

# Atlantic Workforce Partnership

Curriculum Standard

## Steamfitter-Pipefitter

Version: 2017

Revised: N/A

Atlantic Apprenticeship



# PLAN OF TRAINING

## Atlantic Apprenticeship Curriculum Standard

### Steamfitter Pipefitter

March 2017



**Government of Newfoundland and Labrador  
Department of Advanced Education, Skills and Labour  
Apprenticeship and Trades Certification Division**

Approved by:

A handwritten signature in blue ink, appearing to read "Dave Hill", written over a horizontal line.

Chairperson, Provincial Apprenticeship and Certification Board

Date: March 30, 2017

# Atlantic Apprenticeship Curriculum Standard Steamfitter-Pipefitter

## Preface

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This Atlantic Apprenticeship Curriculum Standard is intended to assist instructional staff in the design and delivery of technical, in-class training in support of the Steamfitter-Pipefitter program.

This document contains all the technical training elements required to complete the Steamfitter-Pipefitter apprenticeship program and has been developed based on the 2015 Red Seal Occupational Standard (RSOS) and the 2010 Interprovincial Program Guide (IPG). The RSOS and IPG can be found on the Red Seal website ([www.red-seal.ca](http://www.red-seal.ca)).

Implementation of this AACS for Apprenticeship training is outlined in the following table.

Level	Implementation Effective
Level 1	2017-2018
Level 2	2018-2019
Level 3	2019-2020
Level 4	2020-2021

*\*\* The above implementation schedule was current at time of printing. Please **confirm** with Apprenticeship Staff prior to commencing training.*

Granting of credit or permission to challenge level examinations for pre-employment or pre-apprenticeship training for the Steamfitter-Pipefitter trade will be based on the content outlined in this standard. Training providers must contact their provincial apprenticeship authority for more information on the process and requirements for determining eligibility for credit towards an apprenticeship program. Programs which have been deemed acceptable by the jurisdictional apprenticeship authority will be identified in transfer credit matrix developed through the Atlantic Apprenticeship Harmonization Project.

## Acknowledgements

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The development of the Atlantic Apprenticeship Curriculum Standard (AACCS) is an initiative of the Atlantic Apprenticeship Council's Atlantic Apprenticeship Harmonization Project (AAHP) through the Atlantic Workforce Partnership and Employment and Social Development Canada.

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Advisory committees, industry representatives, instructors and apprenticeship staff provided valuable input to the development of this document. Without their dedication to quality apprenticeship training, this document could not have been produced.

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## User Guide

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Atlantic Apprenticeship Curriculum Standards (AACS) are developed based on the Red Seal Occupational Standard (RSOS) and the Interprovincial Program Guides (IPG), and extensive industry consultation. This document represents the minimum content to be delivered as part of the harmonized Atlantic program for the Steamfitter-Pipefitter trade.

The AACS's are deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. They detail units of training, unit outcomes and objectives. They do not impose a delivery model or teaching format.

Jurisdictions and/or training providers will select and develop delivery materials and techniques that accommodate a variety of learning styles and delivery patterns. The AACS does not dictate study materials, textbooks or learning activities to be used in delivery.

The document includes a Level Structure to facilitate mobility for apprentices moving from one jurisdiction to another.

### Structure

The content of the AACS is divided into units. Unit codes are used as a means of identification and are not intended to convey the order of delivery. It is at the discretion of the training provider to deliver the content in the required logical sequence of delivery within the level. Jurisdictions are free to deliver units one at a time or concurrently within a level, provided all outcomes are met.

The Learning Outcomes describe what the apprentice should know or be able to do at the end of training. Wording of the Learning Outcomes, "Demonstrate knowledge of..." acknowledges the broad spectrum of ways in which knowledge can be assessed (i.e. practical projects, multiple choice testing, presentations, etc.) by instructional staff within the training.

Summative evaluation will be through a multiple-choice Level Examination administered through the jurisdictional Apprenticeship Authority.

## **User Guide** *(continued)*

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The 2015 Red Seal Occupational Standard (RSOS) to AACS Comparison chart outlines the relation between each RSOS sub-task and the AACS units. RSOS References have also been detailed in each unit to highlight the direct link between the unit and relevant sub-tasks in the RSOS.

In the Level Structure section, the document identifies suggested hours in order to provide an indication of the time it should take to cover the material in the unit and is intended as a guide only. Adjustments to the suggested hours for each unit may be required to account for rate of apprentice learning, statutory holidays, storm days, registration and examinations. These suggested hours detailed for each unit will represent both theory and practical training (if relevant) and for consistency will be based on a standard of 30 hours per week of training. The actual length of time required to deliver an outcome successfully will depend upon the learning activities and teaching methods used.

There are two types of objectives found in the AACS document: theoretical and practical.

The theoretical objectives represent the material that is to be covered during the technical training in order to convey the required knowledge to the apprentice.

The practical objectives represent the tasks or skills that have been deemed by the Atlantic Trade Advisory Committee as critical for the apprentices to receive exposure to while attending technical training. For example, exposure could be done through instructor demonstration or individual or group performance of the skill or task. Training providers are encouraged to use practical demonstration and opportunities for hands-on learning whenever possible. Practical objectives are not intended to replace the on-the-job training component of the apprentice's program or to mirror or replace the logbook skills that are to be taught and evaluated in the workplace.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided.



## **Glossary of Terms**

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These definitions are intended as a guide to how language is used in the document.

<b>ADJUST</b>	To put in good working order; regulate; bring to a proper state or position.
<b>APPLICATION</b>	The use to which something is put and/or the circumstance in which an individual would use it.
<b>CHARACTERISTIC</b>	A feature that helps to identify, tell apart or describe recognizably; a distinguishing mark or trait.
<b>COMPONENT</b>	A part that can be separated from or attached to a system; a segment or unit.
<b>DEFINE</b>	To state the meaning of (a word, phrase, etc.).
<b>DESCRIBE</b>	To give a verbal account of; tell about in detail.
<b>EXPLAIN</b>	To make plain or clear; illustrate; rationalize.
<b>IDENTIFY</b>	To point out or name objectives or types.
<b>INTERPRET</b>	To translate information from observation, charts, tables, graphs and written material.
<b>MAINTAIN</b>	To keep in a condition of good repair or efficiency.
<b>METHOD</b>	A means or manner of doing something that has procedures attached to it.
<b>OPERATE</b>	How an object works; to control or direct the functioning of.
<b>PROCEDURE</b>	A prescribed series of steps taken to accomplish an end.
<b>PURPOSE</b>	The reason for which something exists or is done, made or used.

## Glossary of Terms *(continued)*

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<b>TECHNIQUE</b>	Within a procedure, the manner in which technical skills are applied.
<b>TEST</b>	<p>v. To subject to a procedure that ascertains effectiveness, value, proper function or other quality.</p> <p>n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.</p>

## Essential Skills Profiles

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Through extensive research, the Government of Canada and other national and international agencies have identified and validated key essential skills for the workplace. These skills are used in nearly every job and at different levels of complexity. They provide the foundation for learning all other skills and enable people to evolve with their jobs and adapt to workplace change.

Essential Skills Profiles describe how workers in various occupations use each of the key essential skills. They include:

- a brief description of the occupation;
- examples of tasks that illustrate how each essential skill is applied; and,
- complexity ratings that indicate the level of difficulty of the example tasks.

Essential Skills profiles can be found on the Employment and Social Development Canada (ESDC) website at [www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml](http://www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml)

The development and improvement of these Essential Skills is inherent throughout the apprenticeship training program as apprentices work towards achieving journey person status.

## Profile Chart

<b>OCCUPATIONAL SKILLS</b>			
STM-100 Safety	STM-105 Communication and Trade Documentation	STM-110 Tools and Equipment	STM-115 Access Equipment
STM-450 Job Planning	STM-125 Fuel Brazing and Soldering	STM-235 Electrical Principles	STM-135 Bracket, Support, Hanger, Guides and Anchor Fabrication
STM-455 Quality Control	STM-120 Introduction to Welding		
<b>DRAWINGS AND SPECIFICATIONS</b>			
STM-140 Drawings and Specifications I	STM-200 Drawings and Specifications II	STM-205 Template Development	
<b>PIPING LAYOUT AND COMMON INSTALLATION</b>			
STM-145 Copper Tube and Tubing	STM-155 Plastic Piping	STM-160 Carbon Steel Piping	STM-165 Stainless Steel Piping
STM-215 Fiberglass Piping	STM-220 Specialty Piping	STM-170 Piping Valves	STM-330 Cross Connection Control
STM-210 Piping System Component Fabrication (Spool)	STM-150 Pipe and Tube Bending		
<b>RIGGING AND HOISTING</b>			
STM-130 Rigging, Hoisting and Lifting	STM-400 Complex Hoisting, Lifting and Rigging		
<b>DRAINAGE, WASTE AND VENT SYSTEMS</b>			
STM-300 Industrial Water and Waste Systems			

## Profile Chart (*continued*)

<b>STEAM SYSTEM INSTALLATION</b>			
STM-315 Low Pressure Steam Systems	STM-415 High Pressure Steam Systems		
<b>HEATING, COOLING AND PROCESS SYSTEM INSTALLATION</b>			
STM-225 Hydronic Systems	STM-310 Hydronic System Controls	STM-320 Fuel Systems	STM-325 Medical Gas Systems
STM-420 Refrigeration Systems	STM-440 Process Piping Systems	STM-405 Hydraulic Systems	STM-230 Heat Tracing Systems (liquid)
STM-305 Heat Tracing Systems (Steam)			
<b>TESTING AND COMMISSIONING</b>			
STM-445 System Testing and Commissioning			
<b>SPECIALIZED SYSTEMS</b>			
STM-425 Heat Recovery Systems	STM-435 Solar Heating Systems	STM-430 Geo-Exchange and Geothermal Systems	STM-410 Compressed Air and Pneumatic Systems

## Level Structure

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### Level 1 - 8 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
STM-100	Safety	12	22
STM-105	Communication and Trade Documentation	6	25
STM-110	Tools and Equipment	24	27
STM-115	Access Equipment	6	28
STM-120	Introduction to Welding	18	30
STM-125	Fuel Brazing and Soldering	18	32
STM-130	Rigging, Hoisting and Lifting	30	34
STM-135	Bracket, Support, Hanger, Guides and Anchor Fabrication	12	37
STM-140	Drawings and Specifications I	30	38
STM-145	Copper Tube and Tubing	12	40
STM-150	Pipe and Tube Bending	12	43
STM-155	Plastic Piping	12	45
STM-160	Carbon Steel Piping	24	48
STM-165	Stainless Steel Piping	6	51
STM-170	Piping Valves	18	54

### Level 2 - 6 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
STM-200	Drawings and Specifications II	30	58
STM-205	Template Development	30	60
STM-210	Piping System Component Fabrication (Spool)	30	61
STM-215	Fiberglass Piping	6	64
STM-220	Specialty Piping	12	67
STM-225	Hydronic Systems	60	70
STM-230	Heat Tracing Systems (Liquid)	6	76
STM-235	Electrical Principles	6	79

## Level Structure (*continued*)

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### Level 3 - 8 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
STM-300	Industrial Water and Waste Systems	24	82
STM-305	Heat Tracing Systems (Steam)	12	86
STM-310	Hydronic System Controls	12	89
STM-315	Low Pressure Steam Systems	72	91
STM-320	Fuel Systems	60	97
STM-325	Medical Gas Systems	12	102
STM-330	Cross Connection Control	6	106
STM-335	Instrumentation	12	107
STM-340	Controlled Bolting and Tensioning	30	109

### Level 4 - 8 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
STM-400	Complex Hoisting, Lifting and Rigging	24	112
STM-405	Hydraulic Systems	12	114
STM-410	Compressed Air and Pneumatic Systems	12	118
STM-415	High Pressure Steam Systems	60	123
STM-420	Refrigeration Systems	18	128
STM-425	Heat Recovery Systems	15	132
STM-430	Geo-Exchange and Geothermal Systems	12	137
STM-435	Solar Heating Systems	15	142
STM-440	Process Piping Systems	18	147
STM-445	System Testing and Commissioning	12	151
STM-450	Job Planning	6	155
STM-455	Quality Control	6	157
STM-460	Program Review	30	159

## 2015 RSOS Sub-task to AACS Unit Comparison

RSOS Sub-task		AACS Unit	
<b>Task 1 - Performs Safety-Related Functions.</b>			
1.01	Maintains safe work environment.	STM-100	Safety
1.02	Selects, inspects and uses personal protective equipment (PPE) and safety equipment.	STM-100	Safety
1.03	Follows lock-out procedures.	STM-100	Safety
<b>Task 2 - Uses And Maintains Tools And Equipment.</b>			
2.01	Uses common tools and equipment.	STM-110	Tools and Equipment
2.02	Uses access equipment.	STM-115	Access Equipment
2.03	Uses welding equipment.	STM-120	Introduction to Welding
		STM-210	Piping System Component Fabrication (Spool)
2.04	Uses soldering and brazing equipment.	STM-125	Fuel Brazing and Soldering
2.05	Uses oxy-fuel equipment.	STM-125	Fuel Brazing and Soldering
		STM-210	Piping System Component Fabrication (Spool)
<b>Task 3 - Organizes Job.</b>			
3.01	Plans work.	STM-105	Communication and Trade Documentation
		STM-450	Job Planning
3.02	Generates drawings.	STM-140	Drawings and Specifications I
		STM-200	Drawings and Specifications II
3.03	Interprets drawings and specifications.	STM-200	Drawings and Specifications II
3.04	Develops piping templates.	STM-205	Template Development
3.05	Performs quality control functions.	STM-455	Quality Control
<b>Task 4 - Performs Fabrications.</b>			
4.01	Fabricates piping system components.	STM-145	Copper Tube and Tubing
		STM-155	Plastic Piping
		STM-160	Carbon Steel Piping
		STM-165	Stainless Steel Piping
		STM-210	Piping System Component Fabrication (Spool)
4.02	Fabricates brackets, supports, hangers, guides and anchors.	STM-135	Bracket, Support, Hanger, Guides and Anchor Fabrication
		STM-145	Copper Tube and Tubing
		STM-155	Plastic Piping
		STM-160	Carbon Steel Piping
		STM-165	Stainless Steel Piping



RSOS Sub-task		AACS Unit	
<b>Task 5 - Lays Out, Identifies And Installs Piping, Tubing, Fittings And Related Components.</b>			
5.01	Lays out, identifies and installs copper tube, fittings and related components.	STM-145	Copper Tube and Tubing
5.02	Lays out, identifies and installs plastic piping, tubing, fittings and related components.	STM-155	Plastic Piping
5.03	Lays out, identifies and installs carbon steel piping, tubing, fittings and related components.	STM-160	Carbon Steel Piping
5.04	Lays out, identifies and installs stainless steel piping, tubing, fittings and related components.	STM-165	Stainless Steel Piping
5.05	Lays out, identifies and installs fiberglass piping, fittings and related components.	STM-215	Fiberglass Piping
5.06	Lays out, identifies and installs specialty piping, fittings and related components.	STM-220	Specialty Piping
<b>Task 6 - Installs, Maintains, Troubleshoots, Repairs And Tests Valves.</b>			
6.01	Installs valves.	STM-170	Piping Valves
6.02	Maintains, troubleshoots, repairs and tests valves.	STM-170	Piping Valves
<b>Task 7 - Installs, Tests, Maintains, Troubleshoots And Repairs Heat Tracing Systems.</b>			
7.01	Installs steam tracing systems.	STM-305	Heat Tracing Systems (Steam)
7.02	Maintains, troubleshoots, repairs and tests steam tracing systems.	STM-305	Heat Tracing Systems (Steam)
7.03	Installs liquid-filled tracing systems.	STM-230	Heat Tracing Systems (Liquid)
7.04	Maintains, troubleshoots, repairs and tests liquid-filled tracing systems.	STM-230	Heat Tracing Systems (Liquid)
<b>Task 8 - Performs Common Rigging, Hoisting, Lifting And Positioning.</b>			
8.01	Determines load.	STM-130	Rigging, Hoisting and Lifting
8.02	Prepares lift plan(s).	STM-130	Rigging, Hoisting and Lifting
8.03	Selects rigging, hoisting, lifting and positioning equipment.	STM-130	Rigging, Hoisting and Lifting
8.04	Inspects rigging, hoisting, lifting and positioning equipment.	STM-130	Rigging, Hoisting and Lifting
8.05	Secures lift area.	STM-130	Rigging, Hoisting and Lifting
8.06	Sets up rigging, hoisting, lifting and positioning equipment.	STM-130	Rigging, Hoisting and Lifting
		STM-210	Piping System Component Fabrication (Spool)
		STM-215	Fiberglass Piping
		STM-220	Specialty Piping
8.07	Performs lift and positioning.	STM-130	Rigging, Hoisting and Lifting

RSOS Sub-task		AACS Unit	
8.08	Maintains and stores rigging, hoisting, lifting and positioning equipment.	STM-130	Rigging, Hoisting and Lifting
<b>Task 9 - Performs Complex And Critical Rigging, Hoisting, Lifting And Positioning.</b>			
9.01	Prepares lift plan for complex and critical rigging, hoisting, lifting and positioning.	STM-400	Complex Hoisting, Lifting and Rigging
9.02	Performs calculations for complex and critical rigging, hoisting, lifting and positioning.	STM-400	Complex Hoisting, Lifting and Rigging
9.03	Selects rigging, hoisting, lifting and positioning equipment for complex and critical lifts.	STM-400	Complex Hoisting, Lifting and Rigging
9.04	Sets up rigging, hoisting, lifting and positioning equipment for complex and critical lifts.	STM-400	Complex Hoisting, Lifting and Rigging
9.05	Performs complex and critical lifts and positioning.	STM-400	Complex Hoisting, Lifting and Rigging
<b>Task 10 - Installs, Tests, Maintains, Troubleshoots And Repairs Low Pressure Steam And Condensate Systems.</b>			
10.01	Installs equipment for low pressure steam and condensate systems.	STM-315	Low Pressure Steam Systems
10.02	Installs piping for low pressure steam and condensate systems.	STM-315	Low Pressure Steam Systems
10.03	Tests low pressure steam and condensate systems.	STM-315	Low Pressure Steam Systems
10.04	Maintains, troubleshoots and repairs low pressure steam and condensate systems.	STM-315	Low Pressure Steam Systems
<b>Task 11 - Installs, Tests, Maintains, Troubleshoots And Repairs High Pressure Steam And Condensate Systems.</b>			
11.01	Installs equipment for high pressure steam and condensate systems.	STM-415	High Pressure Steam Systems
11.02	Installs piping for high pressure steam and condensate systems.	STM-415	High Pressure Steam Systems
11.03	Tests high pressure steam and condensate systems.	STM-415	High Pressure Steam Systems
11.04	Maintains, troubleshoots and repairs high pressure steam and condensate systems.	STM-415	High Pressure Steam Systems
<b>Task 12 - Installs, Tests, Maintains, Troubleshoots And Repairs Hydronic Systems.</b>			
12.01	Installs equipment for hydronic systems.	STM-225	Hydronic Systems
		STM-310	Hydronic System Controls
12.02	Installs piping for hydronic systems.	STM-225	Hydronic Systems

RSOS Sub-task		AACS Unit	
		STM-310	Hydronic System Controls
12.03	Tests hydronic systems.	STM-225	Hydronic Systems
		STM-310	Hydronic System Controls
12.04	Maintains, troubleshoots and repairs hydronic systems.	STM-225	Hydronic Systems
		STM-310	Hydronic System Controls
<b>Task 13 - Installs, Tests, Maintains, Troubleshoots And Repairs Process Piping Systems.</b>			
13.01	Installs equipment for process piping systems.	STM-440	Process Piping Systems
13.02	Installs piping for process piping systems.	STM-440	Process Piping Systems
13.03	Tests process piping systems.	STM-440	Process Piping Systems
13.04	Maintains, troubleshoots and repairs process piping systems.	STM-440	Process Piping Systems
<b>Task 14 - Installs, Tests, Maintains, Troubleshoots And Repairs Industrial Water And Waste Treatment Systems.</b>			
14.01	Installs equipment for industrial water and waste treatment systems.	STM-300	Industrial Water and Waste Systems
14.02	Installs piping for industrial water and waste treatment systems.	STM-300	Industrial Water and Waste Systems
14.03	Tests industrial water and waste treatment systems.	STM-300	Industrial Water and Waste Systems
14.04	Maintains, troubleshoots and repairs industrial water and waste treatment systems.	STM-300	Industrial Water and Waste Systems
<b>Task 15 - Installs, Tests, Maintains Troubleshoots And Repairs Hydraulic Systems.</b>			
15.01	Installs equipment for hydraulic systems.	STM-405	Hydraulic Systems
15.02	Installs piping, tubing and hoses for hydraulic systems.	STM-405	Hydraulic Systems
15.03	Tests hydraulic systems.	STM-405	Hydraulic Systems
15.04	Maintains, troubleshoots and repairs hydraulic systems.	STM-405	Hydraulic Systems
<b>Task 16 - Installs, Tests, Maintains, Troubleshoots And Repairs Heating, Ventilation, Air Conditioning And Refrigeration (HVACR) Systems.</b>			
16.01	Installs equipment for HVACR systems.	STM-420	Refrigeration Systems
16.02	Installs hydronic piping and refrigeration tubing for HVACR systems.	STM-420	Refrigeration Systems
16.03	Tests associated components of HVACR systems.	STM-420	Refrigeration Systems

RSOS Sub-task		AACCS Unit	
16.04	Maintains, troubleshoots and repairs associated components of HVACR systems.	STM-420	Refrigeration Systems
<b>Task 17 - Installs, Tests, Maintains, Troubleshoots And Repairs Fuel Systems.</b>			
17.01	Installs equipment for fuel systems.	STM-320	Fuel Systems
17.02	Installs piping and tubing for fuel systems.	STM-320	Fuel Systems
17.03	Tests fuel systems.	STM-320	Fuel Systems
17.04	Maintains, troubleshoots and repairs fuel systems.	STM-320	Fuel Systems
<b>Task 18 - Installs, Tests, Maintains, Troubleshoots And Repairs Medical Gas Systems.</b>			
18.01	Installs equipment for medical gas systems.	STM-325	Medical Gas Systems
18.02	Installs piping and tubing for medical gas systems.	STM-325	Medical Gas Systems
18.03	Tests medical gas systems.	STM-325	Medical Gas Systems
18.04	Maintains, troubleshoots and repairs medical gas systems	STM-325	Medical Gas Systems
<b>Task 19 - Installs, Tests, Maintains, Troubleshoots And Repairs Compressed Air And Pneumatic Systems.</b>			
19.01	Installs equipment for compressed air and pneumatic systems.	STM-410	Compressed Air and Pneumatic Systems
19.02	Installs piping and tubing for compressed air and pneumatic systems.	STM-410	Compressed Air and Pneumatic Systems
19.03	Tests compressed air and pneumatic systems.	STM-410	Compressed Air and Pneumatic Systems
19.04	Maintains, troubleshoots and repairs compressed air and pneumatic systems.	STM-410	Compressed Air and Pneumatic Systems
<b>Task 20 - Installs, And Tests Fire Protection Systems. (Not Common Core)</b>			
20.01	Installs equipment for fire protection systems. (NOT COMMON CORE)		
20.02	Installs piping for fire protection systems. (NOT COMMON CORE)		
20.03	Tests fire protection systems. (NOT COMMON CORE)		
<b>Task 21 - Installs, Tests, Maintains, Troubleshoots And Repairs Geo-Exchange And Geothermal Systems.</b>			
21.01	Installs equipment for geo-exchange and geothermal systems.	STM-430	Geo-Exchange and Geothermal Systems
21.02	Installs piping for geo-exchange and geothermal systems.	STM-430	Geo-Exchange and Geothermal Systems
21.03	Tests geo-exchange and geothermal systems.	STM-430	Geo-Exchange and Geothermal Systems

RSOS Sub-task		AACS Unit	
21.04	Maintains, troubleshoots and repairs geo-exchange and geothermal systems.	STM-430	Geo-Exchange and Geothermal Systems
<b>Task 22 - Installs, Tests, Maintains, Troubleshoots And Repairs Solar Heating Systems.</b>			
22.01	Installs equipment for solar heating systems.	STM-435	Solar Heating Systems
22.02	Installs piping for solar heating systems.	STM-435	Solar Heating Systems
22.03	Tests solar heating systems.	STM-435	Solar Heating Systems
22.04	Maintains, troubleshoots and repairs solar heating systems	STM-435	Solar Heating Systems
<b>Task 23 - Installs, Tests, Maintains, Troubleshoots And Repairs Heat Recovery Systems.</b>			
23.01	Installs equipment for heat recovery systems.	STM-425	Heat Recovery Systems
23.02	Installs piping for heat recovery systems.	STM-425	Heat Recovery Systems
23.03	Tests heat recovery systems.	STM-425	Heat Recovery Systems
23.04	Maintains, troubleshoots and repairs heat recovery systems.	STM-425	Heat Recovery Systems
<b>Task 24 - Prepares System For Commissioning, Start-Up And Turnover.</b>			
24.01	Flushes system.	STM-445	System Testing and Commissioning
24.02	Chemically treats system.	STM-445	System Testing and Commissioning
24.03	Pre-checks system for commissioning.	STM-445	System Testing and Commissioning
24.04	Selects and connects commissioning equipment.	STM-445	System Testing and Commissioning
<b>Task 25 - Commissions Systems.</b>			
25.01	Secures commissioning area.	STM-300	Industrial Water and Waste Systems
		STM-310	Hydronic System Controls
		STM-320	Fuel Systems
		STM-325	Medical Gas Systems
		STM-405	Hydraulic Systems
		STM-410	Compressed Air and Pneumatic Systems
		STM-415	High Pressure Steam Systems
		STM-420	Refrigeration Systems
		STM-425	Heat Recovery Systems
		STM-430	Geo-Exchange and Geothermal Systems
		STM-435	Solar Heating Systems
25.02	Pressurizes system.	STM-445	System Testing and Commissioning
25.03	Inspects system.	STM-445	System Testing and Commissioning
25.04	Corrects faulty conditions.	STM-445	System Testing and Commissioning

<b>RSOS Sub-task</b>		<b>AACS Unit</b>	
25.05	Participates in start-up and turnover procedures.	STM-445	System Testing and Commissioning



# Level 1

Unit Code	Title	Hours	Page
STM-100	Safety	12	22
STM-105	Communication and Trade Documentation	6	25
STM-110	Tools and Equipment	24	27
STM-115	Access Equipment	6	28
STM-120	Introduction to Welding	18	30
STM-125	Fuel Brazing and Soldering	18	32
STM-130	Rigging, Hoisting and Lifting	30	34
STM-135	Bracket, Support, Hanger, Guides and Anchor Fabrication	12	37
STM-140	Drawings and Specifications I	30	38
STM-145	Copper Tube and Tubing	12	40
STM-150	Pipe and Tube Bending	12	43
STM-155	Plastic Piping	12	45
STM-160	Carbon Steel Piping	24	48
STM-165	Stainless Steel Piping	6	51
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## STM-100            Safety

### Learning Outcomes:

- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to workplace safety.
- Demonstrate knowledge of PPE and safety equipment, its applications, maintenance and procedures for use.
- Demonstrate knowledge of applications and procedures for locking out equipment.

### 2015 Red Seal Occupational Standard Reference:

- 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.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify hazards and describe safe work practices.
  - i) poor housekeeping
  - ii) overhead hazards
  - iii) confined space hazards
  - iv) hot work hazards
  - v) asbestos
  - vi) noise hazards
  - vii) environmental hazards
  - viii) vibration hazards
  - ix) air quality
2. Identify and describe local and jurisdictional laws and requirements.

3. Identify safety regulations pertaining to locking out electrical equipment, piping equipment and piping.
4. Identify training required by jurisdictional codes and regulations, and site-specific regulations.
5. Identify situations that require lock-out.
6. Identify regulations and safety documentation pertaining to the use of PPE and safety equipment.
7. Identify and describe company or jurisdictional procedures for emergency response.
8. Identify types of PPE and safety equipment and describe their applications, limitations and procedures for use.
  - i) PPE
    - fall arrest systems
    - respirators and face shields
    - steel toed boots
    - hardhats
    - safety glasses
    - hearing protection
    - gloves, face shields
    - protective wristlets
    - fire-retardant clothing
  - ii) equipment
    - fire extinguishers
    - hand rails
    - first aid kits
    - smoke and fume extractors
9. Describe procedures used to care for, maintain and store PPE and safety equipment.
10. Describe procedures for locking out equipment and piping.
  - i) lockout equipment
    - lock and key
    - chains and tags
    - lock-out scissor clamp

- lock-box

Practical Objectives

N/A

**Learning Outcomes:**

- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of trade related documentation and its use.

**2015 Red Seal Occupational Standard Reference:**

3.01 Plans Work.

**Suggested Hours:**

6 Hours

**Objectives and Content:**

Theoretical Objectives

1. Describe the importance of effective verbal and non-verbal communication with.
  - i) other tradespersons
  - ii) colleagues
  - iii) supervisors
  - iv) suppliers/manufacturers
  - v) clients/customers
  - vi) inspectors
2. Identify types of communication equipment and describe their applications and procedures for use.
3. Identify types of trade related documentation and describe their applications and procedures for use.
  - i) manufacturers' specifications
  - ii) codes and standards
  - iii) work orders
  - iv) maintenance schedules
  - v) permits
  - vi) quality control

4. Explain the process, requirements and information sources for completing trade related documentation and reports.
  - i) documentation
  - ii) drawings
  - iii) related professionals
  - iv) clients

Practical Objectives

N/A

## STM-110            Tools and Equipment

### Learning Outcomes:

- Demonstrate knowledge of tools and equipment, their applications, maintenance and procedures for use.

### 2015 Red Seal Occupational Standard Reference:

2.01    Uses common tools and equipment.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify types of hand tools and describe their applications and procedures for use.
2. Identify types of power tools and describe their applications and procedures for use.
  - i) electrical
  - ii) pneumatic
  - iii) hydraulic
3. Identify types of measuring tools and equipment and describe their applications and procedures for use.
4. Identify types of powder-actuated tools and describe their applications.
5. Describe the procedures used to inspect, maintain and store tools and equipment.

#### Practical Objectives

1. Use tools and equipment.

## STM-115            Access Equipment

### Learning Outcomes:

- Demonstrate knowledge of ladders, scaffolding and motorized work platforms, their applications, limitations and procedures for use.

### 2015 Red Seal Occupational Standard Reference:

2.02 Uses access equipment.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify hazards and describe safe work practices pertaining to ladders, scaffolding and motorized work platforms.
2. Identify jurisdictional regulations and site specific requirements pertaining to ladders, scaffolding and motorized work platforms.
  - i) personnel training/certification
  - ii) equipment certification requirements
  - iii) proper use and limitations of equipment
3. Identify types of ladders and describe their characteristics and applications.
  - i) step ladders
  - ii) extension ladders
  - iii) platform ladders
4. Identify types of scaffolding and describe their characteristics and applications.
  - i) tube and clamp
  - ii) swing stage
  - iii) frame scaffolding

5. Identify types of motorized work platforms and describe their characteristics and applications.
  - i) scissor lift
  - ii) articulated boom
  - iii) personnel basket
  
6. Describe the procedures used to erect and dismantle ladders and scaffolding.

Practical Objectives

N/A



## STM-120            Introduction to Welding

### Learning Outcomes:

- Demonstrate knowledge of welding equipment, applications and procedures

### 2015 Red Seal Occupational Standard Reference:

2.03 Uses welding equipment.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify certification requirements for performing welding.
2. Describe the procedures used to inspect, maintain and store welding equipment.
3. Identify types of welding equipment.
  - i) SMAW equipment
  - ii) orbital welding machines and equipment
  - iii) GTAW equipment
  - iv) torches
  - v) GMAW equipment
4. Identify different welding processes and applications.
  - i) metal inert gas (MIG)
    - gas metal arc welding (GMAW)
    - flux core arc welding (FCAW)
  - ii) tungsten inert gas (TIG)
  - iii) electric welding/shielded metal arc welding (SMAW)
  - iv) orbital welding
  - v) GTAW

5. Identify welding consumables.
  - i) welding rods
  - ii) flux
  - iii) grinding discs
6. Identify basic weld joints and describe their applications.
7. Describe the procedures used to tack weld.
8. Describe the properties and characteristics of metals.

Practical Objectives

1. Use welding equipment.

## STM-125            Fuel Brazing and Soldering

### Learning Outcomes:

- Demonstrate knowledge of soldering and brazing equipment, applications and procedures.
- Demonstrate knowledge of oxy-fuel equipment, applications and procedures.

### 2015 Red Seal Occupational Standard Reference:

- 2.04 Uses soldering and brazing equipment.
- 2.05 Uses oxy-fuel equipment.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify types of soldering and brazing equipment.
  - i) oxy-acetylene and air-acetylene torches
  - ii) attachments
    - strikers
    - MAPP
    - gas cylinder and torch heads
2. Identify different soldering and brazing processes and applications.
  - i) cutting
3. Identify purge procedures required for brazing.
  - i) dams
  - ii) purge gas
  - iii) pressures
  - iv) flow rates
4. Identify oxy-fuel equipment components.
  - i) hoses

- ii) flashback arrestors
5. Identify soldering and brazing consumables.
    - i) silver solder
    - ii) flux
    - iii) soft solder
    - iv) brazing rod
    - v) sand cloth
  6. Identify certification requirements for performing brazing.
  7. Describe the procedures used to inspect, maintain and store soldering and brazing equipment.
  8. Describe the procedures used to inspect, maintain and store oxy-fuel equipment.

Practical Objectives

1. Use soldering and brazing equipment.

## STM-130

## Rigging, Hoisting and Lifting

### Learning Outcomes:

- Demonstrate knowledge of hoisting, lifting, positioning and rigging equipment, their applications, limitations and procedures for use and storage.
- Demonstrate knowledge of calculations required when performing hoisting and lifting operations.
- Demonstrate knowledge of the procedures used to select equipment for hoisting, lifting and positioning operations.
- Demonstrate knowledge of the procedures used to perform hoisting, lifting and positioning operations.
- Demonstrate knowledge of inspection for rigging, hoisting, lifting and positioning equipment.

### 2015 Red Seal Occupational Standard Reference:

- 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, hoisting, lifting and positioning equipment.

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with hoisting, lifting, rigging and positioning.
2. Identify hazards and describe safe work practices pertaining to hoisting, lifting, rigging and positioning.
  - i) wind

- ii) shock loading
- 3. Identify codes and regulations pertaining to hoisting, lifting and rigging.
- 4. Identify information pertaining to rigging equipment weight found on drawings and specifications.
  - i) shop drawings
  - ii) manufacturers' specifications
- 5. Identify documentation required for engineered lifts.
- 6. Describe the procedures used to ensure a safe work area.
  - i) supervision of lift
  - ii) securing work area
  - iii) communication
- 7. Describe the procedures used to rig material/equipment for lifting.
  - i) load determination
  - ii) communication methods
  - iii) pre-lift checks
  - iv) placement of load
  - v) post-lift inspection
- 8. Identify the factors to consider when selecting rigging equipment.
  - i) load characteristics
  - ii) rigging inspection
  - iii) equipment fatigue
  - iv) environment
  - v) safety factor (5 to 1 and 10 to 1)
  - vi) sling angles
- 9. Identify types of rigging, hoisting, lifting and positioning equipment and accessories.
  - i) lugs
  - ii) chain falls
  - iii) come alongs
  - iv) spreader bars
  - v) shackles
  - vi) slings
  - vii) tuggers

- viii) cranes
  - ix) forklifts
  - x) rollers
  - xi) chain falls
  - xii) jacks
  - xiii) cable grip hoists
10. Identify and describe procedures used to communicate during set up and lifting operations.
    - i) hand signals
    - ii) electronic communications
    - iii) audible/visual
  11. Identify jurisdictional regulations and trade practice pertaining to rigging, hoisting, lifting and positioning.
  12. Describe the procedures used to inspect, maintain and store rigging, hoisting, lifting, and positioning equipment.
  13. Identify types of knots, hitches and bends and describe their applications and the procedures used to tie them.
  14. Explain correlation of sling angles to sling capacities.
    - i) 45°
    - ii) 60°
  15. Identify types of ropes used in rigging.
  16. Explain how to calculate load weight.

Practical Objectives

1. Perform a basic lift of a pipe spool.

## STM-135            **Bracket, Support, Hanger, Guides and Anchor Fabrication**

### **Learning Outcomes:**

- Demonstrate knowledge of the procedures used to fabricate brackets, supports, hangers, guides and anchors.

### **2015 Red Seal Occupational Standard Reference:**

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

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret information pertaining to brackets, supports, hangers, guides and anchors fabrication found on drawings and specifications.
2. Interpret codes and regulations pertaining to brackets, supports, hangers, guides and anchors fabrication.
  - i) ASME B31
  - ii) Canadian Welding Bureau (CWB)
3. Identify fabrication tools and equipment relating to brackets, supports, hangers, guides and anchors fabrication and describe their applications and procedures for use.
4. Identify types of joining methods and describe their applications.
5. Identify types of fabrication techniques and describe their applications.
6. Describe the procedures used to fabricate and assemble brackets, supports, hangers, guides and anchors.

#### Practical Objectives

1. Fabricate pipe supports.



## STM-140                  Drawings and Specifications I

### Learning Outcomes:

- Demonstrate knowledge of drawings and their applications.
- Demonstrate knowledge of basic drawing and sketching techniques.

### 2015 Red Seal Occupational Standard Reference:

3.02    Generates drawings.

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1.     Describe metric and imperial systems of measurement and the procedures used to perform conversions.
  
2.     Identify the types of drawings and describe their applications.
  - i)     civil/site
  - ii)    architectural
  - iii)   mechanical
  - iv)    structural
  - v)     electrical
  - vi)    shop drawings
  - vii)   sketches
  
3.     Identify types of symbols and describe their characteristics and applications.
  
4.     Identify drawing projections and views, and describe their applications.
  - i)     projections
    - orthographic
    - oblique
    - isometric
    - pictorial

- ii) views
  - plan
  - section
  - detail
  - elevation
  - cross section

5. Describe the use of scales.

Practical Objectives

1. Perform basic drawing and sketching techniques.

## STM-145            Copper Tube and Tubing

### Learning Outcomes:

- Demonstrate knowledge of copper tube and tubing, fittings and related components.
- Demonstrate knowledge of the procedures used to measure and size copper tube and tubing and related components.
- Demonstrate knowledge of the procedures used to cut, bend and join copper tube and tubing and related components.

### 2015 Red Seal Occupational Standard Reference:

- 4.01 Fabricates piping system components.
- 4.02 Fabricates brackets, supports, hangers, guides and anchors.
- 5.01 Lays out, identifies and installs copper tube, fittings and related components.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Explain the systems of measurement for copper tube and tubing.
2. Interpret codes and regulations pertaining to copper tube and tubing.
  - i) manufacturers' certification requirements
  - ii) ASTM
3. Interpret information pertaining to copper tubing found on drawings and specifications.
4. Identify tools and equipment relating to copper tube and tubing, fittings and their components and describe their applications and procedures for use.
5. Identify types of fittings used with copper tube and tubing and describe their purpose and applications.

- i) elbows
  - ii) tees
  - iii) crosses
6. Identify the methods used to cut and join copper tube, and tubing, and describe their associated procedures.
- i) join
    - brazing
    - soldering
    - flaring
    - roll grooving
    - compression fittings
7. Identify copper tube and tubing related components and describe their purpose and applications.
- i) bolts
  - ii) studs
  - iii) gaskets
  - iv) brackets
  - v) supports
  - vi) hangers
  - vii) spring cam
  - viii) guides
  - ix) anchors
8. Describe the procedures used to measure copper tube and tubing and fittings.
- i) fitting allowance
  - ii) offset calculations
  - iii) trade math
9. Describe the procedures and bending tools and equipment used to bend copper tube and tubing.
- i) hand benders
  - ii) hydraulic benders
10. Describe the procedures used to install and test copper tube, tubing, fittings and related components.
11. Describe the identification systems and methods of identification for copper tube and tubing.

- i) K
- ii) L
- iii) M
- iv) DWV
- v) ACR

Practical Objectives

1. Join copper tube and tubing using various methods.

## STM-150          Pipe and Tube Bending

### Learning Outcomes:

- Demonstrate knowledge of pipe and tube bending equipment and their applications.
- Demonstrate knowledge of the procedures to select, layout and bend pipe and tube.

### 2015 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with pipe and tube bending.
2. Identify hazards and describe safe work practices pertaining to pipe and tube bending.
3. Interpret codes and specifications pertaining to pipe and tube bending.
4. Interpret information pertaining to pipe and tube bending found on drawings and specifications.
5. Identify tools and equipment related to pipe and tube bending and describe their applications and procedures for use.
6. Identify the considerations when selecting materials for bending.
7. Identify the methods used to bend pipe and tube and describe their applications.
8. Identify the types of pipe and tube bending and describe their applications.

9. Describe the procedures used to perform cold bending.
10. Describe the procedures used to perform hot bending.
11. Perform calculations pertaining to hot bending.
12. Describe the procedures used to bend copper and stainless steel pipe and tube using hand benders.

Practical Objectives

1. Lay out and mark pipe, tube and tubing for bending.
2. Bend pipe, tube and tubing.

## STM-155            Plastic Piping

### Learning Outcomes:

- Demonstrate knowledge of plastic piping and tubing, fittings and related components.
- Demonstrate knowledge of the procedures used to measure and size plastic piping, tubing and related components.
- Demonstrate knowledge of the procedures used to cut, bend and join plastic piping, tubing and related components.

### 2015 Red Seal Occupational Standard Reference:

- 4.01 Fabricates piping system components.
- 4.02 Fabricates brackets, supports, hangers, guides and anchors.
- 5.02 Lays out, identifies and installs plastic piping, tubing, fittings and related components.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Explain the systems of measurement for plastic piping and tubing.
2. Interpret codes and regulations pertaining to plastic piping and tubing.
3. Interpret information pertaining to plastic piping and tubing found on drawings and specifications.
4. Identify tools and equipment relating to plastic piping and tubing.
5. Identify plastic piping and tubing fittings and related components and describe their applications and procedures for use.



6. Identify types of plastic piping and tubing and describe their purpose and applications.
  - i) ABS
  - ii) CPVC
  - iii) PP
  - iv) PE
  - v) PEX
  
7. Identify types of fittings used with plastic piping and tubing and describe their purpose and applications.
  - i) elbows
  - ii) tees
  - iii) crosses
  
8. Identify the systems and criteria used in referencing, selecting and ordering plastic piping and tubing.
  
9. Identify the methods used to cut and join plastic pipe and tubing, and describe their associated procedures and cutting and reaming tools and equipment.
  - i) join
    - compression fittings
    - solvent cementing
    - threading, fusion
  
10. Describe the procedures and bending tools and equipment used to bend plastic piping and tubing.
  
11. Describe the procedures used to install and test plastic piping and tubing, fittings and related components.
  
12. Describe the identification systems and methods of identification for plastic piping and tubing.
  
13. Describe the procedures used to measure plastic piping, tubing and fittings.
  - i) dimension
  - ii) length
  - iii) fitting allowance
  - iv) offset calculations
  - v) trade math

Practical Objectives

1. Join plastic pipe and tubing using various methods.

## STM-160          Carbon Steel Piping

### Learning Outcomes:

- Demonstrate knowledge of carbon steel piping and tubing, fittings and related components.

### 2015 Red Seal Occupational Standard Reference:

- 4.01 Fabricates piping system components.
- 4.02 Fabricates brackets, supports, hangers, guides and anchors.
- 5.03 Lays out, identifies and installs carbon steel piping, tubing, fittings and related components.

### Suggested Hours:

24 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify tools and equipment relating to carbon steel piping and tubing, fittings and related components and describe their applications and procedures for use.
2. Interpret codes and regulations pertaining to carbon steel piping.
  - i) ASME B31
3. Interpret information pertaining to carbon steel piping and tubing found on drawings and specifications.
4. Describe the identification systems and methods of identification for carbon steel piping and tubing.
5. Identify fittings used with carbon steel piping and tubing and describe their purpose and applications.
  - i) elbows
  - ii) tees
  - iii) crosses

6. Identify carbon steel piping and tubing related components and describe their purpose and applications.
  - i) bolts
  - ii) studs
  - iii) gaskets
  - iv) brackets
  - v) supports
  - vi) hangers
  - vii) guides
  - viii) anchors
  
7. Explain the systems of measurement for carbon steel piping and tubing.
  - i) dimension
  - ii) length
  - iii) wall thickness/schedule
  
8. Describe the procedures used to measure carbon steel piping and tubing, and fittings.
  - i) fitting allowance
  - ii) offset calculations
  - iii) trade math
  
9. Describe the procedures used to inspect carbon steel piping and tubing.
  - i) quality assurance
  - ii) quality control (QA/QC) requirements
  
10. Describe the different methods of pipe and fitting end preparation.
  - i) standard bevel
  - ii) compound bevel
  
11. Identify the methods used to cut carbon steel piping and tubing, and describe their associated procedures.
  
12. Identify the joining methods for carbon steel piping and tubing and describe their associated procedures.
  - i) threading
  - ii) tacking/welding
  - iii) flanging
  - iv) roll grooving
  - v) compression fittings

- vi) flaring
13. Describe pre/post-weld activities.
- i) stress relieving
  - ii) cleaning procedures
  - iii) controlled cooling
  - iv) pre-heating or purging
  - v) chemical treating
  - vi) protective coatings
14. Describe the procedures and bending tools and equipment used to bend carbon steel piping and tubing.
- i) hand benders
  - ii) hydraulic benders
15. Describe the procedures used to install and test fittings and related components for carbon steel piping and tubing.

Practical Objectives

1. Join carbon steel piping using various methods.

## STM-165            Stainless Steel Piping

### Learning Outcomes:

- Demonstrate knowledge of stainless steel piping and tubing, fittings and related components.
- Demonstrate knowledge of the procedures used to measure stainless steel piping.
- Demonstrate knowledge of the procedures used to cut and join stainless steel piping.

### 2015 Red Seal Occupational Standard Reference:

- 4.01 Fabricates piping system components.
- 4.02 Fabricates brackets, supports, hangers, guides and anchors.
- 5.04 Lays out, identifies and installs stainless steel piping, tubing, fittings and related components.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes and regulations pertaining to stainless steel piping.
  - i) ASME B31
2. Interpret information pertaining to stainless steel piping and tubing found on drawings and specifications.
3. Explain the systems of measurement for stainless steel piping and tubing.
  - i) dimension
  - ii) length
  - iii) wall thickness/schedule
4. Identify tools and equipment relating to stainless steel piping, tubing, fittings and related components and describe their applications and procedures for use.

5. Identify fittings used with stainless steel piping and tubing and describe their purpose and applications.
  - i) elbows
  - ii) tees
  - iii) crosses
  
6. Identify stainless steel piping and tubing related components and describe their purpose and applications.
  - i) bolts
  - ii) studs
  - iii) gaskets
  - iv) brackets
  - v) supports
  - vi) hangers
  - vii) guides
  - viii) anchors
  
7. Identify the methods used to cut stainless steel piping and tubing, and describe their associated procedures.
  
8. Identify the joining methods used to join stainless steel piping and tubing and describe their associated procedures.
  
9. Describe pre/post-weld activities.
  - i) stress relieving
  - ii) cleaning procedures
  - iii) controlled cooling
  - iv) pre-heating or purging
  - v) chemical treating
  - vi) protective coatings
  
10. Describe the procedures and bending tools and equipment used to bend stainless steel piping and tubing.
  
11. Describe the procedures used to install and test fittings and related components for stainless steel piping and tubing.
  
12. Describe the procedures and methods to prevent cross contamination.
  - i) labelling
  - ii) physical separation

- iii) barriers
13. Describe the identification systems and methods for stainless steel piping and tubing.
  14. Explain the systems of measurement for carbon steel piping and tubing.
    - i) dimension
    - ii) length
    - iii) wall thickness/schedule
  15. Describe the procedures used to measure stainless steel piping and tubing and fittings.
    - i) fitting allowance
    - ii) offset calculations
    - iii) trade math
  16. Describe the procedures used to inspect stainless steel piping and tubing.
    - i) QA/QC requirements
  17. Describe the different methods of pipe and fitting end preparation.
    - i) standard bevel
    - ii) compound bevel

Practical Objectives

1. Join stainless steel piping using various joining methods.



## STM-170          Piping Valves

### Learning Outcomes:

- Demonstrate knowledge of piping valves, their applications and operation.
- Demonstrate knowledge of the procedures used to install valves.

### 2015 Red Seal Occupational Standard Reference:

- 6.01 Installs valves.
- 6.02 Maintains, troubleshoots, repairs and tests valves.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes, regulations and standards pertaining to piping valves.
  - i) MSS
  - ii) ANSI
2. Interpret information found on drawings and specifications pertaining to valves.
3. Identify tools and equipment relating to piping valves and describe their applications and procedures for use.
4. Identify types of piping valves and describe their characteristics, operation and applications.
  - i) gate
  - ii) globe
  - iii) ball
  - iv) plug
  - v) butterfly
  - vi) check
  - vii) relief
  - viii) pop safety

- ix) pressure reducing
5. Identify types of valve actuators and describe their purpose.
    - i) electric
    - ii) pneumatic
    - iii) manual
    - iv) hydraulic
  6. Identify joining methods used to install piping valves and describe their associated procedures.
  7. Describe necessary documentation for valve repair.
    - i) QA/QC verification
    - ii) recording of signoff that repair has been completed
  8. Describe testing methods for testing valves and related components.
    - i) hydrostatic
    - ii) blue check
  9. Identify defects requiring valve and related component repair.
    - i) passing valve seal
    - ii) leaking packing
    - iii) seized or damaged related components
  10. Describe procedures used to maintain and troubleshoot valves.
    - i) troubleshoot
      - functional checks
      - visual inspections and use of temperature sensing devices
      - stethoscopes
    - ii) maintain
      - lubricating
      - cleaning
      - inspecting
      - replacing
  11. Describe procedures used to repair valves.
    - i) disc and seat refurbishment
    - ii) stem realignment
    - iii) valve repacking

12. Explain piping valve rating systems and installation variables.

Practical Objectives

N/A

# Level 2

Unit Code	Title	Hours	Page
STM-200	Drawings and Specifications II	30	58
STM-205	Template Development	30	60
STM-210	Piping System Component Fabrication (Spool)	30	61
STM-215	Fiberglass Piping	6	64
STM-220	Specialty Piping	12	67
STM-225	Hydronic Systems	60	70
STM-230	Heat Tracing Systems (Liquid)	6	76
STM-235	Electrical Principles	6	79

**Learning Outcomes:**

- Demonstrate knowledge of digital tools and software for layout and design.
- Demonstrate ability to interpret and extract information from types of drawings and specification.
- Demonstrate knowledge of drawings and their applications.

**2015 Red Seal Occupational Standard Reference:**

- 3.02 Generates drawings.
- 3.03 Interprets drawings and specifications.

**Suggested Hours:**

30 Hours

**Objectives and Content:***Theoretical Objectives*

1. Identify types of drawings and specifications and describe their applications.
  - i) P&ID
  - ii) spool sheets
  - iii) isometric drawings
  - iv) revisions
  - v) vendor/shop civil/site
  - vi) architectural
  - vii) mechanical
  - viii) structural
  - ix) electrical
  - x) shop drawings
  - xi) sketches
2. Identify symbols relating to drawings and describe their characteristics and applications.
3. Interpret and extract information from drawings and specifications.

4. Describe metric and imperial systems of measurement and the procedures used to perform conversions.
5. Identify drawing projections and views and describe their applications.
  - i) projections
    - orthographic
    - oblique
    - isometric
    - pictorial
  - ii) views
    - plan
    - section
    - detail
    - elevation
    - cross section
6. Describe the use of scales.
7. Identify types of digital tools and software for layout and design.
  - i) total station
  - ii) auto-CAD
  - iii) CAD
  - iv) building information management (BIM)
8. Identify applications for digital software tools.
  - i) dimensional control
  - ii) visualization of construction

Practical Objectives

1. Interpret drawings and specifications.

## STM-205          Template Development

### Learning Outcomes:

- Demonstrate knowledge of the methods of template development and their associated procedures.

### 2015 Red Seal Occupational Standard Reference:

3.04    Develop piping templates.

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information pertaining to template development found on drawings.
2. Identify tools and equipment relating to template development and describe their applications and procedures for use.
3. Identify specifications for piping requirements used in template development.
4. Describe the procedures used to develop templates.
  - i) standard template design
  - ii) alternative template development methods

#### Practical Objectives

1. Develop a template and fabricate a fitting.

## STM-210

## Piping System Component Fabrication (Spool)

### Learning Outcomes:

- Demonstrate knowledge of the procedures used to fabricate piping system components.

### 2015 Red Seal Occupational Standard Reference:

- 2.03 Uses welding equipment.
- 2.05 Uses oxy-fuel equipment.
- 4.01 Fabricates piping system components.
- 8.06 Sets up rigging, hoisting, lifting and positioning equipment.

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify tools and equipment relating to piping system component fabrication and describe their applications and procedures for use.
  - i) welding
  - ii) oxy-fuel
  - iii) rigging and hoisting
2. Interpret information pertaining to piping system component fabrication found on drawings and specifications.
3. Identify codes and regulations pertaining to piping system component fabrication.
  - i) ASME B31
4. Identify types of fittings and piping system components and describe their characteristics and applications.
  - i) fittings
    - elbows
    - tees



- true wyes
  - laterals
  - crosses
  - ii) components
    - pipe spools
    - fittings, valves
5. Identify types of joining methods and describe their applications.
- i) threading
  - ii) grooving
  - iii) gluing
  - iv) welding
  - v) compression
  - vi) fusion
6. Identify types of fabrication techniques and describe their applications.
- i) cutting
  - ii) bending
  - iii) beveling
7. Identify types of treating methods and describe their applications.
- i) applying protective coatings
  - ii) pickling
  - iii) chemical flushing
8. Identify types of fitting tolerance practices and describe their applications.
- i) two-holing
  - ii) gap
  - iii) high-low
  - iv) transitioning
  - v) alignment
9. Identify pre/post-weld activities and describe their applications.
- i) stress relieving
  - ii) cleaning procedures
  - iii) controlled cooling
  - iv) pre-heating or purging
  - v) chemical treating
  - vi) protective coatings

10. Describe the procedures used to fabricate and assemble piping system components.

*Practical Objectives*

1. Fabricate a carbon steel pipe spool.

## STM-215          Fiberglass Piping

### Learning Outcomes:

- Demonstrate knowledge of fiberglass piping, fittings and related components.
- Demonstrate knowledge of the procedures used to measure fiberglass piping.
- Demonstrate knowledge of the procedures used to cut and join fiberglass piping.

### 2015 Red Seal Occupational Standard Reference:

- 5.05 Lays out, identifies and installs fiberglass piping, fittings and related components.
- 8.06 Sets up rigging, hoisting, lifting and positioning equipment.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information pertaining to fiberglass piping found on drawings and specifications.
2. Explain the systems of measurement for fiberglass piping.
  - i) dimension
  - ii) length
  - iii) wall thickness/schedule
3. Identify the systems and criteria used in referencing, selecting and ordering fiberglass piping.
4. Identify tools and equipment relating to fiberglass piping, fittings and related components and describe their applications and procedures for use.
5. Identify types of fiberglass piping and describe their purpose and applications.
  - i) FRP
  - ii) GFRP

- iii) GRE
- 6. Identify fittings used with fiberglass piping and describe their purpose and applications.
- 7. Identify fiberglass piping related components and describe their purpose and applications.
  - i) washers
  - ii) bolts
  - iii) studs
  - iv) gaskets
  - v) brackets
  - vi) supports
  - vii) hangers
  - viii) guides
  - ix) anchors
- 8. Identify and describe the methods used to join fiberglass piping and describe their associated procedures and materials.
  - i) joining
    - butt and wrap
    - bell and spigot
    - threading
  - ii) material
    - vinyl ester
    - polyester
    - halogenated resins
    - epoxies
- 9. Describe the identification systems and methods for fiberglass piping.
- 10. Describe the procedures used to measure fiberglass piping.
  - i) fitting allowance
  - ii) offset calculations
  - iii) trade math
- 11. Describe the procedures used to install and test fiberglass piping, fittings and related components for fiberglass piping.
  - i) hydrostatic
  - ii) pneumatic
  - iii) NDE

Practical Objectives

N/A

## STM-220 Specialty Piping

### Learning Outcomes:

- Demonstrate knowledge of specialty piping, fittings and related components.
- Demonstrate knowledge of the procedures used to measure specialty piping.
- Demonstrate Knowledge of the procedure used to cut and join specialty piping.

### 2015 Red Seal Occupational Standard Reference:

- 5.06 Lays out, identifies and installs specialty piping, fittings and related components.
- 8.06 Sets up riggings, hoisting, lifting and positioning equipment.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify codes and regulations pertaining to specialty piping.
  - i) ASME B31
2. Interpret information pertaining to specialty piping found on drawings and specifications.
3. Identify types of specialty pipe and describe their applications and procedures for use.
  - i) chrome
  - ii) molybdenum
  - iii) titanium
  - iv) duplex
  - v) lined pipe
4. Explain the systems of measurement for specialty piping.
  - i) dimension
  - ii) length
  - iii) wall thickness/schedule

5. Identify tools and equipment relating to specialty piping fittings and their components and describe their applications and procedures for use.
6. Identify fittings used with specialty piping and describe their purpose and applications.
7. Identify specialty piping related components and describe their purpose and applications.
  - i) bolts
  - ii) studs
  - iii) gaskets
  - iv) brackets
  - v) supports
  - vi) hangers
  - vii) guides
  - viii) anchors
8. Identify the joining methods used to join specialty piping and describe their associated procedures.
  - i) threading
  - ii) tacking/welding
  - iii) flanging
  - iv) roll grooving
9. Identify the methods used to cut specialty piping and fittings in particular lined piping, and describe their associated procedures.
10. Identify the methods used in cutting, bevelling and threading tools and equipment.
11. Describe the identification systems and methods for specialty piping.
12. Describe the different methods of pipe and fitting end preparation.
  - i) standard bevel
  - ii) compound bevel
13. Describe pre/post-weld activities.
  - i) stress relieving
  - ii) cleaning procedures
  - iii) controlled cooling
  - iv) pre-heating or purging

- v) chemical treating
  - vi) protective coatings
14. Describe the procedures used to inspect specialty piping.
    - i) QA/QC requirements
  15. Describe the procedures used to measure specialty piping and fittings.
    - i) fitting allowance
    - ii) offset calculations
    - iii) trade math
  16. Describe the procedures used to install and test fittings and related components for specialty piping.
  17. Describe the procedures and bending tools and equipment used to bend specialty piping.
  18. Describe the procedures and methods to prevent cross contamination.
    - i) labelling
    - ii) physical separation
    - iii) barriers tool selection

Practical Objectives

N/A



## STM-225            Hydronic Systems

### Learning Outcomes:

- Demonstrate knowledge of hydronic systems and equipment, their applications and operation.
- Demonstrate knowledge of hydronic piping configurations, their applications and operation.
- Demonstrate knowledge of the procedures used to install piping and piping components for hydronic systems.
- Demonstrate knowledge of the procedures and testing equipment used to troubleshoot, repair and maintain hydronic systems.

### 2015 Red Seal Occupational Standard Reference:

- 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.

### Suggested Hours:

60 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret jurisdictional codes and specifications for installing and testing of hydronic equipment.
2. Interpret information pertaining to hydronic systems found on drawings, specifications and equipment manuals.
  - i) installation
  - ii) troubleshooting
  - iii) testing
  - iv) repair
  - v) maintenance

3. Identify types of hydronic systems and equipment and describe their purpose and operation.
  - i) systems
    - heating
    - cooling
  - ii) equipment
    - boilers
    - expansion tanks
    - buffer tanks
    - glycol tanks
    - holding tanks
    - heat exchangers
    - circulating pumps
    - transfer pumps
    - isolators
    - relief valves
    - chemical feeders
    - isolation valves for equipment
    - backflow preventers,
    - pressure reducing valves
  
4. Identify types of piping and components and accessories for hydronic systems, and describe their purpose and operation.
  - i) piping
    - plastic
    - carbon steel
    - stainless steel
    - copper
  - ii) components
    - fittings
    - dielectric fittings
    - hangers
    - brackets
    - sleeves
    - anchors
    - guides
    - valves
    - strainers
    - expansion joints
    - expansion loops
    - backflow preventers

5. Identify systems that require pitch and grade of piping for the hydronic system.
6. Identify hydronic equipment supports and fasteners and describe their applications and procedures for use.
  - i) supports
    - brackets
    - stands
    - hangers
    - plates
    - housekeeping pads
    - isolator pads
    - concrete embeds
  - ii) fasteners
    - anchors
    - expansion type inserts
    - beam clamps
    - nuts
    - bolts
    - screws
7. Identify hydronic controls and describe their purpose and operation.
  - i) pressure
  - ii) temperature and liquid level controls
  - iii) zone valves (motorized)
  - iv) safety controls,
  - v) LWCO
  - vi) high and low limit temperature controls
8. Identify sources of heat and cooling used in hydronic systems.
  - i) heat
    - oil
    - gas
    - wood
    - steam
    - geothermal
    - solar
  - ii) cooling
    - ground source
    - cooling towers
    - chillers
    - refrigeration

- plate exchangers

9. Identify types of heat transfer equipment and describe their characteristics and operation.
  - i) radiators
  - ii) convectors
  - iii) pipe coils
  - iv) horizontal and vertical unit heaters
  - v) radiant panels
  - vi) heat/plate exchangers
  
10. Identify types of testing equipment and components and describe their characteristics and applications.
  - i) blind flanges
  - ii) calibrated pressure gauges
  - iii) test pumps
  - iv) relief valves
  - v) gate valves
  - vi) recorders,
  - vii) testing trees/headers
  - viii) regulators
  - ix) multimeter
  - x) manometer
  - xi) infrared thermometer
  - xii) balancing equipment
  - xiii) chemical testing equipment
  
11. Identify types of isolation components and describe their characteristics and applications.
  - i) spectacle blinds
  - ii) spades
  - iii) plugs and caps
  - iv) temporary spool pieces
  
12. Identify method of filling, draining or purging test medium.
  - i) using hand pump
  - ii) centrifugal pump
  - iii) compressors
  - iv) compressed gas cylinders

13. Identify the considerations for selecting piping components for hydronic systems.
  - i) insulation requirements
  - ii) type of supports
  - iii) shoes and sleeves
  - iv) expansion
  - v) contraction
14. Describe the procedures used to perform system testing.
15. Describe the procedures used to remove test medium from system.
16. Describe the procedures used to reinstate system.
17. Describe the procedures used to troubleshoot, repair and maintain hydronic systems.
18. Describe the procedures used to complete documentation following hydronic system repair or maintenance.
19. Describe the procedures used to install piping and piping components for hydronic systems.
20. Describe the procedures used to protect hydronic piping and piping components.
  - i) protection from mechanical damage
  - ii) seismic activity
  - iii) environmental conditions
21. Explain the effect of elevation and temperature on pressure when testing hydronic systems.
22. Explain the effects trapped air in a hydronic system will have on testing and describe the procedures to prevent or correct it
23. Explain the effects of electrolysis when connecting dissimilar metals on hydronic piping and components.
24. Explain the effects of expansion and contraction on piping in hydronic systems.
25. Identify and explain the applications of hydronic piping configurations.

- i) perimeter/series loop
  - ii) reverse return
  - iii) direct return
  - iv) primary/secondary
26. Explain the applications and operation of hydronic systems.
- i) residential
  - ii) industrial
27. Explain the principles of heat transfer.
- i) radiation
  - ii) conduction
  - iii) convection

Practical Objectives

1. Install boiler trim and related piping.

## STM-230            Heat Tracing Systems (Liquid)

### Learning Outcomes:

- Demonstrate knowledge of liquid-filled tracing systems, their applications and operation.
- Demonstrate knowledge of procedures to repair and test liquid-filled tracing systems and their components.

### 2015 Red Seal Occupational Standard Reference:

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

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify codes, regulations and standards pertaining to liquid-filled tracing systems.
2. Interpret information found on drawings and specifications pertaining to liquid-filled tracing system.
3. Identify tools and equipment relating to liquid-filled tracing systems and describe their applications and procedures for use.
4. Identify types of liquid-filled tracing systems and components and describe their characteristics, operation and applications.
  - i) systems
    - low and high temperature hot water
    - glycol
  - ii) components
    - valves
    - breakouts
    - valve baskets

- high point vents
  - pumps
5. Identify joining methods used to install liquid-filled tracing systems and describe their associated piping practices.
- i) welding
  - ii) soldering
  - iii) grooving
  - iv) crimping
  - v) brazing and compression fittings
6. Describe liquid-filled tracing systems and installation variables.
- i) temperature
  - ii) pressure
  - iii) flow
  - iv) functionality
7. Describe procedures used to troubleshoot, test, repair and maintain liquid-filled tracing systems and components.
- i) troubleshoot
    - functional checks
    - visual inspections
    - use of temperature sensing devices
  - ii) test
    - hydrostatic
    - pneumatic
    - in service
  - iii) repair
    - tubing and fitting replacement
  - iv) maintain
    - cleaning
    - inspecting tubing
    - fitting and components for correct operation and wear
  - v) defects
    - kinked tubing
    - broken straps
    - faulty pumps
    - plugged vents



8. Describe necessary documentation for liquid-filled tracing system and component repair and maintenance.
  - i) QA/QC verification
  - ii) recording of signoff that repair has been completed
9. Describe liquid-filled tracing systems and installation variables.
10. Identify disposal procedures of liquid medium.

Practical Objectives

1. Review working principles of high and low temperature hot water/glycol systems.

## STM-235          Electrical Principles

### Learning Outcomes:

- Demonstrate knowledge of the basic concepts of electricity.

### 2015 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with electricity as related to the trade.
2. Identify hazards and describe safe work practices pertaining to electricity.
3. Identify electrical-related information found on drawings and specifications.
4. Identify tools and equipment used to test electrical circuits and describe their applications and procedures for use.
5. Identify and explain Ohm's law.
6. Identify types of current and describe their characteristics and applications.
  - i) direct current (DC)
  - ii) alternating current (AC)
7. Identify types of electrical circuits and describe their characteristics, operation and applications.
  - i) series
  - ii) parallel
  - iii) series-parallel
8. Identify types of related electrical equipment and components and describe their characteristics, operation and applications.

Practical Objectives

1. Use a multi-meter.

# Level 3

<b>Unit Code</b>	<b>Title</b>	<b>Hours</b>	<b>Page</b>
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STM-305	Heat Tracing Systems (Steam)	12	86
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STM-315	Low Pressure Steam Systems	72	91
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STM-330	Cross Connection Control	6	106
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STM-340	Controlled Bolting and Tensioning	30	109

**Learning Outcomes:**

- Demonstrate knowledge of industrial water and waste treatment piping configurations, their applications and operation.
- Demonstrate knowledge of the procedures used to install piping, components and supports for industrial water and waste treatment systems.
- Demonstrate knowledge of testing equipment and components for troubleshooting industrial water and waste treatment systems.
- Demonstrate knowledge of the procedures used to troubleshoot, repair and maintain industrial water and waste treatment systems.

**2015 Red Seal Occupational Standard Reference:**

- 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.
- 25.01 Secures commissioning area.

**Suggested Hours:**

24 Hours

**Objectives and Content:***Theoretical Objectives*

1. Interpret information pertaining to industrial water and waste treatment systems found on drawings, specifications and equipment manuals.
  - i) installation
  - ii) testing
  - iii) troubleshooting
  - iv) repair
  - v) maintenance
2. Interpret jurisdictional codes and specifications for installation of industrial water and waste treatment systems.

3. Describe the applications and operation of industrial water and waste treatment systems.
4. Explain the effect of pressure on elevation when troubleshooting industrial water and waste treatment systems.
5. Explain the effect of elevation and temperature on pressure when testing industrial water and waste treatment systems.
6. Explain the effects trapped air in industrial water and waste treatment system will have on testing and describe the procedures to prevent or correct it.
7. Explain the effects of electrolysis when connecting dissimilar metals on industrial water and waste treatment piping and components.
8. Identify types of testing equipment and components and describe their characteristics and applications.
9. Identify test medium used in testing of industrial water and waste treatment systems, and describe their characteristics and applications.
10. Identify types of piping, piping components and supports for industrial water and waste treatment systems, and describe their purpose and operation.
  - i) piping
    - plastic
    - carbon steel
    - copper
    - stainless steel
  - ii) components
    - fittings
    - dielectric fittings
    - hangers, brackets
    - sleeves
    - anchors
    - guides
    - manual and automatic valves
    - strainers
    - backflow preventers
    - check valves
  - iii) supports

- rollers
- hangers
- clamps
- brackets
- stands
- anchors
- guides
- concrete piers (underground)

11. Identify types of industrial water and waste treatment systems equipment, and describe their characteristics and operation.

- i) pumps
- ii) tanks
- iii) valves
- iv) filters
- v) strainers
- vi) separators
- vii) skimmers
- viii) aerators
- ix) water treatment equipment

12. Identify industrial water and waste treatment systems equipment supports and fasteners and describe their applications and procedures for use.

- i) stands
- ii) hangers
- iii) plates
- iv) housekeeping pads
- v) isolator pads
- vi) concrete embeds

13. Identify industrial water and waste treatment system control components and describe their purpose and operation.

- i) operating and temperature controls
- ii) flow controls
- iii) safety controls

14. Identify types of isolation components and describe their characteristics and applications.

- i) spectacle blinds
- ii) spades
- iii) plugs and caps

- iv) temporary spool pieces
15. Describe the procedures used to install equipment for industrial water and waste treatment systems, their controls, supports and fasteners.
16. Identify and describe the procedures used to fill, drain or purge test medium from system.
- i) medium
    - water
    - compressed air
    - glycol
    - water/glycol mix
    - inert gases
  - ii) methods to filling, drain or purge
    - hand pumps
    - centrifugal pumps
    - compressors
    - compressed gas cylinders
17. Describe the procedures used to reinstate system.
18. Describe the procedures used to protect industrial water and waste treatment system piping and piping components
- i) mechanical damage
  - ii) seismic activity
  - iii) environmental conditions
  - iv) contamination
19. Describe the procedures used to troubleshoot, test, repair and maintain industrial water and waste treatment systems.
- i) equipment
  - ii) tests
    - hydrostatic
    - pneumatic
20. Describe the procedures used to complete documentation following water and waste treatment system repair or maintenance.

Practical Objectives

N/A



## STM-305          Heat Tracing Systems (Steam)

### Learning Outcomes:

- Demonstrate knowledge of steam tracing systems, their applications and operation.
- Demonstrate knowledge of the procedures used to install steam tracing systems.
- Demonstrate knowledge of procedures for repairing and testing steam tracing systems and their components.

### 2015 Red Seal Occupational Standard Reference:

7.01 Installs steam tracing systems.

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

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret codes, regulations and standards pertaining to steam tracing systems.
2. Interpret information found on drawings and specifications pertaining to steam tracing systems.
3. Identify tools and equipment relating to steam tracing systems and describe their applications and procedures for use.
4. Identify types of steam tracing systems and components and describe their characteristics, operation and applications.
  - i) systems
    - low to high pressure
    - pre-insulated tubing bundles
  - ii) components
    - valves
    - breakouts
    - valve baskets

- steam traps
5. Describe steam tracing systems and installation variables.
    - i) temperature
    - ii) pressure
    - iii) flow
    - iv) functionality
    - v) systems
  6. Identify joining methods used to install steam tracing systems and describe their associated piping practices.
    - i) welding
    - ii) soldering
    - iii) grooving
    - iv) crimping
    - v) brazing and compression fittings
  7. Describe procedures used to troubleshoot, test, repair and maintain steam tracing systems and components.
    - i) troubleshoot
      - functional checks
      - visual inspections
      - use of temperature sensing devices and stethoscopes
    - ii) tests
      - hydrostatic
      - pneumatic
    - iii) repair
      - steam traps
      - tubing replacement
      - fitting replacement
    - iv) maintain
      - checking steam traps
      - cleaning
      - inspecting tubing
      - fittings and components for correct operation and wear
  8. Identify steam tracing system and component defects requiring repair.
    - i) defects
      - kinked tubing
      - passing traps
      - broken traps

9. Describe procedures used to test and repair steam tracing system and components.
10. Describe necessary documentation for steam tracing system and component repair and maintenance.
  - i) QA/QC verification
  - ii) recording of signoff that repair has been completed

Practical Objectives

1. Perform heat tracing.

## STM-310            Hydronic Systems Controls

### Learning Outcomes:

- Demonstrate knowledge of hydronic system controls, their applications and operation.
- Demonstrate knowledge of the procedures used to install, maintain, repair, test and troubleshoot hydronic system control.

### 2015 Red Seal Occupational Standard Reference:

- 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.
- 25.01 Secures commissioning area.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with hydronic system control.
2. Identify hazards and describe safe work practices pertaining to hydronic system control.
3. Interpret codes and regulations pertaining to hydronic system control.
4. Interpret information pertaining to hydronic system control found on drawings and specifications.
5. Identify tools and equipment relating to hydronic system controls and describe their applications and procedures for use.
6. Identify types of hydronic system controls and components describe their characteristics, applications and operation.

- i) operating and temperature controls
  - ii) safety controls
  - iii) pressure
  - iv) temperature and liquid level controls
  - v) zone valves (motorized)
  - vi) safety controls
  - vii) LWCO
  - viii) high and low limit temperature controls
7. Describe the procedures used to install hydronic system control components.
8. Describe the procedures used to protect hydronic system control components.
9. Describe the procedures used to set and adjust hydronic system control components.
10. Describe the procedures used to troubleshoot, test, repair and maintain hydronic system controls and components.

Practical Objectives

N/A

**Learning Outcomes:**

- Demonstrate knowledge of the properties of steam.
- Demonstrate knowledge of low pressure steam and condensate piping configurations, their applications and operation.
- Demonstrate knowledge of the procedures used to install piping and piping components for low pressure steam and condensate systems.
- Demonstrate knowledge of testing equipment and components for troubleshooting low pressure steam and condensate systems.
- Demonstrate knowledge of the procedures used to test troubleshoot, repair and maintain low pressure steam and condensate systems.

**2015 Red Seal Occupational Standard Reference:**

- 10.01 Installs equipment for low pressure steam and condensate systems.
- 10.02 Installs piping for low pressure steam and condensation systems.
- 10.03 Tests low pressure steam and condensate systems.
- 10.04 Maintains, troubleshoots and repairs low pressure steam and condensate system.

**Suggested Hours:**

72 Hours

**Objectives and Content:***Theoretical Objectives*

1. Interpret codes, regulations and standards pertaining to low pressure steam systems
  - i) ASME
2. Interpret information pertaining to low pressure steam, and condensate piping found on drawings, specifications and equipment manuals.
  - i) installation
  - ii) testing
  - iii) troubleshooting
  - iv) repair
  - v) maintenance

3. Identify low pressure steam and condensate system equipment, supports and fasteners and describe their applications and procedures for use.
  - i) equipment
    - boilers
    - boiler trim
    - expansion joints
    - pumps
    - heat transfer equipment
    - steam traps
    - tanks
    - valves
    - water treatment equipment
  - ii) supports
    - stands
    - hangers
    - plates
    - housekeeping pads
    - isolator pads
    - concrete embeds
  - iii) fasteners
    - expansion type inserts
    - beam clamps
    - nuts
    - bolts
    - screws
  
4. Identify low pressure steam and condensate system controls and components and describe their purpose and operation.
  - i) low water cut-offs (LWCO)
  - ii) operating pressure control
  - iii) feed water level controls
  - iv) high limit pressure controls
  - v) automatic valves (motorized)
  
5. Identify types of fuel used in low pressure steam and condensate systems.
  - i) fuel oil
  - ii) gas
  - iii) coal
  
6. Identify types of heat transfer equipment and describe their characteristics and operation.

- i) radiators
- ii) convectors
- iii) pipe coils
- iv) horizontal and vertical unit heaters
- v) heat exchangers
- vi) expansion
- vii) contraction

7. Identify type of pipe, piping components and piping configurations for low pressure steam and condensate systems, and describe their purpose, operation and applications.

- i) configurations
  - parallel flow
  - counter flow
  - two pipe
  - gravity return
  - mechanical return
  - wet or dry return
- ii) pipe
  - carbon steel
  - stainless steel
  - copper
- iii) components
  - manual and automatic valves
  - steam traps
  - air vents
  - expansion joints
  - strainers
  - check valves
- iv) application
  - residential heating
  - industrial
  - commercial and institutional (ICI) heating
  - process heating

8. Identify the considerations for selecting piping system components for low pressure steam and condensate systems.

- i) insulation requirements
- ii) type of supports
- iii) shoes and sleeves



9. Describe the procedures used to protect and restrain low pressure steam and condensate system piping and piping components.
  - i) protection from:
    - mechanical damage
    - seismic activity
    - environmental conditions
10. Describe the procedures used to install equipment for low pressure steam and condensate systems, their controls, supports and fasteners.
11. Describe the use of steam tables to identify the relationship between pressure and temperature.
12. Calculate grade and pitch of piping to ensure system efficiency and functionality.
13. Explain the properties of steam.
  - i) pressure
  - ii) temperature
  - iii) latent heat
  - iv) sensible heat
  - v) total heat
  - vi) volume
14. Explain the principles of heat transfer.
  - i) radiation
  - ii) conduction
  - iii) convection
15. Explain the applications and operation of low pressure steam and condensate systems.
  - i) heating
  - ii) process
16. Explain the effect of pressure on elevation when troubleshooting low pressure steam and condensate systems.
17. Explain the effect of elevation and temperature on pressure when testing low pressure steam and condensate systems.

18. 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.
19. Explain the effects of expansion and contraction on piping in low pressure steam and condensate systems.
20. Identify types of testing equipment and components and describe their characteristics and applications.
21. Identify types of isolation components and describe their characteristics and applications.
  - i) spectacle blinds
  - ii) spades
  - iii) plugs and caps
  - iv) temporary spool pieces
22. Identify types of system tests and describe their applications and procedures for use.
  - i) hydrostatic
  - ii) pneumatic
  - iii) vacuum
23. Identify test medium used in testing of low pressure steam and condensate systems, and describe their characteristics and applications.
24. Identify method of filling, draining or purging test medium.
  - i) medium
    - water
    - water/glycol mix
    - air
    - inert gases
  - ii) method of filling, draining or purging
    - using hand pumps
    - centrifugal pumps
    - compressors
    - compressed gas cylinders
25. Describe the procedures used to troubleshoot, repair and maintain low pressure steam and condensate systems.
26. Describe the procedures used to reinstate system.

27. Describe the procedures used to complete documentation following low pressure steam and condensate system repair or maintenance.

Practical Objectives

1. Install a low pressure steam main, unit heaters and associated components.

## STM-320          Fuel Systems

### Learning Outcomes:

- Demonstrate knowledge of fuel systems, their components, applications and operation.
- Demonstrate knowledge of fuel piping and tubing, their applications and operation.
- Demonstrate knowledge of the procedures used to install equipment, piping and components for fuel systems.
- Demonstrate knowledge of the procedures used to test, troubleshoot, repair and maintain fuel systems.

### 2015 Red Seal Occupational Standard Reference:

- 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.
- 25.01 Secures commissioning area.

### Suggested Hours:

60 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret jurisdictional codes and specifications for installation of fuel systems.
2. Interpret information pertaining to fuel systems testing found on drawings and specifications and equipment manuals.
  - i) troubleshooting
  - ii) repair
  - iii) maintenance
3. Explain the effects of electrolysis when connecting dissimilar metals on fuel piping and components.

4. Explain the effect of elevation and temperature on pressure when testing fuel systems.
5. Explain the effects trapped air in a fuel system will have on testing and describe the procedures to prevent or correct it.
6. Explain the effects of expansion and contraction on piping in fuel systems.
7. Explain the effect of pressure on elevation when troubleshooting fuel systems.
8. Explain the applications and operation of fuel systems.
9. Identify types of fuel systems and describe their characteristics and operation.
  - i) natural gas
  - ii) propane
  - iii) diesel
  - iv) fuel oil
  - v) black liquor
  - vi) hydro-carbon derivatives
  - vii) bio fuels
10. Identify equipment, control components, supports and fasteners used in fuel systems, and describe their purpose and operation.
  - i) equipment
    - 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
  - ii) equipment supports
    - expansion tanks
    - pumps
    - outdoor controllers
    - control valves
  - iii) equipment fasteners

- expansion type inserts
- beam clamps
- nuts
- bolts
- screws
- iv) control components
  - operating and temperature controls
  - safety controls
- v) controls
  - operating pressure controls
  - high limit pressure controls
  - pressure relief valves
- vi) supports
  - stands
  - hangers
  - plates
  - isolator pads
  - embeds

11. Identify types of testing equipment and components and describe their characteristics and applications.

- i) test tree and components
- ii) pressure gauges
- iii) pumps
- iv) compressors
- v) test medium

12. Identify types of piping and tubing, piping components and venting and exhaust components for fuel systems, and describe their purpose and operation.

- i) piping and tubing
  - carbon steel
  - copper
  - HDPE
  - stainless steel
  - yellow jacket
- ii) piping components
  - heat exchangers
  - pump trim
  - manual and automatic valves
  - expansion joints
  - flexible connectors

- strainers
  - check valves
  - iii) venting and exhaust components
    - mufflers
    - silencers
    - sound attenuation
13. Identify the considerations for selecting piping and tubing components for fuel systems.
- i) insulation requirements
  - ii) type of supports
  - iii) shoes and sleeves
  - iv) expansion
  - v) contraction
14. Identify test medium used in testing of fuel systems, and describe their characteristics and applications.
- i) water
  - ii) water/glycol mix (appropriate for the piping or system)
  - iii) air
  - iv) inert gases
15. Identify method of filling, draining or purging test medium.
- i) using hand pump
  - ii) centrifugal pump
  - iii) compressors
  - iv) compressed gas cylinders
16. Identify types of isolation components and describe their characteristics and applications.
- i) blind flanges
  - ii) plugs and caps
  - iii) temporary spool pieces
17. Describe the procedures used to protect and restrain fuel system piping and components.
- i) protection from mechanical damage
  - ii) seismic activity
  - iii) environmental conditions

18. Describe the procedures used to reinstate system.
19. Describe the procedures used to troubleshoot, test, repair and maintain fuel systems and components.
  - i) verify continuous bonding
  - ii) tests
    - hydrostatic
    - pneumatic
    - vacuum
20. Describe the procedures used to install equipment for fuel systems, their controls, supports and fasteners.
21. Describe trenching and shoring requirements.
22. Describe the procedures used to complete documentation following fuel system repair or maintenance explain the applications of fuel piping and tubing.

Practical Objectives

N/A



## STM-325      Medical Gas Systems

### Learning Outcomes:

- Demonstrate knowledge of medical gas systems, their components, applications and operation.
- Demonstrate knowledge of the procedures used to install equipment for medical gas systems.
- Demonstrate knowledge of test equipment and test medium, their characteristics and applications.
- Demonstrate knowledge of the procedures used to test, troubleshoot, repair and maintain medical gas systems.

### 2015 Red Seal Occupational Standard Reference:

- 18.01 Installs equipment for medical gas system.
- 18.02 Installs piping and tubing for medical gas systems.
- 18.03 Tests medical gas systems.
- 18.04 Maintains, trouble shoots and repairs medical gas systems.
- 25.01 Secures commissioning area.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information pertaining to medical gas system equipment found on drawings, specifications and equipment manuals.
  - i) testing
  - ii) troubleshooting
  - iii) repair
  - iv) maintenance
2. Interpret codes and regulations pertaining to medical gas system piping and tubing.
  - i) CSA
  - ii) AHJ

- iii) site specifications
  - iv) DISS
  - v) pin indexing system
  - vi) joining methods
  - vii) cleaning
  - viii) supporting
3. Explain the importance of maintaining cleanliness of installation tools, piping, fittings and equipment.
4. Identify types of medical gases and gas systems and describe their applications and characteristics.
- i) systems
    - oxygen
    - nitrogen
    - vacuum
    - mixed gases
  - ii) gases
    - oxygen
    - nitrogen
    - nitrous oxide/anesthetic
    - medical air
  - iii) applications
    - hospitals
    - dental suites
    - veterinary clinics
    - laboratories
5. Identify supports and fasteners used for medical gas system equipment and piping and describe their purpose and operation.
- i) supports
    - brackets
    - stands
    - hangers
    - plates
    - isolator pads
  - ii) fasteners
    - expansion type inserts
    - beam clamps
    - nuts
    - bolts

- screws

6. Identify medical gas connection systems.
  - i) diameter index safety system (DISS)
  - ii) pin indexing system
  
7. Identify types of test equipment and describe their characteristics and applications.
  - i) test trees and components
  - ii) valve boxes
  - iii) terminal boxes
  - iv) compressors
  - v) regulators
  - vi) pumps
  - vii) cryogenic tanks
  - viii) valves
  - ix) gauges
  - x) alarms,
  - xi) test medium
  
8. Identify types of test medium and describe their characteristics and applications.
  - i) nitrogen and system gases
  
9. Identify types of certification tests and describe their applications.
  - i) particulate test
  - ii) purification test
  - iii) cross-connection test
  - iv) operational test
  
10. Identify medical gas system piping and tubing.
  - i) copper certified for medical gas service
  - ii) carbon steel
  - iii) stainless steel
  
11. Identify method of purging and filling medical gas systems.
  - i) compressors
  - ii) compressed gas cylinders
  
12. Identify types of isolation components and describe their characteristics and applications.
  - i) valves

- ii) plugs and caps
- 13. Describe the procedures used to install equipment, piping and tubing for medical gas systems, their supports and fasteners.
- 14. Describe the procedures used to protect medical gas piping and piping components.
  - i) mechanical damage
  - ii) seismic activity
  - iii) environmental conditions
- 15. Describe the procedures used to remove test medium from system.
- 16. Describe the procedures used to reinstate system.
- 17. Describe the procedures used to troubleshoot, test, repair and maintain medical gas systems and components.
- 18. Describe the procedures used to complete documentation following medical gas repair or maintenance.

Practical Objectives

N/A

## STM-330          Cross Connection Control

### Learning Outcomes:

- Demonstrate knowledge of cross connection control devices, their applications and operation.

### 2015 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with cross connection control.
2. Identify hazards and describe safe work practices pertaining to cross connection control.
3. Identify certification requirements pertaining to cross connection control.
4. Interpret information pertaining to cross connection control devices found on drawings and specifications.
5. Explain backflow and its causes.
6. Identify types of cross connection control devices and describe their characteristics, operation and applications.

#### Practical Objectives

N/A

## **STM-335            Instrumentation**

### **Learning Outcomes:**

- Demonstrate knowledge of instrumentation devices, their applications and operation.
- Demonstrate knowledge of the procedures used to install instrumentation devices.
- Demonstrate knowledge of the procedures used to install tubing for instrumentation devices.

### **2015 Red Seal Occupational Standard Reference:**

N/A

### **Suggested Hours:**

12 Hours

### **Objectives and Content:**

#### *Theoretical Objectives*

1. Define terminology associated with instrumentation.
2. Identify hazards and describe safe work practices pertaining to instrumentation.
3. Interpret codes and regulations pertaining to instrumentation.
4. Interpret information found on drawings and specifications pertaining to instrumentation.
5. Identify tools and equipment relating to instrumentation and describe their applications and procedures for use.
6. Identify types of devices used in instrumentation and describe their characteristics, operation and applications.
7. Identify types of controllers and describe their applications and operation.

8. Identify tubing materials used in instrumentation and describe their characteristics and applications.
9. Describe the procedures used to install instrumentation devices.
10. Describe the procedures used to install controllers.
11. Describe the procedures used to install and support tubing for instrumentation devices.
12. Describe the procedures used to maintain and repair instrumentation systems.
13. Describe the procedures used to test and troubleshoot instrumentation systems.

*Practical Objectives*

N/A

## STM-340            Controlled Bolting and Tensioning

### Learning Outcomes:

- Demonstrate knowledge of the principles of torquing and controlled bolting.
- Demonstrate knowledge of torquing procedures for fasteners.

### 2015 Red Seal Occupational Standard Reference:

N/A

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with controlled bolting and tensioning.
2. Identify hazards and describe safe work practices pertaining to controlled bolting and tensioning.
3. Identify codes and regulations pertaining to controlled bolting and tensioning.
4. Identify tools and equipment associated with controlled bolting and tensioning.
5. Explain the importance of controlled bolting of fasteners.
  - i) controlled bolting
  - ii) bolt stress
6. Explain the principle of hydraulic tensioning and torquing of fasteners.
  - i) torque principle
  - ii) hydraulic tensioning equipment
  - iii) hydraulic torque wrenches
7. Describe types of fasteners used for joints on piping and vessels.
  - i) grades of stud bolts and nuts
  - ii) proper lengths of stud bolts



- iii) formulas for length of bolts, nuts and wrench sizes
  - iv) thread lubricants
8. Describe torquing procedures for fasteners.
- i) use of torque wrenches for fastening of flanged piping joints
  - ii) applications of torque patterns on flanges
  - iii) formulas required for use of equipment
  - iv) power supplies for different applications
  - v) safety requirements for use of power supplies in hazardous atmospheres

Practical Objectives

1. Perform hydraulic torquing.
2. Perform hydraulic tensioning.

# Level 4

Unit Code	Title	Hours	Page
STM-400	Complex Hoisting, Lifting and Rigging	24	112
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STM-440	Process Piping Systems	18	147
STM-445	System Testing and Commissioning	12	151
STM-450	Job Planning	6	155
STM-455	Quality Control	6	157
STM-460	Program Review	30	159

**Learning Outcomes:**

- Demonstrate knowledge of hoisting, lifting and rigging and positioning equipment, their applications, limitations and procedures for use.
- Demonstrate knowledge of calculations required when performing advanced hoisting and lifting operations.
- Demonstrate knowledge of the procedures used to perform rigging, hoisting and lifting and positioning operations.

**2015 Red Seal Occupational Standard Reference:**

- 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.

**Suggested Hours:**

24 Hours

**Objectives and Content:***Theoretical Objectives*

1. Identify hazards and describe safe work practices pertaining to advanced rigging, hoisting, lifting and positioning operations.
  - i) energized power lines
  - ii) weather conditions
  - iii) live equipment
  - iv) ground conditions
  - v) multi tag lines
2. Identify documentation required for engineered lifts.

3. Identify complex and critical lifts and describe their application and operation.
  - i) multi-crane lifts
  - ii) load transferring
  - iii) lifts that involve personnel
  - iv) lifts over personnel
  - v) unbalanced load and positioning load
  - vi) engineered lifts
4. Explain the procedures to perform complex and critical lifts and positioning.
5. Perform calculations pertaining to rigging, hoisting, lifting, and positioning.
  - i) sling angle
  - ii) load/weight
  - iii) center of gravity
  - iv) SWL
6. Identify documentation required for engineered lifts.

Practical Objectives

1. Develop a sample lift plan.

## STM-405          Hydraulic Systems

### Learning Outcomes:

- Demonstrate knowledge of hydraulic systems, equipment, their applications and operation.
- Demonstrate knowledge of the procedures used to install hydraulic system equipment, piping, tubing and hoses and their application and operation.
- Demonstrate knowledge of the procedures used to test, troubleshoot, repair and maintain hydraulic systems.

### 2015 Red Seal Occupational Standard Reference:

- 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.
- 25.01 Secures commissioning area.

### Suggested Hours:

12 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information pertaining to hydraulic systems found on drawings, schematics, specifications and equipment manuals.
  - i) piping
  - ii) tubing
  - iii) hoses
  - iv) testing
  - v) equipment
  - vi) testing
  - vii) troubleshooting
  - viii) repair
  - ix) maintenance

2. Explain the importance of ensuring contaminants do not enter the system when repairing or maintain hydraulic systems.
3. Explain the effects trapped air in a hydraulic system will have on testing and describe the procedures to prevent or correct it.
4. Explain the applications and operation of hydraulic piping systems.
5. Identify and describe types of testing equipment, components and test medium used in testing and describe their characteristics and applications.
6. Identify method of filling, draining or purging test medium.
  - i) using hand pumps
  - ii) centrifugal pumps
  - iii) compressed gas cylinders
7. Identify types of isolation components and describe their characteristics and applications.
  - i) spectacle blinds
  - ii) spades
  - iii) plugs and caps
  - iv) temporary spool pieces
8. Identify types of piping, tubing and hoses for hydraulic systems and describe their purpose, operation and considerations for selecting.
  - i) systems
    - open loop
    - closed loop
  - ii) piping
    - plastic
    - carbon steel
    - copper
    - stainless steel
  - iii) considerations
    - type of supports, system pressure, movement of the equipment
    - applications
    - to operate lifting devices, to operate motors
9. Identify types of hydraulic equipment, and describe the procedures for installation.

- i) reservoir tanks
- ii) pumps
- iii) motors
- iv) relief valves, fittings, valves, cylinders, pistons, actuators, accumulators
- v) fluid coolers
- vi) fluid heaters
- vii) strainers
- viii) filters

10. Identify hydraulic equipment supports, fasteners and controls, their installation, applications and procedures for use.

- i) equipment supports
  - stands
  - hangers
  - plates
  - housekeeping pads
  - isolator pads
  - concrete embeds
- ii) equipment fasteners
  - inserts
  - beam clamps
  - nuts
  - bolts
  - screws
- iii) hydraulic control components
  - operating
  - temperature and pressure controls
  - safety controls
  - valves
  - actuators
- iv) controls
  - operating
  - temperature and pressure controls, safety controls, valves
  - actuators

11. Identify types of fluids and fluid-related formulae, and describe their characteristics and applications.

12. Describe the procedures used to troubleshoot, test, repair and maintain hydraulic systems and components.

- i) tests

- hydrostatic
- pneumatic

13. Describe the procedures used to reinstate hydraulic systems.
14. Describe the procedures used to complete documentation following hydraulic system repair or maintenance.
15. Describe the procedures used to install and protect piping, tubing and hoses for hydraulic systems.
  - i) protection from mechanical damage
  - ii) seismic activity
  - iii) vibration, environmental conditions

Practical Objectives

N/A



**Learning Outcomes:**

- Demonstrate knowledge of compressed air and pneumatic piping configurations, their applications and operation.
- Demonstrate knowledge of the procedures used to install, test, maintain, troubleshoot and repair compressed air and pneumatic systems.

**2015 Red Seal Occupational Standard Reference:**

- 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.
- 25.01 Secures commissioning area.

**Suggested Hours:**

12 Hours

**Objectives and Content:***Theoretical Objectives*

1. Interpret codes and regulations pertaining to compressed air and pneumatic systems.
2. Interpret information pertaining to compressed air and pneumatic system found on drawings, specifications and equipment manuals.
  - i) testing
  - ii) troubleshooting
  - iii) repair and maintenance
3. Explain the effects trapped air, moisture and particulate in a compressed air and pneumatic system will have on system operation and describe the procedures to prevent or correct it.
4. Explain the effect of elevation and temperature on pressure when testing compressed air and pneumatic systems.

5. Explain the applications and operation of compressed air/pneumatic piping system configurations.
  - i) piping
    - branch lines above the horizontal centerline
  - ii) applications
    - instrument air
    - utility air
    - process air
    - inert gases used in Industrial settings
  
6. Explain the effects of expansion and contraction on piping in compressed air and pneumatic systems.
  
7. Explain the principles of heat transfer.
  - i) principles
    - radiation
    - conduction
    - convection
  
8. Identify types of heat transfer equipment and describe their characteristics and operation.
  - i) equipment
    - heat exchangers
    - pipe coils
  
9. Explain the effects of electrolysis when connecting dissimilar metals on compressed air and pneumatic piping and components.
  
10. Identify types of testing equipment and describe their characteristics and applications.
  
11. Identify types of isolation components and describe their characteristics and applications.
  - i) spectacle blinds
  - ii) spades, plugs and caps
  - iii) temporary spool pieces
  - iv) lockable block and bleed valves
  
12. Identify test medium used in testing of compressed air and pneumatic systems, and describe their characteristics and applications.

- i) water
  - ii) air
  - iii) inert gases
13. Identify and describe methods of filling, draining or purging test medium.
- i) hand pumps
  - ii) centrifugal pumps
  - iii) compressors
  - iv) compressed gas cylinders
14. Identify types of piping and piping components and describe their purpose and operation.
- i) piping
    - carbon steel
    - copper, plastic (approved to withstand high pressures)
    - galvanized
  - ii) components
    - manual and automatic valves
    - fittings
    - flexible connectors and hoses
    - strainers
    - check valves
15. Identify the considerations for selecting piping system components for compressed air and pneumatic systems.
- i) suitability of piping material for the application
  - ii) insulation requirements
  - iii) type of supports, shoes
16. Identify equipment, controls, supports and fasteners used and describe their purpose and operation.
- i) equipment
    - compressors
      - piston
      - screw type
      - rotary
      - axial
      - reciprocating
      - vane
    - heat transfer equipment

- receiver tanks
  - valves
  - dryers
  - separators
  - filters
  - lubricators
  - compressed gas cylinders
  - tanks
- ii) controls
- regulators
  - solenoids
  - actuators
  - pressure switches
  - flow switches
  - alarm switches
- iii) supports
- stands, hangers
  - plates
  - housekeeping pads
  - isolator pads
  - concrete embeds
- iv) fasteners
- expansion type inserts
  - beam clamps
  - nuts
  - bolts
  - screws

17. Describe the procedures used to troubleshoot, test, repair and maintain compressed air and pneumatic systems and components.

- i) test
- hydrostatic
  - pneumatic

18. Describe the procedures used to complete documentation following compressed air and pneumatic system repair or maintenance.

19. Describe the procedures used to install equipment and piping components for compressed air and pneumatic systems.

20. Describe the procedures used to protect compressed air and pneumatic piping and piping components.
- i) from mechanical damage
  - ii) seismic activity
  - iii) environmental conditions
21. Describe the procedures used to reinstate system.

Practical Objectives

N/A

**Learning Outcomes:**

- Demonstrate knowledge of the properties of steam.
- Demonstrate knowledge of high pressure steam and condensate piping, their applications and operation.
- Demonstrate knowledge of the procedures used to install piping and piping components for high pressure steam and condensate systems.
- Demonstrate knowledge of testing equipment and components for troubleshooting high pressure steam and condensate systems.
- Demonstrate knowledge of the procedures used to troubleshoot, repair and maintain high pressure steam and condensate systems.

**2015 Red Seal Occupational Standard Reference:**

- 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.
- 25.01 Secures commissioning area.

**Suggested Hours:**

60 Hours

**Objectives and Content:***Theoretical Objectives*

1. Interpret information pertaining to high pressure steam and condensate systems, piping and equipment found on drawings, specifications and equipment manuals.
  - i) troubleshooting
  - ii) testing
  - iii) repair
  - iv) maintenance
2. Explain the applications and operation of high pressure steam and condensate systems.

- i) power generation
  - ii) process
  - iii) central heating
3. Explain the effect of elevation and temperature on pressure when testing high pressure steam and condensate systems.
4. Explain the properties of steam and heat transfer.
  - i) heat transfer
    - radiation
    - conduction
    - convection
  - ii) steam
    - pressure
    - temperature
    - latent heat
    - sensible heat
    - total heat
    - superheat
    - volume
5. 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.
6. Explain the effect of pressure on elevation when troubleshooting high pressure steam and condensate systems.
7. Explain the applications of high pressure steam and condensate piping.
8. Explain the effects of expansion and contraction on piping in high pressure steam and condensate systems.
9. Identify test medium used in testing of high pressure steam and condensate systems, and describe their characteristics and applications.
  - i) water
  - ii) water/glycol mix
10. Identify method of filling, draining or purging test medium.
  - i) using pumps
  - ii) using high pressure water supply hoses

11. Identify types of isolation components and describe their characteristics and applications.
  - i) spectacle blinds
  - ii) spades
  - iii) plugs and caps
  - iv) temporary spool pieces
  
12. Identify types of testing equipment and components and describe their characteristics and applications.
  
13. Identify types of pipe and piping components for high pressure steam and condensate systems, and describe their purpose and operation.
  - i) piping
    - chrome
    - carbon steel
    - stainless steel
  - ii) components
    - manual and automatic valves
    - steam traps
    - expansion joints
    - strainers
    - check valves
  
14. Identify the considerations for selecting piping components for high pressure steam and condensate systems.
  
15. Identify types of high pressure steam and condensate system equipment, and describe their characteristics and operation.
  - i) boilers
  - ii) boiler trim
  - iii) expansion joints
  - iv) pumps
  - v) heat transfer equipment
  - vi) steam traps
  - vii) valves, flash tanks
  - viii) superheaters
  - ix) re-heaters
  - x) de aerators
  - xi) desuperheaters
  - xii) condensers
  - xiii) water treatment equipment



16. Identify types of fuel used in high pressure steam and condensate systems.
- i) fuel oil
  - ii) gas
  - iii) coal
  - iv) biomass
  - v) nuclear
17. Identify sources of cooling used in high pressure steam and condensate system.
- i) cooling towers
  - ii) condensers
  - iii) flash tanks
  - iv) blowdown tanks
  - v) converters
18. Identify types of heat transfer equipment and describe their characteristics and operation.
- i) converters
  - ii) turbines
  - iii) radiators
  - iv) convectors
  - v) pipe coils
  - vi) horizontal and vertical unit heaters
19. Identify equipment, controls and components, supports and fasteners used in high pressure steam and condensate systems, and describe their purpose and operation.
- i) supports
    - stands
    - hangers
    - plates
    - housekeeping pads
    - isolator pads
    - concrete embeds
  - ii) fasteners
    - expansion type inserts
    - beam clamps
    - nuts
    - bolts
    - screws
  - iii) control

- LWCO
  - operating pressure controls
  - high limit pressure controls
  - safety controls
  - feed water controls
20. Identify types of tests and describe their applications
- i) hydrostatic
  - ii) pneumatic
21. Describe the use of steam tables to identify the relationship between pressure and temperature.
22. Describe the procedures used to install equipment and piping and piping components for high pressure steam and condensate systems, their controls, supports and fasteners.
23. Describe the procedures used to protect and restrain high pressure steam and condensate system piping and piping components.
24. Describe the procedures used to troubleshoot, test, repair and maintain high pressure steam and condensate systems and components.
25. Describe the procedures used to complete documentation following high pressure steam and condensate system repair or maintenance.
26. Describe the procedures used to reinstate system.
27. Calculate grade and pitch of piping to ensure system efficiency and functionality.

Practical Objectives

N/A

## STM-420            Refrigeration Systems

### Learning Outcomes:

- Demonstrate knowledge of refrigeration systems, their components, applications and operation.
- Demonstrate knowledge of the procedures used to install equipment, piping and piping components for refrigeration systems.
- Demonstrate knowledge of the procedures used to test associated components of refrigeration systems.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair associated components of refrigeration systems.

### 2015 Red Seal Occupational Standard Reference:

- 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.
- 25.01 Secures commissioning area.

### Suggested Hours:

18 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information pertaining to refrigeration equipment and piping found on drawings and specifications.
2. Interpret codes and regulations pertaining to refrigeration systems.
3. Identify types of refrigeration systems, components and equipment and describe their characteristics and applications.
  - i) systems
  - ii) components

- iii) applications
4. Identify refrigeration equipment supports and fasteners and describe their operation, applications, purpose and procedures for use.
    - i) supports
    - ii) fasteners
  5. Describe the procedures used to install equipment, controls, supports and fasteners for refrigeration systems.
  6. Identify refrigeration control components and describe their purpose and operation.
    - i) operating and temperature controls
    - ii) safety controls
  7. Identify types of refrigeration piping and tubing.
    - i) carbon steel
    - ii) copper
    - iii) alloys
  8. Describe the procedures used to install piping and components for refrigeration systems.
  9. Explain the applications and operation of refrigeration systems and of refrigeration piping configurations.
  10. Identify sources of energy used in refrigeration systems.
  11. Explain the principles of heat transfer.
    - i) radiation
    - ii) conduction
    - iii) convection
  12. Identify the properties and characteristics of refrigerants.
    - i) CFCs
    - ii) HCFCs
  13. Explain the effects of electrolysis when connecting dissimilar metals on refrigeration piping and components.

14. Explain the effects of expansion and contraction on piping in refrigeration systems.
15. Explain the effects of trapped air in refrigeration piping systems and describe the procedures to prevent it.
16. Identify the considerations for selecting piping system components for refrigeration systems.
17. Describe the procedures used to test refrigeration systems and control components.
18. Identify types of tests and describe their applications.
19. Identify test medium used in testing of refrigeration systems, and describe their characteristics and applications.
20. Identify method of filling, draining, removing or purging test medium.
21. Identify types of isolation components and describe their characteristics and applications.
22. Explain the effects trapped air in components of a refrigeration system will have on testing and describe the procedures to prevent or correct it.
23. Describe the procedures used to reinstate system.
24. Describe the procedures used to troubleshoot, maintain and repair associated components of refrigeration systems.
25. Describe the procedures used to protect associated components of refrigeration systems and piping and piping components.
  - i) vibration
  - ii) mechanical damage
  - iii) seismic activity
  - iv) environmental conditions

26. Describe the procedures used to set and adjust associated components of refrigeration systems.

Practical Objectives

N/A

## STM-425          Heat Recovery Systems

### Learning Outcomes:

- Demonstrate knowledge of heat recovery systems, equipment and components their applications and operation.
- Demonstrate knowledge of the procedures used to install piping and components and equipment for heat recovery systems.
- Demonstrate knowledge of heat recovery piping configurations, their applications and operation.
- Demonstrate knowledge of system testing and the procedures used to test heat recovery systems.
- Demonstrate knowledge of the procedures used to troubleshoot, test, repair and maintain heat recovery systems and components.

### 2015 Red Seal Occupational Standard Reference:

- 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.
- 25.01 Secures commissioning area.

### Suggested Hours:

15 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information pertaining to heat recovery system and equipment found on drawings and specifications.
2. Interpret information pertaining to heat recovery system found on drawings, specifications and equipment manuals.
3. Identify types of heat recovery equipment and control components and describe their characteristics and operation.
  - i) equipment
    - expansion joints

- pumps
  - heat transfer equipment
    - rooftop units
  - heat exchangers
  - tanks
  - valves
  - water treatment equipment
  - ii) control components
    - operating and temperature controls
    - safety controls
4. Identify heat recovery equipment, controls, supports and fasteners and describe their applications and procedures for use.
- i) supports
    - stands
    - hangers
    - plates
    - housekeeping pads
    - isolator pads
    - concrete embeds
  - ii) fasteners
    - expansion type inserts
    - beam clamps
    - nuts
    - bolts
    - screws
  - iii) different temperature controllers
  - iv) flow switches
  - v) motorized zone valves
  - vi) sensors
5. Identify sources of heat used in heat recovery systems.
- i) gland seals
  - ii) refrigerant gases
  - iii) exhaust steam
  - iv) flash steam
  - v) waste water
  - vi) cooling water
  - vii) heat recovery ventilators (HRV)
    - pre-heat coils
    - exhaust steam coils



6. Identify types of isolation components and describe their characteristics and applications.
7. Identify types of heat transfer and heat recovery equipment and describe their characteristics, principles and operation.
  - i) heat transfer equipment
    - radiators
    - convectors
    - pipe coils
    - horizontal and vertical unit heaters
    - radiant panels
    - heat exchangers
  - ii) principles of heat transfer
    - radiation
    - conduction
    - convection
8. Identify types of testing equipment and components and describe their characteristics and applications.
9. Identify test medium used in testing of heat recovery systems, and describe their characteristics and applications.
10. Identify method of filling, draining or purging test medium.
11. Identify types of piping and piping components for heat recovery systems, and describe their purpose and operation.
  - i) piping components
    - heat exchangers
    - pump trim
    - manual and automatic valves
    - expansion joints
    - flexible connectors
    - strainers
    - check valves
12. Identify the considerations for selecting piping system components for heat recovery systems.
  - i) insulation requirements
  - ii) type of supports
  - iii) shoes and sleeves

- iv) expansion
  - v) contraction
13. Explain the effect of elevation and temperature on pressure when testing heat recovery systems.
  14. Explain the effects trapped air in a heat recovery piping system and describe the procedures to prevent or correct it.
  15. Explain the applications of heat recovery piping configurations.
    - i) open loop
    - ii) closed loop
  16. Explain the effects of electrolysis when connecting dissimilar metals on heat recovery piping and components.
  17. Explain the effects of expansion and contraction on piping in heat recovery systems.
  18. Explain the applications and operation of heat recovery systems.
  19. Describe the procedures used to install piping and components, equipment for heat recovery systems, their controls, supports and fasteners.
  20. Describe the procedures used to troubleshoot, test, repair, and maintain heat recovery systems.
  21. Describe the procedures used to complete documentation following heat recovery systems system repair or maintenance.
  22. Describe the procedures used to reinstate system.
  23. Describe the procedures used to protect and restrain heat recovery system piping and components.
    - i) protection from mechanical damage
    - ii) seismic activity
    - iii) environmental conditions
  24. Calculate pitch or grade in order to ensure system efficiency and functionality

Practical Objectives

N/A

**Learning Outcomes:**

- Demonstrate knowledge of geo-exchange and geothermal piping configurations, their applications and operation.
- Demonstrate knowledge of geo-exchange and geothermal equipment, their applications and operations.
- Demonstrate knowledge of the procedures used to install geo-exchange and geothermal system equipment and piping.
- Demonstrate knowledge of testing equipment and components for troubleshooting geo-exchange and geothermal systems.
- Demonstrate knowledge of the procedures used to test, troubleshoot, repair and maintain geo-exchange and geothermal systems.

**2015 Red Seal Occupational Standard Reference:**

- 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.
- 25.01 Secures commissioning area.

**Suggested Hours:**

12 Hours

**Objectives and Content:***Theoretical Objectives*

1. Interpret information pertaining to geo-exchange and geothermal equipment and piping found on drawings and specifications.
2. Interpret information pertaining to geo-exchange and geothermal system found on drawings, specifications and equipment manuals.
  - i) testing
  - ii) troubleshooting
  - iii) repair
  - iv) maintenance

3. Identify types of geo-exchange and geothermal equipment, supports and fasteners and describe their purpose, characteristics and operation.
  - i) equipment
    - expansion joints
    - pumps
    - heat transfer equipment
    - steam traps
    - tanks
    - valves
    - water treatment equipment
  - ii) supports
    - expansion tanks
    - pumps
    - outdoor controllers
    - control valves
    - stands
    - hangers
    - plates
    - isolator pads
    - embeds
  - iii) fasteners
    - expansion type inserts
    - beam clamps
    - nuts
    - bolts
    - screws
  
4. Identify sources of heat and cooling used in geo-exchange and geothermal systems.
  - i) heat
    - deep earth
    - ground source
  - ii) cooling
    - ground source
    - cooling towers
    - chillers
    - refrigeration
    - heat exchangers
  
5. Identify hazards associated with heat transfer fluid.

6. Identify piping configurations for earth loops.
7. Identify purpose and functionality of reversing valve within heat pump.
8. Identify difference in operation of Direct Expansion (DX) system.
9. Identify types of isolation components and describe their characteristics and applications.
10. Identify types of tests, testing equipment and components and describe their applications.
11. Identify test medium used in testing of geo-exchange and geothermal systems, and describe their characteristics and applications.
12. Identify method of filling, draining or purging test medium.
13. Identify types of piping and piping components for geo-exchange and geothermal systems, and describe their purpose and operation.
  - i) piping types
    - carbon steel
    - copper
    - HDPE
    - PEX
    - PEX-AL-PEX
  - ii) piping components
    - heat exchangers
    - pump trim
    - manual and automatic valves
    - expansion joints
    - strainers
    - check valves
14. Identify the considerations for selecting piping system components for geo-exchange and geothermal systems.
  - i) domestic hot water heating
  - ii) hydronic heating and cooling
  - iii) radiant heating
  - iv) open loop
  - v) closed loop
  - vi) horizontal loop

- vii) vertical loop
15. Identify types and principles of heat transfer equipment and controls and describe their characteristics and operation.
  16. Explain compression refrigeration components and cycle.
    - i) evaporators
    - ii) compressors
    - iii) condensers
    - iv) metering devices
    - v) refrigerant controls
    - vi) related piping
  17. Explain the applications of geo-exchange and geothermal piping configurations.
    - i) residential heating
    - ii) Industrial heating
    - iii) process
  18. Explain the effects of electrolysis when connecting dissimilar metals on geo-exchange and geothermal piping and components.
  19. Explain the effects of expansion and contraction on piping in geo-exchange and geothermal systems.
  20. Explain the effects of elevation and temperature on pressure when testing geo-exchange and geothermal systems.
  21. Explain the effects of trapped air in a geo-exchange and geothermal system will have on testing and describe the procedures to prevent it or correct it.
  22. Explain the effects of pressure on elevation when troubleshooting geo-exchange and geothermal systems.
  23. Describe the procedures used to reinstate system.
  24. Describe the procedures used to protect and restrain geo-exchange and geothermal system piping and components.
    - i) protection from mechanical damage
    - ii) seismic activity
    - iii) environmental conditions

25. Describe the procedures used to troubleshoot, test, repair, and maintain geo-exchange and geothermal systems.
26. Describe the procedures used to complete documentation following geo-exchange and geothermal systems repair or maintenance.
27. Describe the procedures used to install piping, components and equipment for geo-exchange and geothermal systems, their controls, supports and fasteners.

Practical Objectives

N/A



## STM-435          Solar Heating Systems

### Learning Outcomes:

- Demonstrate knowledge of solar heating systems, equipment, their components, applications and operation.
- Demonstrate knowledge of solar piping configurations, their applications and operation.
- Demonstrate knowledge of the procedures used to install piping and components for solar heating systems.
- Demonstrate knowledge of diagnostic and testing equipment for troubleshooting solar heating systems.
- Demonstrate knowledge of the procedures used to install, test, troubleshoot, repair and maintain solar heating systems.

### 2015 Red Seal Occupational Standard Reference:

- 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.
- 25.01 Secures commissioning area.

### Suggested Hours:

15 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Interpret information pertaining to solar heating systems and equipment found on drawings, specifications and equipment manuals.
  - i) troubleshooting
  - ii) repair
  - iii) maintenance
2. Identify types of solar heating systems and describe their characteristics and applications.

3. Identify types of testing equipment and components and describe their characteristics and applications.
4. Identify types of solar equipment, and describe their characteristics and operation.
  - i) solar collectors
    - flat plate
    - evacuated tube
  - ii) indirect water heats
  - iii) heat dissipaters
  - iv) controls expansion joints
  - v) pumps
  - vi) heat transfer equipment tanks
  - vii) tanks
  - viii) valves
  - ix) water treatment equipment
5. Identify types of solar heating systems, and describe their characteristics and operation.
  - i) domestic water heating
  - ii) space heating
  - iii) direct and indirect systems
  - iv) closed loop systems
6. Identify solar control components and describe their applications and procedures for use.
  - i) operating and temperature controls
  - ii) safety control
7. Identify solar equipment controls, supports and fasteners and describe their applications and procedures for use.
  - i) controls
    - differential temperature controllers
    - flow switches
    - motorized zone valves
    - sensors
  - ii) supports
    - expansion tanks
    - pumps
    - collector rackings
    - outdoor controllers

- control valves
  - hangers
  - stands
  - plates
  - isolator pads
  - embeds
- iii) fasteners
- expansion type inserts
  - beam clamps
  - nuts
  - bolts
  - screws
8. Identify sources of heat used in solar heating systems.
- i) solar radiation
9. Identify types of isolation components and describe their characteristics and applications.
10. Identify test medium used in testing of solar heating systems, and describe their characteristics and applications.
11. Identify method of filling, draining or purging test medium.
12. Identify the considerations for selecting piping system components for solar heating systems.
- i) insulation requirements
- ii) types of supports
- iii) shoes and sleeves
- iv) expansion
- v) contraction
13. Identify systems that require grade.
14. Identify hazards related to heat transfer fluid.
15. Identify codes and standards for solar heating systems.
16. Identify types of heat transfer equipment and describe their characteristics and operation.
- i) radiators

- ii) convectors
- iii) pipe coils
- iv) horizontal and vertical unit heaters
- v) radiant panels
- vi) solar collectors
  - flat plate
  - evacuated tube
- vii) water heaters
- viii) heat dissipaters
- ix) heat exchangers

17. Identify types of piping and piping components for solar heating systems, and describe their purpose and operation.

- i) piping types
  - carbon steel
  - copper
  - HDPE
  - PEX
  - PEX-AL-PEX
- ii) piping components
  - heat exchangers
  - pump trim
  - manual and automatic valves
  - expansion joints
  - strainers
  - check valves

18. Explain the effects trapped air in a solar heating system will have on system operation and describe the procedures to prevent or correct it.

19. Explain the effect of elevation and temperature on pressure when testing solar heating systems.

20. Explain the effects of electrolysis when connecting dissimilar metals on solar piping and components.

21. Explain the effects of expansion and contraction on piping in solar heating systems.

22. Explain the applications and operation of solar heating systems.

23. Explain the principles of heat transfer.
  - i) radiation
  - ii) conduction
  - iii) convection
  
24. Describe the procedures used to troubleshoot, test, repair and maintain solar heating systems and components.
  
25. Describe the procedures used to reinstate system.
  
26. Describe the procedures used to complete documentation following solar heating system repair or maintenance.
  
27. Describe the procedures used to install equipment, piping and components for solar heating systems their controls, supports and fasteners.
  
28. Describe the procedures used to protect and restrain solar heating system piping and components.
  - i) protection from mechanical damage
  - ii) seismic activity
  - iii) environmental conditions

Practical Objectives

N/A

## STM-440      **Process Piping Systems**

### **Learning Outcomes:**

- Demonstrate knowledge of process piping system equipment, their applications and operation.
- Demonstrate knowledge of the procedures used to install piping and piping components for process piping systems.
- Demonstrate knowledge of testing equipment and components for troubleshooting process piping systems.
- Demonstrate knowledge of the procedures used to test, troubleshoot, repair and maintain process piping systems.

### **2015 Red Seal Occupational Standard Reference:**

- 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.
- 25.01 Secures commissioning area.

### **Suggested Hours:**

18 Hours

### **Objectives and Content:**

#### Theoretical Objectives

1. Interpret jurisdictional codes and specifications for installation of process piping systems.
2. Interpret information pertaining to process piping systems and equipment found on drawings, specifications and equipment manuals.
  - i) testing
  - ii) troubleshooting
  - iii) repair
  - iv) maintenance
3. Identify types of process piping systems and describe their characteristics and applications.

- i) gas/oil refining
  - ii) pulp production
  - iii) mining
  - iv) food processing
  - v) chemical production
  - vi) ship building
  - vii) sawmills
  - viii) manufacturing
  - ix) Industrial processes
4. Identify types of testing equipment and components and describe their characteristics and applications.
5. Identify test medium used in testing of process piping systems, and describe their characteristics and applications.
6. Identify method of filling, draining or purging test medium.
7. Identify types of isolation components and describe their characteristics and applications.
8. Identify the considerations for selecting piping system components for process piping systems.
- i) client requirements
  - ii) insulation requirements
  - iii) types of supports
  - iv) shoes and sleeves
  - v) expansion
  - vi) contraction
9. Identify types of pipe and piping components for process piping systems, and describe their purpose and operation.
- i) piping
    - carbon steel
    - copper
    - chrome
    - plastic
    - fiberglass
    - titanium
    - copper-nickel
    - stainless steel

- ii) piping components
    - manual and automatic valves
    - fittings
    - expansion joints
    - strainers
    - filters
    - check valves
10. Identify process piping system equipment supports and fasteners and describe their applications and procedures for use.
- i) supports
    - stands
    - hangers
    - plates
    - housekeeping pads
    - isolator pads
    - concrete embeds
  - ii) fasteners
    - expansion type inserts
    - beam clamps
    - nuts
    - bolts
    - screws
11. Identify process piping system controls and describe their purpose and operation.
- i) operating and temperature controls
  - ii) flow meters
  - iii) liquid level controls
  - iv) safety controls
12. Explain the effect of pressure on elevation when troubleshooting process piping systems.
13. Explain the effects trapped air in a process piping system will have on system operation and describe the procedures to prevent or correct it.
14. Explain the effect of elevation and temperature on pressure when testing process piping systems.



15. Explain the effects of electrolysis when connecting dissimilar metals on process piping system piping and piping components.
16. Explain the effects of expansion and contraction on piping in process piping systems.
17. Explain the applications and operation of process piping systems.
18. Describe the procedures used to test, troubleshoot, repair and maintain process piping systems.
19. Describe the procedures used to complete documentation following process piping system repair or maintenance.
20. Describe the procedures used to reinstate system.
21. Describe the procedures used to install equipment for process piping systems, their controls, supports and fasteners.
22. Describe the procedures used to install piping and piping components for process piping systems.
23. Describe the procedures used to protect process piping and piping components.

Practical Objectives

N/A

**Learning Outcomes:**

- Demonstrate knowledge of system flushing and chemical treatment procedures.
- Demonstrate knowledge of system inspection, start-up and system commissioning and its associated procedures.
- Demonstrate knowledge of repair and replacement procedures.

**2015 Red Seal Occupational Standard Reference:**

- 24.01 Flushes system.
- 24.02 Chemically treats system.
- 24.03 Pre-checks system for commissioning.
- 24.04 Selects and connects commissioning.
- 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 procedures.

**Suggested Hours:**

12 Hours

**Objectives and Content:***Theoretical Objectives*

1. Identify piping and equipment in system being inspected.
2. Identify types of testing equipment and components and describe their characteristics and applications.
  - i) test tree and components
  - ii) pressure gauges
  - iii) pumps
  - iv) compressors
  - v) test medium
3. Identify test medium used in testing of piping systems, and describe their characteristics and applications.

- i) water
  - ii) water/glycol mix
  - iii) air
  - iv) inert gases
4. Identify types of testing equipment and components and describe their characteristics and applications.
- i) blind flanges
  - ii) calibrated pressure gauges
  - iii) test pumps
  - iv) relief valves
  - v) gate valves, recorders
  - vi) testing trees/headers
5. Identify hazards and describe safe work practices pertaining to system commissioning and inspection, repair and start-up.
- i) system isolation
  - ii) lock out procedures
  - iii) testing medium
  - iv) system re-energizing
  - v) procedures for removal of lock-outs
  - vi) safe handling of system medium
6. Identify sources of information pertaining to repair, flushing, commissioning, system inspection and start-up.
- i) specifications
  - ii) drawings
  - iii) operating conditions
7. Identify tools and equipment relating to system inspection, system flushing, system commissioning, repair and start-up and describe their applications and procedures for use.
- i) flushing
  - ii) chemical treating
  - iii) start-up and documentation
  - iv) reinstatement after testing
8. Identify types of flushing medium and describe their applications.
9. Identify jurisdictional codes and specifications for chemical treatment and disposal of medium.

10. Identify methods for charging systems to operating design pressure.
11. Identify permits and approvals required to perform pressurization.
12. Identify piping and equipment in system being inspected, repaired and started up.
13. Identify method of filling, draining, removing or purging test medium.
  - i) using hand pumps
  - ii) centrifugal pumps
  - iii) compressors
  - iv) compressed gas cylinders
14. Identify types of isolation components and describe their characteristics and applications.
  - i) blind flanges
  - ii) plugs and caps
  - iii) temporary spool pieces
15. Describe the procedures used to select and connect commissioning equipment.
16. Describe the procedures used to perform start-up, perform pre-checks, repairs, pressurization and system flushing.
  - i) system isolation
  - ii) check of equipment
  - iii) piping for location and orientation
  - iv) selection and connection of test equipment
  - v) system pressurization
  - vi) system inspection and correction of leaks
  - vii) documentation
  - viii) removal of test equipment
  - ix) filling
  - x) venting
  - xi) increasing pressure in a controlled manner
17. Describe the procedures used to perform chemical treatments.

Practical Objectives

N/A

## STM-450          Job Planning

### Learning Outcomes:

- Demonstrate knowledge of the procedures used to plan and organize work.
- Demonstrate knowledge of project costs and efficient trade practices.

### 2015 Red Seal Occupational Standard Reference:

3.01 Plans work.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify sources of information relevant to work planning.
  - i) documentation
  - ii) drawings
  - iii) related professionals
  - iv) clients
2. Describe the considerations for determining job requirements.
  - i) personnel
  - ii) tools and equipment
  - iii) materials
  - iv) permits
3. Describe the procedures used to plan work.
  - i) scheduling
  - ii) estimating
4. Describe the procedures used to organize and maintain inventory.
5. Identify work methods and planning to maximize practices that are most efficient while maintaining commitment to safety.
6. Calculate labour and time costs.

7. Calculate material costs and wastage.

Practical Objectives

N/A

## STM-455            Quality Control

### Learning Outcomes:

- Demonstrate knowledge of quality control and its applications.
- Demonstrate knowledge of procedures used to complete quality control documentation.

### 2015 Red Seal Occupational Standard Reference:

3.05 Performs quality control functions.

### Suggested Hours:

6 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Identify hazards and safe work practices pertaining to quality control.
2. Interpret information pertaining to quality control found on drawings and specifications.
3. Identify tools and equipment relating to quality control.
4. Identify methods of NDE.
  - i) hydrostatic
  - ii) pneumatic
  - iii) visual
  - iv) dye penetrate
  - v) magnetic particle
  - vi) x-ray
  - vii) ultrasonic
5. Identify methods of heat treatment and stress relief.
6. Identify types of QC documentation and describe their applications.
  - i) manuals
  - ii) daily reports



- iii) mill test reports
- iv) welders logs
- v) torque sheet
- vi) bolt tensioning sequence
- vii) punch list
- viii) valve charts

Practical Objectives

N/A

## STM-460            Program Review

### Learning Outcomes:

- Demonstrate knowledge of the Red Seal Occupational Standard and its relationship to the Interprovincial Examination.
- Demonstrate knowledge of overall comprehension of the trade in preparation for the Interprovincial Examination.

### Entire Red Seal Occupational Standard (RSOS)

### Suggested Hours:

30 Hours

### Objectives and Content:

#### Theoretical Objectives

1. Define terminology associated with an RSOS.
  - i) levels
  - ii) tasks
  - iii) sub-tasks
  
2. Explain how an RSOS is developed and the link it has with the Interprovincial Red Seal Examination.
  - i) development
  - ii) validation
  - iii) level and task weighting
  - iv) examination breakdown (pie-chart)
  
3. Identify Red Seal products and describe their use for preparing for the Interprovincial Red Seal Examination.
  - i) Red Seal website
  - ii) examination preparation guide
  - iii) sample questions
  - iv) examination counselling sheets
  
4. Explain the relationship between the RSOS and the AACS.

5. Review Common Occupational Skills for the Steamfitter/Pipefitter trade as identified in the RSOS.
  - i) safety-related functions
  - ii) tools and equipment
  - iii) organizes job
  
6. Review process to perform layout, fabrication and piping installation for the Steamfitter/Pipefitter trade as identified in the RSOS.
  - i) fabrication
  - ii) piping, tubing and related components
  - iii) test valves
  - iv) heat tracing systems
  
7. Review process to perform common and complex rigging, hoisting and lifting positioning for the Steamfitter/Pipefitter trade as identified in the RSOS.
  
8. Review process to install, test, maintain, troubleshoot and repair low and high pressure steam and condensate system for the Steamfitter/Pipefitter trade as identified in the RSOS.
  
9. Review process to install, test, maintain, troubleshoot and repair heating, cooling and process piping systems for the Steamfitter/Pipefitter trade as identified in the RSOS.
  - i) hydronic system
  - ii) process piping system
  - iii) industrial water and waste treatment systems
  - iv) hydraulic systems
  - v) heating, ventilation, air conditioning and refrigeration systems
  - vi) fuel systems
  - vii) medical gas systems
  - viii) compressed air and pneumatic systems
  - ix) fire protection (not common core)
  
10. Review process to install, test, maintain, troubleshoot and repair renewable energy systems for the Steamfitter/Pipefitter trade as identified in the RSOS.
  - i) geo-exchange and geothermal systems
  - ii) solar heating systems
  - iii) heat recovery systems
  
11. Review process to perform commissioning, start-up and turnover for the Steamfitter/Pipefitter trade as identified in the RSOS.

Practical Objectives

N/A

## Feedback and Revisions

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This AACS will be amended periodically; comments or suggestions for improvements should be directed to:

**New Brunswick:**

Apprenticeship and Occupational  
Certification  
Post-Secondary Education, Training and  
Labour  
470 York St., Rm. 110, PO Box 6000  
Fredericton, NB E3B 5H1  
Tel: 506-453-2260  
Toll Free in NB: 1-855-453-2260  
[www.gnb.ca](http://www.gnb.ca)

**Prince Edward Island:**

Apprenticeship, Training and Certification  
Workforce and Advanced Learning  
176 Great George St., PO Box 2000  
Charlottetown, PE C1A 7N8  
Tel: 902-368-4460  
[www.apprenticeship.pe.ca](http://www.apprenticeship.pe.ca)

**Newfoundland and Labrador:**

Apprenticeship and Trades Certification  
Advanced Education and Skills  
Confederation Building, West Block  
Prince Philip Dr., PO Box 8700  
St. John's, NL A1B 4J6  
Toll Free: 877-771-3737  
[www.aes.gov.nl.ca/app](http://www.aes.gov.nl.ca/app)

**Nova Scotia:**

Nova Scotia Apprenticeship Agency  
2021 Brunswick St., PO Box 578  
Halifax, NS B3J 2S9  
Tel: 902-424-5651  
Toll Free in NS: 1-800-494-5651  
[www.nsapprenticeship.ca](http://www.nsapprenticeship.ca)

Any comments or suggestions received will be reviewed and considered to determine the course of action required. If the changes are deemed to be minor, they will be held for implementation during the next review cycle. If immediate change is deemed appropriate and approved by the Atlantic Trade Advisory Committee, it will result in a revision to this version of the AACS and will be detailed in the following section.

### Version Changes

Revision Date	Affected Section	Description of Change