identify types of ***ladders*** and describe their characteristics and applications
		identify types of ***scaffolding*** and describe their characteristics and applications
		identify types of ***motorized work platforms*** and describe their characteristics and applications
		describe the procedures used to erect and dismantle ladders and scaffolding

RANGE OF VARIABLES

jurisdictional regulations and site specific requirements include: personnel training/certification, equipment certification requirements, proper use and limitations of equipment
ladders includes: step ladders, extension ladders, platform ladders
scaffolding includes: tube and clamp, swing stage, frame scaffolding
motorized work platforms include: scissor lift, articulated boom, personnel basket

A-2.03 Uses welding equipment.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.03.01K	demonstrate knowledge of ***welding equipment***, applications and procedures	identify types of ***welding equipment***
		identify different ***welding processes*** and applications
		identify ***welding consumables***

		identify certification requirements for performing welding
		demonstrate use of welding equipment according to industry standards
		describe the procedures used to inspect, maintain and store welding equipment

RANGE OF VARIABLES

welding equipment includes: SMAW equipment, orbital welding machines and equipment, GTAW equipment, torches, GMAW equipment

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

welding consumables include: welding rods, flux, grinding discs

A-2.04 Uses soldering and brazing equipment.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.04.01K	demonstrate knowledge of ***soldering and brazing equipment***, applications and procedures	identify types of ***soldering and brazing equipment***
		identify different soldering and brazing processes and applications
		identify ***purge procedures*** required for brazing
		identify ***soldering and brazing consumables***
		identify certification requirements for performing brazing
		demonstrate use of soldering and brazing equipment according to industry standards
		describe the procedures used to inspect, maintain and store soldering and brazing equipment

RANGE OF VARIABLES

soldering and brazing equipment includes: oxy-acetylene and air-acetylene torches, attachments (strikers, MAPP, gas cylinder and torch heads)

purge procedures include: dams, purge gas, pressures, flow rates

soldering and brazing consumables include: silver solder, flux, soft solder, brazing rod, sand cloth

A-2.05 Uses oxy-fuel equipment.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-2.05.01K	demonstrate knowledge of oxy-fuel equipment, applications and procedures	identify ***oxy-fuel equipment components***
		demonstrate use of oxy-fuel equipment according to industry standards
		describe the procedures used to inspect, maintain and store oxy-fuel equipment

RANGE OF VARIABLES

oxy-fuel equipment components include: hoses, flashback arrestors

TASK A-3 Organizes job.

TASK DESCRIPTOR

Steamfitters/Pipefitters participate in organizing jobs, planning the work, generating material lists and managing their time to meet project deadlines. They ensure the systems are assembled correctly by following regulations and specifications, and participating in quality control practices.
Steamfitters/Pipefitters 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,-templates, which are used in the layout and fabrication of fittings such as mitres and branch connections.

It is very important for steamfitters/pipefitters to develop a strong understanding of labour costs, material costs, and efficiencies in their work. To maintain productivity, lifelong learning is crucial in this trade. Being able to keep “the big picture” in mind, while paying close attention to detail and maintaining a commitment to safe work practices, is an important ability for career success.

Steamfitters/Pipefitters must develop the ability to continuously do preliminary quality control checks to ensure compliance with specifications and AHJ requirements.

A-3.01 Plans work.

Essential Skills	Thinking Skills, Oral Communication, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-3.01.01K	demonstrate knowledge of the procedures used to plan and organize work	identify ***sources of information*** relevant to work planning
		describe the ***considerations*** for determining job requirements
		describe the ***procedures used to plan work***

		describe the procedures used to organize and maintain inventory
A-3.01.02K	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 practices that are most efficient while maintaining commitment to safety

RANGE OF VARIABLES

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

A-3.02 Generates drawings.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-3.02.01K	demonstrate knowledge of drawings and their applications	describe metric and imperial systems of measurement and the procedures used to perform conversions
		identify the types of ***drawings*** and describe their applications
		identify types of symbols and describe their characteristics and applications
		identify ***drawing projections*** and ***views***, and describe their applications
		describe the use of scales
A-3.02.02K	demonstrate knowledge of basic drawing and sketching techniques	demonstrate basic drawing and sketching techniques

RANGE OF VARIABLES

drawings include: civil/site, architectural, mechanical, structural, electrical, shop drawings, sketches
drawing projections include: orthographic, oblique, isometric, pictorial
drawing views include: plan, section, detail, elevation, cross section

A-3.03 Interprets drawings and specifications.

Essential Skills	Document Use, Oral Communication, Digital Technology

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-3.03.01K	demonstrate ability to interpret and extract information from types of ***drawings and specifications***	identify types of ***drawings and specifications*** and describe their applications
		identify symbols relating to drawings and describe their characteristics and applications
		interpret and extract information from drawings and specifications
A-3.03.02K	demonstrate knowledge of drawings and their applications	describe metric and imperial systems of measurement and the procedures used to perform conversions
		identify ***drawing projections*** and ***views*** and describe their applications
		describe the use of scales
A-3.03.03K	demonstrate knowledge of digital tools and software for layout and design	identify types of ***digital tools and software*** for layout and design
		identify ***applications for digital software*** tools

RANGE OF VARIABLES

drawings and specifications include: P&ID, spool sheets, isometric drawings, revisions, vendor/shop civil/site, architectural, mechanical, structural, electrical, shop drawings, sketches

drawing projections include: orthographic, oblique, isometric, pictorial

drawing views include: plan, section, detail, elevation, cross section

digital tools and software includes: total station, auto-CAD, CAD, building information management (BIM)

applications for digital software include: dimensional control, visualization of construction

A-3.04 Develops piping templates.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-3.04.01K	demonstrate knowledge of the methods of template development and their associated procedures	interpret information pertaining to template development found on drawings
		identify ***tools and equipment relating to template development*** and describe their applications and procedures for use
		identify the ***methods used for template development***
		describe the procedures used to develop templates
		identify ***specifications for piping requirements*** used in template development

RANGE OF VARIABLES

tools and equipment relating to template development include: dividers, scribers, protractors, compasses, wrap-around, paper, cardboard, plywood, mitre board, squares

methods used for template development include: standard template design, alternative template development methods

specifications for piping requirements include: wall thickness, type of material, diameter

A-3.05 Performs quality control functions.

Essential Skills	Document Use, Reading, Thinking Skills

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
A-3.05.01K	demonstrate knowledge of quality control and its applications	identify hazards and safe work practices pertaining to quality control
		interpret information pertaining to quality control found on drawings and specifications
		identify tools and equipment relating to quality control
		identify methods of NDE

		identify methods of heat treatment and stress relief
A-3.05.02K	demonstrate knowledge of procedures used to complete quality control documentation	identify types of ***QC documentation*** and describe their applications

RANGE OF VARIABLES

QC documentation includes: manuals, torque sheets, bolt tensioning sequence, mill test reports, welders logs

MAJOR WORK ACTIVITY B
PERFORMS LAYOUT, FABRICATION AND PIPING INSTALLATION

TASK B-4 Performs fabrication.

TASK DESCRIPTOR

Prior to installation of piping and equipment, steamfitters/pipefitters perform fabrication of pipes, piping systems, and associated equipment and supports, either in an off-site fabrication shop or on-site.

B-4.01 Fabricates piping system components.

Essential Skills	Document Use, Thinking Skills, Reading, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-4.01.01K	demonstrate knowledge of the procedures used to fabricate ***piping system components***	identify ***tools and equipment*** relating to ***piping system component*** fabrication and describe their applications and procedures for use
		interpret information pertaining to piping system component fabrication found on drawings and specifications
		interpret ***codes and regulations*** pertaining to piping system component fabrication
		identify types of ***fittings*** and describe their characteristics and applications
		identify types of ***joining methods*** and describe their applications
		identify types of ***fabrication techniques*** and describe their applications
		identify types of ***treating methods*** and describe their applications
		identify types of ***fitting tolerance practices*** and describe their applications
		identify ***pre/post-weld activities*** and describe their applications
		describe the procedures used to fabricate and assemble piping system components

RANGE OF VARIABLES

piping system components include: pipe spools, fittings, valves
tools and equipment include: pipe stands, pipe vises, bevelling machines, levels, measuring tools, flange squares, temperature sticks, oxygen analyzers
codes and regulations include: American Society of Mechanical Engineers (ASME) B31
fittings include: elbows, tees, true wyes, laterals, crosses
joining methods include: threading, grooving, gluing, welding, compression, fusion
fabrication techniques include: cutting, bending, bevelling
treating methods include: applying protective coatings, pickling, chemical flushing
fitting tolerance practices include: two-holing, gap, high-low, transitioning, alignment
pre/post-weld activities include: purging, controlled heating, stress relieving, controlled cooling

B-4.02 Fabricates brackets, supports, hangers, guides and anchors.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-4.02.01K	demonstrate knowledge of the procedures used to fabricate brackets, supports, hangers, guides and anchors	interpret information pertaining to brackets, supports, hangers, guides and anchors fabrication found on drawings and specifications
		interpret ***codes and regulations*** pertaining to brackets, supports, hangers, guides and anchors fabrication
		identify ***fabrication tools and equipment*** relating to brackets, supports, hangers, guides and anchors fabrication and describe their applications and procedures for use
		identify types of ***joining methods*** and describe their applications
		identify types of ***fabrication techniques*** and describe their applications
		identify ***post-weld activities*** and describe their applications
		describe the procedures used to fabricate and assemble brackets, supports, hangers, guides and anchors

RANGE OF VARIABLES

codes and regulations include: ASME B31, Canadian Welding Bureau (CWB)
fabrication tools and equipment include: chop saws, cutting torches, band saws, grinders, magnetic base drills, pipe vises, two-foot squares
joining methods include: bolt-on, inserting, welding

fabrication techniques include: cutting, bending, bevelling
post-weld activities include: stress relieving, controlled cooling

TASK B-5 LAYS OUT, IDENTIFIES AND INSTALLS PIPPING, TUBING, FITTINGS AND RELATED COMPONENTS.

TASK DESCRIPTOR

The layout and installation of various piping, tubing, fittings and related components requires a wide range of skills including, preparation, measuring, cutting and joining techniques. Testing of these systems follows strict guidelines predetermined by industry.

B-5.01 Lays out, identifies and installs copper tube, tubing, fittings and related components.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-5.01.01K	demonstrate knowledge of ***copper tube and tubing***, fittings and ***related components***	identify ***tools and equipment*** relating to ***copper tube and tubing***, fittings and their ***components*** and describe their applications and procedures for use
		interpret ***codes and regulations*** pertaining to copper tube and tubing
		interpret information pertaining to copper tubing found on drawings and specifications
		describe the identification systems and ***methods of identification*** for copper tube and tubing
		identify types of ***fittings*** used with copper tube and tubing and describe their purpose and applications
		identify copper tube and tubing related components and describe their purpose and applications
B-5.01.02K	demonstrate knowledge of the procedures used to measure and size copper tube and tubing and related components	explain the ***systems of measurement*** for copper tube and tubing
		identify the systems and criteria used in referencing, selecting and ordering copper tube and tubing

		describe the ***procedures*** used to measure copper tube and tubing and fittings
B-5.01.03K	demonstrate knowledge of the procedures used to cut, bend and join copper tube and tubing and related components	identify the methods used to cut copper tube, and tubing, and describe their associated procedures and ***cutting and reaming tools and equipment***
		demonstrate ***joining methods*** for copper tube and tubing
		describe the procedures and ***bending tools and equipment*** used to bend copper tube and tubing
		describe the procedures used to install and test copper tube, tubing, fittings and related components

RANGE OF VARIABLES

copper tube and tubing related components include: bolts, studs, gaskets, brackets, supports, hangers, spring cans, guides, anchors
tools and equipment include: tube cutters, tube benders, reamers, soldering, brazing
codes and regulations include: manufacturers' certification requirements, ASTM
types/methods of identification of copper tubing include: M, L, K, DWV, ACR
fittings include: elbows, tees, crosses
systems of measurement include: dimension, diameter, length
measuring procedures include: fitting allowance, offset calculations, trade math
cutting and reaming tools and equipment include: tubing cutters, hack saws, reamers, power cutting tools
joining methods include: brazing, soldering, flaring, roll grooving, compression fittings
bending tools and equipment include: hand benders, hydraulic benders

B-5.02 Lays out, identifies and installs plastic piping, tubing, fittings and related components.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-5.02.01K	demonstrate knowledge of ***plastic piping and tubing***, fittings and ***related components***	identify ***tools and equipment*** relating to ***plastic piping and tubing***, fittings and ***related components*** and describe their applications and procedures for use
		interpret codes and regulations pertaining to ***plastic piping and tubing***
		interpret information pertaining to plastic piping and tubing found on drawings and specifications

		describe the identification systems and methods of identification for plastic piping and tubing
		identify types of plastic piping and tubing and describe their purpose and applications
		identify types of ***fittings*** used with plastic piping and tubing and describe their purpose and applications
		identify plastic piping and tubing related components and describe their purpose and applications
B-5.02.02K	demonstrate knowledge of the procedures used to measure and size plastic piping, tubing and related components	explain the ***systems of measurement*** for plastic piping and tubing
		describe the ***procedures*** used to ***measure*** plastic piping, tubing and fittings
		identify the systems and criteria used in referencing, selecting and ordering plastic piping and tubing
B-5.02.03K	demonstrate knowledge of the procedures used to cut, bend and join plastic piping, tubing and related components	identify the methods used to cut plastic pipe and tubing, and describe their associated procedures and ***cutting and reaming tools and equipment***
		demonstrate ***joining methods*** for plastic pipe and tubing
		describe the procedures and ***bending tools and equipment*** used to bend plastic piping and tubing
		describe the procedures used to install and ***test*** plastic piping and tubing, fittings and related components

RANGE OF VARIABLES

tools and equipment include: tube cutters, fusion machines, scrapers, facers, reamers

plastic piping and tubing related components include: bolts, studs, gaskets, brackets, supports, hangers, guides, anchors

plastic piping and tubing include: ABS, CPVC, PP, PE, PEX

fittings include: elbows, tees, crosses

systems of measurement include: dimension, length

measuring procedures include: fitting allowance, offset calculations, trade math

cutting and reaming tools and equipment include: tubing cutters, hack saws, reamers, power cutting tools

joining methods include: compression fittings, solvent cementing, threading, fusion

bending tools and equipment include: heated bending tools

testing methods include: hydrostatic, pneumatic

B-5.03 Lays out, identifies and installs carbon steel piping, tubing, fittings and related components.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-5.03.01K	demonstrate knowledge of ***carbon steel piping and tubing***, fittings and related components	identify ***tools and equipment*** relating to ***carbon steel piping and tubing***, fittings and related components and describe their applications and procedures for use
		interpret ***codes and regulations*** pertaining to carbon steel piping
		interpret information pertaining to carbon steel piping and tubing found on drawings and specifications
		describe the identification systems and methods of identification for carbon steel piping and tubing
		identify ***fittings*** used with carbon steel piping and tubing and describe their purpose and applications
		identify ***carbon steel piping and tubing related components*** and describe their purpose and applications
B-5.03.02K	demonstrate knowledge of the procedures used to measure carbon steel piping and tubing	explain the ***systems of measurement*** for carbon steel piping and tubing
		describe the ***procedures*** used to ***measure*** carbon steel piping and tubing, and fittings
B-5.03.03K	demonstrate knowledge of the procedures used to cut and join carbon steel piping and tubing	describe the ***procedures*** used to ***inspect*** carbon steel piping and tubing
		describe the different ***methods*** of pipe and fitting end ***preparation***
		identify the methods used to cut carbon steel piping and tubing, and describe their associated procedures and ***cutting, bevelling and threading tools and equipment***
		identify the ***joining methods*** for carbon steel piping and tubing and describe their associated procedures
		describe pre/post-weld activities

	describe the procedures and ***bending tools and equipment*** used to bend carbon steel piping and tubing
	describe the procedures used to install and test fittings and related components for carbon steel piping and tubing

RANGE OF VARIABLES

tools and equipment include: grinders, oxyacetylene cutting torches, threading equipment, files, grooving equipment, tube cutters, tube benders

carbon steel piping and tubing include: grades, schedules

codes and regulations include: ASME B31

fittings include: elbows, tees, crosses

carbon steel piping and tubing related components include: bolts, studs, gaskets, brackets, supports, hangers, guides, anchors

systems of measurement include: dimension, length, wall thickness/schedule

measuring procedures include: fitting allowance, offset calculations, trade math

inspection procedures include: quality assurance, quality control (QA/QC) requirements

preparation methods include: standard bevel, compound bevel

cutting, bevelling and threading tools and equipment include: grinders, reamers, power cutting tools, cutters

joining methods include: threading, tacking/welding, flanging, roll grooving, compression fittings, flaring

pre/post-weld activities include: stress relieving, cleaning procedures, controlled cooling, pre-heating or purging, chemical treating, protective coatings

bending tools and equipment include: hand benders, hydraulic benders

B-5.04 Lays out, identifies and installs stainless steel piping, tubing, fittings and related components.

Essential Skills	Document Use, Thinking Skills, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-5.04.01K	demonstrate knowledge of ***stainless steel piping and tubing***, fittings and related components	describe the procedures and methods to prevent ***cross contamination***
		identify ***tools and equipment*** relating to stainless steel piping, tubing, fittings and related components and describe their applications and procedures for use
		interpret ***codes and regulations*** pertaining to stainless steel piping
		interpret information pertaining to stainless steel piping and tubing found on drawings and specifications

		describe the identification systems and methods for stainless steel piping and tubing
		identify ***fittings*** used with stainless steel piping and tubing and describe their purpose and applications
		identify ***stainless steel piping and tubing related components*** and describe their purpose and applications
B-5.04.02K	demonstrate knowledge of the procedures used to measure stainless steel piping	explain the ***systems of measurement*** for stainless steel piping and tubing
		describe the ***procedures*** used to ***measure*** stainless steel piping and tubing and fittings
B-5.04.03K	demonstrate knowledge of the procedures used to cut and join stainless steel piping	describe the ***procedures used to inspect*** stainless steel piping and tubing
		identify the methods used to cut stainless steel piping and tubing, and describe their associated procedures and ***cutting, bevelling and threading tools and equipment***
		describe the different ***methods*** of pipe and fitting end ***preparation***
		identify the ***joining methods*** used to join stainless steel piping and tubing and describe their associated procedures
		describe ***pre/post-weld activities***
		describe the procedures and ***bending tools and equipment*** used to bend stainless steel piping and tubing
		describe the procedures used to install and ***test*** fittings and related components for stainless steel piping and tubing

RANGE OF VARIABLES

stainless steel piping and tubing include: 304, 308, 316 stainless steel

cross contamination control methodology include: labelling, physical separation, barriers

tools and equipment include: grinders, plasma cutters, threading equipment, files, grooving equipment, tube cutters, tube benders

codes and regulations include: ASME B31

fittings include: elbows, tees, crosses

stainless steel piping and tubing related components include: bolts, studs, gaskets, brackets, supports, hangers, guides, anchors

systems of measurement include: dimension, length, wall thickness/schedule

measuring procedures include: fitting allowance, offset calculations, trade math

inspection procedures include: QA/QC requirements

cutting, bevelling and threading tools and equipment include: grinders, reamers, power cutting tools, cutters

preparation methods include: standard bevel, compound bevel

joining methods include: threading, tacking/welding, flanging, roll grooving, compression fittings, flaring
pre/post-weld activities include: stress relieving, cleaning procedures, controlled cooling, pre-heating or purging, chemical treating, protective coatings
bending tools and equipment include: hand benders, hydraulic benders
testing methods include: hydrostatic, pneumatic, NDE

B-5.05 Lays out, identifies and installs fibreglass piping, fittings and related components.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-5.05.01K	demonstrate knowledge of fibreglass piping, fittings and related components	identify ***tools and equipment*** relating to fibreglass piping, fittings and related components and describe their applications and procedures for use
		interpret information pertaining to fibreglass piping found on drawings and specifications
		describe the identification systems and methods for fibreglass piping
		identify types of ***fiberglass piping*** and describe their purpose and applications
		identify fittings used with fibreglass piping and describe their purpose and applications
		identify ***fibreglass piping related components*** and describe their purpose and applications
B-5.05.02K	demonstrate knowledge of the procedures used to measure fibreglass piping	explain the ***systems of measurement*** for fibreglass piping
		identify the systems and criteria used in referencing, selecting and ordering fibreglass piping
		describe the ***procedures*** used to ***measure*** fibreglass piping
B-5.05.03K	demonstrate knowledge of the procedures used to cut and join fibreglass piping	describe the procedures and ***cutting***, ***tapering and sanding tools and equipment*** used to cut fibreglass piping

		identify the ***methods used to join fibreglass piping*** and describe their associated procedures and ***materials***
		describe the procedures used to install and ***test*** fibreglass piping, fittings and related components for fibreglass piping

RANGE OF VARIABLES

tools and equipment include: air saws, jig saws, grinders
fibreglass piping include: FRP, GFRP, GRE
fibreglass piping related components include: washers, bolts, studs, gaskets, brackets, supports, hangers, guides, anchors
systems of measurement include: dimension, length, wall thickness/schedule
measuring procedures include: fitting allowance, offset calculations, trade math
cutting, tapering and sanding tools and equipment include: hack saws, power cutting tools, sanders, grinders
joining methods include: butt and wrap, bell and spigot, and threading
materials include: vinyl ester, polyester, halogenated resins, epoxies
testing methods include: hydrostatic, pneumatic, NDE

B-5.06 Lays out, identifies and installs specialty piping, fittings and related components.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-5.06.01K	demonstrate knowledge of specialty piping, fittings and related components	describe the procedures and ***methods*** to prevent ***cross contamination***
		identify ***tools and equipment*** relating to specialty piping fittings and their ***components*** and describe their applications and procedures for use
		interpret ***codes and regulations*** pertaining to specialty piping
		interpret information pertaining to specialty piping found on drawings and specifications
		describe the identification systems and methods for ***specialty piping***
		identify fittings used with specialty piping and describe their purpose and applications

		identify specialty piping related components and describe their purpose and applications
B-5.06.02K	demonstrate knowledge of the procedures used to measure specialty piping	explain the ***systems of measurement*** for specialty piping
		describe the ***procedures used to measure*** specialty piping and fittings
B-5.06.03K	demonstrate knowledge of the procedures used to cut and join specialty piping	describe the ***procedures used to inspect*** specialty piping
		identify the methods used to cut specialty piping and fittings in particular lined piping, and describe their associated procedures and ***cutting, bevelling and threading tools and equipment***
		describe the different ***methods*** of pipe and fitting end ***preparation***
		identify the ***joining methods*** used to join specialty piping and describe their associated procedures
		describe ***pre/post-weld activities***
		describe the procedures *and* ***bending tools and equipment*** used to bend specialty piping
		describe the procedures used to install and test fittings and related components for specialty piping

RANGE OF VARIABLES

cross contamination control methodology includes: labelling, physical separation, barriers tool selection

tools and equipment include: grinders, plasma cutters, threading equipment, files, grooving equipment

components include: bolts, studs, gaskets, brackets, supports, hangers, guides, anchors

codes and regulations include: ASME B31

specialty piping includes: chrome, molybdenum, titanium, duplex, lined pipe

systems of measurement include: dimension, length, wall thickness/schedule

measuring procedures include: fitting allowance, offset calculations, trade math

inspection procedures include: QA/QC requirements

cutting, bevelling and threading tools and equipment include: grinders, reamers, power cutting tools, cutters

preparation methods include: standard bevel, compound bevel

joining methods include: threading, tacking/welding, flanging, roll grooving ***pre/post-weld activities*** include: stress relieving, cleaning procedures, controlled cooling, pre-heating or purging, chemical treating, protective coatings

bending tools and equipment includes: hand benders, hydraulic benders

TASK B-6 INSTALLS, MAINTAINS, TROUBLESHOOTS, REPAIRS AND TESTS VALVES.

TASK DESCRIPTOR

Valves are commonplace and widely used in industry. The failure or improper selection of these pieces of equipment can shut down plants and cause buildings to lose heat. This failure can cause the release of hazardous materials into the environment, at a chemical plant, prevent a refinery from meeting a critical production deadline, or create a dangerous situation by interrupting the daily operation at a health care facility. Steamfitter/pipefitters install piping systems and valves that are part of those systems.

B-6.01 Installs valves.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-6.01.01K	demonstrate knowledge of piping valves, their applications and operation	interpret codes, regulations and ***standards*** pertaining to piping valves
		interpret information found on drawings and specifications pertaining to piping valves.
		identify ***tools and equipment*** relating to piping valves and describe their applications and procedures for use
		identify types of ***piping valves*** and describe their characteristics, operation and applications
		identify types of ***valve actuators*** and describe their purpose
		explain ***piping valve rating*** systems and ***installation variables***
B-6.01.02K	demonstrate knowledge of the procedures used to install valves	identify ***joining methods*** used to install piping valves and describe their associated procedures
		describe ***testing methods*** for testing valves and related components

RANGE OF VARIABLES

standards include: MSS, ANSI
service conductors include: wire, cables, conductors
tools and equipment include: assorted wrenches, rigging tools, pinch bars
piping valves include: gate, globe, ball, plug, butterfly, check, relief, pop safety, pressure reducing
valve actuators include: electric, pneumatic, manual, hydraulic

piping valve rating include: pressure, temperature
installation variables include: temperature, medium, pressure, flow, functionality, systems
joining methods include: threading, tacking/welding, flanging, roll grooving, compression fittings
testing methods include: hydrostatic, pneumatic

B-6.02 Maintains, troubleshoots, repairs and tests valves.

Essential Skills	Document Use, Thinking Skills, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-6.02.01K	demonstrate knowledge of valves, their applications and operation	interpret codes, regulations and ***standards*** pertaining to piping valves
		interpret information found on drawings and specifications pertaining to valves
		identify ***valve repair and maintenance tools and equipment*** to maintain, troubleshoot, repair and test valves and describe their applications and procedures for use
		describe ***procedures used to maintain*** and ***troubleshoot*** valves
		identify valve and related component ***defects*** requiring repair
		describe procedures used to ***repair*** and ***test*** valves
		identify types of ***valve actuators*** and describe their purpose
		describe necessary ***documentation*** for valve repair

RANGE OF VARIABLES

standards include: MSS, ANSI
valve repair and maintenance tools and equipment include: valve repair hooks, micrometers, lapping plates, grease gun, tool makers ink, stethoscope, temperature gun, assorted wrenches
maintenance procedures include: lubricating, cleaning and inspecting equipment for components for wear, replacing worn components if required
troubleshooting procedures include: functional checks, visual inspections and use of temperature sensing devices, stethoscopes
defects include: passing valve seal, leaking packing, seized or damaged related components
repairs include: disc and seat refurbishment, stem realignment, valve repacking
tests include: hydrostatic, blue check
valve actuators include: electric, pneumatic, manual, hydraulic
documentation includes: QA/QC verification, recording of signoff that repair has been completed

TASK B-7 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS HEAT TRACING SYSTEMS.

TASK DESCRIPTOR

Tracing accompanies existing piping systems to facilitate the delivery of the medium. Tracing systems are made with a variety of materials such as carbon steel, stainless steel and copper. Steamfitters/Pipefitters install, attach, diagnose, repair and energize tracing systems. These systems can be installed during construction or after completion. In liquid-filled tracing systems water, glycol or a combination of both is used as a medium when consistent temperature control is required. Steam is used when high levels of heat energy are required.

B-7.01 Installs steam tracing systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-7.01.01K	demonstrate knowledge of ***steam tracing systems***, their applications and operation	interpret codes, regulations and ***standards*** pertaining to ***steam tracing systems***
		interpret information found on drawings and specifications pertaining to steam tracing systems
		identify ***tools and equipment*** relating to steam tracing systems and describe their applications and procedures for use
		identify types of steam tracing systems and describe their characteristics, operation and applications
		review working principles of steam systems
		describe steam tracing systems and ***installation variables***
B-7.01.02K	demonstrate knowledge of the procedures used to install steam tracing systems	identify ***joining methods*** used to install steam tracing systems and describe their associated ***piping practices***
		describe ***testing methods*** for steam tracing systems

RANGE OF VARIABLES

standards include: ASME

steam tracing systems include: low to high pressure, pre-insulated tubing bundles

tools and equipment include: benders, flaring and strapping devices
installation variables include: temperature, pressure, flow, functionality, systems
joining methods include: welding, soldering, grooving, crimping, brazing and compression fittings
piping practices include: joints are accessible with consideration given to insulation requirements
testing methods include: hydrostatic, pneumatic

B-7.02 Maintains, troubleshoots, repairs and tests steam tracing systems.

Essential Skills	Document Use, Thinking Skills, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-7.02.01K	demonstrate knowledge of ***steam tracing systems***, their applications and operation	interpret codes, regulations and ***standards*** pertaining to ***steam tracing systems***
		interpret information found on drawings and specifications pertaining to steam tracing system
		identify ***steam tracing system repair and maintenance tools and equipment*** to maintain, troubleshoot, repair and test and describe their applications and procedures for use
		describe ***procedures*** used to ***maintain*** and ***troubleshoot*** steam tracing systems
B-7.02.02K	demonstrate knowledge of procedures for repairing and testing steam tracing systems and their ***components***	identify ***steam tracing system*** and ***component defects*** requiring repair
		describe procedures used to ***repair*** and ***test*** steam tracing system and components
		describe necessary ***documentation*** for steam tracing system and component repair and maintenance

RANGE OF VARIABLES

standards include: ASME, CSA
steam tracing systems include: low to high pressure, pre-insulated tubing bundles
steam tracing system repair and maintenance tools and equipment include: benders, temperature sensing devices, rubber mallets, stethoscopes, flaring and strapping devices
maintenance procedures include: checking steam straps, cleaning, inspecting tubing, fittings and components for correct operation and wear
troubleshooting procedures include: functional checks, visual inspections, use of temperature sensing devices and stethoscopes
steam tracing system components include: valves, breakouts, valve baskets, steam traps
defects include: kinked tubing, passing traps, broken straps

repairs include: steam traps, tubing and fitting replacement
tests include: hydrostatic, pneumatic, in-service
documentation includes: QA/QC verification, recording of signoff that repair has been completed

B-7.03 Installs liquid-filled tracing systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-7.03.01K	demonstrate knowledge of ***liquid-filled tracing systems***, their applications and operation	interpret codes, regulations and ***standards*** pertaining to ***liquid-filled tracing systems***
		interpret information found on drawings and specifications pertaining to liquid-filled tracing systems
		identify ***tools and equipment*** relating to liquid-filled tracing systems and describe their applications and procedures for use
		identify types of liquid-filled tracing systems and describe their characteristics, operation and applications
		review working principles of high and low temperature hot water/glycol systems
		describe liquid-filled tracing systems and ***installation variables***
B-7.03.02K	demonstrate knowledge of the procedures used to install liquid-filled tracing systems	identify ***joining methods*** used to install liquid-filled tracing systems and describe their associated ***piping practices***
		describe ***testing methods*** for liquid-filled systems

RANGE OF VARIABLES

liquid-filled tracing systems include: low and high temperature hot water, glycol
standards include: ASME
tools and equipment include: benders, flaring and strapping devices
installation variables include: temperature, pressure, flow, functionality, systems
joining methods include: welding, soldering, grooving, crimping, brazing and compression fittings
piping practices include: joints are accessible with consideration given to insulation and tie in points requirements and ensure high point vents and pumps installed where necessary
testing methods include: hydrostatic, pneumatic

B-7.04 Maintains, troubleshoots, repairs and tests liquid-filled tracing systems.

Essential Skills	Document Use, Thinking Skills, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
B-7.04.01K	demonstrate knowledge of ***liquid-filled tracing systems***, their applications and operation	interpret ***codes, regulations and standards*** pertaining to ***liquid-filled tracing systems***
		interpret information found on drawings and specifications pertaining to liquid-filled tracing system
		identify liquid-filled tracing system repair and maintenance ***tools and equipment*** to maintain, troubleshoot, repair and test and describe their applications and procedures for use
		describe ***procedures*** used to ***maintain*** and ***troubleshoot*** liquid-filled tracing systems
B-7.04.02K	demonstrate knowledge of procedures to repair and test ***liquid-filled tracing systems*** and their ***components***	identify liquid-filled tracing system and component ***defects*** requiring repair
		describe procedures used to ***repair*** and ***test*** liquid-filled tracing system and component
		describe necessary ***documentation*** for liquid-filled tracing system and component repair and maintenance
		identify disposal procedures of liquid medium

RANGE OF VARIABLES

liquid-filled tracing systems include: low and high temperature hot water, glycol

codes, regulations and standards include: ASME, WHMIS, LEED

tools and equipment include: benders, flaring and strapping devices

maintenance procedures include: cleaning, inspecting tubing, fitting and components for correct operation and wear

troubleshooting procedures include: functional checks, visual inspections, use of temperature sensing devices

liquid-filled tracing system components include: valves, breakouts, valve baskets, high point vents, pumps

defects include: kinked tubing, broken straps, faulty pumps, plugged vents

repairs include: tubing and fitting replacement

tests include: hydrostatic, pneumatic, in-service

documentation includes: QA/QC verification, recording of signoff that repair has been completed

MAJOR WORK ACTIVITY C
PERFORMS RIGGING, HOISTING, LIFTING AND POSITIONING

TASK C-8 PERFORMS COMMON RIGGING, HOISTING, LIFTING AND POSITIONING.

TASK DESCRIPTOR

When performing common rigging, hoisting, lifting and positioning steamfitter/pipefitters determine the load, prepare a lift plan and select all rigging, hoisting, lifting and positioning equipment in a safe manner. They inspect the equipment and secure lift areas. Steamfitter/Pipefitters may work in conjunction with crane operators to set up equipment and perform lifts. These lifts may include engineered lifts. They also maintain and store equipment to prevent premature defects and damage.

C-8.01 Determines load.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-8.01.01K	demonstrate knowledge of hoisting, lifting and rigging equipment, their applications, limitations and procedures for use	define terminology associated with hoisting, lifting, rigging and positioning
		identify ***hazards*** and describe safe work practices pertaining to hoisting, lifting, rigging and positioning
		identify codes and regulations pertaining to hoisting, lifting and rigging
		identify types of ***rigging equipment*** and accessories and their weight using various ***sources***
C-8.01.02K	demonstrate knowledge of calculations required when performing hoisting and lifting operations	explain how to calculate load weight

RANGE OF VARIABLES

hazards include: wind, shock loading
rigging equipment includes: lugs, chain falls, come-alongs, spreader bars, shackles, slings, tuggers
sources of rigging equipment weight include: shop drawings, manufacturers' specifications

C-8.02 Prepares lift plan(s).

Essential Skills	Document Use, Oral Communication, Thinking Skills

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-8.02.01K	demonstrate knowledge of rigging, hoisting, lifting and positioning equipment, their applications, limitations and procedures for use	define terminology associated with rigging, hoisting, lifting, and positioning
		identify ***hazards*** and describe safe work practices pertaining to rigging, hoisting, lifting, and positioning
		identify codes and regulations pertaining to rigging, hoisting, lifting and positioning
		identify types of ***rigging equipment*** and accessories and describe their limitations, applications and procedures for use
C-8.02.02K	demonstrate knowledge of the procedures used to select equipment for hoisting, lifting and positioning operations	identify types of ***hoisting, lifting and positioning equipment*** and accessories and describe their applications and procedures for use
		identify types of knots, hitches and bends and describe their applications and the procedures used to tie them
		identify documentation required for engineered lifts
C-8.02.03K	demonstrate knowledge of calculations required when performing hoisting and lifting operations	explain ***sling angle*** when preparing for hoisting and lifting operation
		explain correlation of sling angles to sling capacities
		identify the ***factors to consider when selecting*** rigging hoisting and lifting equipment

RANGE OF VARIABLES

hazards include: wind, shock loading
rigging equipment includes: lugs, chain falls, come-alongs, spreader bars, shackles, slings, tuggers
hoisting, lifting and positioning equipment includes: cranes, forklifts, rollers, chain falls, jacks, cable grip hoists

sling angle includes: 45°, 60°

selection factors include: load characteristics, rigging inspection, equipment fatigue, environment, safety factors, sling angles

C-8.03 Selects rigging, hoisting, lifting and positioning equipment.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-8.03.01K	demonstrate knowledge of rigging, hoisting, lifting and positioning equipment, their applications, limitations and procedures for use	define terminology associated with rigging, hoisting, lifting, and positioning
		identify hazards and describe safe work practices pertaining to rigging, hoisting, lifting, and positioning
		identify codes and regulations pertaining to rigging, hoisting and lifting
		identify types of ***rigging equipment*** and accessories and describe their limitations, applications and procedures for use
C-8.03.02K	demonstrate knowledge of the procedures used to perform hoisting, lifting and positioning operations	identify types of ***hoisting, lifting and positioning equipment*** and accessories and describe their applications and procedures for use
		describe the procedures used to inspect, maintain and store rigging, hoisting, lifting and positioningequipment
		identify types of knots, hitches and bends and describe their applications and the procedures used to tie them
		identify documentation required for engineered lifts
		identify types of ropes used in rigging
C-8.03.03K	demonstrate knowledge of calculations required when performing hoisting and lifting operations	describe the procedures used to rig material/equipment for lifting
		explain ***sling angle*** when preparing for hoisting and lifting operation
		explain correlation of sling angles to sling capacities

		identify the ***factors to consider when selecting*** rigging, hoisting and lifting equipment
		describe the procedures used for attaching rigging equipment to the load

RANGE OF VARIABLES

rigging equipment includes: lugs, chain falls, come-alongs, spreader bars, shackles, slings, tuggers

hoisting, lifting and positioning equipment includes: cranes, forklifts, rollers, chain falls, jacks, cable grip hoists

sling angle includes: 45°, 60°

selection factors include: load characteristics, rigging inspection, equipment fatigue, environment, safety factor (5 to 1 and 10 to 1), sling angles

C-8.04 Inspects rigging, hoisting, lifting and positioning equipment.

Essential Skills	Document Use, Thinking Skills, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-8.04.01K	demonstrate knowledge of inspection for rigging, hoisting, lifting and positioning equipment	identify hazards and describe safe work practices pertaining to rigging, hoisting, lifting and positioning
		identify codes, regulations and certification pertaining to rigging, hoisting, lifting, and positioning equipment
		identify types of rigging equipment and accessories and describe their limitations, applications and procedures for use
		identify documentation required for inspection of engineered lifts
		identify types of hoisting and lifting equipment and accessories and describe their applications and procedures for use
		describe the procedures used to inspect, maintain and store rigging, hoisting, lifting and positioning equipment
		identify types of knots, hitches and bends and describe their applications and the procedures used to tie them

C-8.05 Secures lift area.

Essential Skills	Oral Communication, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-8.05.01K	demonstrate knowledge of rigging, hoisting, lifting and positioning equipment, their applications, limitations and procedures for use	identify hazards and describe safe work practices pertaining to rigging, hoisting, lifting and positioning
		identify jurisdictional regulations and trade practice pertaining to rigging, hoisting, lifting and positioning
		identify types of equipment used to secure the lift area
		identify documentation required for engineered lifts
		identify types of hoisting, lifting and positioning equipment and accessories and describe their applications and procedures for use
		describe the ***procedures used to ensure the work area*** is safe for rigging, hoisting, lifting and positioning
		identify and describe ***procedures used to communicate*** during rigging, hoisting, lifting and positioning operations

RANGE OF VARIABLES

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

communication procedures include: hand signals, electronic communications, audible/visual

C-8.06 Sets up rigging, hoisting, lifting and positioning equipment.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-8.06.01K	demonstrate knowledge of rigging, hoisting, lifting and positioning equipment, their applications, limitations and procedures for use	define terminology associated with rigging, hoisting, lifting and positioning
		identify hazards and describe safe work practices pertaining to rigging, hoisting, lifting and positioning
		identify codes and regulations pertaining to rigging, hoisting, lifting and positioning
		identify types of rigging equipment and accessories and describe their limitations, applications and procedures for use
C-8.06.02K	demonstrate knowledge of the procedures used to perform rigging, hoisting and lifting and positioning operations	identify types of rigging, hoisting, lifting and positioning equipment and accessories and describe their applications and procedures for use
		identify types of knots, hitches and bends and describe their applications and the procedures used to tie them
		identify documentation required for engineered lifts
C-8.06.03K	demonstrate knowledge of calculations required when performing hoisting and lifting operations	describe the procedures used to rig material/equipment for lifting
		describe the ***procedures used to ensure the work area*** is safe for lifting
		identify and describe ***procedures used to communicate*** during set up operations
		explain sling angle when preparing for hoisting and lifting operations
		describe the procedures used for attaching rigging equipment to the load

RANGE OF VARIABLES

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

communication procedures include: hand signals, electronic communications, audible/visual

C-8.07 Performs lift and positioning.

Essential Skills	Oral Communication, Thinking Skills, Working with Others

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-8.07.01K	demonstrate knowledge of rigging, hoisting, lifting and positioning equipment, their applications, limitations and procedures for use	define terminology associated with rigging, hoisting, lifting and positioning
		identify hazards and describe safe work practices pertaining to rigging, hoisting, lifting and positioning
		identify codes and regulations pertaining to rigging, hoisting, lifting and positioning according to site and jurisdictional requirements
		identify types of rigging equipment and accessories and describe their limitations, applications and procedures for use
C-8.07.02K	demonstrate knowledge of the procedures used to perform hoisting, lifting and positioning operations	identify types of hoisting, lifting and positioning equipment and accessories and describe their applications and procedures for use
		identify types of knots, hitches and bends and describe their applications and the procedures used to tie them
		identify documentation required for engineered lifts
C-8.07.03K	demonstrate knowledge of calculations required when performing hoisting and lifting operations	describe the procedures used to rig material/equipment for lifting
		describe the ***procedures used to ensure the work area*** is safe for lifting
		identify and describe ***procedures used to communicate*** during rigging, hoisting, lifting and positioning operations
		explain ***sling angle*** when preparing for hoisting and lifting operation
		explain correlation of sling angles to sling capacities
		identify the ***factors to consider when selecting*** rigging equipment

	describe the procedures used for attaching rigging equipment to the load
	describe the ***procedures used to perform a lift***

RANGE OF VARIABLES

ensuring safe work area procedures include: supervision of lift, securing work area, communication
communication procedures include: hand signals, electronic communications, audible/visual
sling angle includes: 45°, 60°
selection factors includes: load characteristics, environment, safety factors
lift procedures include: load determination, communication methods, pre-lift checks, placement of load, post-lift inspection

C-8.08 Maintains and stores rigging, hoisting, lifting and positioning equipment.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-8.08.01K	demonstrate knowledge of hoisting, lifting and rigging equipment, their applications, limitations and procedures for use and storage	define terminology associated with hoisting, lifting and rigging
		identify hazards and describe safe work practices pertaining to storage of hoisting, lifting, rigging and positioning equipment
		describe the procedures used to inspect, maintain and store rigging, hoisting, lifting, and positioning equipment
		identify the ***factors to consider when selecting*** rigging equipment
		identify documentation required for engineered lifts

RANGE OF VARIABLES

selection factors includes: load characteristics, environment, safety factors

MAJOR WORK ACTIVITY C
PERFORMS LAYOUT, FABRICATION AND PIPING INSTALLATION

TASK C-9 PERFORMS COMPLEX AND CRITICAL RIGGING, HOISTING, LIFTING AND POSITIONING.

TASK DESCRIPTOR

When performing complex and critical rigging, hoisting, lifting and positioning steamfitter/pipefitters determine the load, prepare a lift plan and select all rigging, hoisting, lifting and positioning equipment in a safe manner. They inspect the equipment and secure lift areas. Steamfitter/Pipefitters may work in conjunction with crane operators to set up equipment and perform a lift. They also maintain and store equipment to prevent premature defects and damage.

Lifts are considered to be complex or critical when they include multi-crane lifts, load transferring, unbalanced load, lifting over live equipment and are affected by environmental conditions such as wind, ground conditions and weather. When operating cranes close to maximum rated capacity, according to site and manufacturers' specifications, lifts are considered critical and an engineer may be consulted. Complex and critical lifts may be engineered lifts.

B-9.01 Prepares lift plan for complex and critical rigging, hoisting, lifting and positioning.

Essential Skills	Document Use, Thinking Skills, Oral Communication

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-9.01.01K	demonstrate knowledge of ***rigging, hoisting, lifting, and positioning equipment***, their applications, limitations and procedures for use	identify ***hazards*** and describe safe work practices pertaining to complex and critical rigging, hoisting, lifting and positioning operations
		identify documentation required for engineered lifts
		demonstrate procedures for ***complex and critical lifts*** and positioning
C-9.01.02K	demonstrate knowledge of ***calculations*** required when performing complex and critical rigging, hoisting, lifting and positioning operations	perform ***calculations*** pertaining to rigging, hoisting, lifting and positioning

RANGE OF VARIABLES

hazards include: energized power lines, weather conditions, live equipment, ground conditions, multi-tag lines

rigging equipment includes: lugs, chain falls, come-alongs, spreader bars, shackles, slings, tuggers

hoisting equipment includes: cranes, boom trucks, chain falls

lifting equipment includes: jacks, forklifts, high lifts, articulated fork trucks

positioning equipment includes: lugs, chain falls, come-alongs, jacks, rollers, forklifts, shackles, shims, skids, pinch bars, slings, tuggers

complex and critical lifts include: multi-crane lifts, load transferring, transferring, unbalanced load and positioning load, may include engineered lifts

calculations include: sling angle, load/weight, centre of gravity, SWL

C-9.02 Performs calculations for complex and critical rigging, hoisting, lifting and positioning.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-9.02.01K	demonstrate knowledge of rigging, hoisting, lifting and positioning equipment, their applications, limitations and procedures for use	identify ***hazards*** and describe safe work practices pertaining to advanced rigging, hoisting, lifting, and positioning operations
		identify documentation required for engineered lifts
		demonstrate procedures for ***complex and critical lifts*** and positioning
C-9.02.02K	demonstrate knowledge of ***calculations*** required when performing complex and critical rigging, hoisting, lifting and positioning operations	perform ***calculations*** pertaining to rigging, hoisting, lifting, and positioning

RANGE OF VARIABLES

hazards include: energized power lines, weather conditions, live equipment, ground conditions, multi-tag lines

complex and critical lifts include: multi-crane lifts, load transferring, lifts that involve personnel, lifts over personnel, unbalanced load and positioning load, may include engineered lifts

calculations include: sling angle, load/weight, centre of gravity, SWL

C-9.03 Selects rigging, hoisting, lifting and positioning equipment for complex and critical lifts.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-9.03.01K	demonstrate knowledge of rigging, hoisting, lifting, and positioning equipment, their applications, limitations and procedures for use	identify ***hazards*** and describe safe work practices pertaining to complex and critical rigging, hoisting, lifting, and positioning operations
		identify documentation required for engineered lifts
		demonstrate procedures for ***complex and critical lifts*** and positioning
C-9.03.02K	demonstrate knowledge of ***calculations*** required when performing advanced hoisting and lifting operations	perform ***calculations*** pertaining to rigging, hoisting and lifting

RANGE OF VARIABLES

hazards include: energized power lines, weather conditions, live equipment, ground conditions, multi-tag lines

complex and critical lifts include: multi-crane lifts, load transferring, unbalanced load and positioning load, may include engineered lifts

calculations include: sling angle, load/weight, centre of gravity, SWL

C-9.04 Sets up rigging, hoisting, lifting and positioning equipment for complex and critical lifts.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-9.04.01K	demonstrate knowledge of hoisting, lifting and rigging and positioning equipment, their applications, limitations and procedures for use	identify ***hazards*** and describe safe work practices pertaining to advanced rigging, hoisting, lifting and positioning operations
		identify documentation required for engineered lifts
		demonstrate ***complex and critical lifts***
C-9.04.02K	demonstrate knowledge of ***calculations*** required when performing complex and critical hoisting and lifting operations	perform ***calculations*** pertaining to rigging, hoisting, lifting and positioning

RANGE OF VARIABLES

hazards include: energized power lines, weather conditions, live equipment, ground conditions, multi-tag lines

complex and critical lifts include: multi-crane lifts, load transferring, unbalanced load and positioning load, may include engineered lifts

calculations include: sling angle, load/weight, centre of gravity, SWL

C-9.05 Performs complex and critical lifts and positioning.

Essential Skills	Oral Communication, Thinking Skills, Working with Others

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
C-9.05.01K	demonstrate knowledge of rigging, hoisting, lifting, and positioning equipment, their applications, limitations and procedures for use	identify ***hazards*** and describe safe work practices pertaining to complex and critical rigging, hoisting, lifting and positioning operations
		identify documentation required for engineered lifts
		demonstrate procedures for ***complex and critical lifts***
C-9.05.02K	demonstrate knowledge of ***calculations*** required when performing advanced hoisting, lifting and positioning operations	perform ***calculations*** pertaining to rigging, hoisting, lifting, and positioning

RANGE OF VARIABLES

hazards include: energized power lines, weather conditions, live equipment, limited visibility, ground conditions, multi-tag lines

complex and critical lifts include: multi-crane lifts, load transferring, lift over live equipment, unbalanced load and positioning load, may include engineered lifts

calculations include: sling angle, load/weight, centre of gravity, SWL

MAJOR WORK ACTIVITY D

INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS LOW AND HIGH PRESSURE STEAM AND CONDENSATE SYSTEMS

TASK D-10 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS LOW PRESSURE STEAM AND CONDENSATE SYSTEMS.

TASK DESCRIPTOR

Steamfitters/Pipefitters install low pressure steam and condensate system equipment and piping in industrial locations such as distilleries, pulp mills, mines, automotive plants, commercial settings and process plants. Processes that use low pressure steam include indirect water heating and central heating.

Steamfitters/Pipefitters are responsible for the maintenance of piping, components and equipment for these systems. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

D-10.01 Installs equipment for low pressure steam and condensate systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-10.01.01K	demonstrate knowledge of low pressure steam and condensate systems, their applications and operation	explain the applications and operation of low pressure steam and condensate systems
		interpret information pertaining to low pressure steam and condensate system equipment found on drawings and specifications
D-10.01.02K	demonstrate knowledge of low pressure steam and condensate system ***equipment***, their applications and operation	identify types of low pressure steam and condensate system ***equipment*** and describe their characteristics and operation

		identify low pressure steam and condensate system equipment ***supports and fasteners*** and describe their applications and procedures for use
		identify low pressure steam and condensate system ***control components*** and describe their purpose and operation
		identify types of ***fuel*** used in low pressure steam and condensate systems
		explain the ***principles of heat transfer***
		identify types of ***heat transfer equipment*** and describe their characteristics and operation
D-10.01.03K	demonstrate knowledge of the procedures used to install equipment for low pressure steam and condensate systems	identify equipment, controls, supports and fasteners used in low pressure steam and condensate systems, and describe their purpose and operation
		describe the procedures used to install equipment for low pressure steam and condensate systems, their controls, supports and fasteners

RANGE OF VARIABLES

equipment includes: boilers, boiler trim, expansion joints, pumps, heat transfer equipment, steam traps, tanks, valves, water treatment equipment

equipment supports include: stands, hangers, plates, housekeeping pads, isolator pads, concrete embeds

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

control components include: low water cut-offs (LWCO), operating pressure controls, feed water level controls, high limit pressure controls, automatic valves (motorized)

fuel includes: fuel oil, gas, coal

principles of heat transfer include: radiation, conduction, convection

heat transfer equipment includes: radiators, convectors, pipe coils, horizontal and vertical unit heaters, heat exchangers

D-10.02 Installs piping for low pressure steam and condensate systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-10.02.01K	demonstrate knowledge of the ***properties of steam***	explain the ***properties of steam***
		describe the use of steam tables to identify the relationship between pressure and temperature
		calculate grade and pitch of piping to ensure system efficiency and functionality
D-10.02.02K	demonstrate knowledge of low pressure steam and condensate piping ***configurations***, their ***applications*** and operation	explain the ***applications*** of low pressure steam and condensate piping ***configurations***
		identify type of ***pipe*** and ***piping components*** for low pressure steam and condensate systems***,*** and describe their purpose and operation
		interpret information pertaining to low pressure steam and condensate piping found on drawings and specifications
		explain the effects of expansion and contraction on piping in low pressure steam and condensate systems
		explain the effects of trapped air in low pressure steam and condensate piping systems and describe the procedures to prevent it
		identify the ***considerations*** for selecting piping system components for low pressure steam and condensate systems
D-10.02.03K	demonstrate knowledge of the procedures used to install piping and piping components for low pressure steam and condensate systems	describe the procedures used to install piping and piping components for low pressure steam and condensate systems
		describe the procedures used to ***protect*** and restrain low pressure steam and condensate system piping and piping components

RANGE OF VARIABLES

properties of steam include: pressure, temperature, latent heat, sensible heat, total heat, volume

configurations include: parallel flow, counter flow, two pipe, gravity return, mechanical return, wet or dry return

applications include: residential heating, industrial, commercial and institutional (ICI) heating, process heating

piping includes: carbon steel, stainless steel, copper

piping components include: manual and automatic valves, steam traps, air vents, expansion joints, strainers, check valves

selection considerations include: insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

D-10.03 Tests low pressure steam and condensate systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-10.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
D-10.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of low pressure steam and condensate systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to low pressure steam and condensate system testing found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing low pressure steam and condensate systems
		explain the effects trapped air in a low pressure steam and condensate system will have on testing and describe the procedures to prevent or correct it
D-10.03.03K	demonstrate knowledge of the procedures used to test low pressure steam and condensate systems	describe the procedures used to perform system testing

	describe the procedures used to remove test medium from system
	describe the procedures used to reinstate system

RANGE OF VARIABLES

testing equipment and components include: blind flanges, calibrated pressure gauges***,*** test pumps, relief valves, gate valves, recorders, testing trees/headers, regulators

tests include: hydrostatic, pneumatic, vacuum

test medium includes: water, water/glycol mix, air, inert gases

method of filling, draining or purging includes: using hand pumps, centrifugal pumps, compressors, compressed gas cylinders

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

D-10.04 Maintains, troubleshoots and repairs low pressure steam and condensate systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-10.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting low pressure steam and condensate systems	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to low pressure steam and condensate system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the effect of pressure on elevation when troubleshooting low pressure steam and condensate systems
		explain the effects trapped air in a low pressure steam and condensate system will have on system operation and describe the procedures to prevent or correct it
D-10.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain low pressure steam and condensate systems	describe the procedures used to troubleshoot low pressure steam and condensate systems

	describe the procedures used to repair low pressure steam and condensate systems
	describe the procedures used to maintain low pressure steam and condensate systems
	describe the procedures used to complete documentation following low pressure steam and condensate system repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, manometer, infrared thermometer, chemical testing equipment

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

TASK D-11 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS HIGH PRESSURE STEAM AND CONDENSATE SYSTEMS.

TASK DESCRIPTOR

Steamfitters/Pipefitters install high pressure steam and condensate system equipment and piping in industrial locations such as refineries, pulp mills, mines, automotive plants, commercial settings and power generating and process plants. Processes that use high pressure steam include running turbines, indirect water heating and central heating.

D-11.01 Installs equipment for high pressure steam and condensate systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-11.01.01K	demonstrate knowledge of high pressure steam and condensate systems, their applications and operation	explain the ***applications*** and operation of high pressure steam and condensate systems
		interpret information pertaining to high pressure steam and condensate system ***equipment*** found on drawings and specifications
D-11.01.02K	demonstrate knowledge of high pressure steam and condensate system equipment, their applications and operation	identify types of high pressure steam and condensate system equipment, and describe their characteristics and operation

		identify high pressure steam and condensate system ***supports*** and ***fasteners,*** and describe their applications and procedures for use
		identify high pressure steam and condensate system ***control components*** and describe their purpose and operation
		identify types of ***fuel*** used in high pressure steam and condensate systems
		identify ***sources of cooling*** used in high pressure steam and condensate system
		explain the ***principles of heat transfer***
		identify types of ***heat transfer equipment*** and describe their characteristics and operation
D-11.01.03K	demonstrate knowledge of the procedures used to install equipment for high pressure steam and condensate systems	identify equipment, controls, supports and fasteners used in high pressure steam and condensate systems, and describe their purpose and operation
		describe the procedures used to install equipment for high pressure steam and condensate systems, their controls, supports and fasteners

RANGE OF VARIABLES

applications include: power generation, process, central heating

equipment includes: boilers, boiler trim, expansion joints, pumps, heat transfer equipment, steam traps, valves, flash tanks, superheaters, re-heaters, de-aerators, desuperheaters, condensers, water treatment equipment

system supports include: stands, hangers, plates, housekeeping pads, isolator pads, concrete embeds

system fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

control components include: LWCO, operating pressure controls, high limit pressure controls, safety controls, feed water controls

fuel includes: fuel oil, gas, coal, biomass, nuclear

sources of cooling include: cooling towers, condensers, flash tanks, blowdown tanks, converters

principles of heat transfer include: radiation, conduction, convection

heat transfer equipment includes: converters, turbines, radiators, convectors, pipe coils, horizontal, and vertical unit heaters

D-11.02 Installs piping for high pressure steam and condensate systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-11.02.01K	demonstrate knowledge of the properties of steam	explain the ***properties of steam***
		describe the use of steam tables to identify the relationship between pressure and temperature
D-11.02.02K	demonstrate knowledge of high pressure steam and condensate piping, their ***applications*** and operation	explain the ***applications*** of high pressure steam and condensate piping
		identify types of ***pipe*** and ***piping components*** for high pressure steam and condensate systems, and describe their purpose and operation
		interpret information pertaining to high pressure steam and condensate system piping found on drawings and specifications
		explain the effects of expansion and contraction on piping in high pressure steam and condensate systems
		identify the ***considerations*** for selecting piping components for high pressure steam and condensate systems
		calculate grade and pitch of piping to ensure system efficiency and functionality
D-11.02.03K	demonstrate knowledge of the procedures used to install piping and piping components for high pressure steam and condensate systems	describe the procedures used to install piping and piping components for high pressure steam and condensate systems
		describe the procedures used to ***protect*** and restrain high pressure steam and condensate system piping and piping components

RANGE OF VARIABLES

properties of steam include: pressure, temperature, latent heat, sensible heat, total heat, superheat, volume

applications include: power generation, process, central heating

piping includes: chrome, carbon steel, stainless steel

piping components include: manual and automatic valves, steam traps, expansion joints, strainers, check valves

considerations include: insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

D-11.03 Installs valves.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-11.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
D-11.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of high pressure steam and condensate systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to high pressure steam and condensate system testing found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing high pressure steam and condensate systems
		explain the effects trapped air in a high pressure steam and condensate system will have on testing and describe the procedures to prevent or correct it
D-11.03.03K	demonstrate knowledge of the procedures used to test high pressure steam and condensate systems	describe the procedures used to perform system testing
		describe the procedures used to remove test medium from system
		describe the procedures used to reinstate system

RANGE OF VARIABLES

testing equipment and components include: blind flanges, calibrated pressure gauges**,** test pumps, relief valves, gate valves, recorders, testing trees/headers

tests include: hydrostatic, pneumatic

test medium include: water, water/glycol mix

method of filling, draining or purging includes: using pumps, using high pressure water supply hoses

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

D-11.04 Maintains, troubleshoots and repairs high pressure steam and condensate systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
D-11.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting high pressure steam and condensate systems	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to high pressure steam and condensate system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the effect of pressure on elevation when troubleshooting high pressure steam and condensate systems
D-11.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain high pressure steam and condensate systems	describe the procedures used to troubleshoot high pressure steam and condensate systems
		describe the procedures used to repair high pressure steam and condensate systems
		describe the procedures used to maintain high pressure steam and condensate systems
		describe the procedures used to complete documentation following high pressure steam and condensate system repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, manometer, infrared thermometer, chemical testing equipment

isolation components include: spectacle blinds, spades, plugs and caps and temporary spool pieces

MAJOR WORK ACTIVITY E

INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS HEATING, COOLING AND PROCESS PIPING SYSTEMS

TASK E-12 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS HYDRONIC SYSTEMS.

TASK DESCRIPTOR

This refers to the installation of “comfort” heating and cooling systems, and systems that are used for process heating and cooling, including high temperature and low temperature hot water heating systems, chilled water cooling systems and cooling towers.

Steamfitters/Pipefitters are responsible for the maintenance of piping, components and equipment. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

E-12.01 Installs equipment for hydronic systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-12.01.01K	demonstrate knowledge of ***hydronic systems***, their applications and operation	explain the applications and operation of ***hydronic systems***
		interpret information pertaining to hydronic systems found on drawings and specifications
E-12.01.02K	demonstrate knowledge of ***hydronic equipment***, their applications and operation	identify types of piping components and accessories for hydronic systems, and describe their purpose and operation
		identify hydronic ***equipment supports*** and ***fasteners*** and describe their applications and procedures for use
		identify ***hydronic controls*** and describe their purpose and operation
		identify ***sources of heat*** used in hydronic systems
		identify ***sources of cooling*** used in hydronic systems

		explain the ***principles of heat transfer***
		identify types of ***heat transfer equipment*** and describe their characteristics and operation
E-12.01.03K	demonstrate knowledge of the procedures used to install equipment for hydronic systems	identify hydronic equipment, controls, supports and fasteners used in hydronic systems, and describe their purpose and operation
		describe the procedures used to install equipment for hydronic systems, their controls, supports and fasteners
		interpret jurisdictional codes and specifications for the installation of hydronic equipment

RANGE OF VARIABLES

hydronic systems include: heating, cooling

hydronic equipment includes: boilers, expansion tanks, buffer tanks, glycol tanks, heat exchangers, circulating pumps, transfer pumps, holding tanks, isolators, relief valves, chemical feeders, isolation valves for equipment, backflow preventers, pressure reducing valves

equipment supports include: brackets, stands, hangers, plates, housekeeping pads, isolator pads, concrete embeds

equipment fasteners include: anchors, expansion type inserts, beam clamps, nuts, bolts, screws

hydronic controls include: pressure, temperature and liquid level controls, zone valves (motorized), safety controls, LWCO, high and low limit temperature controls

sources of heat include: oil, gas, wood, steam, geothermal, solar

sources of cooling include: ground source, cooling towers, chillers, refrigeration, plate exchangers

principles of heat transfer include: radiation, conduction, convection

heat transfer equipment includes: radiators, convectors, pipe coils, horizontal and vertical unit heaters, radiant panels, heat/plate exchangers

E-12.02 Installs piping for hydronic systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-12.02.01K	demonstrate knowledge of hydronic ***piping configurations***, their ***applications*** and operation	explain the ***applications*** of hydronic ***piping configurations***
		identify types of ***piping*** and ***piping components*** for hydronic systems***,*** and describe their purpose and operation
		interpret information pertaining to hydronic piping found on drawings and specifications

		explain the effects of electrolysis when connecting dissimilar metals on hydronic piping and components
		explain the effects of expansion and contraction on piping in hydronic systems
		explain the effects of trapped air in hydronic piping systems and describe the procedures to prevent it
		identify the ***considerations*** for selecting piping components for hydronic systems
E-12.02.02K	demonstrate knowledge of the procedures used to install piping and piping components for hydronic systems	describe the procedures used to install piping and piping components for hydronic systems
		describe the procedures used to ***protect*** hydronic piping and piping components
		identify systems that require pitch and grade of piping for the hydronic system

RANGE OF VARIABLES

piping configurations include: perimeter/series loop, reverse return, direct return, primary/secondary

applications include: residential, ICI heating and/or cooling

piping includes: plastic, carbon steel, stainless steel, copper

piping components include: fittings, dielectric fittings, hangers, brackets, sleeves, anchors, guides, valves, strainers, expansion joints, expansion loops, backflow preventers

selection considerations include: insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

E-12.03 Tests hydronic systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-12.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
E-12.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of hydronic systems and, describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium

		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to hydronic system testing found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing hydronic systems
		explain the effects trapped air in a hydronic system will have on testing and describe the procedures to prevent or correct it
E-12.03.03K	demonstrate knowledge of the procedures used to test hydronic systems	describe the procedures used to perform system testing
		describe the procedures used to remove test medium from system
		describe the procedures used to reinstate system
		interpret jurisdictional codes and specifications for testing of hydronic equipment

RANGE OF VARIABLES

testing equipment and components include: blind flanges, calibrated pressure gauges***,*** test pumps, relief valves, gate valves, recorders, testing trees/headers, regulators

tests include: hydrostatic, pneumatic

method of filling, draining or purging includes: using hand pump, centrifugal pump, compressors, compressed gas cylinders

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

E-12.04 Maintains, troubleshoots and repairs hydronic systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-12.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting ***hydronic systems***	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to hydronic system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the effects of pressure on elevation when troubleshooting hydronic systems
		explain the effects trapped air in a hydronic system will have on system operation and describe the procedures to prevent or correct it
E-12.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain hydronic systems	describe the procedures used to troubleshoot hydronic systems
		describe the procedures used to repair hydronic systems
		describe the procedures used to maintain hydronic systems
		describe the procedures used to complete documentation following hydronic system repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, manometer, infrared thermometer, balancing equipment, chemical testing equipment

hydronic systems include: heating, cooling

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

TASK E-13 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS PROCESS PIPING SYSTEMS.

TASK DESCRIPTOR

Steamfitters/Pipefitters install process piping systems, which are used in specific industry processes, including gas and oil refining, pulp production, mining, food processing and chemical production. These industry processes dictate the use of a wide variety of piping materials and joining methods.

Steamfitters/Pipefitters are responsible for the maintenance of piping, components and equipment. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

E-13.01 Installs equipment for process piping systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-13.01.01K	demonstrate knowledge of process piping systems, their applications and operation	explain the applications and operation of ***process piping systems***
		interpret information pertaining to process piping systems equipment found on drawings and specifications
E-13.01.02K	demonstrate knowledge of process piping system ***equipment***, their applications and operation	identify types of process piping system ***equipment***, and describe their characteristics and operation
		identify process piping system ***equipment supports and fasteners*** and describe their applications and procedures for use
		identify process piping system ***controls*** and describe their purpose and operation
E-13.01.03K	demonstrate knowledge of the procedures used to install equipment for process piping systems	describe the procedures used to install equipment for process piping systems, their controls, supports and fasteners
		interpret jurisdictional codes and specifications for installation of process piping systems

RANGE OF VARIABLES

process piping systems include: gas/oil refining, pulp production, mining, food processing, chemical production, ship building, sawmills, manufacturing

equipment includes: circulating pumps, tanks, pressure vessels, heat exchangers, transfer pumps, holding tanks, isolators, relief valves, isolation valves for equipment, strainers, filter

equipment supports include: stands, hangers, plates, housekeeping pads, isolator pads, concrete embeds

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

controls include: operating and temperature controls, flow meters, liquid level controls, safety controls

E-13.02 Installs piping for process piping systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-13.02.01K	demonstrate knowledge of ***process piping system***, their applications and operation	explain the ***applications*** of ***process piping systems***
		identify types of ***pipe*** and ***piping components*** for process piping systems, and describe their purpose and operation
		interpret information pertaining to process piping found on drawings and specifications
		explain the effects of electrolysis when connecting dissimilar metals on process piping system piping and piping components
		explain the effects of expansion and contraction on piping in process piping systems
		explain the effects of trapped air in a process piping system and describe the procedures to prevent it
		identify the ***considerations for selecting*** piping system components for process piping systems
E-13.02.02K	demonstrate knowledge of the procedures used to install piping and piping components for process piping systems	describe the procedures used to install piping and piping components for process piping systems
		describe the procedures used to ***protect*** process piping and piping components

RANGE OF VARIABLES

process piping systems include: gas/oil refining, pulp production, mining, food processing, chemical production, ship building, sawmills, manufacturing

applications include: ICI processes

piping includes: carbon steel, copper, chrome, plastic, fibreglass, titanium, copper-nickel, stainless steel

piping components include: manual and automatic valves, fittings, expansion joints, strainers, filters, check valves

selection considerations include: client requirements, insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: dielectric unions, cathodic protection, protection from contamination, protective coatings, impressed current

E-13.03 Tests process piping systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-13.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
E-13.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of ***process piping systems***, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to process piping system testing found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing process piping systems
		explain the effects trapped air in a process piping system will have on testing and describe the procedures to prevent or correct it
E-13.03.03K	demonstrate knowledge of the procedures used to test process piping systems	describe the procedures used to perform system testing

	describe the procedures used to remove test medium from system
	describe the procedures used to reinstate system

RANGE OF VARIABLES

testing equipment and components include: blind flanges, calibrated pressure gauges***,*** test pumps, relief valves, gate valves, recorders, testing trees/headers, regulators

tests include: hydrostatic, pneumatic, vacuum

test medium includes: water, compressed air, glycol, water/glycol mix, inert gases

process piping systems include: gas/oil refining, pulp production, mining, food processing, chemical production, ship building, sawmills, manufacturing

method of filling, draining or purging includes: using hand pump, centrifugal pump, compressors, compressed gas cylinders

isolation components include: blind flanges, plugs and caps, temporary spool pieces

E-13.04 Maintains, troubleshoots and repairs process piping systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-13.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting ***process piping systems***	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to process piping system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the effect of pressure on elevation when troubleshooting process piping systems
		explain the effects trapped air in a process piping system will have on system operation and describe the procedures to prevent or correct it
E-13.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain process piping systems	describe the procedures used to troubleshoot process piping systems
		describe the procedures used to repair process piping systems

	describe the procedures used to maintain process piping systems
	describe the procedures used to complete documentation following process piping system repair or maintenance

RANGE OF VARIABLES

process piping systems include: gas/oil refining, pulp production, mining, food processing, chemical production, ship building, sawmills, manufacturing

testing equipment and components include: multimeter, manometer, infrared thermometer, chemical testing equipment

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

TASK E-14 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS INDUSTRIAL WATER AND WASTE TREATMENT SYSTEMS.

TASK DESCRIPTOR

Industrial water and waste treatment systems remove biological or chemical waste products from water. The functions of these systems may be to treat sewage, agriculture or industrial wastewater. Steamfitter/Pipefitters are responsible for installing, maintaining and repairing the piping, associated components and equipment for these systems. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

E-14.01 Installs equipment for industrial water and waste treatment systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-14.01.01K	demonstrate knowledge of industrial water and waste treatment systems, their applications and operation	explain the applications and operation of industrial water and waste treatment systems
		interpret information pertaining to industrial water and waste treatment equipment found on drawings and specifications
E-14.01.02K	demonstrate knowledge of industrial water and waste treatment ***equipment***, their applications and operation	identify types of industrial water and waste treatment systems ***equipment***, and describe their characteristics and operation
		identify industrial water and waste treatment systems ***equipment supports and fasteners*** and describe their applications and procedures for use
		identify industrial water and waste treatment system ***control components*** and describe their purpose and operation
E-14.01.03K	demonstrate knowledge of the procedures used to install equipment for industrial water and waste treatment systems	identify equipment, controls, supports and fasteners used in industrial water and waste treatment systems, and describe their purpose and operation

		describe the procedures used to install equipment for industrial water and waste treatment systems, their controls, supports and fasteners
		interpret jurisdictional codes and specifications for installation of industrial water and waste treatment systems

RANGE OF VARIABLES

equipment includes: pumps, tanks, valves, filters, strainers, separators, skimmers, aerators, water treatment equipment

equipment supports include: stands, hangers, plates, housekeeping pads, isolator pads, concrete embeds

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

control components include: operating and temperature controls, flow controls, safety controls

E-14.02 Installs piping for industrial water and waste treatment systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-14.02.01K	demonstrate knowledge of industrial water and waste treatment ***piping configurations***, their ***applications*** and operation	explain the ***applications*** of industrial water and waste treatment ***piping configurations***
		identify types of ***piping, piping components*** and ***supports*** for industrial water and waste treatment systems, and describe their purpose and operation
		interpret information pertaining to industrial water and waste treatment piping found on drawings and specifications
		explain the effects of electrolysis when connecting dissimilar metals on industrial water and waste treatment piping and components
		explain the effects of trapped air in industrial water and waste treatment piping system and describe the procedures to prevent it
		identify the ***considerations*** for selecting piping system components for industrial water and waste treatment systems

E-14.02.02K	demonstrate knowledge of the procedures used to install piping, components and supports for industrial water and waste treatment systems	describe the procedures used to install piping, components and supports for industrial water and waste treatment systems
		describe the procedures used to ***protect*** industrial water and waste treatment system piping and piping components

RANGE OF VARIABLES

piping configurations include: gravity, pressurized

applications include: transfer liquid from point of use for treatment and possible reuse

piping includes: plastic, carbon steel, copper***,*** stainless steel

piping components include: fittings, dielectric fittings, hangers, brackets, sleeves, anchors, guides, manual and automatic valves, strainers, backflow preventers, check valves

piping supports include: rollers, hangers, clamps, brackets, stands, anchors, guides, concrete piers (underground)

selection considerations include: insulation requirements, type of supports, shoes, sleeves

protection includes: protection from mechanical damage, seismic activity, environmental conditions, contamination

E-14.03 Tests industrial water and waste treatment systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-14.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
E-14.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of industrial water and waste treatment systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to industrial water and waste treatment system testing found on drawings and specifications

		explain the effect of elevation and temperature on pressure when testing industrial water and waste treatment systems
		explain the effects trapped air in an industrial water and waste treatment system will have on testing and describe the procedures to prevent or correct it
E-14.03.03K	demonstrate knowledge of the procedures used to test industrial water and waste treatment systems	describe the procedures used to perform system testing
		describe the procedures used to remove test medium from system
		describe the procedures used to reinstate system

RANGE OF VARIABLES

testing equipment and components include: blind flanges, calibrated pressure gauges***,*** test pumps, relief valves, gate valves, recorders, testing trees/headers, regulators

tests include: hydrostatic, pneumatic

test medium includes: water, compressed air, glycol, water/glycol mix, inert gases

method of filling, draining or purging includes: using hand pumps, centrifugal pumps, compressors, compressed gas cylinders

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

E-14.04 Maintains, troubleshoots and repairs industrial water and waste treatment systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-14.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting industrial water and waste treatment systems	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to industrial water and waste treatment system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the effect of pressure on elevation when troubleshooting industrial water and waste treatment systems

		explain the effects trapped air in an industrial water and waste treatment system will have on system operation and describe the procedures to prevent or correct it
E-14.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain industrial water and waste treatment systems	describe the procedures used to troubleshoot industrial water and waste treatment systems
		describe the procedures used to repair industrial water and waste treatment systems
		describe the procedures used to maintain industrial water and waste treatment systems
		describe the procedures used to complete documentation following water and waste treatment system repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, micrometer, stethoscope, chemical testing equipment

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

TASK E-15 INSTALLS, TESTS, MAINTAINS TROUBLESHOOTS AND REPAIRS HYDRAULIC SYSTEMS.

TASK DESCRIPTOR

Hydraulic systems are used to drive hydraulic motors and actuators in a variety of industrial and manufacturing processes.

Steamfitters/Pipefitters are responsible for the maintenance of piping, components and equipment. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

E-15.01 Installs equipment for hydraulic systems

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-15.01.01K	demonstrate knowledge of hydraulic systems, their applications and operation	explain the applications and operation of hydraulic systems
		interpret information pertaining to hydraulic system equipment found on drawings, schematics and specifications
E-15.01.02K	demonstrate knowledge of ***hydraulic equipment***, their applications and operation	identify types of ***hydraulic equipment***, and describe their characteristics and operation
		identify hydraulic ***equipment supports*** and ***fasteners*** and describe their applications and procedures for use
		identify ***hydraulic control components*** and describe their purpose and operation
		identify types of fluids and fluid-related formulae, and describe their characteristics and applications
E-15.01.03K	demonstrate knowledge of the procedures used to install equipment for hydraulic systems	identify equipment, controls, supports and fasteners used in hydraulic systems, and describe their purpose and operation
		describe the procedures used to install equipment for hydraulic systems, their ***controls***, supports and fasteners

RANGE OF VARIABLES

hydraulic equipment includes: reservoir tanks, pumps, motors, relief valves, fittings, valves, cylinders, pistons, actuators, accumulators, fluid coolers, fluid heaters, strainers, filters

equipment supports include: stands, hangers, plates, housekeeping pads, isolator pads, concrete embeds

equipment fasteners include: inserts, beam clamps, nuts, bolts, screws

hydraulic control components include: operating, temperature and pressure controls, safety controls, valves, actuators

controls include: operating, temperature and pressure controls, safety controls, valves, actuators

E-15.02 Installs piping, tubing and hoses for hydraulic systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-15.02.01K	demonstrate knowledge of ***hydraulic piping systems***, their ***applications*** and operation	explain the ***applications*** of ***hydraulic piping systems***
		identify types of ***piping***, tubing and hoses for hydraulic systems, and describe their purpose and operation
		interpret information pertaining to hydraulic piping, tubing and hoses found on drawings, schematics and specifications
		explain the effects of trapped air in hydraulic systems and describe the procedures to prevent it
		identify the ***considerations*** for selecting piping, tubing and hoses for hydraulic systems
E-15.02.02K	demonstrate knowledge of the procedures used to install piping, tubing and hoses for hydraulic systems	describe the procedures used to install piping, tubing and hoses for hydraulic systems
		describe the procedures used to ***protect*** hydraulic system piping, tubing and hoses
E-15.02.01K	demonstrate knowledge of ***hydraulic piping systems***, their ***applications*** and operation	explain the ***applications*** of ***hydraulic piping systems***

RANGE OF VARIABLES

hydraulic piping systems include: open loop, closed loop
applications include: to operate lifting devices, to operate motors
piping includes: plastic, carbon steel, copper***,*** stainless steel
selection considerations include: type of supports, system pressure, movement of the equipment
protection includes: protection from mechanical damage, seismic activity, vibration, environmental conditions

E-15.03 Tests hydraulic systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-15.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
E-15.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of hydraulic systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to hydraulic system testing found on drawings, schematics and specifications
		explain the effects trapped air in a hydraulic system will have on testing and describe the procedures to prevent or correct it
E-15.03.03K	demonstrate knowledge of the procedures used to test hydraulic systems	describe the procedures used to perform system testing
		describe the procedures used to remove test medium from system
		describe the procedures used to reinstate system

RANGE OF VARIABLES

testing equipment and components include: blind flanges, calibrated pressure gauges, test pumps, relief valves, valves, testing trees/headers, regulators

tests include: hydrostatic, pneumatic

test medium includes: test fluids, test gases

method of filling, draining or purging includes: using hand pumps, centrifugal pumps, compressed gas cylinders

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

E-15.04 Maintains, troubleshoots and repairs hydraulic systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-15.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting hydraulic systems	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to hydraulic system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the importance of ensuring contaminants do not enter the system when repairing or maintain hydraulic systems
		explain the effects trapped air in a hydraulic system will have on system operation and describe the procedures to prevent or correct it
E-15.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain hydraulic systems	describe the procedures used to troubleshoot hydraulic systems
		describe the procedures used to repair hydraulic systems
		describe the procedures used to maintain hydraulic systems
		describe the procedures used to complete documentation following hydraulic system repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, infrared thermometer, calibrated gauges
isolation components include: spectacle blinds, spades, plugs and caps

TASK E-16 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS HEATING, VENTILATION, AIR CONDITIONING AND REFRIGERATION (HVACR) SYSTEMS.

TASK DESCRIPTOR

According to jurisdictional guidelines, steamfitters/pipefitters install refrigeration equipment and piping for ICI applications such as food processing plants, recreational facilities, medical facilities, industrial manufacturing processes and liquefied natural gas plants. System components and design can vary depending on the type of refrigerant used, such as chlorofluorocarbons (CFC) and hydrofluorocarbons (HCFC). They may also work on the refrigeration units for co-gen systems in industrial applications.

Steamfitters/Pipefitters are responsible for the maintenance of piping, equipment and associated components. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are responsible for diagnosing, locating and repairing or replacing equipment and associated components.

E-16.01 Installs equipment for HVACR systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-16.01.01K	demonstrate knowledge of refrigeration systems, their components, applications and operation	interpret information pertaining to refrigeration equipment found on drawings and specifications
		identify types of ***refrigeration systems*** and describe their characteristics and applications
		identify refrigeration system ***equipment*** and describe their purpose and operation
		identify ***refrigeration system components*** and describe their purpose and operation
		identify refrigeration ***equipment supports*** and ***fasteners*** and describe their applications and procedures for use
		identify refrigeration ***control components*** and describe their purpose and operation

		identify ***sources of energy*** used in refrigeration systems
		explain the ***principles of heat transfer***
		identify types of ***heat transfer equipment*** and describe their characteristics and operation
		interpret codes and regulations pertaining to refrigeration systems
		explain the applications and operation of refrigeration systems
E-16.01.02K	demonstrate knowledge of the procedures used to install ***equipment*** for refrigeration systems	identify ***equipment, supports*** and fasteners used in refrigeration systems, and describe their purpose and operation
		describe the procedures used to install equipment for refrigeration systems, their controls , supports and fasteners

RANGE OF VARIABLES

refrigeration systems include: compressor, absorption

equipment includes: condensers, heat pumps, chillers, cooling towers, fin fans, co-gen devices, plate exchangers

refrigeration system components include: expansion joints, controls, coils, compressors, evaporators, condensers

equipment supports include: expansion tanks, pumps, outdoor controllers, control valves

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

control components include: operating and temperature controls, safety controls

sources of energy include: oil, gas, wood, steam, geothermal, solar

principles of heat transfer include: radiation, conduction, convection

heat transfer equipment includes: pipe coils, radiant panels, demisters, heat/plate exchangers

equipment includes: compressors, condensers, heat pumps, chillers, evaporators, cooling towers, fin fans, liquid receivers, accumulators, humidifiers

supports include: stands, hangers, plates, isolator pads, embeds

E-16.02 Installs hydronic piping and refrigeration tubing for HVACR systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-16.02.01K	demonstrate knowledge of refrigeration systems, their components, applications and operation	interpret information pertaining to refrigeration equipment found on drawings and specifications
		identify types of ***refrigeration systems*** and describe their characteristics and applications
		identify refrigeration system ***equipment*** and describe their purpose and operation
		identify ***refrigeration system components*** and describe their purpose and operation
		identify refrigeration equipment ***supports and fasteners*** and describe their applications and procedures for use
		identify ***refrigeration control components*** and describe their purpose and operation
		identify types of refrigeration ***piping and tubing***
		identify ***sources of energy*** used in refrigeration systems
		explain the ***principles of heat transfer***
		identify types of ***heat transfer equipment*** and describe their characteristics and operation
		explain the applications and operation of refrigeration systems
		interpret codes and regulations pertaining to refrigeration systems
		identify the properties and characteristics of ***refrigerants***
E-16.02.02K	demonstrate knowledge of the procedures used to install piping and components for refrigeration systems	describe the procedures used to install piping and components for refrigeration systems
		explain the ***applications*** of ***refrigeration piping configurations***
		interpret information pertaining to refrigeration piping found on drawings and specifications

	explain the effects of electrolysis when connecting dissimilar metals on refrigeration piping and components
	explain the effects of expansion and contraction on piping in refrigeration systems
	explain the effects of trapped air in refrigeration piping systems and describe the procedures to prevent it
	identify the ***considerations*** for selecting piping system components for refrigeration systems
	describe the procedures used to ***protect*** refrigeration system piping and components from vibration

RANGE OF VARIABLES

refrigeration systems include: compressor, absorption

equipment includes: condensers, heat pumps, chillers, cooling towers, fin fans, co-gen devices, plate exchangers

refrigeration system components include: expansion joints, controls, coils, compressors, evaporators, condensers

equipment supports include: expansion tanks, pumps, outdoor controllers, control valves

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

refrigeration control components include: operating and temperature controls, safety controls

piping and tubing includes: carbon steel, copper, alloys

sources of energy include: oil, gas, wood, steam, geothermal, solar

principles of heat transfer include: radiation, conduction, convection

heat transfer equipment includes: pipe coils, radiant panels, demisters, heat/plate exchangers

refrigerants include: CFCs, HCFCs

applications include: residential cooling, ICI cooling, process applications

refrigeration piping configurations include: liquid line, gas line, grade, supply and return

selecting considerations include: insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

E-16.03 Tests associated components of HVACR systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-16.03.01K	demonstrate knowledge of the procedures used to test ***associated components of refrigeration systems***	describe the procedures used to test refrigeration systems
		describe the procedures used to test refrigeration system control components
		identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of refrigeration systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to testing of associated components of refrigeration system found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing the components of refrigeration systems
		explain the effects trapped air in components of a refrigeration system will have on testing and describe the procedures to prevent or correct it
		describe the procedures used to remove test medium from system
		describe the procedures used to reinstate system

RANGE OF VARIABLES

associated components of refrigeration systems include: high point vents, low point drains, test pumps, gauges, test trees

testing equipment and components includes: chart recorders, nitrogen bottles, pressure gauges, hydro pumps

tests include: hydrostatic, pneumatic

test medium includes: water, water/glycol mix, compressed air, inert gases

method of filling, draining or purging includes: using hand pumps, centrifugal pumps, compressors, compressed gas cylinders

isolation components include: blind flanges, plugs and caps, temporary spool pieces

E-16.04 Maintains, troubleshoots and repairs associated components of HVACR systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-16.04.01K	demonstrate knowledge of the procedures used to maintain, troubleshoot and repair associated components of refrigeration systems	describe the procedures used to maintain and repair associated components of refrigeration systems
		describe the procedures used to troubleshoot associated components of refrigeration systems
		describe the procedures used to protect associated components of refrigeration systems and piping
		describe the procedures used to set and adjust associated components of refrigeration systems

TASK E-17 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS FUEL SYSTEMS.

TASK DESCRIPTOR

Fuel systems supply required liquid or vapour phase fuels to support combustion systems for heat, process, power generation and transportation. Steamfitter/pipefitters install, maintain and repair piping, associated components and equipment for fuel systems throughout all aspects of industry including rail, storage tanks and marine tanker transportation systems.

Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are also responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

E-17.01 Installs equipment for fuel systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-17.01.01K	demonstrate knowledge of ***fuel systems***, their components, applications and operation	explain the applications and operation of ***fuel systems***
		interpret information pertaining to fuel system equipment found on drawings and specifications
E-17.01.02K	demonstrate knowledge of fuel system ***equipment***, their applications and operation	identify types of fuel system ***equipment***, and describe their characteristics and operation
		identify fuel system ***equipment supports and fasteners*** and describe their applications and procedures for use
		identify ***fuel system control components*** and describe their purpose and operation
E-17.01.03K	demonstrate knowledge of the procedures used to install equipment for fuel systems	identify equipment, ***controls***, ***supports*** and fasteners used in fuel systems, and describe their purpose and operation
		describe the procedures used to install equipment for fuel systems, their controls, supports and fasteners
		describe trenching and shoring requirements

RANGE OF VARIABLES

fuel systems include: natural gas, propane, diesel, fuel oil, black liquor, hydro-carbon derivatives, bio fuels

equipment includes: expansion joints, pumps, heat transfer equipment, heat exchangers, tanks (may include rail or marine), vacuum breakers, valves and blowers, flare stacks, flashback arrestors, scrubbers, vaporizers

equipment supports include: expansion tanks, pumps, outdoor controllers, control valves

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

fuel system control components include: operating and temperature controls, safety controls

controls include: operating pressure controls, high limit pressure controls, pressure relief valves,

supports include: stands, hangers, plates, isolator pads, embeds

E-17.02 Installs piping and tubing for fuel systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-17.02.01K	demonstrate knowledge of fuel piping and tubing, their ***applications*** and operation	explain the ***applications*** of fuel piping and tubing
		identify types of ***piping and tubing, piping components*** and ***venting and exhaust components*** for fuel systems, and describe their purpose and operation
		interpret information pertaining to fuel piping and tubing found on drawings and specifications
		explain the effects of electrolysis when connecting dissimilar metals on fuel piping and components
		explain the effects of expansion and contraction on piping in fuel systems
		explain the effects of trapped air in fuel piping systems and describe the procedures to prevent it
		identify the ***considerations*** for selecting piping and tubing components for fuel systems
E-17.02.02K	demonstrate knowledge of the procedures used to install piping and components for fuel systems	describe the procedures used to install piping and components for fuel systems

	describe the procedures used to ***protect*** and restrain fuel system piping and components
	interpret jurisdictional codes and specifications for installation of fuel systems

RANGE OF VARIABLES

applications include: residential heating, ICI heating and/or process

piping and tubing include: carbon steel, copper, HDPE, stainless steel, yellow jacket

piping components include: heat exchangers, pump trim, manual and automatic valves, expansion joints, flexible connectors, strainers, check valves

venting and exhaust components include: mufflers, silencers, sound attenuation

selection considerations include: insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

E-17.03 Tests fuel systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-17.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components,*** and describe their characteristics and applications
E-17.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of fuel systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to fuel systems system testing found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing fuel systems
		explain the effects trapped air in a fuel system will have on testing and describe the procedures to prevent or correct it

E-17.03.03K	demonstrate knowledge of the procedures used to test fuel systems	describe the procedures used to perform system testing
		describe the procedures used to remove test medium from system
		describe the procedures used to reinstate system

RANGE OF VARIABLES

testing equipment and components include: test tree and components, pressure gauges, pumps, compressors, test medium

tests include: hydrostatic, pneumatic, vacuum

test medium includes: water, water/glycol mix (appropriate for the piping or system), air, inert gases

method of filling, draining or purging includes: using hand pump, centrifugal pump, compressors, compressed gas cylinders

isolation components include: blind flanges, plugs and caps, temporary spool pieces

E-17.04 Maintains, troubleshoots and repairs fuel systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-17.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting fuel systems	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to fuel system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the effect of pressure on elevation when troubleshooting fuel systems
		explain the effects trapped air in a fuel system will have on system operation and describe the procedures to prevent or correct it
E-17.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain fuel systems	describe the procedures used to troubleshoot fuel systems
		describe the ***procedures*** used to repair fuel systems

	describe the procedures used to maintain fuel systems
	describe the procedures used to complete documentation following fuel system repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, manometer, infrared thermometer, combustible gas indicators, O_2 and CO sensors

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

procedures include: verify continuous bonding

TASK E-18 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS MEDICAL GAS SYSTEMS.

TASK DESCRIPTOR

Medical gas piping systems are addressed separately due to their unique installation methods and applications. Additional certification may be required in certain jurisdictions. Medical gas systems are almost exclusively installed in health care facilities. Medical gas piping systems supply piped gases, such as oxygen, nitrous oxide, nitrogen, carbon dioxide and medical air, to various parts of the facility.

Steamfitters/Pipefitters are responsible for the installation and maintenance of piping, associated components and equipment for these systems. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are also responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

E-18.01 Installs equipment for medical gas systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-18.01.01K	demonstrate knowledge of ***medical gas systems***, their components, applications and operation	identify types of ***medical gas systems*** and describe their ***applications***
		identify types of ***medical gases*** and describe their characteristics
		identify medical gas system ***equipment*** and describe their applications and operation
		identify ***supports*** and ***fasteners*** used for medical gas system equipment, and describe their purpose and operation

		interpret information pertaining to medical gas system equipment found on drawings and specifications
		interpret ***codes and regulations*** pertaining to medical gas system equipment
		identify ***medical gas connection systems***
		explain the importance of maintaining cleanliness of installation tools and equipment
E-18.01.02K	demonstrate knowledge of the procedures used to install equipment for medical gas systems	describe the procedures used to install equipment for medical gas systems, their supports and fasteners

RANGE OF VARIABLES

medical gas systems include: oxygen, nitrogen, vacuum, mixed gases
applications include: hospitals, dental suites, veterinary clinics, laboratories
medical gases include: oxygen, nitrogen, nitrous oxide/anesthetic, medical air
equipment includes: valve boxes, terminal boxes, compressors, regulators, pumps, cryogenic tanks, valves, gauges, alarms
equipment supports include: brackets, stands, hangers, plates, isolator pads
equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws
codes and regulations include: CSA, AHJ, site specifications
medical gas connection systems include: diameter index safety system (DISS), pin indexing system

E-18.02 Installs piping and tubing for medical gas systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-18.02.01K	demonstrate knowledge of ***medical gas systems***, their components, applications and operation	identify types of ***medical gas systems*** and describe their ***applications***
		identify types of ***medical gases*** and describe their characteristics
		identify medical gas system ***piping and tubing***
		identify ***supports*** and ***fasteners*** used for medical gas piping and tubing, and describe their purpose and operation
		interpret information pertaining to medical gas system piping and tubing found on drawings and specifications

		interpret ***codes and regulations*** pertaining to medical gas system piping and tubing
		explain the importance of maintaining cleanliness of installation tools, piping and fittings
E-18.02.02K	demonstrate knowledge of the procedures used to install piping and tubing for medical gas systems	describe the procedures used to install piping and tubing for medical gas systems, their supports and fasteners
		describe the procedures used to ***protect*** medical gas piping and piping components

RANGE OF VARIABLES

medical gas systems include: oxygen, nitrogen, vacuum, mixed gases
applications include: hospitals, dental suites, veterinary clinics, laboratories
medical gases include: oxygen, nitrogen, nitrous oxide/anesthetic, medical air
piping and tubing include: copper certified for medical gas service, carbon steel, stainless steel
supports include: brackets, stands, hangers, plates
fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws
codes and regulations include: DISS, pin indexing system, joining methods, cleaning, supporting
protection includes: protection from mechanical damage, seismic activity, environmental conditions

E-18.03 Tests medical gas systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-18.03.01K	demonstrate knowledge of ***test equipment*** and test medium, their characteristics and applications	identify types of ***test equipment*** and describe their characteristics and applications
		identify types of ***test medium*** and describe their characteristics and applications
E-18.03.02K	demonstrate knowledge of the procedures used to test medical gas systems	explain the importance of maintaining cleanliness of installation tools, piping and fittings
		identify types of ***certification tests*** and describe their applications
		identify ***method of purging and filling*** medical gas systems
		identify types of ***isolation components*** and describe their characteristics and applications

	interpret information pertaining to medical gas system testing found on drawings and specifications
	describe the procedures used to perform system testing
	describe the procedures used to remove test medium from system
	describe the procedures used to reinstate system

RANGE OF VARIABLES

test equipment includes: test trees and components, pressure gauges, compressors, test medium
test medium includes: nitrogen and system gases
certification tests include: particulate test, purification test, cross-connection test, operational test
method of purging and filling includes: compressors, compressed gas cylinders
isolation components include: valves, plugs and caps

E-18.04 Maintains, troubleshoots and repairs medical gas systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-18.04.01K	demonstrate knowledge of ***test equipment*** for troubleshooting medical gas systems	identify types of ***test equipment*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to medical gas system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
E-18.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain medical gas systems	describe the procedures used to troubleshoot medical gas systems
		describe the procedures used to repair medical gas systems
		describe the procedures used to maintain medical gas systems
		describe the procedures used to complete documentation following medical gas repair or maintenance

RANGE OF VARIABLES

test equipment includes: multimeter, pressure gauges, manometers
isolation components include: valves, plugs and caps

TASK E-19 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS COMPRESSED AIR AND PNEUMATIC SYSTEMS.

TASK DESCRIPTOR

Compressed air and pneumatic systems refer to instrument air, utility air and process air piping used in ICI settings.

Steamfitters/Pipefitters are responsible for the maintenance of piping, components and equipment. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

E-19.01 Installs equipment for compressed air and pneumatic systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-19.01.01K	demonstrate knowledge of compressed air and pneumatic systems, their applications and operation	explain the applications and operation of compressed air and pneumatic systems
		interpret information pertaining to compressed air/pneumatic equipment found on drawings and specifications
E-19.01.02K	demonstrate knowledge of compressed air and pneumatic ***equipment***, their applications and operation	identify types of compressed air and pneumatic ***equipment***, and describe their characteristics and operation
		identify compressed air and pneumatic ***equipment supports*** and ***fasteners*** and describe their applications and procedures for use
		identify compressed air and pneumatic ***control*** components and describe their purpose and operation
		explain the ***principles of heat transfer***
		identify types of ***heat transfer equipment*** and describe their characteristics and operation

E-19.01.03K	demonstrate knowledge of the procedures used to install equipment for compressed air and pneumatic systems	identify equipment, controls, supports and fasteners used in compressed air and pneumatic systems, and describe their purpose and operation
		describe the procedures used to install equipment for compressed air and pneumatic systems, their controls, supports and fasteners

RANGE OF VARIABLES

equipment includes: compressors (piston, screw type, rotary, axial, reciprocating, vane), heat transfer equipment, receiver tanks, valves, dryers, separators, filters, lubricators, compressed gas cylinders, tanks

equipment supports include: stands, hangers, plates, housekeeping pads, isolator pads, concrete embeds

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

controls include: regulators, solenoids, actuators, pressure switches, flow switches, alarm switches

principles of heat transfer include: radiation, conduction, convection

heat transfer equipment includes: heat exchangers, pipe coils

E-19.02 Installs piping and tubing for compressed air and pneumatic systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-19.02.01K	demonstrate knowledge of compressed air and pneumatic ***piping configurations***, their applications and operation	explain the ***applications*** of compressed air/pneumatic ***piping configurations***
		identify types of ***piping*** and ***piping components*** for compressed air and pneumatic systems***,*** and describe their purpose and operation
		interpret information pertaining to compressed air and pneumatic piping found on drawings and specifications
		explain the effects of electrolysis when connecting dissimilar metals on compressed air and pneumatic piping and components
		explain the effects of expansion and contraction on piping in compressed air and pneumatic systems
		explain the effects of trapped moisture in compressed air and pneumatic piping systems and describe the procedures to prevent it

		identify the ***considerations*** for selecting piping system components for compressed air and pneumatic systems
E-19.02.02K	demonstrate knowledge of the procedures used to install piping and piping components for compressed air and pneumatic systems	describe the procedures used to install piping and piping components for compressed air and pneumatic systems
		describe the procedures used to ***protect*** compressed air and pneumatic piping and piping components

RANGE OF VARIABLES

piping configurations include: branch lines above the horizontal centerline

applications include: instrument air, utility air, process air, inert gases used in ICI settings

piping includes: carbon steel, copper, plastic (approved to withstand high pressures), galvanized

piping components include: manual and automatic valves, fittings, flexible connectors and hoses, strainers, check valves

selection considerations include: suitability of piping material for the application, insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

E-19.03 Tests compressed air and pneumatic systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-19.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
E-19.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of compressed air and pneumatic systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to compressed air and pneumatic system testing found on drawings and specifications

		explain the effect of elevation and temperature on pressure when testing compressed air and pneumatic systems
		explain the effects trapped air in a compressed air and pneumatic system will have on hydrostatic testing and describe the procedures to prevent or correct it
E-19.03.03K	demonstrate knowledge of the procedures used to test compressed air and pneumatics systems	describe the procedures used to perform system testing
		describe the procedures used to remove test medium from system
		describe the procedures used to reinstate system

RANGE OF VARIABLES

testing equipment and components include: blind flanges, calibrated pressure gauges, test pumps, relief valves, valves, recorders, testing trees/headers, regulators

tests include: hydrostatic, pneumatic

test medium includes: water, air, inert gases

method of filling, draining or purging includes: using hand pumps, centrifugal pumps, compressors, compressed gas cylinders

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

E-19.04 Maintains, troubleshoots and repairs compressed air and pneumatic systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-19.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting compressed air and pneumatic systems	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to compressed air and pneumatic system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals

		explain the effects trapped moisture and particulate in a compressed air and pneumatic system will have on system operation and describe the procedures to prevent or correct it
E-19.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain compressed air and pneumatic systems	describe the procedures used to troubleshoot compressed air and pneumatic systems
		describe the procedures used to repair compressed air/pneumatic systems
		describe the procedures used to maintain compressed air and pneumatic systems
		describe the procedures used to complete documentation following compressed air and pneumatic system repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, infrared thermometer, test gauge, flow meter, ultrasonic leak detector, liquid leak detector

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces, lockable block and bleed valves

TASK E-20 INSTALLS, AND TESTS FIRE PROTECTION SYSTEMS. (NOT COMMON CORE)

TASK DESCRIPTOR

Fire protection systems include fire sprinkler systems (wet, dry, pre-action and deluge), gaseous agents and wet and dry chemical agents. These systems protect buildings from the spread of fire.

In some jurisdiction in Canada, work on fire protection systems can only be performed by a certified and trained sprinkler system installer or apprentice. While steamfitters/pipefitters may possess similar skills required to install piping for fire protection systems, their installation and testing requires the application of specific codes and regulations.

Steamfitters/Pipefitters may do work associated with the installation and maintenance of piping, associated components and equipment for these systems. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters may perform diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

E-20.01 Installs equipment for fire protection systems. (NOT COMMON CORE)

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-20.01.01K	demonstrate knowledge of ***fire protection systems***, their applications and operation	explain the applications and operation of ***fire protection systems***
		interpret information pertaining to fire protection equipment found on drawings and specifications
E-20.01.02K	demonstrate knowledge of fire protection ***equipment***, their applications and operation	identify types of fire protection ***equipment***, and describe their characteristics and operation
		identify fire protection ***equipment supports*** and ***fasteners*** and describe their applications and procedures for use
		explain the requirements for control valves supplying water to fire protection systems
E-20.01.03K	demonstrate knowledge of the procedures used to install equipment for fire protection systems	identify equipment, supports and fasteners used in fire protection systems, and describe their purpose and operation
		describe the procedures used to install equipment for fire protection systems, their supports and fasteners

RANGE OF VARIABLES

fire protection systems include: standpipes, hose cabinets, and wet, dry, pre-action, deluge systems
equipment includes: water supply systems, tanks, valves, drains, connections, backflow preventers
equipment supports include: stands, hangers, plates, housekeeping pads, isolator pads, concrete embeds
equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

E-20.02 Installs piping for fire protection systems. (NOT COMMON CORE)

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-20.02.01K	demonstrate knowledge of ***fire protection systems*** their applications and operation	explain the applications of ***fire protection systems***
		identify types of ***pipe*** and ***piping components*** for fire protection systems, and describe their purpose and operation
		identify ***piping supports*** and ***fasteners*** for fire protection piping
		interpret information pertaining to fire protection systems found on drawings and specifications
		explain the effects of electrolysis when connecting dissimilar metals on fire protection systems
		explain the effects of expansion and contraction on piping in fire protection systems
		explain the effects of trapped air in fire protection systems and describe the procedures to prevent it
		identify the ***considerations*** for selecting piping system components for fire protection systems
E-20.02.02K	demonstrate knowledge of the procedures used to install piping and piping components for fire protection systems	describe the procedures used to install piping and piping components for fire protection systems
		describe the procedures used to ***protect*** fire protection piping and piping components

RANGE OF VARIABLES

fire protection systems include: standpipes, hose cabinets, and wet, dry, pre-action and deluge systems

piping includes: carbon steel, copper, plastic, galvanized, copper-nickel, stainless steel

piping components include: manual and automatic valves, fittings, strainers, check valves, backflow preventers

piping supports include: hangers, clamps, brackets, stands, guides

piping fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

selection considerations include: suitability of piping material for the application, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

E-20.03 Tests fire protection systems. (NOT COMMON CORE)

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
E-20.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
E-20.03.02K	demonstrate knowledge of ***fire protection systems*** testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of ***fire protection systems***, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to fire protection system testing found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing fire protection systems
		explain the effects trapped air in a fire protection system will have on hydrostatic testing and describe the procedures to prevent or correct it
E-20.03.03K	demonstrate knowledge of the procedures used to test fire protection systems	describe the procedures used to perform system testing

	describe the procedures used to remove test medium from system
	describe the procedures used to reinstate system

RANGE OF VARIABLES

testing equipment and components include: blind flanges, calibrated pressure gauges***,*** test pumps, relief valves, valves, recorders, testing trees/headers, regulators

tests include: hydrostatic, pneumatic

test medium includes: water, glycol, water/glycol mix, compressed air, inert gases

fire protection systems include: standpipes, hose cabinets, and wet, dry, pre-action and deluge systems

method of filling, draining or purging includes: using hand pumps, centrifugal pumps, compressors, compressed gas cylinders

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

MAJOR WORK ACTIVITY F

INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS RENEWABLE ENERGY SYSTEMS

TASK F-21 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS GEO-EXCHANGE AND GEOTHERMAL SYSTEMS.

TASK DESCRIPTOR

Geo-exchange and geothermal systems transfer heat from either ground source or deep earth by means of conduction, convection and radiation by use of closed or open loop systems.

Steamfitters/Pipefitters are responsible for the installation and maintenance of piping, associated components and equipment for these systems. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

F-21.01 Installs equipment for geo-exchange and geothermal systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-21.01.01K	demonstrate knowledge of ***geo-exchange and geothermal systems***, their components, applications and operation	explain the applications and operation of ***geo-exchange and geothermal systems***
		interpret information pertaining to geothermal system equipment found on drawings and specifications
		explain ***compression refrigeration components*** and cycle
F-21.01.02K	demonstrate knowledge of ***geo-exchange and geothermal equipment***, their applications and operation	identify types of ***geo-exchange and geothermal equipment***, and describe their characteristics and operation
		identify geo-exchange and geothermal equipment ***supports*** and ***fasteners*** and describe their applications and procedures for use

		identify geo-exchange and geothermal ***control components*** and describe their purpose and operation
		identify ***sources of heat*** used in geo-exchange and geothermal systems
		identify ***sources of cooling*** used in geo-exchange and geothermal systems
		explain the ***principles of heat transfer***
		identify types of ***heat transfer equipment*** and describe their characteristics and operation
		identify piping configurations for earth loops
		identify purpose and functionality of reversing valve within heat pump
		identify difference in operation of DX system
F-21.01.03K	demonstrate knowledge of the procedures used to install equipment for geo-exchange and geothermal systems	identify equipment***, controls***, ***supports*** and fasteners used in geo-exchange and geothermal systems, and describe their purpose and operation
		describe the procedures used to install equipment for geo-exchange and geothermal systems, their controls, supports and fasteners

RANGE OF VARIABLES

geo-exchange and geothermal systems include: domestic hot water heating, hydronic heating and cooling, radiant heating, open loop, closed loop, horizontal loop, vertical loop

compression refrigeration components include: evaporators, compressors, condensers, metering devices, refrigerant controls, related piping

geo-exchange and geothermal equipment includes: expansion joints, pumps, heat transfer equipment, steam traps, tanks, valves, water treatment equipment

equipment supports include: expansion tanks, pumps, outdoor controllers, control valves

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

control components include: operating and temperature controls, safety controls

sources of heat include: deep earth, ground source

sources of cooling include: ground source, cooling towers, chillers, refrigeration, heat exchangers

principles of heat transfer include: radiation, conduction, convection

heat transfer equipment includes: radiators, convectors, pipe coils, horizontal and vertical unit heaters, radiant panels, heat exchangers

controls include: LWCO, operating pressure controls, high limit pressure controls, zone valves (motorized)

supports include: stands, hangers, plates, isolator pads, embeds

F-21.02 Installs piping for geo-exchange and geo-thermal systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-21.02.01K	demonstrate knowledge of geo-exchange and geothermal ***piping configurations***, their ***applications*** and operation	explain the ***applications*** of geo-exchange and geothermal ***piping configurations***
		identify types of ***piping*** and ***piping components*** for geo-exchange and geothermal systems***,*** and describe their purpose and operation
		interpret information pertaining to geo-exchange and geothermal piping found on drawings and specifications
		explain the effects of electrolysis when connecting dissimilar metals on geo-exchange and geothermal piping and components
		explain the effects of expansion and contraction on piping in geo-exchange and geothermal systems
		explain the effects of trapped air in geo-exchange and geothermal piping systems and describe the procedures to prevent it
		identify the ***considerations*** for selecting piping system components for geo-exchange and geothermal systems
F-21.02.02K	demonstrate knowledge of the procedures used to install piping and piping components for geo-exchange and geothermal systems	describe the procedures used to install piping and components for geo-exchange and geothermal systems
		describe the procedures used to ***protect*** and restrain geo-exchange and geothermal system piping and components

RANGE OF VARIABLES

piping configurations include: domestic hot water heating, hydronic heating and cooling, radiant heating, open loop, closed loop, horizontal loop, vertical loop

applications include: residential heating, ICI heating, process

piping includes: carbon steel, copper, HDPE, LDPE, MDPE, PEX, PEX-AL-PEX, stainless steel

piping components include: heat exchangers, pump trim, manual and automatic valves, expansion joints, strainers, check valves

selection considerations include: insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

F-21.03 Tests geo-exchange and geothermal systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-21.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
F-21.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of geo-exchange and geothermal systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to geo-exchange and geothermal system testing found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing geo-exchange and geothermal systems
		explain the effects trapped air in a geo-exchange and geothermal system will have on testing and describe the procedures to prevent or correct it
F-21.03.03K	demonstrate knowledge of the procedures used to test geo-exchange and geothermal systems	describe the procedures used to perform system testing
		describe the procedures used to remove test medium from system

	describe the procedures used to reinstate system
	identify hazards associated with heat transfer fluid

RANGE OF VARIABLES

testing equipment and components include: test tree and components, pressure gauge, pumps, compressors, test medium

tests include: hydrostatic, pneumatic, vacuum

test medium includes: water, water/glycol mix (appropriate for the piping), air, inert gases

method of filling, draining or purging includes: using hand pumps, centrifugal pumps, compressors, compressed gas cylinders

isolation components include: blind flanges, plugs and caps, temporary spool pieces

F-21.04 Maintains, troubleshoots and repairs geo-exchange and geothermal systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-21.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting geo-exchange and geothermal systems	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to geo-exchange and geothermal system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the effect of pressure on elevation when troubleshooting geo-exchange and geothermal systems
		explain the effects trapped air in a geo-exchange and geothermal system will have on system operation and describe the procedures to prevent or correct it
F-21.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain geo-exchange and geothermal systems	describe the procedures used to troubleshoot geo-exchange and geothermal systems
		describe the procedures used to repair geo-exchange and geothermal systems

	describe the procedures used to maintain geo-exchange and geothermal systems
	describe the procedures used to complete documentation following geo-exchange and geothermal systems repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, manometer, infrared thermometer, balancing equipment, chemical testing equipment

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

TASK F-22 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS SOLAR HEATING SYSTEMS.

TASK DESCRIPTOR

Solar heating systems harness energy from the sun and deliver it through means such as conduction, convection and radiation to its intended destination. It encompasses environmentally sound practices, technologies and methodologies to generate energy. These systems create heating, cooling and electricity. Steamfitters/Pipefitters install these systems in residential and ICI settings.

Steamfitters/Pipefitters are responsible for the installation and maintenance of piping, associated components and equipment for these systems. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are also responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

F-22.01 Installs equipment for solar heating systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-22.01.01K	demonstrate knowledge of ***solar heating systems***, their components, applications and operation	explain the applications and operation of solar heating systems
		interpret information pertaining to solar system equipment found on drawings and specifications
F-22.01.02K	demonstrate knowledge of solar ***equipment***, their applications and operation	identify types of solar ***equipment***, and describe their characteristics and operation

		identify solar equipment ***supports*** and ***fasteners*** and describe their applications and procedures for use
		identify ***solar control components*** and describe their purpose and operation
		identify ***sources of heat*** used in solar heating systems
		explain the ***principles of heat transfer***
		identify types of ***heat transfer equipment*** and describe their characteristics and operation
F-22.01.03K	demonstrate knowledge of the procedures used to install equipment for solar heating systems	identify equipment, ***controls***, ***supports*** and ***fasteners*** used in solar heating systems, and describe their purpose and operation
		describe the procedures used to install equipment for solar heating systems, their controls, supports and fasteners

RANGE OF VARIABLES

solar heating systems include: domestic water heating, space heating, direct and indirect systems, closed loop systems

equipment includes: solar collectors (flat plate, evacuated tube), indirect water heaters, heat dissipaters, controls expansion joints, pumps, heat transfer equipment, tanks, valves, water treatment equipment

equipment supports include: expansion tanks, pumps, collector rackings, outdoor controllers, control valves

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

solar control components include: operating and temperature controls, safety controls

sources of heat include: solar radiation

principles of heat transfer include: radiation, conduction, convection

heat transfer equipment includes: radiators, convectors, pipe coils, horizontal and vertical unit heaters, radiant panels, solar collectors (flat plate, evacuated tube), water heaters, heat dissipaters, heat exchangers

controls include: differential temperature controllers, flow switches, motorized zone valves, sensors

supports include: stands, hangers, plates, isolator pads, embeds

fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

F-22.02 Installs piping for solar heating systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-22.02.01K	demonstrate knowledge of solar ***piping configurations***, their ***applications*** and operation	explain the ***applications*** of solar ***piping configurations***
		identify types of ***piping*** and ***piping components*** for solar heating systems, and describe their purpose and operation
		interpret information pertaining to solar piping found on drawings and specifications
		explain the effects of electrolysis when connecting dissimilar metals on solar piping and components
		explain the effects of expansion and contraction on piping in solar heating systems
		explain the effects of trapped air in solar piping systems and describe the procedures to prevent it
		identify the ***considerations for selecting*** piping system components for solar heating systems
		identify systems that require pitch
F-22.02.02K	demonstrate knowledge of the procedures used to install piping and components for solar heating systems	describe the procedures used to install piping and components for solar heating systems
		describe the procedures used to ***protect*** and restrain solar heating system piping and components

RANGE OF VARIABLES

piping configurations include: domestic hot water heating, hydronic heating and cooling, radiant heating, open loop, closed loop, horizontal loop, vertical loop

applications include: residential heating, ICI heating, process

piping includes: carbon steel, copper, HDPE, LDPE, MDPE, PEX, PEX-AL-PEX, stainless steel

piping components include: heat exchangers, pump trim, manual and automatic valves, expansion joints, flexible connectors, strainers, check valves

selection considerations include: insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

F-22.03 Tests solar heating systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-22.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
F-22.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of solar heating systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to solar heating system testing found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing solar heating systems
		explain the effects trapped air in a solar heating system will have on testing and describe the procedures to prevent or correct it
		identify hazards related to heat transfer fluid
F-22.03.03K	demonstrate knowledge of the procedures used to test solar heating systems	describe the procedures used to perform system testing
		describe the procedures used to remove test medium from system
		describe the procedures used to reinstate system
		identify codes and standards

RANGE OF VARIABLES

testing equipment and components include: test tree and components, pressure gauges, pumps, compressors, test medium

tests include: hydrostatic, pneumatic, vacuum

test medium includes: water, water/glycol mix, air, inert gases

method of filling, draining or purging includes: using hand pump, centrifugal pump, compressors, compressed gas cylinders

isolation components include: blind flanges, plugs and caps, temporary spool pieces

F-22.04 Maintains, troubleshoots and repairs solar heating systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-22.04.01K	demonstrate knowledge of diagnostic and testing equipment for troubleshooting solar heating systems	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to solar heating systems system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the effect of pressure on elevation when troubleshooting solar heating systems
		explain the effects trapped air in a solar heating system will have on system operation and describe the procedures to prevent or correct it
F-22.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain solar heating systems	describe the procedures used to troubleshoot solar heating systems
		describe the procedures used to repair solar heating systems
		describe the procedures used to maintain solar heating systems
		describe the procedures used to complete documentation following solar heating system repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, manometer, infrared thermometer, balancing equipment, chemical testing equipment

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

TASK F-23 INSTALLS, TESTS, MAINTAINS, TROUBLESHOOTS AND REPAIRS HEAT RECOVERY SYSTEMS.

TASK DESCRIPTOR

Heat recovery systems transfer heat from various sources of heat such as gland seals, refrigerant gas, exhaust steam, flash steam, waste water, cooling water and heat recovery ventilators. Steamfitter/pipefitters install, test, maintain, troubleshoot and repair heat recovery systems.

Steamfitters/Pipefitters are responsible for the installation and maintenance of piping, associated components and equipment for these systems. Maintenance is done on a regular schedule or on an emergency basis to ensure the integrity of the piping system. Steamfitters/Pipefitters are also responsible for diagnosing, locating and repairing or replacing equipment and material. Repairs are performed on an as-needed basis.

F-23.01 Installs equipment for heat recovery systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-23.01.01K	demonstrate knowledge of ***heat recovery systems***, their components, applications and operation	explain the applications and operation of ***heat recovery systems***
		interpret information pertaining to heat recovery system equipment found on drawings and specifications
F-23.01.02K	demonstrate knowledge of heat recovery ***equipment***, their applications and operation	identify types of heat recovery ***equipment***, and describe their characteristics and operation
		identify heat recovery ***equipment supports*** and ***fasteners*** and describe their applications and procedures for use
		identify heat recovery ***control components*** and describe their purpose and operation
		identify ***sources of heat*** used in heat recovery systems
		explain the ***principles of heat transfer***
		identify types of ***heat transfer equipment*** and describe their characteristics and operation

F-23.01.03K	demonstrate knowledge of the procedures used to install equipment for heat recovery systems	identify equipment, ***controls***, ***supports*** and fasteners used in heat recovery systems, and describe their purpose and operation
		describe the procedures used to install equipment for heat recovery systems, their controls, supports and fasteners

RANGE OF VARIABLES

heat recovery systems include: domestic and process water heating, space heating and cooling

equipment includes: expansion joints, pumps, heat transfer equipment (rooftop units), heat exchangers, tanks, valves, water treatment equipment

equipment supports include: stands, hangers, plates, housekeeping pads, isolator pads, concrete embeds

equipment fasteners include: expansion type inserts, beam clamps, nuts, bolts, screws

control components include: operating and temperature controls, safety controls

sources of heat include: gland seals, refrigerant gases, exhaust steam, flash steam, waste water, cooling water, heat recovery ventilators (HRV) (pre-heat coils, exhaust steam coils)

principles of heat transfer include: radiation, conduction, convection

heat transfer equipment includes: radiators, convectors, pipe coils, horizontal and vertical unit heaters, radiant panels, heat exchangers

controls include: differential temperature controllers, flow switches, motorized zone valves, sensors

F-23.02 Installs piping for heat recovery systems.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-23.02.01K	demonstrate knowledge of heat recovery ***piping configurations***, their ***applications*** and operation	explain the ***applications*** of heat recovery ***piping configurations***
		identify types of ***piping*** and ***piping components*** for heat recovery systems, and describe their purpose and operation
		interpret information pertaining to heat recovery piping found on drawings and specifications
		explain the effects of electrolysis when connecting dissimilar metals on heat recovery piping and components
		explain the effects of expansion and contraction on piping in heat recovery systems

		explain the effects of trapped air in heat recovery piping systems and describe the procedures to prevent it
		identify the ***considerations*** for selecting piping system components for heat recovery systems
		calculate pitch or grade in order to ensure system efficiency and functionality
F-23.02.02K	demonstrate knowledge of the procedures used to install piping and components for heat recovery systems	describe the procedures used to install piping and components for heat recovery systems
		describe the procedures used to ***protect*** and restrain heat recovery system piping and components

RANGE OF VARIABLES

heat recovery ***piping configurations*** include: open loop, closed loop

applications include: residential heating, ICI heating, process

piping includes: carbon steel, copper, HDPE, LDPE, MDPE, PEX, PEX-AL-PEX, stainless steel

piping components include: heat exchangers, pump trim, manual and automatic valves, expansion joints, flexible connectors, strainers, check valves

considerations include: insulation requirements, type of supports, shoes and sleeves, expansion, contraction

protection includes: protection from mechanical damage, seismic activity, environmental conditions

F-23.03 Tests heat recovery systems.

Essential Skills	Document Use, Numeracy, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-23.03.01K	demonstrate knowledge of ***testing equipment and components***	identify types of ***testing equipment and components*** and describe their characteristics and applications
F-23.03.02K	demonstrate knowledge of system testing	identify types of ***tests*** and describe their applications
		identify ***test medium*** used in testing of heat recovery systems, and describe their characteristics and applications
		identify ***method of filling, draining or purging*** test medium
		identify types of ***isolation components*** and describe their characteristics and applications

		interpret information pertaining to heat recovery system testing found on drawings and specifications
		explain the effect of elevation and temperature on pressure when testing heat recovery systems
		explain the effects trapped air in a heat recovery system will have on testing and describe the procedures to prevent or correct it
F-23.03.03K	demonstrate knowledge of the procedures used to test heat recovery systems	describe the procedures used to perform system testing
		describe the procedures used to remove test medium from system
		describe the procedures used to reinstate system

RANGE OF VARIABLES

testing equipment and components include: test tree and components, pressure gauges, pumps, compressors, test medium

tests include: hydrostatic, pneumatic, vacuum

test medium includes: water, water/glycol mix, air, inert gases

method of filling, draining or purging includes: using hand pumps, centrifugal pumps, compressors, compressed gas cylinders

isolation components include: blind flanges, plugs and caps, temporary spool pieces

F-24.04 Maintains, troubleshoots and repairs heat recovery systems.

Essential Skills	Oral Communication, Thinking Skills, Document Use

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
F-23.04.01K	demonstrate knowledge of ***testing equipment and components*** for troubleshooting heat recovery systems	identify types of ***testing equipment and components*** and describe their characteristics and applications
		identify types of ***isolation components*** and describe their characteristics and applications
		interpret information pertaining to heat recovery system troubleshooting, repair and maintenance found on drawings, specifications and equipment manuals
		explain the effect of pressure on elevation when troubleshooting heat recovery systems

		explain the effects trapped air in a heat recovery system will have on system operation and describe the procedures to prevent or correct it
F-23.04.02K	demonstrate knowledge of the procedures used to troubleshoot, repair and maintain heat recovery systems	describe the procedures used to troubleshoot heat recovery systems
		describe the procedures used to repair heat recovery systems
		describe the procedures used to maintain heat recovery systems
		describe the procedures used to complete documentation following heat recovery systems system repair or maintenance

RANGE OF VARIABLES

testing equipment and components include: multimeter, manometer, infrared thermometer, balancing equipment, chemical testing equipment

isolation components include: spectacle blinds, spades, plugs and caps, temporary spool pieces

MAJOR WORK ACTIVITY G
PERFORMS COMMISSIONING, START-UP AND TURNOVER

TASK G-24 PREPARES SYSTEM FOR COMMISSIONING, START-UP AND TURNOVER.

TASK DESCRIPTOR

Steamfitters/Pipefitters must carefully pre-check and isolate the systems as necessary by commissioning and start-up procedures. This is done for protection of the system, the surrounding areas and safety of personnel. They must also select proper commissioning equipment, reference system specifications and procedures, and include any accessories required.

G-24.01 Flushes system.

Essential Skills	Document Use, Thinking Skills, Reading

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
G-24.01.01K	demonstrate knowledge of system flushing procedures	identify hazards and describe safe work practices pertaining to system flushing
		identify ***sources of information*** pertaining to system flushing
		identify tools and equipment relating to system flushing and describe their applications and procedures for use
		identify types of ***flushing medium*** and describe their applications
		describe the ***procedures used to perform system flushing***
		identify jurisdictional codes and specifications for chemical treatment and disposal of medium

RANGE OF VARIABLES

sources of information include: specifications, WHMIS information
flushing medium includes: water, water/glycol mix, methanol, acid flush, compressed gas, steam, oil
procedures used to perform system flushing include: checking vents and drains, attaching hoses, filling system

G-24.02 Chemically treats system.

Essential Skills	Document Use, Thinking Skills, Reading

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
G-24.02.01K	demonstrate knowledge of chemical treatment procedures	identify hazards and describe safe work practices pertaining to chemical treatment
		identify ***sources of information*** pertaining to chemical treatment
		identify tools and equipment relating to chemical treatment and describe their applications and procedures for use
		describe the ***procedures used to perform chemical treatments***

RANGE OF VARIABLES

sources of information include: specifications, chemical engineer, WHMIS information
procedures used to perform chemical treatments include: checking vents and drains, attaching hoses, filling system

G-24.03 Pre-checks system for commissioning.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
G-24.03.01K	demonstrate knowledge of system commissioning procedures	identify hazards and describe ***safe work practices*** pertaining to system commissioning
		identify ***sources of information*** pertaining to system commissioning
		identify tools and equipment relating to system commissioning and describe their applications and procedures for use

	identify methods for charging systems to operating design pressure
	describe the ***procedures*** used to perform ***pre-checks***
	describe the ***procedures used to commission systems***

RANGE OF VARIABLES

safe work practices include: system isolation, lock-out procedures, testing medium

sources of information include: specifications, drawings

pre-check procedures include: system isolation, check of equipment, piping for location and orientation, selection and connection of test equipment, system pressurization, system inspection and correction of leaks, documentation, removal of test equipment

commission procedures include: flushing, chemical treating, start-up and documentation, reinstatement after testing

G-24.04 Selects and connects commissioning equipment.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
G-24.04.01K	demonstrate knowledge of system commissioning procedures	identify hazards and describe ***safe work practices*** pertaining to system commissioning
		identify ***sources of information*** pertaining to system commissioning
		identify tools and equipment relating to system commissioning and describe their applications and procedures for use
		identify methods for charging systems to operating design pressure
		describe the procedures used to select and connect commissioning equipment
		describe the ***procedures used to commission systems***

RANGE OF VARIABLES

safe work practices include: system isolation, lock-out procedures, testing medium

sources of information include: specifications, drawings

commission procedures include: flushing, chemical treating, start-up and documentation, reinstatement after testing

TASK G-25 COMMISSIONS SYSTEMS.

TASK DESCRIPTOR

Commissioning systems involves bringing the piping systems online. This can be done in collaboration with owners' representatives or AHJ.

Steamfitters/pipefitters must commission a system to normal operational conditions to satisfy necessary codes, regulations and quality control standards. This encompasses making repairs and adjustments along the way and documenting all findings.

G-25.01 Secures commissioning area.

Essential Skills	Writing, Oral Communication, Working with Others

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
G-25.01.01K	demonstrate knowledge of system commissioning and its associated procedures	identify hazards and describe ***safe work practices*** pertaining to system commissioning
		identify ***sources of information*** pertaining to system commissioning
		identify tools and equipment relating to system commissioning and describe their applications and procedures for use

RANGE OF VARIABLES

safe work practices include: system re-energizing, procedures for removal of lock-outs, safe handling of system medium

sources of information include: specifications, drawings, operating conditions

G-25.02 Pressurizes system.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
G-25.02.01K	demonstrate knowledge of system commissioning and its associated procedures	identify hazards and describe ***safe work practices*** pertaining to system commissioning
		identify ***sources of information*** pertaining to system commissioning
		identify tools and equipment relating to system commissioning and describe their applications and procedures for use
		identify permits and approvals required to perform pressurization
		describe the ***procedures used to perform pressurization***

RANGE OF VARIABLES

safe work practices include: system re-energizing, procedures for removal of lock-outs, safe handling of system medium

sources of information include: specifications, drawings, operating conditions

procedures used to perform pressurization include: filling, venting, increasing pressure in a controlled manner

G-25.03 Inspects system.

Essential Skills	Document Use, Thinking Skills, Writing

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
G-25.03.01K	demonstrate knowledge of system inspection and its associated procedures	identify hazards and describe ***safe work practices*** pertaining to system inspection
		identify ***sources of information*** pertaining to system inspection
		identify tools and equipment relating to system inspection and describe their applications and procedures for use
		identify piping and equipment in system being inspected

RANGE OF VARIABLES

safe work practices include: use of PPE (respirator, face shield), barricading, H_2S training

sources of information include: specifications, drawings, operating conditions

G-25.04 Corrects faulty conditions.

Essential Skills	Document Use, Thinking Skills, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
G-25.04.01K	demonstrate knowledge of repair and replacement procedures	identify hazards and describe ***safe work practices*** pertaining to repair
		identify ***sources of information*** pertaining to repair
		identify tools and equipment relating to repair and describe their applications and procedures for use
		identify piping and equipment in system being repaired
		describe the procedures used to perform repairs

RANGE OF VARIABLES

safe work practices include: acquiring permits, applying lock-outs, using PPE
sources of information include: specifications, drawings, operating conditions

G-25.05 Participates in start-up and turnover procedures.

Essential Skills	Document Use, Oral Communication, Numeracy

	KNOWLEDGE	
	Learning Outcomes	**Learning Objectives**
G-25.05.01K	demonstrate knowledge of start-up procedures	identify hazards and describe ***safe work practices*** pertaining to start-up
		identify ***sources of information*** pertaining to start-up
		identify tools and equipment relating to start-up and describe their applications and procedures for use
		identify piping and equipment in system being started up
		describe the ***procedures*** used to perform start-up

RANGE OF VARIABLES

safe work practices include: acquiring permits, removing lock-outs, using PPE

sources of information include: manufacturers' recommendations, specifications, drawings, operating conditions

procedures for start-up include: organizing inspection date, notifying client, checking connections, verifying parameters, performing operational tests, making final adjustments

APPENDIX A
ACRONYMS

ABS	acrylonitrile butadiene styrene
ACR	air-conditioning and refrigeration
AHJ	authority having jurisdiction
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
AWS	American Welding Society
BIM	Building Information Management
CAD	computer-aided design
CFC	chlorofluorocarbon
CPVC	chlorinated polyvinyl chloride
CRN	Canadian Registration Number
CSA	Canadian Standards Association
CWB	Canadian Welding Bureau
DISS	diameter index safety system
DWV	drain, waste and vent
DX	direct exchange
FLRA	field level risk assessments
FRP	fibreglass reinforced plastic
GA	general arrangement
GFRP	glass fibreglass reinforced plastic
GMAW	gas metal arc welding
GRE	glass reinforced epoxy
GSHP	ground source heat pump
GTAW	gas tungsten arc welding
HCFC	hydrofluorocarbon
HDPE	high density polyethylene
HRV	heat recovery ventilators
HVACR	heating, ventilation and air conditioning and refrigeration
ICI	industrial, commercial and institutional
JSA	job safety analysis
LEED	Leadership in Energy and Environmental Design
LDPE	low density polyethylene
LWCO	low water cut-offs
MAPP	methylacetylene-propadiene propane
MDPE	medium density polyethylene
MIG	metal inert gas
MSDS	Material Safety Data Sheet
MSS	Manufacturers Standardization Society
NDE	non-destructive examination
OH&S	Occupational Health and Safety

P&ID	process and instrumentation drawings
PE-PP	polyethylene-polypropylene
PEX	cross linked polyethylene
PPE	personal protective equipment
PVC	polyvinyl chloride
QA/QC	quality assurance and quality control
RFI	Request for Information
SMAW	shielded metal arc welding
SPA	safety plan of action
SWL	safe working load
TIG	tungsten inert gas
WHMIS	Workplace Hazardous Materials Information System
WPS	welding procedures specifications

APPENDIX B
TOOLS AND EQUIPMENT

Hand Tools

alignment clamps – external and internal
angle finder
bending tools – hand and hydraulic
bolt cutter
bolt die
bolt tap
C-clamp
calculator
centre punch
chain pipe tongs
coil fin straightener
cold chisels
computer
contour markers
drafting accessories
files
flange alignment pins
flange spreader (jacks)
flaring tool
freeze pack
gasket cutter
hacksaws – hand, portable band, large band
hammers – ball peen, chipping, sledge, soft-face
hand beveller
hi-lo gauge
hole punch
levels – laser, standard, builders, digital (smart)
marking tool
pin punch
pinch bars
pipe cutters– single-wheel, multi-wheel pipe/tube cutters
pipe reamer – spiral, fluted
pipe tap
pipe threader
pipe vises – chain and yokes, tri-stand and bench, power vise (power drive)
PEX tools
pliers
prying tool
ratchet
screwdrivers
shear
shrink-fit device
spacing tool
strapping device
swaging tool
tip cleaner
tube cleaner
tube bender
wheel and bearing pullers
wrap-around
wrenches – adjustable, chain, combination (open-/closed-end), hammer, hex-key, non-spark, pin, pipe, socket, torque

Power Tools

air compressor
bevelling tools – electric drive, pneumatic, oxy-fuel
bending machine
bolt tensioner
drills – electric, pneumatic, hammer, bench or stand press, mag
facing tool
grinders (electric or pneumatic) angle, bench, die, pedestal
grooving machine
hydraulic flange spreaders
hydraulic jacks
hydraulic torque wrench
hydrostatic pump
impact driver
portable end-prep milling – pneumatic, electric
powder-actuated tools
saws – circular, cut-off, jig, sabre
threading machine

Measuring and Testing Tools and Devices

ampere probe
calculator
callipers
centre finder
chart recorders
compass
dead weights
feeler gauge
gauges – temperature, pressure, liquid, vacuum, specialty
holiday detector (GEEP™ tester)
geometry set
hydrostatic test pump
infrared temperature sensor
levels – laser, standard, builders (transit), digital (smart)
measuring tape
manometer
micrometer
multimeter
plumb bob
rulers
scales
squares – standard 24-in., combination, flange straightedge, rigging
string line
thermometer

Rigging and Hoisting Equipment

beam clamps
cable clips
cable puller
chain block
chain fall
chain puller
come-along
cranes
D ring
equalizer beam
eye bolts
forklift
grip hoist (Tirfor®)
hooks
jacks (hydraulic, ram and piston)
plate clamp
rope
shackle
slings (nylon, wire rope, wire mesh)
snatch block
softeners
spreader bar
tag line
tugger

Welding, Soldering and Brazing Equipment

arc welders (electric, fuel)
compressed gas cylinders (purge, shield, cutting)
fusion welding equipment
flashback arrestor
hot air welding machine
orbital welder
plasma cutters
propane tiger torches (preheating)
regulator
torches (oxy-fuel cutting, heating and welding)
welding machines (SMAW, GMAW, TIG)

Ladders, Stands and Platforms

combination ladder
extension ladder
manlifts – electrical, hydraulic, pneumatic, winch (hand and power), one-man, platform, scissor lift, articulating boom
material lifts
scaffolding (staging)
pipe racks
pipe stands – roller and V type
platform ladder
step ladder

Personal Protective Equipment (PPE) and Safety Equipment

air quality monitors
anti-vibration gloves
breathing apparatus
chemical protective clothing
coveralls (standard and fire retardant)
dust mask
ear protection
face shield
fall arrest harness
fire extinguisher
first aid kit
fume extractor
hard hat
leather apron
leather gloves and sleeves
respirator
rubber gloves
safety boots
safety glasses
safety vest/gauntlets
welding goggles (shade 5) and flash goggles(shade 2)
welding helmet

APPENDIX C
GLOSSARY

backflow preventer	a device or a method that prevents a reverse flow from the normal direction of flow in a piping system
balancing valve	valve used to add artificial resistance where required to achieve design flow rate
blowdown	a connection at the bottom or lowest portion of a gauge glass, low water cutoff, automatic water feeder, cast iron water column, etc., to facilitate cleaning out or testing of the equipment
boiler	equipment used to heat water or generate steam
boiler trim	the controls, equipment and accessories connected to a boiler for its safe and efficient operation
butt fusion	a joining method that requires ends of pipe to be joined by direct heat application on material such as steel or plastic
CAD	computer aided design; used for drawing, altering and recalling views and details on a computer
chilled water cooling system	piping systems for cooling buildings, equipment or processes by circulating chilled water
circuit	the piping path from a heat exchanger to a heat transfer unit and back to the heat exchanger
condensate return system	a piping arrangement designated to return condensate to a steam generator
contour marker	instrument used in the fabrication of pipe that will trace lines for the cutting of tees, wyes and laterals
control valve	a valve which controls the flow of a liquid or gas automatically as directed by an electrical or pneumatic signal or a capillary tube
controller	device with a sensing element which takes measurements and adjusts the setting of a preselected component accordingly
converter	a piece of equipment used to heat or cool water and other liquids by means of steam, high temperature hot water, or chilled water without the two mediums coming in contact with each other (e.g. heat exchanger; indirect heater)
de-aerator	a device used to remove temporary hardness and unwanted gases (such as oxygen and carbon dioxide) from the make-up water
desuperheater	a device which uses water as a cooling medium to lower the temperature of the superheated steam
direct return	a two-pipe heating system (hydronic system) in which the first unit supplied has the shortest return to the boiler
double-block-and-bleed	a valving system wherein a full flow vent valve is located on piping between two shut-off valves in series for the purpose of bleeding to the atmosphere excess pressure between valves

dry return	a condensate return line which is located above the water line of the boiler and carries condensate and air
equalizer beam	usually used on dual hoist lines to make tandem lifts, but can also be used to equalize the load on sling legs. They are connected with a crane hook connected directly to the beam.
expansion joint	a manufactured, mechanical device to take up or to compensate for the expansion and contraction of a pipe line due to temperature change
feed water	water that is fed into a boiler or systems
flashback	flashback always occurs in the line carrying the lower pressure and will always occur beyond the mixer, and may include the hose and regulator as well. It is usually a devastating explosion or series of explosions, leaving the equipment in shambles
heat exchanger	a device for transferring heat from one fluid to another without mixing the two fluids
heat transfer unit	a device used to transfer heat from a fluid to a space for conduction, convection or radiation
high temperature hot-water system	a system which has hot water above 350°F (180°C)
HVAC system	heating, ventilation and air-conditioning system
indicator	an instrument that shows a measurement, but makes no permanent record, e.g. pressure gauge
isolator	a device used to isolate equipment from its piping for testing or flushing purposes; isolators are also used to give separation from its support to prevent the transmission of noise and/or vibration
low water cut off (LWCO)	a device which shuts off the automatic fuel control valve when the water falls below a safe level in the boiler
make-up water	water supplied to a system that replaces system fluid that has been lost through evaporation, leakage, etc.
pin indexing	refers to a fail-safe design by which end connections for specific gases can only be connected to other ends intended for use with the same gas; for example, equipment intended to utilize oxygen cannot physically be connected to a nitrous oxide gas supply
post heating	use of a heat source to heat an area after a process such as welding takes place
preheating	use of a heat source to heat an area before a process such as welding takes place
resin	a bonding agent used in the fibreglass process; used because of its resistance to acids and alkalines
safety relief valve	a safety device that will open before a dangerous pressure or temperature is reached
saturated steam	steam which is at the same temperature as the boiling water from which it was formed (dry saturated; wet saturated)
single-seated control valve	a control valve with a single seat and a single plug or disc
solvent fusion	joining plastic pipe by the use of a solvent which dissolves the surface of the pipe and forms a continuous bond upon evaporation
spool sheets	detail views of a piping system identifying specific piping and pieces to be fabricated

spreader bar/beam	used to support long, hard-to-handle loads. These bars eliminate load tipping, sliding or bending. They connect by using slings from the beam to the crane hook.
spreaders	a set of chokers or slings of equal length used to lift a load
steam separator	a device used to remove entrained moisture present in steam
steam tracing	a pipe or tube which is placed along or around pipe, vessels and pumps and is filled with steam to control the primary pipe's medium's temperature
steam trap	an automatic device which allows the passage of air and condensate but prevents the passage of steam
straightening vanes	device used to take the turbulence out of liquids and gases flowing in pipes so measuring instruments can get an accurate reading
superheated steam	saturated steam with the addition of sensible heat; an increase in temperature of saturated steam without an increase in pressure
superheater	a device used to heat dry or wet-saturated steam and increase the temperature without increasing the pressure of the steam
vacuum pump	a device used to lower atmospheric pressure inside a vessel or piping system
wrap-around	a coil of gasket material used to wrap around pipe, when in the process of marking a pipe