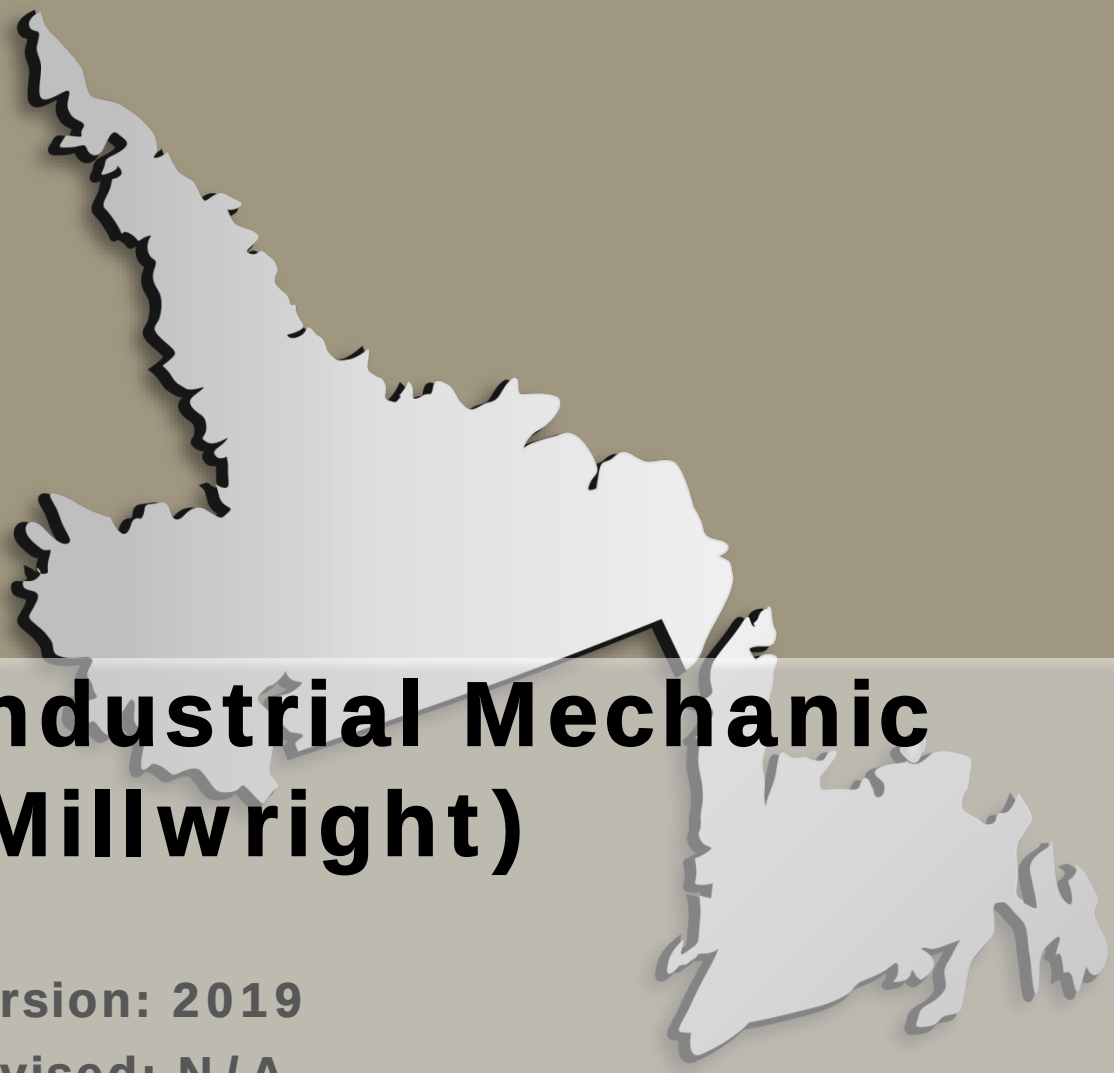
Atlantic Workforce Partnership

Curriculum Standard



Industrial Mechanic (Millwright)

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Atlantic Apprenticeship

COUNCIL OF ATLANTIC PREMIERS
CONSEIL DES PREMIERS MINISTRES DE L'ATLANTIQUE

Employment and Social Development Canada
Emploi et Développement social Canada

Atlantic Apprenticeship Curriculum Standard

Industrial Mechanic (Millwright)

PLAN OF TRAINING

Atlantic Apprenticeship Curriculum Standard

Industrial Mechanic (Millwright)

March, 2019

Newfoundland Labrador

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

Approved by:

Dave H

Chairperson, Provincial Apprenticeship and Certification Board

Date: March 20, 2019

Preface

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 Industrial Mechanic (Millwright) program.

This document contains all the technical training elements required to complete the Industrial Mechanic (Millwright) apprenticeship program and has been developed based on the 2017 Red Seal Occupational Standard (RSOS). The RSOS can be found on the Red Seal website (www.red-seal.ca).

Implementation of this Atlantic Apprenticeship Curriculum and Standard (AACS) for Apprenticeship training is outlined in the following table.

Level	Implementation Effective
Level 1	2019/2020
Level 2	2020/2021
Level 3	2021/2022
Level 4	2022/2023

** *The above implementation schedule identifies the training season where implementation is required to be complete in all Atlantic jurisdictions. Please* ***confirm*** *with Apprenticeship Staff in your jurisdiction for more specific implementation dates for your jurisdiction prior to commencing training.*

Granting of credit or permission to challenge level examinations for pre-employment or pre-apprenticeship training for the Industrial Mechanic (Millwright) 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

The development of the Atlantic Apprenticeship Curriculum Standard (AACS) 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.

The Atlantic Apprenticeship Council wishes to acknowledge the contributions of the following industry and instructional representatives on the Atlantic Trade Advisory Committee (ATAC) who participated in the development of this document in April, 2018.

Frank Denine	New Brunswick
Shannon Savoy	New Brunswick
David Steeve	New Brunswick
Gavin Brake	Newfoundland and Labrador
Ben Strickland	Newfoundland and Labrador
Frank Emilio	Nova Scotia
Jeff Richardson	Nova Scotia
Terry Dobbin	Nova Scotia

** Prince Edward Island recused from the committee due to low volume trade uptake in their jurisdiction.*

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.

Table of Contents

User Guide

Atlantic Apprenticeship Curriculum Standards (AACS) are developed based on Red Seal Occupational Standards (RSOS), National Occupational Analyses (NOA), Interprovincial Program Guides (IPG) (if available) and extensive industry consultation. This document represents the minimum content to be delivered as part of the harmonized Atlantic program for the Industrial Mechanic (Millwright) 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.

The 2017 Red Seal Occupational Standard References (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

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

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

Glossary of Terms *(continued)*

SERVICE	Routine inspection and replacement of worn or deteriorating parts. An act or business function provided to a customer in the course of an individual's profession (e.g., haircut).
TECHNIQUE	Within a procedure, the manner in which technical skills are applied.
TEST	v. To subject to a procedure that ascertains effectiveness, value, proper function or other quality. n. A way of examining something to determine its characteristics or properties, or to determine whether or not it is working correctly.

Essential Skills Profiles

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

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

Profile Chart

PERFORMS COMMON OCCUPATIONAL SKILLS			
IMM-105 Safety	IMM-110 Hand and Portable Power Tools	IMM-115 Stationary Tools and Equipment	IMM-120 Access and Fall Protection Awareness
IMM-125 Lubricants	IMM-130 Measuring and Layout	IMM-135 Metallurgy & Metals	IMM-140 Oxy-Fuel Cutting and Welding
IMM-145 Plasma Arc Cutting	IMM-155 Communication and Trade Documentation	IMM-160 Work Planning	IMM-165 Fasteners and Retainers
IMM-170 Mechanical Drawings	IMM-200 Shafts, Bearings and Seals	IMM-225 Shielded Metal Arc Welding (SMAW)	IMM-230 Gas Metal Arc Welding (GMAW)
IMM-235 Gas Tungsten Arc Welding (GTAW)	IMM-445 Mentoring		
PERFORMS RIGGING, HOISTING/LIFTING AND MOVING			
IMM-150 Rigging, Hoisting, Lifting and Moving			
SERVICES MECHANICAL POWER TRANSMISSION COMPONENTS AND SYSTEMS			
IMM-200 Shafts, Bearings and Seals	IMM-205 Couplings, Clutches and Brakes	IMM-210 Chain and Belt Drive Systems	IMM-215 Gear Systems
IMM-220 Shaft Alignment I	IMM-300 Shaft Alignment II	IMM-400 Prime Movers	
SERVICES MATERIAL HANDLING/PROCESS SYSTEMS			
IMM-305 Fans and Blowers	IMM-310 Pumps	IMM-315 Compressors	IMM-320 Process Piping
IMM-325 Process Tanks and Containers	IMM-405 Conveying Systems	IMM-440 Robotics and Automated Equipment	
SERVICES FLUID POWER SYSTEMS			
IMM-330 Hydraulic Systems	IMM-335 Pneumatic and Vacuum Systems		

Profile Chart *(continued)*

PERFORMS PREVENTATIVE AND PREDICTIVE MAINTENANCE, COMMISSIONING AND DECOMMISSIONING			
IMM-410 Preventative and Predictive Maintenance	IMM-415 Vibration Analysis	IMM-420 Balancing	IMM-425 Non-Destructive Testing (NDT)
IMM-430 Fluid Analysis	IMM-435 Commissioning and Decommissioning		

Level Structure

Level 1 – 8 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
IMM-105	Safety	18	20
IMM-110	Hand and Portable Power Tools	18	23
IMM-115	Stationary Tools and Equipment	30	25
IMM-120	Access and Fall Protection Awareness	12	27
IMM-125	Lubricants	12	29
IMM-130	Measuring and Layout	30	31
IMM-135	Metallurgy and Metals	18	34
IMM-140	Oxy-Fuel Cutting and Welding	12	36
IMM-145	Plasma Arc Cutting	6	38
IMM-150	Rigging, Hoisting, Lifting and Moving	24	40
IMM-155	Communication and Trade Documentation	6	43
IMM-160	Work Planning	6	45
IMM-165	Fasteners and Retainers	18	47
IMM-170	Mechanical Drawings	30	49

Level 2 – 7 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
IMM-200	Shafts, Bearings and Seals	30	54
IMM-205	Couplings, Clutches and Brakes	30	56
IMM-210	Chain and Belt Drive Systems	30	59
IMM-215	Gear Systems	30	62
IMM-220	Shaft Alignment I	30	65
IMM-225	Shielded Metal Arc Welding (SMAW)	20	67
IMM-230	Gas Metal Arc Welding (GMAW)	20	69
IMM-235	Gas Tungsten Arc Welding (GTAW)	20	71

Level Structure *(continued)*

Level 3 - 7 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
IMM-300	Shaft Alignment II	24	74
IMM-305	Fans and Blowers	24	76
IMM-310	Pumps	24	78
IMM-315	Compressors	24	81
IMM-320	Process Piping	30	83
IMM-325	Process Tanks and Containers	12	86
IMM-330	Hydraulic Systems	54	89
IMM-335	Pneumatic and Vacuum Systems	18	92

Level 4 - 6 Weeks

Unit Code	Unit Title	Suggested Hours	Page Number
IMM-400	Prime Movers	30	98
IMM-405	Conveying Systems	30	100
IMM-410	Preventative and Predictive Maintenance	18	103
IMM-415	Vibration Analysis	15	106
IMM-420	Balancing	15	108
IMM-425	Non-Destructive Testing	12	110
IMM-430	Fluid Analysis	12	112
IMM-435	Commissioning and Decommissioning	6	114
IMM-440	Robotics and Automated Equipment	6	116
IMM-445	Mentoring	6	118
IMM-450	Program Review	30	120

2017 RSOS Sub-task to AACS Unit Comparison

RSOS Sub-task		AACS Unit	
Task A-1 - Performs safety-related functions			
1.01	Uses personal protective equipment (PPE) and safety equipment.	IMM-105	Safety
1.02	Maintains safe worksite.	IMM-105	Safety
1.02	Protects the environment.	IMM-105	Safety
1.04	Performs lock-out/tag-out and zero energy procedures.	IMM-105	Safety
Task A-2 - Uses tools and equipment			
2.01	Uses hand and portable power tools.	IMM-110	Hand and Portable Power Tools
2.02	Uses shop machines.	IMM-115	Stationary Tools and Equipment
2.03	Uses access equipment.	IMM-120	Access and Fall Protection Awareness
Task A-3 - Performs routine trade tasks			
3.01	Plans work.	IMM-160	Work Planning
3.02	Fabricates workpiece.	IMM-115	Stationary Tools and Equipment
		IMM-135	Metallurgy and Metals
3.03	Lubricates systems and components.	IMM-200	Shafts, Bearings and Seals
3.04	Performs leveling of components and systems.	IMM-130	Measuring and Layout
3.05	Uses fastening and retaining devices.	IMM-165	Fasteners and Retainers
3.06	Performs material identification.	IMM-135	Metallurgy and Metals
3.07	Performs heat treatment of metal.	IMM-135	Metallurgy and Metals
3.08	Uses mechanical drawings and schematics.	IMM-170	Mechanical Drawings
Task A-4 - Uses communication and mentoring techniques			
4.01	Uses communication techniques.	IMM-155	Communication and Trade Documentation
4.02	Uses mentoring techniques.	IMM-445	Mentoring
Task A-5 - Performs measuring and layout			
5.01	Prepares work area, tools and materials.	IMM-130	Measuring and Layout
		IMM-135	Metallurgy and Metals
5.02	Measures material and components.	IMM-130	Measuring and Layout
5.03	Lays out components.	IMM-130	Measuring and Layout
5.04	Maintains precision measuring and layout tools.	IMM-130	Measuring and Layout
Task A-6 - Performs cutting and welding operations			
6.01	Cuts material with gas and plasma arc cutting equipment.	IMM-140	Oxy-Fuel Cutting and Welding

RSOS Sub-task		AACS Unit	
		IMM-145	Plasma Arc Cutting
6.02	Joins material using oxy-fuel welding equipment.	IMM-140	Oxy-Fuel Cutting and Welding
6.03	Welds material using arc welding equipment (SMAW).	IMM-225	Shielded Metal Arc Welding (SMAW)
6.04	Welds material with gas metal arc welding (GMAW) equipment.	IMM-230	Gas Metal Arc Welding (GMAW)
6.05	Welds material with gas tungsten arc welding (GTAW) equipment.	IMM-235	Gas Tungsten Arc Welding (GTAW)
6.06	Maintains welding equipment.	IMM-140	Oxy-Fuel Cutting and Welding
Task B-7 - Plans rigging, hoisting/lifting and moving			
7.01	Determines load.	IMM-150	Rigging, Hoisting, Lifting and Moving
7.02	Selects rigging equipment.	IMM-150	Rigging, Hoisting, Lifting and Moving
7.03	Selects hoisting/lifting and moving equipment.	IMM-150	Rigging, Hoisting, Lifting and Moving
7.04	Secures area.	IMM-150	Rigging, Hoisting, Lifting and Moving
Task B-8 - Rigs, hoists/lifts and moves load			
8.01	Sets up rigging, hoisting/lifting and moving equipment.	IMM-150	Rigging, Hoisting, Lifting and Moving
8.02	Performs hoist/lift and move.	IMM-150	Rigging, Hoisting, Lifting and Moving
8.03	Maintains rigging, hoisting/lifting and moving equipment.	IMM-150	Rigging, Hoisting, Lifting and Moving
Task C-9 - Services prime movers			
9.01	Installs prime movers.	IMM-400	Prime Movers
9.02	Diagnoses prime movers.	IMM-400	Prime Movers
9.03	Maintains prime movers.	IMM-400	Prime Movers
9.04	Repairs prime movers.	IMM-400	Prime Movers
Task C-10 - Services shafts, bearings and seals			
10.01	Installs shafts, bearings and seals.	IMM-200	Shafts, Bearings and Seals
10.02	Diagnoses shafts, bearings and seals.	IMM-200	Shafts, Bearings and Seals
10.03	Maintains shafts, bearings and seals.	IMM-200	Shafts, Bearings and Seals
10.04	Repairs shafts, bearings and seals.	IMM-200	Shafts, Bearings and Seals
Task C-11 - Services couplings, clutches and brakes			
11.01	Installs couplings, clutches and brakes.	IMM-205	Couplings, Clutches and Brakes
11.02	Diagnoses couplings, clutches and brakes.	IMM-205	Couplings, Clutches and Brakes
11.03	Maintains couplings, clutches and	IMM-205	Couplings, Clutches and Brakes

RSOS Sub-task		AACS Unit	
	brakes.		
11.04	Repairs couplings, clutches and brakes.	IMM-205	Couplings, Clutches and Brakes
Task C-12 - Services chains and belt drive systems			
12.01	Installs chain and belt drive systems.	IMM-210	Chain and Belt Drive Systems
12.02	Diagnoses chain and belt drive systems.	IMM-210	Chain and Belt Drive Systems
12.03	Maintains chains and belt drive systems.	IMM-210	Chain and Belt Drive Systems
12.04	Repairs chains and belt drive systems.	IMM-210	Chain and Belt Drive Systems
Task C-13 - Services gear systems			
13.01	Installs gear systems.	IMM-215	Gear Systems
13.02	Diagnoses gear systems.	IMM-215	Gear Systems
13.02	Maintains gear systems.	IMM-215	Gear Systems
13.04	Repairs gear systems.	IMM-215	Gear Systems
Task C-14 - Performs shaft alignment procedures			
14.01	Performs rough alignment.	IMM-220	Shaft Alignment I
14.02	Performs dial alignment.	IMM-220	Shaft Alignment I
		IMM-300	Shaft Alignment II
14.03	Performs laser and optical alignment.	IMM-300	Shaft Alignment II
Task D-15 - Services robotics and automated equipment			
15.01	Installs robotics and automated equipment.	IMM-440	Robotics and Automated Equipment
15.02	Diagnoses robotics and automated equipment.	IMM-440	Robotics and Automated Equipment
15.03	Maintains robotics and automated equipment.	IMM-440	Robotics and Automated Equipment
15.04	Repairs robotics and automated equipment.	IMM-440	Robotics and Automated Equipment
Task D-16 - Services fans and blowers			
16.01	Installs fans and blowers.	IMM-305	Fans and Blowers
16.02	Diagnoses fans and blowers.	IMM-305	Fans and Blowers
16.03	Maintains fans and blowers.	IMM-305	Fans and Blowers
16.04	Repairs fans and blowers.	IMM-305	Fans and Blowers
Task D-17 - Services pumps			
17.01	Installs pumps.	IMM-310	Pumps
17.02	Diagnoses pumps.	IMM-310	Pumps
17.03	Maintains pumps.	IMM-310	Pumps
17.04	Repairs pumps.	IMM-310	Pumps
Task D-18 - Services compressors			

RSOS Sub-task		AACS Unit	
18.01	Installs compressors.	IMM-315	Compressors
18.02	Diagnoses compressors.	IMM-315	Compressors
18.03	Maintains compressors.	IMM-315	Compressors
18.04	Repairs compressors.	IMM-315	Compressors
Task D-19 - Services process piping, tanks and containers			
19.01	Installs process tanks and containers.	IMM-325	Process Tanks and Containers
19.02	Installs process piping.	IMM-320	Process Piping
19.03	Diagnoses process tanks and containers.	IMM-325	Process Tanks and Containers
19.04	Diagnoses process piping.	IMM-320	Process Piping
19.05	Maintains process tanks and containers.	IMM-325	Process Tanks and Containers
19.06	Maintains process piping.	IMM-320	Process Piping
19.07	Repairs process tanks and containers.	IMM-325	Process Tanks and Containers
19.08	Repairs process piping.	IMM-320	Process Piping
Task D-20 - Services conveying systems			
20.01	Installs conveying systems.	IMM-405	Conveying Systems
20.02	Diagnoses conveying systems.	IMM-405	Conveying Systems
20.03	Maintains conveying systems.	IMM-405	Conveying Systems
20.04	Repairs conveying systems.	IMM-405	Conveying Systems
Task E-21 - Services hydraulic systems			
21.01	Installs hydraulic systems.	IMM-330	Hydraulic Systems
21.02	Diagnoses hydraulic systems.	IMM-330	Hydraulic Systems
21.03	Maintains hydraulic systems.	IMM-330	Hydraulic Systems
21.04	Repairs hydraulic systems.	IMM-330	Hydraulic Systems
Task E-22 - Services pneumatic and vacuum systems			
22.01	Installs pneumatic and vacuum systems.	IMM-335	Pneumatic and Vacuum Systems
22.02	Diagnoses pneumatic and vacuum systems.	IMM-335	Pneumatic and Vacuum Systems
22.03	Maintains pneumatic and vacuum systems.	IMM-335	Pneumatic and Vacuum Systems
22.04	Repairs pneumatic and vacuum systems.	IMM-335	Pneumatic and Vacuum Systems
Task F-23 - Performs preventative and predictive maintenance			
23.01	Performs preventative maintenance activities.	IMM-410	Preventative and Predictive Maintenance
23.02	Performs vibration analysis procedures.	IMM-415	Vibration Analysis
23.03	Performs balancing procedures.	IMM-420	Balancing

RSOS Sub-task		AACS Unit	
23.04	Performs non-destructive evaluation procedures.	IMM-425	Non-Destructive Testing
23.05	Performs fluid analysis procedures.	IMM-430	Fluid Analysis
23.06	Performs predictive maintenance activities.	IMM-410	Preventative and Predictive Maintenance
Task F-24 - Commissions and decommissions equipment			
24.01	Commissions systems and components.	IMM-435	Commissioning and Decommissioning
24.02	Decommissions systems and components.	IMM-435	Commissioning and Decommissioning

LEVEL 1

IMM-105 Safety

Learning Outcomes:

- Demonstrate knowledge of personal protective equipment (PPE) and safety equipment, their applications, maintenance and procedures for use.
- Demonstrate knowledge of safe work practices.
- Demonstrate knowledge of regulatory requirements pertaining to environmental safety and protection.
- Demonstrate knowledge of the procedures and potential hazards associated with lock-out/tag-out and zero energy state procedures.

2017 Red Seal Occupational Standard Reference:

1.01 Uses personal protective equipment (PPE) and safety equipment.
1.02 Maintains safe work environment.
1.03 Protects the environment.
1.04 Performs lock-out/tag-out and zero energy procedures.

Suggested Hours:

18 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with safety in the worksite.

2. Identify hazards and describe safe work practices.
   i) job hazard assessment
   ii) procedures to maintain a safe worksite
   iii) rigging, hoisting, lifting and moving
   iv) inert gases, oxy-fuel cutting, heating, welding, brazing and soldering
   v) working in confined spaces
   vi) working at heights
   vii) working around energized equipment
   viii) personal ergonomics

3. Interpret jurisdictional regulations.

i) workplace health and safety
ii) rigging, hoisting/lifting and moving
iii) inert gases, oxy-fuel cutting, heating, welding, brazing and soldering
iv) working in confined spaces
v) working at heights
vi) working around energized equipment
vii) mobile equipment

4. Identify types of PPE and clothing, and describe their characteristics, applications and procedures.
   i) safety glasses (face shield)
   ii) respirators
   iii) hardhats
   iv) footwear
   v) gloves
   vi) coveralls
   vii) acid suits
   viii) personal monitors
   ix) fall protection
   x) hearing protection
   xi) high-visibility clothing

5. Identify types of safety equipment, and describe their characteristics, applications and procedures for use.
   i) lockout devices
   ii) fire extinguishers
   iii) gas detectors
   iv) fall protection equipment and devices

6. Describe the procedures used to care for, inspect, maintain and store safety equipment and PPE.

7. Identify environmental hazards, assess risks and describe the procedures used to protect the environment.

8. Identify how to access current information on site specifications and jurisdictional regulations.

9. Identify reporting requirements and procedures.

10. Identify energy potential in machines, process systems and components and methods to verify zero energy state.

11. Describe the procedures used to lock-out and tag-out equipment and to return to zero energy state.

12. Identify and describe situations where zero energy state cannot be achieved.

13. Identify and describe potential outcomes of not following procedures used to lock-out and tag-out equipment and to return to zero energy state.

Practical Objectives

1. Demonstrate ability to perform lock-out and tag-out procedures.

2. Demonstrate hazard identification.

IMM-110 Hand and Portable Power Tools

Learning Outcomes:

- Demonstrate knowledge of hand tools, their applications and procedures for use.
- Demonstrate knowledge of the procedures used to maintain and store hand tools.
- Demonstrate knowledge of portable power tools, their applications and procedures for use.
- Demonstrate knowledge of the procedures used to maintain and store portable power tools.
- Demonstrate knowledge of safety practices related to hand and portable power tools.

2017 Red Seal Occupational Standard Reference:

2.01 Uses hand and portable power tools.

Suggested Hours:

18 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with hand tools and portable power tools.

2. Identify hazards and describe safe work practices pertaining to the use of hand and portable power tools.

3. Interpret jurisdictional regulations, and manufacturers' specifications pertaining to hand tools and portable power tools.
   - i) federal
   - ii) provincial/territorial
   - iii) municipal
   - iv) site specific
   - v) International Organization for Standards (ISO) procedures
   - vi) Canadian Nuclear Safety Commission (CNSC)

4. Identify types of hand tools, and describe their applications and procedures for use.
   i) wrenches
   ii) screwdrivers
   iii) measuring tools
   iv) hammers
   v) pry bars
   vi) hand saws

5. Identify types of portable power tools, and describe their applications and procedures for use.
   i) grinders
   ii) power metal saws
   iii) drilling machines
   iv) wrenches
      - hydraulic
      - impact
   v) portable hydraulic unit
   vi) pneumatic tools
   vii) explosive actuated tools
   viii) portable milling machine

6. Describe the procedures used to clean and inspect hand tools.

7. Describe the procedures used to maintain and store hand tools.

8. Describe the procedures used to clean, inspect, maintain and store portable power tools.

Practical Objectives

1. Inspect, use and maintain hand and portable power tools.

IMM-115 Stationary Tools and Equipment

Learning Outcomes:

- Demonstrate knowledge of shop machines, their applications and procedures for use, safety practices, associated calculations, cleaning, inspection, maintenance and storage.

2017 Red Seal Occupational Standard Reference:

2.02 Uses shop machines.
3.02 Fabricates workpiece.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Identify hazards and describe safe work practices pertaining to shop machines.

2. Identify types of shop machines and their components.
   i) drill presses
   ii) pedestal grinders
   iii) surface and cylindrical grinders
   iv) abrasive and cold cutoff saws
   v) band saws
   vi) lathes
   vii) milling machines
   viii) ironworker
   ix) slip-roll and brakes
   x) sandblasters
   xi) shears
   xii) hydraulic press
   xiii) arbour press

3. Describe the procedures used to perform grinding operations.

i) select grinding wheels
ii) change, ring test, mount and dress grinding wheels

4. Describe the procedures used to perform cutting operations using power metal saws.
   i) select cutting fluids and coolants
   ii) select saw blades
   iii) change saw blades and tension
   iv) select saw feed and speed

5. Describe the procedures used to perform drilling operations.
   i) select cutting fluids and coolants
   ii) calculate speeds and feeds for drilling operations

6. Describe the procedures used to perform basic lathe operations.
   i) set up and align work pieces
   ii) prevent and correct problems during lathe operations
   iii) select tool holding and work holding devices,
   iv) select lathe tools
   v) sharpen lathe cutting tools
   vi) calculate and determine speeds, feeds and depth of cut
   vii) select cutting fluids and coolants

7. Describe the procedures used to perform milling operations.
   i) select cutting fluids and coolants
   ii) select tool holding and work holding devices
   iii) select cutting tools
   iv) calculate and determine speeds, feeds and depth of cut

Practical Objectives

1. Use stationary tools and equipment.
   i) calculate speeds and feeds
   ii) face, turn and mill work piece to specific tolerance
   iii) layout, drill and tap holes

IMM-120 Access and Fall Protection Awareness

Learning Outcomes:

- Demonstrate knowledge of access equipment and fall protection equipment, their applications, procedures and limitations.

2017 Red Seal Occupational Standard Reference:

2.03 Uses access equipment.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with access equipment and fall protection equipment.

2. Identify hazards and describe safe work practices pertaining to access equipment and fall protection equipment.

3. Interpret jurisdictional regulations pertaining to access equipment and fall protection equipment.
   - i) federal
   - ii) provincial/territorial
   - iii) municipal
   - iv) site specific
   - v) International Organization for Standards (ISO) procedures
   - vi) Canadian Nuclear Safety Commission (CNSC)

4. Identify types of access equipment, and describe their characteristics and applications.
   - i) powered mobile equipment (PME)
   - ii) ladders
   - iii) scaffolds

5. Identify types of fall protection equipment, and describe their applications and procedures for use.

6. Describe the procedures used to erect and dismantle ladders and scaffolding.

7. Describe the procedures used to inspect and maintain access equipment and fall protection equipment.

Practical Objectives

None

IMM-125 Lubricants

Learning Outcomes:

- Demonstrate knowledge of lubricants, lubrication systems and their components, applications and procedures for use.
- Demonstrate knowledge of the procedures used to handle, store, recycle and dispose of lubricants.
- Demonstrate knowledge of safety practices related to lubricants and lubricant systems.

2017 Red Seal Occupational Standard Reference:

3.03 Lubricates systems and components.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with lubricants and lubrication systems.

2. Identify hazards and describe safe work practices pertaining to lubricants and lubrication systems.
   - i) environmental
   - ii) personal health
   - iii) fire
   - iv) contamination
   - v) housekeeping issues
   - vi) using personal protective equipment (PPE)
   - vii) disposing according to jurisdictional requirements
   - viii) spill response procedures and reporting
   - ix) storing materials.

3. Interpret jurisdictional regulations and specifications pertaining to lubricants and lubrication systems.

i) storage
ii) recycling
iii) disposal

4. Identify types of lubricants and lubrication systems, and describe their characteristics and applications.
   i) oil
   ii) grease
   iii) dry solid
   iv) water
   v) once through
   vi) oil bath
   vii) oil mist
   viii) manual
   ix) enclosed circulating
   x) pressurized
   xi) automated

5. Identify maintenance and troubleshooting procedures for lubrication systems.

6. Identify tools and equipment used with lubricants and lubrication systems, and describe their applications and procedures.

7. Explain the principles and types of friction, and their effects on surfaces in contact.

8. Identify the properties and characteristics of lubricants.

9. Identify the factors to consider when selecting lubricants.

10. Explain the effects of using incorrect lubricant.

11. Identify sources of information relating to system lubricant and lubrication requirements.

12. Describe the effect of lubricant levels on machine operation.

Practical Objectives

None

IMM-130 Measuring and Layout

Learning Outcomes:

- Demonstrate knowledge of the procedures used to level and align equipment.
- Demonstrate knowledge of the procedures used to maintain, calibrate and store precision measuring and layout tools.
- Demonstrate knowledge of measuring and layout and their applications.
- Demonstrate knowledge of the procedures used to perform layout operations.
- Demonstrate knowledge of precision measuring and layout tools, their applications and procedures.

2017 Red Seal Occupational Standard Reference:

3.04 Performs leveling of components and systems.
5.01 Prepares work area, tools and materials.
5.02 Measures material and components.
5.03 Lays out components.
5.04 Maintains precision measuring and layout tools.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with equipment leveling and alignment, measuring and layout.

2. Identify hazards and describe safe work practices pertaining to leveling, alignment, measuring and layout procedures, and their use.

3. Identify measuring and layout tools and equipment and describe their application and procedures.
   i) equipment leveling and alignment
      - theodolites
      - levels (optical, laser, spirit)

- piano wire
- plumb bob

ii) precision measuring tools
- micrometers
- calipers
- dial indicators
- protractors
- vernier height gauges
- feeler gauges
- plug, ring and snap gauges
- gauge blocks
- theodolites
- transits
- total station

iii) layout tools
- straightedges
- squares
- combination sets
- surface plates
- scribers
- hermaphrodite calipers
- dividers
- trammels
- prick and centre punches
- angle plates
- parallels
- v-blocks
- surface gauges
- layout dye

4. Identify types of bases used and describe their applications.
   i) base plate
   ii) sole plate
   iii) fabricated
   iv) skid mounted

5. Describe the procedures used to level and align equipment.

6. Describe the procedures to inspect, maintain, calibrate and store precision measuring and layout tools.

7. Describe the procedures used to lay out equipment and components.

8. Describe the procedures used to transfer and document measurements.

9. Interpret information from precision measuring tools.

Practical Objectives

1. Select and use measuring tools and equipment.

2. Read and interpret measurements.

3. Transfer measurements to components, work area and material.

4. Take inside and outside measurements.

IMM-135 Metallurgy & Metals

Learning Outcomes:

- Demonstrate knowledge of metals and their characteristics.
- Demonstrate knowledge of metallurgic principles.
- Demonstrate knowledge of structural shapes and their applications.
- Demonstrate knowledge of processes used in the heat treatment of metals.
- Demonstrate knowledge of safety practices related to heat treatment of metal.

2017 Red Seal Occupational Standard Reference:

3.02 Fabricates workpiece.
3.06 Performs material identification.
3.07 Performs heat treatment of metal.

Suggested Hours:

18 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with metallurgy and non-metallic materials.

2. Define terminology associated with heat treatment of metal.

3. Interpret jurisdictional regulations pertaining to heat treatment of metal.

4. Describe the properties of metals.
   i) hardness
   ii) colour
   iii) malleability
   iv) embeddability
   v) ductility
   vi) conductivity

5. Describe the identification systems for metals.

6. Identify the methods and processes used in the manufacture of steel and alloys.

7. Describe the problems that can occur when working metals.
   i) stress
   ii) contraction
   iii) expansion
   iv) distortion
   v) work hardening
   vi) galvanic action

8. Describe the procedures used to prevent and correct problems that occur when working metals.

9. Identify structural shapes, and describe their characteristics and applications.

10. Identify types of heat treating equipment and accessories, and describe their applications.

11. Describe the procedures used in the heating of metal.
   i) stress relieving
   ii) hardening
   iii) annealing
   iv) tempering
   v) normalizing
   vi) quenching

12. Identify hazards and describe safe work practices pertaining to heat treatment of metal.
   i) personal
   ii) shop/facility
   iii) equipment
   iv) ventilation
   v) storage

Practical Objectives

1. Fabricate and heat treat a test piece.

IMM-140 Oxy-Fuel Cutting and Welding

Learning Outcomes:

- Demonstrate knowledge of oxy-fuel equipment and accessories.
- Demonstrate knowledge of the procedures used to cut with oxy-fuel.
- Demonstrate knowledge of safety practices related to oxy-fuel cutting, heating, welding, brazing, soldering.
- Demonstrate knowledge of the procedures used to heat, weld, solder and braze with oxy-fuel equipment.

2017 Red Seal Occupational Standard Reference:

6.01 Cuts material with gas and plasma arc cutting equipment.
6.02 Joins material using oxy-fuel welding equipment.
6.06 Maintains welding equipment.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with oxy-fuel cutting, heating and welding.

2. Identify hazards and describe safe work practices pertaining to oxy-fuel cutting, oxy-fuel heating, welding, brazing and soldering.
   i) personal
   ii) shop/facility
   iii) equipment
   iv) ventilation
   v) storage, handling and transportation
   vi) pressures and tank safety

3. Interpret jurisdictional and site regulations pertaining to oxy-fuel cutting, heating, welding, brazing and soldering.

4. Identify types of oxy-fuel cutting, heating, welding, brazing and soldering equipment and accessories, and describe their applications.

5. Describe the procedures used to set up, adjust and shut down oxy-fuel equipment.
   i) adjusting flame characteristics (carburizing, neutral and oxidizing)
   ii) assembling equipment
   iii) adjusting pressures

6. Describe the procedures used to inspect and maintain and repair oxy-fuel equipment.

7. Describe the procedures used to cut, heat, weld, braze and solder materials using oxy-fuel equipment.

8. Describe the procedures used to prepare materials using oxy-fuel equipment.

Practical Objectives

1. Demonstrate safe use of oxy-fuel equipment.

IMM-145 Plasma Arc Cutting

Learning Outcomes:

- Demonstrate knowledge of plasma arc equipment and accessories.
- Demonstrate knowledge of the procedures used to cut with plasma arc equipment.
- Demonstrate knowledge of safety practices related to plasma arc cutting.

2017 Red Seal Occupational Standard Reference:

6.01 Cuts material with gas and plasma arc cutting equipment.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with plasma arc cutting.

2. Identify hazards and describe safe work practices pertaining to plasma arc cutting.

3. Interpret jurisdictional regulations pertaining to plasma arc cutting.

4. Interpret information pertaining to plasma arc cutting found on drawings and specifications.

5. Describe the plasma arc cutting process and its applications.

6. Describe the procedures used to prepare materials when plasma arc cutting.

7. Identify plasma arc equipment and accessories, and describe their application.

8. Describe the procedures used to set up, adjust and shut down plasma arc equipment.

9. Describe the procedures used to inspect and maintain plasma arc equipment.

Practical Objectives

1. Demonstrate safe use of plasma arc equipment.

IMM-150 Rigging, Hoisting, Lifting and Moving

Learning Outcomes:

- Demonstrate knowledge of rigging, hoisting, lifting and moving equipment, their applications, limitations and procedures for use.
- Demonstrate knowledge of calculations required when performing hoisting, lifting and moving operations.
- Demonstrate knowledge of safety practices related to rigging, hoisting/lifting and moving equipment.
- Demonstrate knowledge of the procedures used to perform rigging, hoisting/lifting and moving operations.
- Demonstrate knowledge of the use of standard hand signals.
- Demonstrate knowledge of the procedures used to maintain rigging, hoisting, lifting and moving equipment.

2017 Red Seal Occupational Standard Reference:

7.01 Determines load.
7.02 Selects rigging equipment.
7.03 Selects hoisting, lifting and moving equipment.
7.04 Secures area.
8.01 Sets up rigging, hoisting, lifting and moving equipment.
8.02 Performs hoist, lift and move.
8.03 Maintains rigging, hoisting, lifting and moving equipment.

Suggested Hours:

24 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with rigging, hoisting, lifting and moving equipment and procedures.

2. Identify hazards and describe safe work practices.
   i) company policies

ii) site procedures
iii) jurisdictional regulations
iv) manufacturers' recommendations
v) hazard identification
- suspended loads
- blocking

3. Interpret jurisdictional regulations pertaining to rigging, hoisting, lifting and moving equipment and procedures.

4. Identify types of equipment and accessories, and describe their applications, limitations and procedures for use.
i) rigging
ii) hoisting
iii) lifting
iv) moving
v) cribbing

5. Identify the factors to consider when selecting rigging, hoisting, lifting and moving equipment.
i) weight (dry or wet)
ii) material, dimensions
iii) sling angles
iv) centre of gravity
v) environmental conditions
vi) working load limit

6. Describe the procedures used to determine the weight and weight distribution of loads.
i) reference load charts
ii) determine types of loads
iii) engineered drawings
iv) nameplates
v) calculations
vi) scales

7. Describe the procedures used to rig material or equipment for hoisting, lifting and moving.

8. Describe the procedures used to ensure the work area is safe for lifting.

i) barriers installed and tagged
ii) assessment of ground conditions
iii) non-congestion of the work area
iv) approach limits
v) obtain required permits

9. Identify types of knots, hitches and bends, and describe their applications.

10. Explain sling angle when preparing for rigging, hoisting, lifting and moving operations.

11. Describe the procedures used to perform a lift.
    i) planning
    ii) environment analysis
    iii) load determination
    iv) communication methods
    v) pre-lift checks
    vi) placement of load
    vii) post-lift inspection
    viii) supervision of lift
    ix) securing work area

12. Describe procedures used to communicate during hoisting, lifting and moving operations.
    i) hand signals
    ii) radios

13. Describe the procedures used to inspect, maintain and store rigging, hoisting, lifting and moving equipment.

Practical Objectives

1. Tie basic knots.

2. Rig and lift a load.

IMM-155 Communication and Trade Documentation

Learning Outcomes:

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

2017 Red Seal Occupational Standard Reference:

4.01 Uses communication techniques.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

1. Describe the importance of using effective verbal and non-verbal communication.

2. Identify various types of communication practices.
   - i) verbal
   - ii) hand signal
   - iii) written
   - iv) electronic

3. Identify types of trade related documentation, and describe their applications and procedures for use.
   - i) manufacturers' specifications
   - ii) safety/hazard assessment forms
   - iii) mill certificates
   - iv) heat numbers
   - v) customer specifications
   - vi) codes and standards
   - vii) manuals/catalogues
   - viii) work orders
   - ix) requisitions/purchase orders

x) permits
xi) procedure sheets

4. Identify personal responsibilities and attitudes that contribute to on-the-job success.

5. Identify communication and learning styles.

Practical Objectives

None

IMM-160 Work Planning

Learning Outcomes:

- Demonstrate knowledge of job planning.
- Demonstrate knowledge of the procedures used to plan and organize jobs.

2017 Red Seal Occupational Standard Reference:

3.01 Plans work.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with job planning.

2. Identify sources of information relevant to job planning.
   - i) procedures
   - ii) documentation
     - machine history
     - manufacturer documentation
   - iii) drawings
   - iv) related professionals
   - v) clients
   - vi) feedback

3. Identify the factors to consider for determining job requirements.
   - i) personnel
   - ii) tools and equipment
   - iii) materials
   - iv) permits
   - v) environmental
   - vi) time
   - vii) safety

viii) priorities

4. Explain job sequencing, its application, and purpose in the job planning process.

5. Describe the procedures used to plan job tasks.
   i) scheduling
   ii) estimating

6. Describe the procedures used to organize and store tools, equipment and materials on-site.

Practical Objectives

None

IMM-165 Fasteners and Retainers

Learning Outcomes:

- Demonstrate knowledge of fastening and retaining devices, and their applications.
- Demonstrate knowledge of the procedures used to install and remove fastening and retaining devices.
- Demonstrate knowledge of safety practices related to fastening and retaining devices.

2017 Red Seal Occupational Standard Reference:

3.05 Plans work.

Suggested Hours:

18 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with fastening and retaining devices.

2. Identify hazards and describe safe work practices pertaining to the use of fastening and retaining devices.

3. Identify tools and equipment pertaining to the use of fastening and retaining devices, and describe their applications and procedures.
   i) torque wrenches
   ii) impact wrenches
   iii) hydraulic tensioning devices
   iv) hand tools (snap ring pliers, riveting tools)

4. Identify types of fastening devices and materials, and describe their characteristics and applications.
   i) mechanical
   ii) chemical

5. Identify strength of fasteners by grade and applications.

6. Identify types of retaining devices, and describe their characteristics and applications.
   i) snap-rings
   ii) pins
   iii) keys
   iv) set screws
   v) locking tabs
   vi) anchors

7. Identify thread types and classifications, and describe the procedures used for thread identification.

8. Explain the purpose of torquing and tensioning fastening devices, and describe associated procedures.

9. Describe the procedures used to install, remove and repair fastening devices.

10. Describe the procedures used to install and remove retaining devices.

11. Describe the procedures used to make internal and external threads to specifications.
   i) external threading (dies)
   ii) internal threading (taps)
   iii) threading machines

Practical Objectives

1. Drill, tap and torque exercise.

IMM-170 Mechanical Drawings

Learning Outcomes:

- Demonstrate knowledge of drawings, their use and interpretation.
- Demonstrate knowledge of calculations relevant to drawings.
- Demonstrate knowledge of basic sketching techniques.

2017 Red Seal Occupational Standard Reference:

3.08 Plans work.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with drawings.
   - i) civil/site
   - ii) engineered
   - iii) architectural
   - iv) mechanical
   - v) structural
   - vi) electrical
   - vii) shop drawings
   - viii) field drawings
   - ix) sketches
   - x) as-builts
   - xi) working
   - xii) piping and instrumentation diagram (P&ID)
   - xiii) installation
   - xiv) inspection and test plan (ITP)
   - xv) drawing assembly

2. Identify the views found on drawings, and describe their characteristics.
   - i) elevation

ii) plan
iii) section
iv) detail

3. Interpret drawings and instructions on drawings.

4. Interpret material specifications found on drawings.

5. Identify the purposes for drawings
   i) determine location of components
   ii) determine the positioning of components
   iii) determine elevation of components

6. Describe the procedures used to perform calculations relevant to drawings.

7. Identify the metric and imperial systems of measurement, and describe the procedures used to perform conversions between the systems.

8. Identify drawing projections and describe their applications.
   i) orthographic
   ii) oblique
   iii) isometric
   iv) section
   v) auxiliary

9. Interpret and extract information from drawings.
   i) dimensions
   ii) lines
   iii) legend
   iv) symbols and abbreviations
   v) title block
   vi) notes and specifications
   vii) tolerances/allowances
   viii) bill of materials

10. Explain the use of scales.

11. Identify the styles of dimensioning on drawings, and describe their applications.

12. Demonstrate basic sketching techniques.

13. Demonstrate awareness of computer aided drawing (CAD) systems.

Practical Objectives

1. Create sketch using a blueprint and/or drawing as a starting point.

2. Interpret and extract information from drawings.

LEVEL 2

IMM-200 Shafts, Bearings and Seals

Learning Outcomes:

- Demonstrate knowledge of shafts, bearings and seals, their components and operation.
- Demonstrate knowledge of safety practices related to shafts, bearings and seals.
- Demonstrate knowledge of the procedures used to install shafts, bearings and seals.
- Demonstrate knowledge of the procedures used to diagnose, maintain and repair shafts, bearings and seals.

2017 Red Seal Occupational Standard Reference:

3.03 Lubricates systems and components.
10.01 Installs shafts, bearings and seals.
10.02 Diagnoses shafts, bearings and seals.
10.03 Maintains shafts, bearings and seals.
10.04 Repairs shafts, bearings and seals.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with shafts, bearings and seals.

2. Identify hazards and describe safe work practices associated with shafts, bearings and seals.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Identify types of shafts, bearings and seals and their components and accessories, and describe their purpose, applications and operation.
   i) shafts
      - drive
      - counter
      - jack
   ii) bearings
      - plain (friction)
      - rolling element (anti-friction)
      - type of load
      - fixed/floating
   iii) seals
      - static (gaskets)
      - dynamic
      - mechanical
      - non-contacting (labyrinth/annulus)

4. Identify tools and equipment used with shafts, bearings and seals and describe their applications and procedures.

5. Describe the procedures used to install shafts, bearings and seals and their components.

6. Describe the procedures used to inspect, diagnose, maintain and repair shafts, bearings and seals and their components.

Practical Objectives

1. Heat, install and remove a bearing.

IMM-205 Couplings, Clutches and Brakes

Learning Outcomes:

- Demonstrate knowledge of couplings, clutches and brakes, their components and operation.
- Demonstrate knowledge of safety practices related to couplings, clutches and brakes.
- Demonstrate knowledge of the procedures used to install couplings, clutches and brakes.
- Demonstrate knowledge of the procedures used to diagnose, maintain and repair couplings, clutches and brakes.

2017 Red Seal Occupational Standard Reference:

11.01 Installs couplings, clutches and brakes.
11.02 Diagnoses couplings, clutches and brakes.
11.03 Maintains couplings, clutches and brakes.
11.04 Repairs couplings, clutches and brakes.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with couplings, clutches and brakes.

2. Identify hazards and describe safe work practices associated with couplings, clutches and brakes.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of couplings, clutches and brakes.

4. Identify types of couplings, clutches and brakes, their components and accessories, and describe their purpose, applications and operation.
   i) couplings
      - rigid
      - elastomeric
      - grid
      - mechanical
      - fluid
   ii) clutches
      - overrunning
      - friction
      - positive contact
      - fluid
      - electromagnetic
   iii) brakes
      - friction
      - fluid/wet disc
      - electromagnetic

5. Identify tools and equipment used to install, diagnose, repair and maintain couplings, clutches and brakes, and describe their applications and procedures.
   i) torque wrenches
   ii) feeler gauges
   iii) straight edges
   iv) micrometers
   v) calipers
   vi) presses
   vii) pullers
   viii) laser alignment equipment
   ix) hand tools
   x) dial indicators

6. Describe the procedures used to remove and install couplings, clutches and brakes and their components.

7. Describe the procedures used to inspect, maintain and repair couplings, clutches and brakes and their components.

Practical Objectives

None

IMM-210 Chain and Belt Drive Systems

Learning Outcomes:

- Demonstrate knowledge of chain and belt drive systems, their components and operation.
- Demonstrate knowledge of safety practices related to chain and belt drive systems.
- Demonstrate knowledge of the procedures used to install chain and belt drive systems.
- Demonstrate knowledge of the procedures used to align, diagnose, repair and maintain chain and belt drive systems.
- Demonstrate knowledge of formulae and calculations pertaining to chain and belt drive systems.

2017 Red Seal Occupational Standard Reference:

12.01 Installs chain and belt drive systems.
12.02 Diagnoses chain and belt drive systems.
12.03 Maintains chains and belt drive systems.
12.04 Repairs chains and belt drive systems.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with chain and belt drive systems.

2. Identify hazards and describe safe work practices associated with chain and belt drive systems.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of chain and belt drive systems.

4. Identify types of chain and belt drive systems and their components and accessories, and describe their purpose, applications and operation.
   i) chain drive
      - roller
      - silent
      - composite
      - lube free
   ii) belt drive
      - v-belt
      - cog belt
      - timing
      - flat belt
   iii) components
      - sprockets and sheaves
      - taper bushing
      - link (half link, off-set)

5. Identify tools and equipment used to install, align, diagnose, repair, and maintain chain and belt drive systems, and describe their applications and procedures.
   i) presses
   ii) tensioners
   iii) chain breakers
   iv) ropes/pullers
   v) torque wrenches
   vi) straight edges
   vii) parallel shaft alignment tools
   viii) hand tools
   ix) belt tensioning tools

6. Describe the procedures used to install chain and belt drive systems and their components.

7. Describe the procedures used to inspect, diagnose, repair, and maintain chain and belt drive systems and their components.

8. Identify the factors to consider and required calculations to determine chain and belt drive systems requirements.

9. Identify formulae and perform calculations.
   i) belt/chain lengths
   ii) speed and torque ratios
   iii) belt tension

Practical Objectives

1. Align sheaves and sprockets.

2. Break and install drive chain.

IMM-215 Gear Systems

Learning Outcomes:

- Demonstrate knowledge of gears and gear drives, their components and operation.
- Demonstrate knowledge of safety practices related to gears and gear drives.
- Demonstrate knowledge of the procedures used to install and align gears and gear drives.
- Demonstrate knowledge of the procedures used to diagnose, maintain and repair gears and gear drives.
- Demonstrate knowledge of gear engagement procedures.
- Demonstrate knowledge of formulae and calculations pertaining to gears and gear drives.

2017 Red Seal Occupational Standard Reference:

13.01 Installs gear systems.
13.02 Diagnoses gear systems.
13.03 Maintains gear systems.
13.04 Repairs gear systems.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with gears and gear drives.

2. Identify hazards and describe safe work practices associated with gears and gear drives.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of gears and gear drives.

4. Identify tools and equipment used to install, diagnose, maintain and repair gears and gear drives, and describe their applications and procedures.
   i) presses
   ii) hydraulic jacks
   iii) torque wrenches
   iv) jacks
   v) alignment tools
   vi) mechanics' blue
   vii) plasti-gauges
   viii) dial indicators
   ix) calipers
   x) micrometers
   xi) hand tools
   xii) strobe lights

5. Identify tools and equipment used to set backlash and tooth contact.

6. Identify types of gears and gear drives and their components and accessories, and describe their purpose, applications and operation.
   i) gears
      - spur
      - bevel
      - spiral
      - herringbone
      - helical
      - worm
   ii) gear drives
      - planetary
      - worm
      - parallel shaft
      - crown and pinion
      - rack and pinion

7. Identify the factors to consider and required calculations to determine gears and gear drives requirements.
   i) worn bearings
   ii) gear pass frequency

iii) tribology

8. Describe the procedures used to install and align gears and gear drives and their components.

9. Describe the procedures used to inspect, maintain, and repair gears and gear drives and their components.

10. Describe the procedures used to set backlash and tooth contact.

11. Describe the procedures used to perform gear calculations.
    i) diametrical pitch
    ii) pitch diameter
    iii) gear ratios

Practical Objectives

None

IMM-220 Shaft Alignment I

Learning Outcomes:

- Demonstrate knowledge of shaft alignment.
- Demonstrate knowledge of the procedures used to align shafts.
- Demonstrate knowledge of safety practices related to shaft alignment.

2017 Red Seal Occupational Standard Reference:

14.01 Performs rough alignment.
14.02 Performs dial alignment.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with shaft alignment methods.

2. Identify hazards and describe safe work practices pertaining to shaft alignment.

3. Identify tools and equipment used for shaft and dial alignment methods, and describe their applications and procedures.
   i) mag bases
   ii) dial indicators
   iii) contact points
   iv) feeler gauges
   v) straightedges
   vi) tape measure
   vii) calipers

4. Describe the procedures used to determine shaft misalignment.

5. Identify rough and dial alignment methods, and describe their applications and limitations.

i) rim and face

6. Describe the procedures used to calculate shims for hot or cold alignment.

7. Describe the procedures used to align shafts using the straight edge and feeler gauge, and dial alignment methods.
   i) pre-alignment checks
   ii) selecting tools and equipment
   iii) performing calculations
   iv) making adjustments

Practical Objectives

1. Perform rough alignment.

2. Perform rim and face dial alignment.

IMM-225 Shielded Metal Arc Welding (SMAW)

Learning Outcomes:

- Demonstrate knowledge of shielded metal arc welding (SMAW) equipment and accessories.
- Demonstrate knowledge of procedures used to weld using shielded metal arc welding (SMAW) equipment.
- Demonstrate knowledge of safety practices related to shielded metal arc welding (SMAW).

2017 Red Seal Occupational Standard Reference:

6.03 Welds material using arc welding equipment (SMAW).

Suggested Hours:

20 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with shielded metal arc welding (SMAW).

2. Interpret jurisdictional regulations pertaining to SMAW.

3. Identify hazards and describe safe work practices pertaining to SMAW.
   i) personal
   ii) shop/facility
   iii) equipment
   iv) ventilation sparks
   v) radiation
   vi) ultraviolet light
   vii) storage

4. Interpret information pertaining to SMAW found on drawings and specifications.

5. Identify SMAW equipment, consumables and accessories, and describe their applications.

6. Describe the SMAW process and its applications.

7. Describe the procedures used to set up and adjust SMAW equipment.

8. Identify the types of welds performed using SMAW equipment.

9. Identify welding positions and describe their applications.

10. Describe the procedures used to weld using SMAW equipment.

11. Describe weld defects, their causes and prevention.

Practical Objectives

1. Set up and perform a weld using SMAW equipment.

IMM-230 Gas Metal Arc Welding (GMAW)

Learning Outcomes:

- Demonstrate knowledge of gas metal arc welding (GMAW) equipment and accessories.
- Demonstrate knowledge of procedures used to weld using gas metal arc welding (GMAW) equipment.
- Demonstrate knowledge of safety practices related to gas metal arc welding (GMAW).

2017 Red Seal Occupational Standard Reference:

6.04 Welds material with gas metal arc welding (GMAW) equipment.

Suggested Hours:

20 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with gas metal arc welding (GMAW).

2. Interpret jurisdictional regulations pertaining to GMAW.

3. Identify hazards and describe safe work practices pertaining to GMAW.
   i) personal
   ii) shop/facility
   iii) equipment
   iv) ventilation sparks

4. Interpret information pertaining to GMAW found on drawings and specifications.

5. Identify GMAW equipment, consumables and accessories, and describe their applications.

6. Describe the GMAW process and its applications.

7. Describe the procedures used to set up, adjust and shut down GMAW equipment.

8. Identify the types of welds performed using GMAW equipment.

9. Identify welding positions and describe their applications.

10. Describe the procedures used to weld using GMAW equipment.

11. Describe weld defects, their causes and prevention.

Practical Objectives

1. Set up and perform a weld using GMAW equipment**.**

IMM-235 Gas Tungsten Arc Welding (GTAW)

Learning Outcomes:

- Demonstrate knowledge of gas tungsten arc welding (GTAW) equipment and accessories.
- Demonstrate knowledge of procedures used to weld using gas tungsten arc welding (GTAW) equipment.
- Demonstrate knowledge of safety practices related to gas tungsten arc welding (GTAW).

2017 Red Seal Occupational Standard Reference:

6.05 Welds material with gas tungsten arc welding (GTAW) equipment.

Suggested Hours:

20 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with gas tungsten arc welding (GTAW).

2. Interpret jurisdictional regulations pertaining to GTAW.

3. Identify hazards and describe safe work practices pertaining to GTAW.
   i) personal
   ii) shop/facility
   iii) equipment
   iv) ventilation sparks
   v) radiation
   vi) ultraviolet light
   vii) storage

4. Interpret information pertaining to GTAW found on drawings and specifications.

5. Identify GTAW equipment, consumables and accessories, and describe their applications.

6. Describe the GTAW process and its applications.

7. Describe the procedures used to set up, adjust and shut down GTAW equipment.

8. Identify the types of welds performed using GTAW equipment.

9. Identify welding positions and describe their applications.

10. Describe the procedures used to weld using GTAW equipment.

11. Describe weld defects, their causes and prevention.

Practical Objectives

1. Set up and perform a weld using GTAW equipment.

LEVEL 3

IMM-300 Shaft Alignment II

Learning Outcomes:

- Demonstrate knowledge of shaft alignment.
- Demonstrate knowledge of the procedures used to align shafts.
- Demonstrate knowledge of safety practices related to shaft alignment.

2017 Red Seal Occupational Standard Reference:

14.02 Performs dial alignment.
14.03 Performs laser and optical alignment.

Suggested Hours:

24 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with shaft alignment methods.

2. Identify hazards and describe safe work practices pertaining to shaft alignment.

3. Identify tools and equipment used for shaft and dial alignment methods, and describe their applications and procedures.
   i) mag bases
   ii) dial indicators
   iii) contact points
   iv) feeler gauges
   v) straightedges
   vi) tape measure
   vii) laser

4. Describe the procedures used to determine shaft misalignment.

5. Identify reverse dial and laser alignment methods, and describe their applications and limitations.

6. Describe the procedures to shim for hot or cold alignment.
   i) performing pre-alignment checks
   ii) selecting tools and equipment
   iii) performing calculations
   iv) making adjustments

7. Describe the procedures used to align shafts using the dial and laser alignment methods.

Practical Objectives

1. Perform a reverse dial alignment.

2. Perform a laser alignment.

IMM-305 Fans and Blowers

Learning Outcomes:

- Demonstrate knowledge of fans and blowers, their components and operation.
- Demonstrate knowledge of safe work practices related to fans and blowers.
- Demonstrate knowledge of the procedures used to remove and install fans and blowers.
- Demonstrate knowledge of the procedures used to diagnose, maintain, and repair fans and blowers.

2017 Red Seal Occupational Standard Reference:

16.01 Installs fans and blowers.
16.02 Diagnoses fans and blowers.
16.03 Maintains fans and blowers.
16.04 Repairs fans and blowers.

Suggested Hours:

24 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with fans and blowers.

2. Interpret jurisdictional regulations and manufacturers' specifications pertaining to fans and blowers.

3. Identify hazards and describe safe work practices pertaining to fans and blowers.
   i) company policies
   ii) site procedure
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

4. Identify types of fans and blower systems, and describe their components and operation.

5. Identify tools and equipment used to remove and install, diagnose, maintain and repair fans and blowers, and describe their applications and procedures.
   i) hand tools
   ii) dial indicators
   iii) precision levels
   iv) optical or laser alignment equipment
   v) hydraulic rams
   vi) rigging/lifting equipment
   vii) tachometers
   viii) thermal imaging equipment
   ix) strobe light

6. Identify types of fan blades, and describe their applications.

7. Describe the procedures used to remove and install fans and blowers.

8. Describe the procedures used to diagnose, inspect, maintain, and repair fans and blowers.

9. Describe the procedures used to regulate output for fans and blowers.

10. Describe the procedures used to balance fans and blowers.

Practical Objectives

None

IMM-310 Pumps

Learning Outcomes:

- Demonstrate knowledge of pumps, their components and operation.
- Demonstrate knowledge of safety practices related to pumps.
- Demonstrate knowledge of the procedures used to remove and install pumps.
- Demonstrate knowledge of the procedures used to diagnose, maintain, and repair pumps.

2017 Red Seal Occupational Standard Reference:

17.01 Installs pumps.
17.02 Diagnoses pumps.
17.03 Maintains pumps.
17.04 Repairs pumps.

Suggested Hours:

24 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with pumps.

2. Identify hazards and describe safe work practices associated with pumps and their components and accessories.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Interpret jurisdictional regulations, site and manufacturers' specifications pertaining to the use of pumps.

4. Identify types of pumps and their components and accessories, and describe their purpose, applications and operation.

i) pumps
   - non-positive (centrifugal)
   - positive displacement (reciprocating)
   - America Petroleum Institute (API) pumps

ii) components
   - filters
   - gaskets
   - wear sleeves
   - seals
   - impeller
   - shafts
   - wear rings
   - stuffing box assembly
   - rotating assembly
   - bearings

iii) relevant science
   - Pascal's Law
   - Bernoulli's Principle
   - Atmospheric Pressure

5. Identify the types of seals and gaskets and describe their applications.
   i) packings
   ii) o-rings
   iii) mechanical seal
   iv) v-rings
   v) labyrinth

6. Explain the method used to interpret pump curves.

7. Identify tools and equipment used to remove and install, diagnose, maintain, and repair pumps, and describe their applications and procedures.
   i) hand tools
   ii) levelling and alignment tools
   iii) measuring tools
   iv) monitoring equipment
   v) rigging and hoisting equipment
   vi) manual for troubleshooting

8. Describe the procedures used to remove and install, inspect, diagnose, maintain, and repair pumps and their components and accessories.

Practical Objectives

1. Disassemble pump.

2. Install seals and packing.

3. Set clearances.

IMM-315 Compressors

Learning Outcomes:

- Demonstrate knowledge of compressors, their components and operation.
- Demonstrate knowledge of safety practices related to compressors.
- Demonstrate knowledge of the procedures used to remove, install and align compressors.
- Demonstrate knowledge of the procedures used to diagnose, maintain, and repair compressors.

2017 Red Seal Occupational Standard Reference:

18.01 Installs compressors.
18.02 Diagnoses compressors.
18.03 Maintains compressors.
18.04 Repairs compressors.

Suggested Hours:

24 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with compressors.

2. Identify hazards and describe safe work practices associated with compressors and their components.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of compressors.

4. Identify classifications and types of compressors and components, and describe their purpose and operation.
   i) compressors
      - dynamic/centrifugal
      - positive displacement (reciprocating, radial, screw, vane)
   ii) components
      - filters
      - pressure relief valves
      - temperature controllers
      - regulators
      - unloading valve
      - dryers
   iii) relevant science
      - Charles' law
      - Boyle's law
      - Atmospheric Pressure

5. Identify tools and equipment used to install, diagnose, maintain, and repair compressors, and describe their applications and procedures.
   i) straight edge
   ii) hand tools
   iii) impact wrenches
   iv) dial indicators
   v) precision levels
   vi) optical or laser alignment equipment
   vii) rigging/lifting equipment

6. Describe the procedures used to remove, install and align compressors and their components.

7. Describe the procedures used to inspect, diagnose, maintain, and repair compressors and their components.
   i) condition-based monitoring reports (worn bearings, oil analysis, vibration analysis, temperature analysis),
   ii) reliability centered maintenance (RCM)

Practical Objectives

None

IMM-320 Process Piping

Learning Outcomes:

- Demonstrate knowledge of process piping, components and application.
- Demonstrate knowledge of safety practices related to process piping.
- Demonstrate knowledge of the procedures used to remove and install process piping.
- Demonstrate knowledge of the procedures used to diagnose, maintain, and repair process piping.
- Demonstrate knowledge of the procedures used to test and inspect process piping and their components.

2017 Red Seal Occupational Standard Reference:

19.02 Installs process piping.
19.04 Diagnoses process piping.
19.06 Maintains process piping.
19.08 Repairs process piping.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with process piping.

2. Interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of process piping and their components.

3. Identify hazards and describe safe work practices associated with process piping.
   i) residual materials
   ii) pressure
   iii) heat
   iv) weight
   v) acidic (caustic/corrosive) level of product (ph)

vi) alkaline
vii) poisonous substances

4. Identify tools and equipment used to install, diagnose, maintain, and repair process piping and their components, and describe their applications and procedures.

5. Identify types of process piping and their components, accessories and supports and describe their purpose, applications and operation.
   i) piping
      - acrylonitrile butadiene styrene (ABS)
      - high-density polyethylene (HDPE)
      - polyvinyl chloride (PVC)
      - stainless
      - composite
      - carbon steel
      - tubing
      - copper
   ii) hose
   iii) components
      - fittings
      - valves
      - strainers
      - gaskets
      - connectors
   iv) supports
      - stands
      - hangers
      - brackets

6. Describe the procedures used to remove and install process piping and its components.

7. Describe the procedures used to test, inspect, diagnose, maintain, and repair process piping and its components.

8. Identify the factors to consider when determining if process piping needs to be repaired or replaced.
   i) vibration
   ii) expansion/contraction

iii) pipe strain

Practical Objectives

1. Thread pipe using handheld die and threading machine.

2. Fabricate and assemble piping system.

IMM-325 Process Tanks and Containers

Learning Outcomes:

- Demonstrate knowledge of process tanks and containers, components and application.
- Demonstrate knowledge of safety practices related to process tanks and containers.
- Demonstrate knowledge of the procedures used to remove and install process tanks and containers.
- Demonstrate knowledge of the procedures used to diagnose, maintain, and repair process tanks and containers.
- Demonstrate knowledge of the procedures used to test and inspect process tanks and containers and their components.

2017 Red Seal Occupational Standard Reference:

19.01 Installs process tanks and containers.
19.03 Diagnoses process tanks and containers.
19.05 Maintains process tanks and containers.
19.07 Repairs process tanks and containers.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with process tanks and containers.

2. Interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of process tanks and containers and their components.

3. Identify hazards and describe safe work practices associated with process tanks and containers.
   i) residual materials
   ii) pressure

iii) heat
iv) weight
v) acidic (caustic/corrosive) level of product (ph)
vi) alkaline
vii) poisonous substances

4. Identify tools and equipment used to install, diagnose, maintain, and repair process tanks, containers and their components, and describe their applications and procedures.
   i) layout
   ii) levelling tools
   iii) rigging and hoisting equipment

5. Identify types of process tanks, containers and their components and accessories, and describe their purpose, applications and operation.
   i) process tanks and containers
      - bins
      - hoppers
      - receivers
      - reservoirs
      - storage tanks
      - pressure vessel
   ii) components
      - agitators
      - impellers
      - scrapers
      - mixers
      - level indicators
      - skimmers
      - valves

6. Describe the procedures used to remove and install process tanks and containers and their components.

7. Describe the procedures used to test, inspect, diagnose, maintain, and repair process tanks, containers and their components.

Practical Objectives

None

IMM-330 Hydraulic Systems

Learning Outcomes:

- Demonstrate knowledge of safety practices related to hydraulic systems.
- Demonstrate knowledge of the principles and applications of hydraulics.
- Demonstrate knowledge of hydraulic system related calculations.
- Demonstrate knowledge of schematics, their use and interpretation.
- Demonstrate knowledge of hydraulic systems, their components and operation.
- Demonstrate knowledge of the procedures used to install hydraulic systems and components.
- Demonstrate knowledge of the procedures used to diagnose, maintain, and repair hydraulic systems and components.

2017 Red Seal Occupational Standard Reference:

21.01 Installs hydraulic systems.
21.02 Diagnoses hydraulic systems.
21.03 Maintains hydraulic systems.
21.04 Repairs hydraulic systems.

Suggested Hours:

54 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with the installation of hydraulic systems and their components.

2. Identify hazards and describe safe work practices pertaining to hydraulic and piping systems and their components.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Interpret jurisdictional regulations and manufacturers' specifications pertaining to hydraulic and piping systems and their components.

4. Identify tools and equipment used to install, diagnose, maintain, and repair hydraulic systems and their components, and describe their applications and procedures.

5. Explain the principles and theories of hydraulics.
   i) Pascal's law
   ii) Bernoulli's principle

6. Describe units of measure as they relate to hydraulic systems.

7. Identify formulae related to hydraulic systems, and describe their applications.

8. Describe and perform the calculations used to select, install and diagnose hydraulic systems and components.

9. Identify symbols and abbreviations related to hydraulic systems found on schematics.

10. Describe and interpret hydraulic systems schematics and their applications.

11. Identify types of hydraulic systems and their components, and describe their purpose, applications and operation.
   i) pumps
   ii) valves
   iii) actuators
   iv) reservoirs
   v) hoses
   vi) seals
   vii) fittings
   viii) strainers
   ix) filters
   x) accumulators
   xi) motors

12. Describe the procedures used to install hydraulic systems.

13. Describe the procedures used to inspect, diagnose, maintain, and repair hydraulic systems.
    i) check hoses, piping and tubing
    ii) check fluids (condition and level)
    iii) check/change filters
    iv) determine operating parameters
    v) adjust system pressure
    vi) temperature and flow
    vii) replacing hoses, piping and tubing, fluids
    viii) check/change filters
    ix) adjust system pressure
    x) temperature and flow
    xi) condition-based monitoring
    xii) sensory inspection

Practical Objectives

1. Assemble, operate and troubleshoot a hydraulic circuit.

IMM-335 Pneumatic and Vacuum Systems

Learning Outcomes:

- Demonstrate knowledge of the principles and applications of pneumatic and vacuum systems.
- Demonstrate knowledge of pneumatic and vacuum systems related calculations.
- Demonstrate knowledge of schematics, their use and interpretation.
- Demonstrate knowledge of safety practices related to pneumatic and vacuum systems.
- Demonstrate knowledge of pneumatic and vacuum systems, their components and operation.
- Demonstrate knowledge of the procedures used to install pneumatic and vacuum systems and components.
- Demonstrate knowledge of the procedures used to diagnose, maintain, and repair pneumatic and vacuum systems and components.

2017 Red Seal Occupational Standard Reference:

22.01 Installs pneumatic and vacuum systems.
22.02 Diagnoses pneumatic and vacuum systems.
22.03 Maintains pneumatic and vacuum systems.
22.04 Repairs pneumatic and vacuum systems.

Suggested Hours:

18 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with pneumatic, vacuum and piping systems and their components.

2. Interpret jurisdictional regulations and manufacturers' specifications pertaining to installation of pneumatic, vacuum and piping systems and their components.

3. Identify hazards and describe safe work practices pertaining to pneumatic, vacuum and piping systems and their components.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

4. Identify tools and equipment used to install, diagnose, maintain and repair pneumatic and vacuum systems, and their components, and describe their applications and procedures.

5. Explain the principles and theories of pneumatic and vacuum systems.
   i) Pascal's law
   ii) Boyle's law
   iii) Charles' law
   iv) Gay-Lussac's law
   v) Bernoulli's principle

6. Describe units of measure as they relate to pneumatic and vacuum systems.

7. Identify formulae related to pneumatic and vacuum systems, and describe their applications.

8. Describe and perform the calculations used to select, install, diagnose, maintain and repair pneumatic and vacuum systems and their components.

9. Identify symbols and abbreviations related to pneumatic and vacuum systems found on schematics.

10. Describe and interpret schematics to determine the assembly and operation of pneumatic, and vacuum systems and their applications.

11. Identify types of pneumatic and vacuum systems and their components and describe their applications and operation.
   i) hoses
   ii) seals
   iii) fittings
   iv) strainers
   v) filter regulator lubricator (FRL)
   vi) piping

vii) receivers
viii) blowers
ix) pumps
x) motors
xi) actuators
xii) valves

12. Describe the methods of air treatment in pneumatic and vacuum systems.
    i) dryers
    ii) inter/after-coolers
    iii) de-icers
    iv) filters

13. Describe the procedures used to install pneumatic, vacuum, piping, tubing and hose systems and their components.

14. Describe the procedures used to diagnose, inspect, maintain and repair pneumatic, vacuum, piping, tubing and hose systems and components.
    i) check hoses, piping and tubing
    ii) check lubricating fluids (condition and level)
    iii) check/change filters
    iv) determine operating parameters
    v) adjust system pressure
    vi) temperature and flow
    vii) replacing hoses, piping and tubing, fluids
    viii) check/change filters
    ix) adjust system pressure, temperature and flow
    x) condensate drains

15. Identify types of piping systems, and describe their applications.

16. Identify types of piping, tubing, and hoses, and describe their compatibility, characteristics and applications.

17. Identify types of fittings and valves used in piping systems, and describe their characteristics and applications.

18. Identify piping system accessories, and describe their characteristics and applications.

Practical Objectives

1. Assemble, operate and troubleshoot a pneumatic or vacuum system.

Level 4

IMM-400 Prime Movers

Learning Outcomes:

- Demonstrate knowledge of prime movers, their components and operation.
- Demonstrate knowledge of safety practices related to prime movers.
- Demonstrate knowledge of the procedures used to install prime movers.
- Demonstrate knowledge of the procedures used to diagnose, maintain and repair prime movers.

2017 Red Seal Occupational Standard Reference:

9.01 Installs prime movers.
9.02 Diagnoses prime movers.
9.03 Maintains prime movers.
9.04 Repairs prime movers.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with prime movers.

2. Interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of prime movers.

3. Identify hazards and describe safe work practices associated with prime movers.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

4. Identify tools and equipment used to install, inspect, diagnose, maintain and repair prime movers, and describe their applications and procedures.
   i) torque wrenches

ii) dial indicators
iii) precision levels
iv) optical or laser alignment equipment
v) hand tools
vi) hoisting and rigging equipment

5. Identify types of prime movers and their components and accessories, and describe their purpose, applications and operation.
   i) prime movers
      - electric/hydraulic/pneumatic motors
      - turbines (wind, water, gas or steam)
      - internal combustion engines
   ii) components
      - gear boxes
      - drive shafts
   iii) auxiliary systems
      - fuel
      - intake and exhaust
      - cooling
      - controls
      - lubrication
      - filtration

6. Describe the procedures used to install prime movers and their components.

7. Describe the procedures used inspect, diagnose, maintain and repair prime movers and their components.

Practical Objectives

None

IMM-405 Conveying Systems

Learning Outcomes:

- Demonstrate knowledge of conveying systems, their components and operation.
- Demonstrate knowledge of safety practices related to conveying systems.
- Demonstrate knowledge of the procedures used to install conveying systems.
- Demonstrate knowledge of the procedures used to diagnose, maintain and repair conveying systems.

2017 Red Seal Occupational Standard Reference:

20.01 Installs conveying systems.
20.02 Diagnoses conveying systems.
20.03 Maintains conveying systems.
20.04 Repairs conveying systems.

Suggested Hours:

30 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with conveying systems.

2. Interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of conveying systems.

3. Identify hazards and describe safe work practices associated with conveying systems.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

4. Identify tools and equipment used to install, inspect, diagnose, maintain and repair conveying systems, and describe their applications and procedures.

i) hand tools
ii) gauges
iii) levelling and alignment equipment
iv) hoisting and rigging equipment

5. Identify types of conveying systems and their components and accessories, and describe their purpose, applications and operation.
   i) conveying systems
      - pneumatic
      - belt
      - rollers
      - chain
      - screw
      - bucket
      - flume/water
   ii) components
      - bearings
      - pulleys
      - rollers
      - gear reduction units
      - take-ups
      - scrapers
      - brushes
      - skirting
      - guarding

6. Describe the procedures used to install conveying systems and their components.

7. Describe the procedures used to inspect, diagnose, maintain and repair conveying systems and their components.

8. Describe the procedures used to cut and splice a conveyor belt.

9. Describe the procedures used to track a conveyor.

10. Identify the factors to consider and required calculations to determine conveying system requirements.

Practical Objectives

None

IMM-410 Preventative and Predictive Maintenance

Learning Outcomes:

- Demonstrate knowledge of preventative and predictive maintenance.
- Demonstrate knowledge of safety practices related to preventative and predictive maintenance procedures.
- Demonstrate knowledge of the procedures used to perform preventative and predictive maintenance.

2017 Red Seal Occupational Standard Reference:

23.01 Performs preventative maintenance activities.
23.06 Performs predictive maintenance activities.

Suggested Hours:

18 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with preventative and predictive maintenance.

2. Interpret jurisdictional regulations, site and manufacturers' specifications pertaining to preventative and predictive maintenance procedures.

3. Identify hazards and describe safe work practices pertaining to preventative and predictive maintenance procedures.
   i) company policies
   ii) site procedures
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

4. Identify tools and equipment used for preventative and predictive maintenance, and describe their applications and procedures.
   i) hand tools
   ii) strobe lights

iii) dye penetrant tool kit
iv) ultrasonic thickness tester
v) thermographic camera
vi) pressure gauges
vii) vibration analysis tools
viii) balancing tools

5. Identify types of maintenance, and describe their purpose and applications.
   i) breakdown (run to failure)
   ii) preventative
   iii) predictive
   iv) proactive
   v) corrective
   vi) reliability centered maintenance (RCM)

6. Identify sources of information used to develop maintenance history.
   i) reports
      - lab
      - inspection
   ii) checklists
   iii) manufacturers' specifications
   iv) root cause analysis
   v) spectrums
   vi) graphs
   vii) logbooks
   viii) images
   ix) work order history

7. Identify preventative and predictive maintenance practices, and describe their applications.
   i) non-destructive testing
   ii) fluid analysis
   iii) balancing
   iv) thermography
   v) motor current analysis
   vi) ultrasonic
   vii) reactive
   viii) scheduled overhauls
   ix) scheduled replacement
   x) running preventative maintenance

xi) data analysis

8. Describe the procedures used to schedule, perform and record preventative and predictive maintenance activities.

Practical Objectives

None

IMM-415 Vibration Analysis

Learning Outcomes:

- Demonstrate knowledge of safety practices related to vibration analysis.
- Demonstrate knowledge of the procedures used to perform vibration analysis.

2017 Red Seal Occupational Standard Reference:

23.02 Performs vibration analysis procedures.

Suggested Hours:

15 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with vibration analysis.

2. Identify hazards and describe safe work practices pertaining to vibration analysis.
   i) company policies
   ii) site procedure
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Identify tools and equipment used for vibration analysis, and describe their applications and procedures.
   i) data collector
   ii) probes
   iii) vibration pen
   iv) strobe
   v) online monitor
   vi) transducers

4. Identify and interpret sources of information pertaining to vibration analysis.
   i) manufacturers' specifications

ii) vibration standards and charts
iii) Canadian Machinery Vibration Association (CMVA) interpretations and guidelines
iv) equipment history

5. Identify causes of vibration.
   i) eccentricity
   ii) misalignment
   iii) shaft faults
   iv) mechanical looseness
   v) mechanical frequencies
   vi) natural frequencies
   vii) imbalance

6. Identify vibration analysis methods, and describe their applications.

7. Describe the procedures used to perform vibration analysis.

8. Describe the procedures used to record and interpret data collected using vibration analysis equipment.

Practical Objectives

1. Read and interpret vibration data

IMM-420 Balancing

Learning Outcomes:

- Demonstrate knowledge of safety practices related to balancing procedures.
- Demonstrate knowledge of balancing procedures.

2017 Red Seal Occupational Standard Reference:

23.03 Performs balancing procedures.

Suggested Hours:

15 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with balancing.

2. Identify hazards and describe safe work practices pertaining to balancing procedures.
   i) company policies
   ii) site procedure
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Identify tools and equipment used for balancing, and describe their applications and procedures.
   i) hand tools
   ii) weights
   iii) polar graphing charts
   iv) protractor
   v) balancing equipment

4. Identify and interpret sources of information pertaining to balancing.
   i) manufacturers' specifications.
   ii) vibration standards and charts

iii) Canadian Machinery Vibration Association (CMVA) interpretations and guidelines
iv) equipment history

5. Identify the conditions of imbalance, and describe their characteristics.
   i) static
   ii) couple
   iii) quasi-static
   iv) dynamic

6. Identify and describe balancing methods, their applications and procedures.
   i) single-plane
   ii) multi-plane

7. Identify the calculations required for balancing.

Practical Objectives

None

IMM-425 Non-Destructive Testing

Learning Outcomes:

- Demonstrate knowledge of safety practices related to non-destructive testing.
- Demonstrate knowledge of the procedures used to perform non-destructive testing.

2017 Red Seal Occupational Standard Reference:

23.04 Performs non-destructive testing (NDT) procedures.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with non-destructive testing (NDT).

2. Demonstrate an awareness of jurisdictional regulations pertaining to NDT methods.

3. Identify hazards and describe safe work practices pertaining to vibration analysis.
   i) company policies
   ii) site procedure
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

4. Identify tools and equipment used for NDT, and describe their applications and procedures.
   i) hand tools
   ii) dye penetrant tool kit
   iii) ultrasonic thickness tester
   iv) thermographic camera
   v) pressure gauges

5. Identify types of NDT methods, and describe their applications.
    i) dye penetrant
    ii) magnetic particle
    iii) radiography
    iv) ultrasonic
    v) visual
    vi) thermography
    vii) air or water pressure testing
    viii) eddy current analysis

6. Describe the procedures used to perform NDT methods.

7. Describe the procedures used to record and interpret data collected using NDT methods.

Practical Objectives

1. Perform a dye penetrant test.

IMM-430 Fluid Analysis

Learning Outcomes:

- Demonstrate knowledge of safety practices related to fluid sampling.
- Demonstrate knowledge of fluid analysis.
- Demonstrate knowledge of the procedures used to collect and test fluid samples.

2017 Red Seal Occupational Standard Reference:

23.05 Performs fluid analysis procedures.

Suggested Hours:

12 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with fluid analysis.

2. Identify hazards and describe safe work practices pertaining to fluid analysis.
   i) company policies
   ii) site procedure
   iii) jurisdictional regulations
   iv) manufacturers' recommendations

3. Identify tools and equipment used for fluid analysis, and describe their applications and procedures.
   i) hot plate
   ii) viscometer (viscosimeter)
   iii) litmus paper
   iv) infrared
   v) sample bottles
   vi) hand tools

4. Identify fluid contaminants, and describe their causes and remedies.

5. Describe the procedures used to collect and test fluid samples from systems.

6. Interpret fluid sampling results according to jurisdictional regulations.

7. Describe the procedures used to record and interpret data collected from fluid analysis.

Practical Objectives

1. Perform a visual inspection of an oil sample.

IMM-435 Commissioning and Decommissioning

Learning Outcomes:

- Demonstrate knowledge of safety practices related to commissioning and decommissioning.
- Demonstrate knowledge of commissioning and its purpose.
- Demonstrate knowledge of decommissioning and its purpose.
- Demonstrate knowledge of the procedures used to commission systems and components.
- Demonstrate knowledge of the procedures used to decommission systems and components.

2017 Red Seal Occupational Standard Reference:

24.01 Commissions systems and components.
24.02 Decommissions systems and components.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with commissioning and decommissioning.

2. Identify hazards and describe safe work practices pertaining to commissioning and decommissioning.
   i) mechanical
   ii) fluid power systems

3. Explain the purpose of commissioning and decommissioning and identify the types of mechanical and fluid power systems and components involved.

4. Interpret information sources and documentation pertaining to commissioning and decommissioning of systems, components and parts.
   i) manufacturers' specifications

ii) operating parameters
iii) jurisdictional codes and regulations
iv) Workplace Hazardous Material Information System (WHMIS)/Globally Harmonized System (GHS)
v) environmental assessment

5. Describe the procedures used to commission mechanical and fluid power systems and components.

6. Describe the procedures used to decommission mechanical and fluid power systems and components.

7. Identify the potential environmental impact of commissioning and decommissioning.

Practical Objectives

None

IMM-440 Robotics and Automated Equipment

Learning Outcomes:

- Demonstrate knowledge of safety practices related to robotics and automated equipment.
- Demonstrate knowledge of robotics and automated equipment, their components and operation.
- Demonstrate knowledge of the procedures used to install robotics and automated equipment.
- Demonstrate knowledge of the procedures used to diagnose, maintain and repair robotics and automated equipment.

2017 Red Seal Occupational Standard Reference:

15.01 Installs robotics and automated equipment.
15.02 Diagnoses robotics and automated equipment.
15.03 Maintains robotics and automated equipment.
15.04 Repairs robotics and automated equipment.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

1. Define terminology associated with robotics and automated equipment.
   i) three-axis
   ii) six-axis
   iii) seven-axis
   iv) end of arm tooling (EOAT)
   v) grippers and effectors
   vi) Selective Compliance Assembly Robot Arm (SCARA)

2. Identify hazards and describe safe work practices associated with robotics and automated equipment.
   i) company policies

ii) site procedures
iii) jurisdictional regulations
iv) manufacturers' recommendations

3. Interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of robotics and automated equipment.

4. Identify tools and equipment used to install, diagnose, maintain and repair robotics and automated equipment and describe their applications and procedures.
   i) hoisting and rigging equipment
   ii) hand tools
   iii) alignment tools

5. Identify classifications for robotics and automated equipment and their components, and describe their purpose, applications and operation.
   i) type of movement (degrees of freedom after application)
   ii) application (manufacturing process)
   iii) architecture (serial or parallel)

6. Identify classifications of auxiliary equipment, and describe their purpose, applications and operation.
   i) wire feeders
   ii) articulating fingers
   iii) filtering systems
   iv) tip cleaners
   v) tip changers

7. Describe the procedures used to install robotics and automated equipment and their components.

8. Describe the procedures used to inspect, diagnose, maintain and repair robotics and automated equipment and their components.

Practical Objectives

None

IMM-445 Mentoring

Learning Outcomes:

- Demonstrate knowledge of strategies for teaching workplace skills.

2017 Red Seal Occupational Standard Reference:

4.02 Uses mentoring techniques.

Suggested Hours:

6 Hours

Objectives and Content:

Theoretical Objectives

1. Identify different roles played by a workplace mentor.
2. Explain the importance of identifying the point of a lesson.
3. Identify how to choose a good time to present a lesson.
4. Explain the importance of linking the lesson.
5. Identify the component of the skill (the context).
6. Describe considerations in setting up opportunities for skill practice.
7. Explain the importance of giving feedback.
8. Identify techniques for giving effective feedback.
9. Describe a skills assessment.
10. Identify methods of assessing progress.

11. Explain how to adjust a lesson to different situations.

Practical Objectives:

None

IMM-450 Program Review

Learning Outcomes:

- Demonstrate knowledge of the Red Seal Occupational Standard (RSOS) 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 a Red Seal Occupational Standard (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 when 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 Atlantic Apprenticeship Curriculum and Standards (AACS).

5. Review common occupational skills for the Industrial Mechanic (Millwright) trade as identified in the RSOS.
   i) safety-related functions
   ii) tools and equipment
   iii) routine trade tasks
   iv) communication and mentoring
   v) measuring and layout
   vi) cutting and welding techniques

6. Review process to preform rigging, hoisting lifting and moving for the Industrial Mechanic (Millwright) trade as identified in the RSOS.

7. Review process to service mechanical power transmission components and systems for the Industrial Mechanic (Millwright) trade as identified in the RSOS.
   i) prime movers
   ii) shafts, bearings and seals
   iii) couplings, clutches and brakes
   iv) chains and belt drive systems
   v) gear systems
   vi) shaft alignment procedures

8. Review process to service material handling and process systems for the Industrial Mechanic (Millwright) trade as identified in the RSOS.
   i) robotics and automated equipment
   ii) fans and blowers
   iii) pumps
   iv) compressors
   v) process piping, tanks and containers
   vi) conveying systems

9. Review process to service fluid power systems for the Industrial Mechanic (Millwright) trade as identified in the RSOS.
   i) hydraulic systems
   ii) pneumatic and vacuum systems

10. Review process to perform preventative and predictive maintenance, commissioning and decommissioning for the Industrial Mechanic (Millwright) trade as identified in the RSOS.

Practical Objectives

N/A

Feedback and Revisions

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

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

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

Nova Scotia:
Nova Scotia Apprenticeship Agency
1256 Barrington St., PO Box 578
Halifax, NS B3J 2S9
Tel: 902-424-5651
Toll Free in NS: 1-800-494-5651
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