PROGRAM PROGRAMME
EXCELLENCE
RED SEAL · SCEAU ROUGE

Interprovincial Program Guide

Industrial Mechanic (Millwright)

2015

CANADIAN STANDARD OF EXCELLENCE
FOR SKILLED TRADES

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Canada

Interprovincial Program Guide

Industrial Mechanic (Millwright)

2015

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Foreword

The Canadian Council of Directors of Apprenticeship (CCDA) recognizes this Interprovincial Program Guide (IPG) as the national curriculum for the occupation of Industrial Mechanic (Millwright).

Jurisdictions have long recognized the benefit of pooling resources in the development and maintenance of apprenticeship training standards. A successful example of this is the Interprovincial Standards Red Seal Program itself. Essential to the establishment of standards is the development of suitable training systems and programs which enable tradespeople to acquire certification based on these standards. While certification is the responsibility of Apprenticeship administrators throughout Canada, the development and delivery of technical training is the responsibility of jurisdictions.

In 1999, work to develop common training for apprenticeship programs within the Atlantic Provinces began. To date, 22 Curriculum Standards have been developed through the Atlantic Standards Partnership (ASP) project to assist programming staff and instructors in the design and delivery of technical training. Similarly, the CCDA embarked on a process for the development of national IPGs for the Boilermaker, Carpenter and Sprinkler System Installer trades. At its January 2005 strategic planning session, the CCDA identified developing common training standards as one of the key activities in moving towards a more cohesive apprenticeship system.

With the support of Employment and Social Development Canada (ESDC), several provinces and territories have partnered to build on the ASP and the CCDA processes to further develop IPGs to be used across the country. This partnership will create efficiencies in time and resources and promote consistency in training and apprentice mobility.

Acknowledgements

The CCDA and the IPG Committee wish to acknowledge the contributions of the following industry and instructional representatives who participated in the original development of this document in 2008.

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In addition to the representatives above, various federal, provincial and territorial representatives contributed to the development of this document including the host province of Manitoba.

In 2014, a review, update and jurisdictional validation of this IPG were completed to ensure adequate coverage of the occupation as outlined in the 2013 National Occupational Analysis (NOA).

As this program guide will be amended periodically, comments or suggestions for improvement should be directed to:

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User Guide

According to the Canadian Apprenticeship Forum, the IPG is: "a list of validated technical training outcomes, based upon those sub-tasks identified as common core in the National Occupational Analysis (NOA), and validated by industry in the provinces and territories as incorporating the essential tasks, knowledge and skills associated with a given trade."

Learning outcomes contained in the IPG represent the minimum common core content for the development of jurisdictional training standards and outlines. IPGs are developed based on the NOAs and extensive industry consultation. The IPG is intended to assist program development staff in the design of jurisdictional plans of training. Each jurisdiction has the flexibility to add additional content.

The IPG was deliberately constructed for ease of use and flexibility of structure in order to adapt to all delivery requirements. It details units of training, unit outcomes and objectives. It does 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 IPG does not dictate study materials, textbooks or learning activities to be used in delivery.

The IPG document includes a recommended levelling structure to facilitate mobility for apprentices moving from one jurisdiction to another. Because of difference in jurisdictional regulations and program durations, levels are offered as suggestions only.

Structure

The IPG is divided into units which are identified by unique codes. The unit codes are used as a means of identification and are not intended to convey the order of delivery. Prerequisites have not been detailed. Each unit consists of *Learning Outcomes* and *Objectives and Content.*

The *Learning Outcomes* are the specific performances that must be evaluated. Wording of the learning outcomes, "Demonstrate knowledge of…", acknowledges the broad spectrum of ways in which knowledge can be shown. It is at the discretion of each jurisdiction to determine the manner in which learning outcomes are evaluated; theoretically, practically or a combination of both.

The *Objectives and Content* for the unit details the information to be covered in order to achieve the performances specified in the *Learning Outcomes*. These objectives can be either theoretical or practical in nature, based on the requirements identified through the industry consultation process. The learning activities used to cover the objectives are at the discretion of the jurisdiction; however, practically worded objective statements have been used where industry indicated a need for the apprentices to receive exposure to performing the task or skill outlined while attending technical training. For example, this exposure could be done through instructor demonstration or individual or group performance of the skill or task. This practical training will help to reinforce the theoretical component of the technical training.

Detailed content for each objective has not been developed. Where detail is required for clarity, content has been provided. The content listed within the IPG document is **not** intended to represent an inclusive list; rather, it is included to illustrate the intended direction for the objective. Content may be added or extended in jurisdictional training plans as required.

Jurisdictions are free to deliver the IPG units one at a time or concurrently, provided that all *Learning Outcomes* are met. The IPG does not indicate the amount of time to be spent on a particular unit as the length of time required to deliver the *Learning Outcomes* successfully will depend upon the learning activities and teaching methods used.

IPG Glossary of Terms

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

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 you 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.
PROCEDURE	A prescribed series of steps taken to accomplish an end.
PURPOSE	The reason for which something exists or is done, made or used.

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.
TROUBLESHOOT	To follow a systematic procedure to identify and locate a problem or malfunction and its cause.

Essential Skills Profiles

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

Over the past several years, the Government of Canada has conducted research examining the skills people use at work. From this research, Essential Skills Profiles have been developed for various occupations.

For more information regarding Essential Skills and to access Essential Skills Profiles for specific occupations, visit Employment and Social Development Canada's Essential Skills website at:

http://www.esdc.gc.ca/eng/jobs/les/profiles/index.shtml

Profile Chart

COMMON OCCUPATIONAL SKILLS			
IMM-105 Safety	IMM-110 Communications	IMM-115 Drawings and Sketching	IMM-120 Introduction to Trade-Related Tools and Equipment
IMM-125 Measuring and Layout	IMM-130 Grinders	IMM-135 Power Metal Saws	IMM-140 Drilling Machines
IMM-145 Fastening and Retaining Devices	IMM-150 Metallurgy	IMM-160 Access Equipment	IMM-170 Oxy-fuel Cutting, Heating and Welding
IMM-185 Lubrication Systems	IMM-205 Equipment Assembly Drawings	IMM-250 Shielded Metal Arc Welding (SMAW)	IMM-255 Gas Metal Arc Welding (GMAW [MIG])
IMM-260 Gas Tungsten Arc Welding (GTAW [TIG])	IMM-265 Plasma Arc Cutting	IMM-270 Lathe Operations	IMM-275 Milling Machines
IMM-415 Electrical Principles	IMM-440 Mechanical Installation Drawings	IMM-445 Equipment Installation and Alignment	IMM-470 Job Planning
RIGGING, HOISTING/LIFTING AND MOVING			
IMM-165 Rigging, Hoisting/Lifting and Moving			
MECHANICAL COMPONENTS AND SYSTEMS			
IMM-175 Bearings	IMM-180 Seals and Gaskets	IMM-215 Couplings	IMM-220 Clutches and Brakes
IMM-225 Shafts and Attachments	IMM-235 Chain and Belt Drive Systems	IMM-240 Gear Drives	IMM-420 Prime Movers (Electric Motors)

Profile Chart (*continued)*

MECHANICAL COMPONENTS AND SYSTEMS			
IMM-425 Prime Movers (Internal Combustion Engines)	IMM-430 Prime Movers (Turbines)		
MATERIAL HANDLING/ PROCESS SYSTEMS			
IMM-245 Compressors I	IMM-325 Process Tanks and Containers	IMM-330 Compressors II	IMM-335 Centrifugal pumps
IMM-340 Positive Displacement Pumps	IMM-345 Conveying Systems	IMM-435 Fans and Blowers	
HYDRAULIC, PNEUMATIC AND VACUUM SYSTEMS			
IMM-305 Introduction to Fluid Power	IMM-310 Hydraulic Systems I	IMM-315 Pneumatic Systems I	IMM-320 Piping Systems
IMM-400 Hydraulic Systems II	IMM-405 Pneumatic Systems II	IMM-410 Vacuum Systems	
PREVENTIVE AND PREDICTIVE MAINTENANCE, TESTING AND COMMISSIONING			
IMM-200 Introduction to Commissioning	IMM-230 Shaft Alignment I	IMM-300 Shaft Alignment II	IMM-450 Preventive and Predictive Maintenance
IMM-455 Vibration Analysis	IMM-460 Balancing	IMM-465 Fluid Analysis	IMM-475 Non-Destructive Testing

Recommended Level Structure

Level 1			Level 2		
Unit Code	**Title**	**Page**	**Unit Code**	**Title**	**Page**
IMM-105	Safety	20	IMM-200	Introduction to Commissioning	50
IMM-110	Communications	22	IMM-205	Equipment Assembly Drawings	51
IMM-115	Drawings and Sketching	24	IMM-215	Couplings	52
IMM-120	Introduction to Trade-Related Tools and Equipment	26	IMM-220	Clutches and Brakes	53
IMM-125	Measuring and Layout	28	IMM-225	Shafts and Attachments	55
IMM-130	Grinders	30	IMM-230	Shaft Alignment I	57
IMM-135	Power Metal Saws	31	IMM-235	Chain and Belt Drive Systems	59
IMM-140	Drilling Machines	32	IMM-240	Gear Drives	61
IMM-145	Fastening and Retaining Devices	34	IMM-245	Compressors I	63
IMM-150	Metallurgy	36	IMM-250	Shielded Metal Arc Welding (SMAW)	65
IMM-160	Access Equipment	38	IMM-255	Gas Metal Arc Welding (GMAW [MIG])	67
IMM-165	Rigging, Hoisting/Lifting and Moving	39	IMM-260	Gas Tungsten Arc Welding (GTAW [TIG])	69
IMM-170	Oxy-fuel Cutting, Heating and Welding	42	IMM-265	Plasma Arc Cutting	71
IMM-175	Bearings	43	IMM-270	Lathe Operations	73
IMM-180	Seals and Gaskets	45	IMM-275	Milling Machines	75
IMM-185	Lubrication Systems	47			

Level 3			Level 4		
Unit Code	**Title**	**Page**	**Unit Code**	**Title**	**Page**
IMM-300	Shaft Alignment II	78	IMM-400	Hydraulic Systems II	98
IMM-305	Introduction to Fluid Power	80	IMM-405	Pneumatic Systems II	100
IMM-310	Hydraulic Systems I	81	IMM-410	Vacuum Systems	102
IMM-315	Pneumatic Systems I	83	IMM-415	Electrical Principles	104
IMM-320	Piping Systems	85	IMM-420	Prime Movers (Electric Motors)	106
IMM-325	Process Tanks and Containers	87	IMM-425	Prime Movers (Internal Combustion Engines)	108
IMM-330	Compressors II	89	IMM-430	Prime Movers (Turbines)	110
IMM-335	Centrifugal Pumps	91	IMM-435	Fans and Blowers	112
IMM-340	Positive Displacement Pumps	93	IMM-440	Mechanical Installation Drawings	114
IMM-345	Conveying Systems	95	IMM-445	Equipment Installation and Alignment	115
			IMM-450	Preventive and Predictive Maintenance	117
			IMM-455	Vibration Analysis	119
			IMM-460	Balancing	120
			IMM-465	Fluid Analysis	122
			IMM-470	Job Planning	123
			IMM-475	Non-Destructive Testing	124

2013 NOA Sub-task to IPG Unit Comparison

NOA Sub-task		IPG Unit	
Task 1 – Performs safety-related functions.			
1.01	Uses personal protective equipment (PPE) and safety equipment.	IMM-105	Safety
1.02	Maintains safe work environment.	IMM-105	Safety
		IMM-165	Rigging, Hoisting/Lifting and Moving
1.03	Protects the environment.	IMM-105	Safety
1.04	Performs lock-out/tag-out and zero energy procedures.	IMM-105	Safety
Task 2 – Maintains and uses tools and equipment.			
2.01	Maintains hand and portable power tools.	IMM-120	Introduction to Trade-Related Tools and Equipment
		IMM-130	Grinders
		IMM-135	Power Metal Saws
2.02	Maintains precision measuring and layout tools.	IMM-120	Introduction to Trade-Related Tools and Equipment
		IMM-125	Measuring and Layout
2.03	Maintains rigging, hoisting/lifting and moving equipment.	IMM-120	Introduction to Trade-Related Tools and Equipment
		IMM-165	Rigging, Hoisting/Lifting and Moving
2.04	Maintains welding equipment.	IMM-120	Introduction to Trade-Related Tools and Equipment
		IMM-170	Oxy-Fuel Cutting, Heating and Welding
		IMM-250	Shielded Metal Arc Welding (SMAW)
		IMM-255	Gas Metal Arc Welding (GMAW [MIG])
		IMM-260	Gas Tungsten Arc Welding (GTAW [TIG])
		IMM-265	Plasma Arc Cutting
2.05	Uses shop machines.	IMM-120	Introduction to Trade-Related Tools and Equipment
		IMM-140	Drilling Machines
		IMM-270	Lathe Operations
		IMM-275	Milling Machines
2.06	Uses access equipment.	IMM-120	Introduction to Trade-Related Tools and Equipment
		IMM-160	Access Equipment

Task 3 – Performs routine trade tasks			
3.01	Plans work.	IMM-470	Job Planning
3.02	Fabricates workpiece.	IMM-130	Grinders
		IMM-135	Power Metal Saws
		IMM-140	Drilling Machines
		IMM-270	Lathe Operations
		IMM-275	Milling Machines
		IMM-445	Equipment Installation and Alignment
3.03	Lubricates systems and components.	IMM-185	Lubrication Systems
3.04	Performs leveling of components and systems.	IMM-445	Equipment Installation and Alignment
3.05	Uses fastening and retaining devices.	IMM-145	Fastening and Retaining Devices
3.06	Tests metal and other materials using standardized procedures.	IMM-150	Metallurgy
3.07	Performs heat treatment of metal.	IMM-150	Metallurgy
		IMM-170	Oxy-Fuel Cutting, Heating and Welding
3.08	Uses mechanical drawings and schematics.	IMM-115	Drawings and Sketching
		IMM-205	Equipment Assembly Drawings
		IMM-440	Mechanical Installation Drawings
Task 4 – Performs measuring and layout.			
4.01	Prepares work area, tools and materials.	IMM-125	Measuring and Layout
4.02	Measures material and components.	IMM-125	Measuring and Layout
4.03	Lays out components.	IMM-125	Measuring and Layout
Task 5 – Performs cutting and welding operations.			
5.01	Cuts material with gas and plasma arc cutting equipment.	IMM-170	Oxy-Fuel Cutting, Heating and Welding
		IMM-265	Plasma Arc Cutting
5.02	Joins material using gas welding equipment.	IMM-170	Oxy-Fuel Cutting, Heating and Welding
5.03	Welds material using arc welding equipment.	IMM-250	Shielded Metal Arc Welding (SMAW)
5.04	Welds material with gas metal arc welding (GMAW (MIG)) equipment.	IMM-255	Gas Metal Arc Welding (GMAW [MIG])
5.05	Welds material with gas tungsten arc welding (GTAW (TIG)) equipment.	IMM-260	Gas Tungsten Arc Welding (GTAW [TIG])
Task 6 – Plans rigging, hoisting/lifting and moving.			
6.01	Determines load.	IMM-165	Rigging, Hoisting/Lifting and Moving

6.02	Selects rigging equipment.	IMM-165	Rigging, Hoisting/Lifting and Moving
6.03	Selects hoisting/lifting and moving equipment.	IMM-165	Rigging, Hoisting/Lifting and Moving
Task 7 – Rigs, hoists/lifts and moves load.			
7.01	Secures area.	IMM-165	Rigging, Hoisting/Lifting and Moving
7.02	Sets up rigging, hoisting/lifting and moving equipment.	IMM-165	Rigging, Hoisting/Lifting and Moving
7.03	Performs hoist/lift and move.	IMM-165	Rigging, Hoisting/Lifting and Moving
Task 8 – Services prime movers.			
8.01	Installs prime movers.	IMM-420	Prime Movers (Electric Motors)
		IMM-425	Prime Movers (Internal Combustion Engines)
		IMM-430	Prime Movers (Turbines)
8.02	Diagnoses prime movers.	IMM-420	Prime Movers (Electric Motors)
		IMM-425	Prime Movers (Internal Combustion Engines)
		IMM-430	Prime Movers (Turbines)
8.03	Repairs prime movers.	IMM-420	Prime Movers (Electric Motors)
		IMM-425	Prime Movers (Internal Combustion Engines)
		IMM-430	Prime Movers (Turbines)
Task 9 – Services shafts, bearings and seals.			
9.01	Installs shafts, bearings and seals.	IMM-175	Bearings
		IMM-180	Seals and Gaskets
		IMM-225	Shafts and Attachments
9.02	Diagnoses shafts, bearings and seals.	IMM-175	Bearings
		IMM-180	Seals and Gaskets
		IMM-225	Shafts and Attachments
9.03	Repairs shafts, bearings and seals.	IMM-175	Bearings
		IMM-180	Seals and Gaskets
		IMM-225	Shafts and Attachments
9.04	Maintains shafts, bearings and seals.	IMM-175	Bearings
		IMM-180	Seals and Gaskets
		IMM-225	Shafts and Attachments
Task 10 – Services couplings, clutches and brakes.			
10.01	Installs couplings, clutches and brakes.	IMM-215	Couplings
		IMM-220	Clutches and Brakes
10.02	Installs couplings, clutches and brakes.	IMM-215	Couplings
		IMM-220	Clutches and Brakes
10.03	Repairs couplings, clutches and brakes.	IMM-215	Couplings
		IMM-220	Clutches and Brakes

Task 11 – Services chain and belt drive systems.			
11.01	Installs chain and belt drive systems.	IMM-235	Chain and Belt Drive Systems
11.02	Diagnoses chain and belt drive systems.	IMM-235	Chain and Belt Drive Systems
11.03	Repairs chain and belt drive systems.	IMM-235	Chain and Belt Drive Systems
11.04	Maintains chain and belt drive systems.	IMM-235	Chain and Belt Drive Systems
Task 12 – Services gear systems.			
12.01	Installs gear systems.	IMM-240	Gear Drives
12.02	Diagnoses gear systems.	IMM-240	Gear Drives
12.03	Repairs gear systems.	IMM-240	Gear Drives
12.04	Maintains gear systems.	IMM-240	Gear Drives
Task 13 – Services fans and blowers.			
13.01	Installs fans and blowers.	IMM-435	Fans and Blowers
13.02	Diagnoses fans and blowers.	IMM-435	Fans and Blowers
13.03	Repairs fans and blowers.	IMM-435	Fans and Blowers
13.04	Maintains fans and blowers.	IMM-435	Fans and Blowers
Task 14 – Services compressors.			
14.01	Installs compressors.	IMM-245	Compressors I
		IMM-330	Compressors II
14.02	Diagnoses compressors.	IMM-245	Compressors I
		IMM-330	Compressors II
14.03	Repairs compressors.	IMM-245	Compressors I
		IMM-330	Compressors II
14.04	Maintains compressors.	IMM-245	Compressors I
		IMM-330	Compressors II
Task 15 – Services pumps.			
15.01	Installs pumps.	IMM-335	Centrifugal Pumps
		IMM-340	Positive Displacement Pumps
15.02	Diagnoses pumps.	IMM-335	Centrifugal Pumps
		IMM-340	Positive Displacement Pumps
15.03	Repairs pumps.	IMM-335	Centrifugal Pumps
		IMM-340	Positive Displacement Pumps
15.04	Maintains pumps.	IMM-335	Centrifugal Pumps
		IMM-340	Positive Displacement Pumps
Task 16 – Services conveying systems.			
16.01	Installs conveying systems.	IMM-345	Conveying Systems
16.02	Diagnoses conveying systems.	IMM-345	Conveying Systems
16.03	Repairs conveying systems.	IMM-345	Conveying Systems
16.04	Maintains conveying systems.	IMM-345	Conveying Systems

Task 17 – Services process tanks and containers.			
17.01	Installs process tanks and containers.	IMM-325	Process Tanks and Containers
17.02	Diagnoses process tanks and containers.	IMM-325	Process Tanks and Containers
17.03	Repairs process tanks and containers.	IMM-325	Process Tanks and Containers
17.04	Maintains process tanks and containers.	IMM-325	Process Tanks and Containers
Task 18 – Services hydraulic systems.			
18.01	Installs hydraulic systems.	IMM-305	Introduction to Fluid Power
		IMM-310	Hydraulic Systems I
		IMM-320	Piping Systems
		IMM-400	Hydraulic Systems II
18.02	Diagnoses hydraulic systems.	IMM-305	Introduction to Fluid Power
		IMM-310	Hydraulic Systems I
		IMM-400	Hydraulic Systems II
18.03	Repairs hydraulic systems.	IMM-305	Introduction to Fluid Power
		IMM-310	Hydraulic Systems I
		IMM-400	Hydraulic Systems II
18.04	Maintains hydraulic systems.	IMM-305	Introduction to Fluid Power
		IMM-310	Hydraulic Systems I
		IMM-400	Hydraulic Systems II
Task 19 – Services pneumatic and vacuum systems.			
19.01	Installs pneumatic and vacuum systems.	IMM-305	Introduction to Fluid Power
		IMM-315	Pneumatic Systems I
		IMM-320	Piping Systems
		IMM-405	Pneumatic Systems II
		IMM-410	Vacuum Systems
19.02	Diagnoses pneumatic and vacuum systems.	IMM-305	Introduction to Fluid Power
		IMM-315	Pneumatic Systems I
		IMM-405	Pneumatic Systems II
		IMM-410	Vacuum Systems
19.03	Repairs pneumatic and vacuum systems.	IMM-305	Introduction to Fluid Power
		IMM-315	Pneumatic Systems I
		IMM-405	Pneumatic Systems II
		IMM-410	Vacuum Systems
19.04	Maintains pneumatic and vacuum systems.	IMM-305	Introduction to Fluid Power
		IMM-315	Pneumatic Systems I
		IMM-405	Pneumatic Systems II
		IMM-410	Vacuum Systems

Task 20 – Performs preventive and predictive maintenance.			
20.01	Performs preventive maintenance activities.	IMM-450	Preventive and Predictive Maintenance
20.02	Performs predictive maintenance activities.	IMM-450	Preventive and Predictive Maintenance
20.03	Schedules preventive and predictive maintenance.	IMM-450	Preventive and Predictive Maintenance
Task 21 – Performs specialized testing and analysis.			
21.01	Performs vibration analysis procedures.	IMM-455	Vibration Analysis
21.02	Performs balancing procedures.	IMM-460	Balancing
21.03	Performs alignment procedures.	IMM-230	Shaft Alignment I
		IMM-300	Shaft Alignment II
		IMM-445	Equipment Installation and Alignment
21.04	Performs non-destructive testing (NDT) procedures.	IMM-475	Non-Destructive Testing
21.05	Performs fluid analysis procedures.	IMM-465	Fluid Analysis
Task 22 – Commissions equipment.			
22.01	Commissions mechanical systems and components, and material handling/process systems.	IMM-200	Introduction to Commissioning
		IMM-240	Gear Drives
		IMM-245	Compressors I
		IMM-330	Compressors II
		IMM-335	Centrifugal Pumps
		IMM-340	Positive Displacement Pumps
		IMM-345	Conveying Systems
		IMM-420	Prime Movers (Electric Motors)
		IMM-425	Prime Movers (Internal Combustion Engines)
		IMM-430	Prime Movers (Turbines)
		IMM-435	Fans and Blowers
22.02	Commissions hydraulic, pneumatic and vacuum systems.	IMM-200	Introduction to Commissioning
		IMM-400	Hydraulic Systems II
		IMM-405	Pneumatic Systems II
		IMM-410	Vacuum Systems

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 safety.
- Demonstrate knowledge of the procedures used to perform lock-out/tag-out and zero energy procedures.

2013 National Occupational Analysis 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.

Objectives and Content:

1. Define terminology associated with safety in the workplace.

2. Identify workplace hazards, assess risks and describe the procedures used to maintain a safe work environment.
   i) personal
   ii) workplace
      - electrical
      - chemical
      - potential sources of energy
      - confined spaces
      - fire
      - heights
      - air quality
      - rotating equipment

3. Identify environmental hazards, assess risks and describe the procedures used to protect the environment.
   i) contamination
      - water

- air
- soil

ii) hazardous materials

4. Interpret codes and regulations related to workplace health and safety.
   i) federal
      - material safety data sheets (MSDS)
      - workplace hazardous material information system (WHMIS)
   ii) provincial/territorial
      - worker's rights and responsibilities
   iii) municipal
   iv) company safety policies

5. Identify types of PPE and clothing, and describe their characteristics, applications and procedures for use.

6. Identify types of safety equipment and describe their characteristics, applications and procedures for use.

7. Describe the procedures used to care for, maintain and store PPE according to manufacturers' specifications.

8. Describe the procedures used to care for, maintain and store safety equipment according to manufacturers' specifications.

9. Identify sources of stored energy.

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

IMM-110 Communications

Learning Outcomes:

- Demonstrate knowledge of effective communication practices.
- Demonstrate knowledge of trade-related documentation and its use.
- Demonstrate knowledge of the procedures used to prepare and complete trade-related documentation.

Objectives and Content:

1. Define terminology associated with communication and trade-related documentation.

2. Explain the importance of effective verbal and non-verbal communication.
   i) interpersonal interactions
      - other tradespersons
      - co-workers
      - supervisors
      - clients
      - apprentices
   ii) conflict resolution

3. Identify types of electronic communication devices, and describe their applications and procedures for use.
   i) computers
      - software
      - email
      - internet
   ii) smart phones
      - applications
   iii) point of sale equipment
   iv) global positioning system (GPS)

4. Explain the importance of appropriate and effective use of electronic devices and sources of information.

5. Identify types of trade-related documentation and describe their applications.
   i) work orders
   ii) purchase orders
   iii) parts lists
   iv) manufacturers' specifications
   v) codes and standards
   vi) manuals
      - safety
      - service
      - operating
   vii) permits
   viii) drawing and specifications
   ix) employer-specific forms and reports
   x) preventative/predictive maintenance sheets
   xi) technical bulletins
   xii) service records
   xiii) warranties
   xiv) estimates

6. Describe the procedures used to prepare and complete trade-related documentation.

7. Describe the procedures used to access, interpret and apply information found on trade-related documentation.

IMM-115 Drawings and Sketching

Learning Outcomes:

- Demonstrate knowledge of drawings and sketches, their use and interpretation.
- Demonstrate knowledge of basic sketching techniques.

2013 National Occupational Analysis Reference:

3.08 Uses mechanical drawings and schematics.

Objectives and Content:

1. Define terminology associated with drawings and sketches.

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

3. Identify types of drawings and describe their applications.
   i) civil/site
   ii) architectural
   iii) mechanical
   iv) structural
   v) electrical
   vi) shop drawings
   vii) field drawings
   viii) sketches
   ix) as-builts

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

5. Identify views used drawings.
   i) elevation
   ii) plan

iii) section
iv) detail

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

7. Explain the use of scales.

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

9. Demonstrate basic sketching techniques.

10. Demonstrate awareness of Computer Aided Drawing (CAD) systems.

11. Perform conversions between the metric and imperial systems of measurement.

12. Perform a basic take-off from a blueprint/drawing.

IMM-120 Introduction to Trade-Related Tools and Equipment

Learning Outcomes:

- Demonstrate knowledge of tools and equipment, their applications and procedures for use.
- Demonstrate knowledge of the procedures used to clean, inspect, maintain and store tools and equipment.

2013 National Occupational Analysis Reference:

2.01 Maintains hand and portable power tools.
2.02 Maintains precision measuring and layout tools.
2.03 Maintains rigging, hoisting/lifting and moving equipment.
2.04 Maintains welding equipment.
2.05 Uses shop machines.
2.06 Uses access equipment.

Objectives and Content:

1. Define terminology associated with tools and equipment.

2. Identify hazards and describe safe work practices pertaining to the use of tools and equipment.

3. Interpret codes, regulations and specifications pertaining to tools and equipment.
   i) licensing
   ii) training

4. Identify types of hand tools and describe their applications and procedures for use.

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

6. Identify types of welding equipment and describe their applications and procedures for use.

7. Identify types of shop machines and describe their applications and procedures for use.
i) drill presses
ii) stationary grinders
iii) abrasive cut off saw (chop saw)
iv) band saws

8. Describe the procedures used to clean, inspect, maintain and store tools and equipment according to manufacturers' specifications.

IMM-125 Measuring and Layout

Learning Outcomes:

- Demonstrate knowledge of precision measuring and layout tools, their applications and procedures for use.
- Demonstrate knowledge of the procedures used to lay out equipment and components.

2013 National Occupational Analysis Reference:

2.02 Maintains precision measuring and layout tools.
4.01 Prepares work area, tools and materials.
4.02 Measures material and components.
4.03 Lays out components.

Objectives and Content:

1. Define terminology associated with measuring and layout.

2. Identify types of precision measuring tools and describe their applications and procedures for use.
   i) micrometers
   ii) calipers
   iii) dial indicators
   iv) protractors
   v) height gauges
   vi) feeler gauges
   vii) plug, ring and snap gauges
   viii) gauge blocks

3. Identify types of layout tools and describe their applications and procedures for use.
   i) straightedges
   ii) solid squares
   iii) combination sets
   iv) surface plates
   v) scribers
   vi) hermaphrodite calipers

vii) dividers
viii) trammels
ix) prick and centre punches
x) angle plates
xi) parallels
xii) V-blocks
xiii) surface gauges
xiv) layout dye

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

5. Describe the procedures used to transfer measurements.

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

IMM-130 Grinders

Learning Outcomes:

- Demonstrate knowledge of grinders and their applications.
- Demonstrate knowledge of the procedures used to perform grinding operations.

2013 National Occupational Analysis Reference:

3.02 Fabricates workpiece.

Objectives and Content:

1. Define terminology associated with grinders.

2. Identify hazards and describe safe work practices pertaining to grinding operations.

3. Identify types of grinders and describe their characteristics and applications.

4. Identify grinder components, accessories and attachments and describe their applications and maintenance.

5. Identify the factors to consider when selecting grinding wheels for specific operations.

6. Describe the procedures used to change, ring test, mount and dress grinding wheels.

7. Describe the procedures used to operate grinders.

8. Describe the techniques used to sharpen or dress tools using grinders.
   i) chisels
   ii) twist drills
   iii) punches

IMM-135 Power Metal Saws

Learning Outcomes:

- Demonstrate knowledge of power metal saws and their maintenance and applications.
- Demonstrate knowledge of the procedures used to perform cutting operations using power metal saws.

2013 National Occupational Analysis Reference:

3.02 Fabricates workpiece.

Objectives and Content:

1. Define terminology associated with power metal saws.

2. Identify hazards and describe safe work practices pertaining to power metal saws.

3. Identify types of power metal saws and describe their maintenance and applications.

4. Identify power metal saw components, accessories and attachments and describe their applications.

5. Identify cutting fluids and coolants used during cutting operations.

6. Describe the procedures used to perform and troubleshoot cutting operations using power metal saws.

IMM-140 Drilling Machines

Learning Outcomes:

- Demonstrate knowledge of drilling machines, their accessories and their applications.
- Demonstrate knowledge of the procedures used to perform drilling machine maintenance.
- Demonstrate knowledge of the procedures used to perform drilling operations, and the associated calculations.

2013 National Occupational Analysis Reference:

2.05 Uses shop machines.
3.02 Fabricates workpiece.

Objectives and Content:

1. Define terminology associated with drilling machines and drilling operations.

2. Identify hazards and describe safe work practices pertaining to drilling operations.
3. Identify types of drilling machines, their components and accessories and describe their characteristics and applications.

4. Identify types of drill bits and describe their characteristics and applications.

5. Identify cutting fluids and coolants used during drilling operations and describe their characteristics and applications.

6. Describe the procedures used to set up, operate and troubleshoot drilling machines.
   i) drilling
   ii) boring
   iii) reaming
   iv) counterboring
   v) countersinking
   vi) tapping
   vii) spot facing

7. Describe the procedures used to inspect and maintain drilling machines, their components and accessories.

8. Determine and calculate speeds and feeds for drilling operations.

IMM-145 Fastening and Retaining Devices

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.

2013 National Occupational Analysis Reference:

3.05 Uses fastening and retaining devices.

Objectives and Content:

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 for use.

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.

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

8. Explain the purpose of torqueing 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 hand drill and tap to specifications and make external threads to specifications.
    i) hand tapping
    ii) external threading (dies)
    iii) internal threading (taps)

IMM-150 Metallurgy

Learning Outcomes:

- Demonstrate knowledge of metals and their characteristics.
- Demonstrate knowledge of metallurgic principles.
- Demonstrate knowledge of material testing procedures.
- Demonstrate knowledge of structural shapes and their applications.

2013 National Occupational Analysis Reference:

3.06 Tests metal and other materials using standardized procedures.
3.07 Performs heat treatment of metal.

Objectives and Content:

1. Define terminology associated with metallurgy.

2. Describe the properties of metals.

3. Describe the identification systems for metals.

4. Identify structural shapes and describe their characteristics and applications.

5. Describe the processes used in the heat treatment of metals.
   i) stress relieving
   ii) hardening
   iii) annealing
   iv) tempering
   v) normalizing
   vi) quenching

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. Identify common metal testing techniques and describe their associated procedures.
   i) Rockwell
   ii) Brinnell
   iii) spark
   iv) chisel
   v) file

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

IMM-160 Access Equipment

Learning Outcomes:

- Demonstrate knowledge of ladders, scaffolding and hydraulic lifts, their applications, limitations and procedures for use.

2013 National Occupational Analysis Reference:

2.06 Uses access equipment.

Objectives and Content:

1. Define terminology associated with ladders, scaffolding and hydraulic lifts.

2. Identify hazards and describe safe work practices pertaining to ladders, scaffolding and hydraulic lifts.

3. Interpret codes and regulations pertaining to ladders, scaffolding and hydraulic lifts.

4. Identify types of ladders, scaffolding and hydraulic lifts and describe their characteristics and applications.

5. Identify types of fall arrest 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 ladders, scaffolding and hydraulic lifts.

IMM-165 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 the procedures used to perform hoisting and lifting operations.
- Demonstrate knowledge of calculations required when performing hoisting and lifting operations.
- Demonstrate knowledge of the use of standard hand signals.

2013 National Occupational Analysis Reference:

6.01 Determines load.
6.02 Selects rigging equipment.
6.03 Selects hoisting/lifting and moving equipment.
7.01 Secures area.
7.02 Sets up rigging, hoisting/lifting and moving equipment.
7.03 Performs hoist/lift and move.

Objectives and Content:

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

2. Identify hazards and describe safe work practices pertaining to rigging, hoisting/lifting and moving.

3. Identify hazards and describe safe work practices pertaining to mobile and overhead cranes.

4. Interpret codes and regulations pertaining to rigging, hoisting/lifting and moving.

5. Identify types of rigging equipment and accessories, and describe their applications, limitations and procedures for use.

6. Identify types of hoisting and lifting equipment and accessories, and describe their applications, limitations and procedures for use.

7. Identify types of moving equipment and accessories, and describe their applications, limitations and procedures for use.

8. Identify types of knots, hitches and bends, and describe their applications and the procedures used to tie them.

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

10. Describe the procedures used to rig material/equipment for lifting.

11. Describe the procedures used to ensure the work area is safe for lifting.
    i) supervision of lift
    ii) securing work area
    iii) communication

12. Describe procedures used to communicate during rigging, hoisting/lifting and moving operations.
    i) hand signals
    ii) electronic communications
    iii) audible/visual

13. Explain sling angle when preparing for hoisting and lifting operations.

14. Describe the procedures used to determine the weight and weight distribution of loads.
    i) reference load charts
    ii) determine types of loads
    iii) engineered lifts

15. Identify the factors to consider when selecting rigging, hoisting/lifting and moving equipment.

16. Describe the procedures used to perform a lift.
    i) load determination
    ii) communication methods
    iii) pre-lift checks

iv) placement of load
v) post-lift inspection

17. Perform standard hand signals.

IMM-170 Oxy-Fuel Cutting, Heating and Welding

Learning Outcomes:

- Demonstrate knowledge of oxy-fuel equipment and accessories.
- Demonstrate knowledge of the procedures used to cut, heat, weld, solder and braze with oxy-fuel equipment.

2013 National Occupational Analysis Reference:

3.07 Performs heat treatment of metal.
5.01 Cuts material with gas and plasma arc cutting equipment.
5.02 Joins material using gas welding equipment.

Objectives and Content:

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

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

3. Interpret codes and 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.

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

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

IMM-175 Bearings

Learning Outcomes:

- Demonstrate knowledge of bearings and their applications.
- Demonstrate knowledge of the procedures used to remove, install, maintain, troubleshoot and repair bearings.

2013 National Occupational Analysis Reference:

9.01 Installs shafts, bearings and seals.
9.02 Diagnoses shafts, bearings and seals.
9.03 Repairs shafts, bearings and seals.
9.04 Maintains shafts, bearings and seals.

Objectives and Content:

1. Define terminology associated with bearings.

2. Identify hazards and describe safe work practices pertaining to bearings.

3. Identify types of bearings and describe their applications.
   i) friction
   ii) anti-friction

4. Identify types of bearing housings and describe their applications.

5. Identify types of bearing fits and describe their applications.

6. Identify tools and equipment used to remove, install, maintain, troubleshoot and repair bearings, and describe their applications and procedures for use.

7. Describe the procedures used to remove and install bearings.

8. Describe the procedures used to inspect and maintain bearings.

9. Describe the procedures used to troubleshoot bearing problems.

10. Identify the factors to consider when determining if bearing repair or replacement is required.

11. Describe the procedures used to repair bearings.

IMM-180 Seals and Gaskets

Learning Outcomes:

- Demonstrate knowledge of seals and gaskets, and their characteristics and applications.
- Demonstrate knowledge of the procedures used to remove and install seals and gaskets.

2013 National Occupational Analysis Reference:

9.01 Installs shafts, bearings and seals.
9.02 Diagnoses shafts, bearings and seals.
9.03 Repairs shafts, bearings and seals.
9.04 Maintains shafts, bearings and seals.

Objectives and Content:

1. Define terminology associated with seals and gaskets.

2. Identify hazards and describe safe work practices pertaining to seals and gaskets.

3. Identify types of seals and describe their characteristics and applications.
   i) static
   ii) dynamic
   iii) mechanical
   iv) non-contacting (labyrinth/annulus)

4. Identify types of gaskets and describe their characteristics and applications.

5. Identify tools and equipment used to remove and install seals and gaskets, and describe their applications and procedures for use.

6 Identify the tools and equipment used with seals and gaskets, and describe their applications and procedures for use.

7. Describe the procedures used to remove and install seals and gaskets.

8. Identify the factors to consider when determining if mechanical seal repair or replacement is required.

9. Describe the procedures used to repair mechanical seals.

IMM-185 Lubrication Systems

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 and fluids.

2013 National Occupational Analysis Reference:

3.03 Lubricates systems and components.

Objectives and Content:

1. Define terminology associated with lubricants and lubrication systems.

2. Identify hazards and describe safe work practices pertaining to lubricants and lubrication systems.

3. Interpret codes, regulations and specifications pertaining to lubricants and lubrication systems.

4. Identify tools and equipment used with lubricants and lubrication systems, and describe their applications and procedures for use.

5. Explain the principles of friction and its effects on surfaces in contact.

6. Identify types of lubricants and describe their applications.
   i) oil
   ii) grease
   iii) dry solid

7. Identify the properties and characteristics of lubricants.
   i) adhesion/cohesion
   ii) viscosity
   iii) additives and inhibitors
   iv) penetration
   v) dropping point

vi) flash point
vii) classifications and grades

8. Identify the factors to consider when selecting lubricants.

9. Explain the effects of using incorrect lubricant.

10. Identify types of lubrication systems and describe their characteristics and applications.

11. Identify sources of information relating to system lubricant and lubrication requirements.
    i) technical manuals
    ii) manufacturers' specifications

12. Describe the procedures used to handle, store, recycle and dispose of lubricants and fluids.

LEVEL 2

IMM-200 Introduction to Commissioning

Learning Outcomes:

- Demonstrate knowledge of commissioning and its purpose.

2013 National Occupational Analysis Reference:

22.01 Commissions mechanical systems and components, and material handling/process systems.
22.02 Commissions hydraulic, pneumatic and vacuum systems.

Objectives and Content:

1. Define terminology associated with commissioning.

2. Identify hazards and describe safe work practices pertaining to commissioning systems or components.

3. Explain the purpose of commissioning and identify the types of systems and components that need to be commissioned.

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

IMM-205 Equipment Assembly Drawings

Learning Outcomes:

- Demonstrate knowledge of equipment assembly drawings, their use and interpretation.

2013 National Occupational Analysis Reference:

3.08 Uses mechanical drawings and schematics.

Objectives and Content:

1. Define terminology associated with equipment assembly drawings.

2. Identify the views found on equipment assembly drawings and describe their characteristics.

3. Interpret assembly instructions on equipment assembly drawings.

4. Interpret material specifications found on equipment assembly drawings.

IMM-215 Couplings

Learning Outcomes:

- Demonstrate knowledge of couplings and their applications.
- Demonstrate knowledge of the procedures used to remove and install couplings.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair couplings.

2013 National Occupational Analysis Reference:

10.01 Installs couplings, clutches and brakes.
10.02 Installs couplings, clutches and brakes.
10.03 Repairs couplings, clutches and brakes.

Objectives and Content:

1. Define terminology associated with couplings.

2. Identify hazards and describe safe work practices pertaining to couplings.

3. Interpret codes, regulations and specifications pertaining to couplings.

4. Identify tools and equipment used with couplings, and describe their applications and procedures for use.

5. Identify types of couplings and describe their characteristics and applications.

6. Describe the procedures used to remove and install couplings.

7. Describe the procedures used to inspect and maintain couplings.

8. Describe the procedures used to troubleshoot couplings.

9. Identify the factors to consider when determining if coupling repair or replacement is required.

10. Describe the procedures used to repair couplings.

IMM-220 Clutches and Brakes

Learning Outcomes:

- Demonstrate knowledge of clutches and brakes and their applications.
- Demonstrate knowledge of the procedures used to remove and install clutches and brakes.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair clutches and brakes.

2013 National Occupational Analysis Reference:

10.01 Installs couplings, clutches and brakes.
10.02 Installs couplings, clutches and brakes.
10.03 Repairs couplings, clutches and brakes.

Objectives and Content:

1. Define terminology associated with clutches and brakes.

2. Identify hazards and describe safe work practices pertaining to clutches and brakes.

3. Interpret codes, regulations and specifications pertaining to clutches and brakes.

4. Identify tools and equipment used with clutches and brakes, and describe their applications and procedures for use.

5. Identify types of clutches and describe their characteristics and applications.
   i) overrunning
   ii) friction
   iii) positive contact
   iv) fluid

6. Identify types of brakes and describe their characteristics and applications.
   i) friction
   ii) fluid/wet disc
   iii) electromagnetic

7. Describe the procedures used to remove and install clutches and brakes.

8. Describe the procedures used to inspect and maintain clutches and brakes.

9. Describe the procedures used to troubleshoot clutches and brakes.

10. Identify the factors to consider when determining if clutch and brake repair or replacement is required.

11. Describe the procedures used to repair clutches and brakes.

IMM-225 Shafts and Attachments

Learning Outcomes:

- Demonstrate knowledge of shafts, their accessories and applications.
- Demonstrate knowledge of the procedures used to remove and install shafts and accessories.
- Demonstrate knowledge of the procedures used to maintain and repair shafts and accessories.

2013 National Occupational Analysis Reference:

9.01 Installs shafts, bearings and seals.
9.02 Diagnoses shafts, bearings and seals.
9.03 Repairs shafts, bearings and seals.
9.04 Maintains shafts, bearings and seals.

Objectives and Content:

1. Define terminology associated with shafts and accessories.

2. Identify hazards and describe safe work practices pertaining to shafts and accessories.

3. Interpret codes, regulations and specifications pertaining to shafts and accessories.

4. Identify tools and equipment used with shafts and accessories, and describe their applications and procedures for use.

5. Identify types of shafts and describe their characteristics and applications.
   i) drive
   ii) counter
   iii) jack
   iv) hollow

6. Identify shaft accessories and describe their characteristics and applications.
   i) keys
   ii) pins

iii) taper lock bushings
iv) retaining rings
v) sleeves

7. Describe the procedures used to remove and install shafts and accessories.

8. Describe the procedures used to inspect and maintain shafts and accessories.

9. Identify the factors to consider when determining if shaft repair or replacement is required.

10. Describe the procedures used to repair shafts.

IMM-230 Shaft Alignment I

Learning Outcomes:

- Demonstrate knowledge of the procedures used to align shafts using the straight edge and feeler gauge method.
- Demonstrate knowledge of the procedures used to align shafts using the rim and face dial method.

2013 National Occupational Analysis Reference:

21.03 Performs alignment procedures.

Objectives and Content:

1. Define terminology associated with shaft alignment.

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

3. Interpret codes, regulations and specifications pertaining to shaft alignment.

4. Identify tools and equipment used for shaft alignment, and describe their applications and procedures for use.

5. Describe the procedures used to determine shaft misalignment.

6. Identify the types of alignment methods and describe their applications and limitations.
   i) straight edge and feeler gauge
   ii) rim and face dial
   iii) reverse dial
   iv) cross dial
   v) laser

7. Describe the procedures used to align shafts using the straight edge and feeler gauge method.
   i) pre-alignment checks
   ii) select tools and equipment

iii) perform calculations
iv) make adjustments

8. Describe the procedures used to align shafts using the rim and face dial method.
   i) pre-alignment checks
   ii) select tools and equipment
   iii) perform calculations
   iv) make adjustments

IMM-235 Chain and Belt Drive Systems

Learning Outcomes:

- Demonstrate knowledge of chain and belt drive systems, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install chain and belt drive systems.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair chain and belt drive systems.

2013 National Occupational Analysis Reference:

11.01 Installs chain and belt drive systems.
11.02 Diagnoses chain and belt drive systems.
11.03 Repairs chain and belt drive systems.
11.04 Maintains chain and belt drive systems

Objectives and Content:

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

2. Identify hazards and describe safe work practices pertaining to chain and belt drive systems.

3. Interpret codes, regulations and specifications pertaining to chain and belt drive systems.

4. Identify tools and equipment used with chain and belt drive systems, and describe their applications and procedures for use.

5. Identify types of chain drive systems, their components and accessories, and describe their characteristics and applications.
   i) roller
   ii) silent

6. Identify types of belt drive systems, their components and accessories, and describe their characteristics and applications.
   i) v-belt drive

ii) cog belt drive
iii) timing drive
iii) flat belt drive

7. Identify types of chain links.
   i) offset
   ii) connecting
   iii) single or double roller

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

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

10. Describe the procedures used to inspect and maintain chain and belt drive systems and their components.

11. Describe the procedures used to troubleshoot chain and belt drive systems and their components.

12. Identify the factors to consider when determining if chain and belt drive systems or their components need repair or replacement.

13. Describe the procedures used to repair chain and belt drive systems and their components.

IMM-240 Gear Drives

Learning Outcomes:

- Demonstrate knowledge of gears and gear drives, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install gears and gear drives.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair gears and gear drives.
- Demonstrate knowledge of the procedures used to commission gears and gear drives.

2013 National Occupational Analysis Reference:

12.01 Installs gear systems.
12.02 Diagnoses gear systems.
12.03 Repairs gear systems.
12.04 Maintains gear systems.
22.01 Commissions mechanical systems and components, and material handling/process systems.

Objectives and Content:

1. Define terminology associated with gears and gear drives.

2. Identify hazards and describe safe work practices pertaining to gears and gear drives.

3. Interpret codes, regulations and specifications pertaining to gears and gear drives.

4. Identify tools and equipment used with gears and gear drives, and describe their applications and procedures for use.

5. Identify types of gears and describe their characteristics and applications.
   i) spur
   ii) bevel
   iii) spiral

iv) herringbone
v) helical
vi) worm

6. Identify types of gear drives and describe their components, applications and operation.
   i) planetary
   ii) worm
   iii) parallel shaft
   iv) crown and pinion

7. Identify formulae and perform gear ratio calculations.

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

9. Describe the procedures used to inspect and maintain gears, gear drives and their components.
   i) monitor temperature
   ii) perform vibration analysis
   iii) check lubrication
   iv) check contact patterns
   v) adjust clearance and backlash

10. Describe the procedures used to troubleshoot gears, gear drives and their components.

11. Identify the factors to consider when determining if gear drive components need to be repaired or replaced.

12. Describe the procedures used to repair gears, gear drives and their components.

13. Describe the procedures used to commission gear drives.

IMM-245 Compressors I

Learning Outcomes:

- Demonstrate knowledge of reciprocating compressors, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install reciprocating compressors.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair reciprocating compressors.
- Demonstrate knowledge of the procedures used to commission reciprocating compressors.

2013 National Occupational Analysis Reference:

14.01 Installs compressors.
14.02 Diagnoses compressors.
14.03 Repairs compressors.
14.04 Maintains compressors.

Objectives and Content:

1. Define terminology associated with reciprocating compressors.

2. Identify hazards and describe safe work practices associated with reciprocating compressors.

3. Interpret codes, regulations and specifications pertaining to the use of reciprocating compressors.

4. Identify tools and equipment used with reciprocating compressors and describe their applications and procedures for use.

5. Identify classifications and types of compressors.
   i) dynamic/centrifugal
   ii) positive displacement
      - reciprocating
      - radial

- screw
- vane

6. Identify reciprocating compressor components and accessories, and describe their purpose and operation.

7. Describe the procedures used to remove and install reciprocating compressors and their components.

8. Describe the procedures used to inspect and maintain reciprocating compressors and their components.

9. Describe the procedures used to troubleshoot reciprocating compressors and their components.

10. Identify the factors to consider when determining if reciprocating compressors or their components need to be repaired or replaced.

11. Describe the procedures used to repair reciprocating compressors and their components.

12. Describe the procedures used to commission reciprocating compressors.

IMM-250 Shielded Metal Arc Welding (SMAW)

Learning Outcomes:

- Demonstrate knowledge of SMAW equipment and accessories.
- Demonstrate knowledge of procedures used to weld using SMAW equipment.

2013 National Occupational Analysis Reference:

2.04 Maintains welding equipment.
5.03 Welds material using arc welding equipment.

Objectives and Content:

1. Define terminology associated with SMAW.

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

3. Interpret codes and regulations pertaining to SMAW.

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

5. Describe the SMAW welding process and its applications.

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

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

8. Describe the procedures used to inspect and maintain SMAW equipment.

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

10. Identify welding positions and describe their applications.

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

12. Describe weld defects, their causes and prevention.

IMM-255 Gas Metal Arc Welding (GMAW [MIG])

Learning Outcomes:

- Demonstrate knowledge of gas metal arc welding (GMAW) equipment and accessories.
- Demonstrate knowledge of the procedures used to weld with GMAW equipment.

2013 National Occupational Analysis Reference:

2.04 Maintains welding equipment.
5.04 Welds material with gas metal arc welding (GMAW (MIG)) equipment.

Objectives and Content:

1. Define terminology associated with the GMAW process.

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

3. Interpret codes and regulations pertaining to the GMAW process.

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

5. Describe the GMAW process and its applications.

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

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

8. Describe the procedures used to inspect and maintain GMAW equipment.

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

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

11. Describe weld defects, their causes and prevention.

IMM-260 Gas Tungsten Arc Welding (GTAW [TIG])

Learning Outcomes:

- Demonstrate knowledge of GTAW equipment and accessories.
- Demonstrate knowledge of procedures used to weld using GTAW equipment.

2013 National Occupational Analysis Reference:

2.04 Maintains welding equipment.
5.05 Welds material with gas tungsten arc welding (GTAW (TIG)) equipment.

Objectives and Content:

1. Define terminology associated with the GTAW process.

2. Identify hazards and describe safe work practices pertaining to the GTAW process.
   i) personal
   ii) shop/facility
   iii) equipment
   iv) ventilation

3. Interpret codes and regulations pertaining to the GTAW process.

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

5. Describe the GTAW process and its applications.

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

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

8. Describe the procedures used to inspect and maintain GTAW equipment.

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

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

11. Describe weld defects, their causes and prevention.

IMM-265 Plasma Arc Cutting

Learning Outcomes:

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

2013 National Occupational Analysis Reference:

2.04 Maintains welding equipment.
5.01 Cuts material with gas and plasma arc cutting equipment.

Objectives and Content:

1. Define terminology associated with plasma arc cutting.

2. Identify hazards and describe safe work practices pertaining to plasma arc cutting.
   i) personal
   ii) shop/facility
   iii) equipment
   iv) ventilation

3. Interpret codes and 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. Identify plasma arc cutting equipment and accessories and describe their applications.

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

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

9. Describe the procedures used to cut using plasma arc cutting equipment.

IMM-270 Lathe Operations

Learning Outcomes:

- Demonstrate knowledge of lathes, their accessories, attachments and applications.
- Demonstrate knowledge of the procedures used to perform lathe operations, and the associated calculations.

2013 National Occupational Analysis Reference:

2.05 Uses shop machines.
3.02 Fabricates workpiece.

Objectives and Content:

1. Define terminology associated with lathes.

2. Identify hazards and describe safe work practices pertaining to lathe operations.

3. Identify types of lathes and describe their applications and operation.

4. Identify lathe components, accessories and attachments, and describe their characteristics, applications and maintenance.

5. Identify types of tool holding and work holding devices, and describe their characteristics and applications.

6. Identify types of lathe tools and describe their characteristics and applications.

7. Describe the procedures used to sharpen lathe cutting tools.

8. Calculate and determine speeds, feeds and depth of cut for lathe operations.

9. Describe the procedures used to set up lathes.

10. Identify cutting fluids and coolants used during lathe operations.

11. Describe the procedures used to perform basic lathe operations.
    i) turning
    ii) boring
    iii) grooving
    iv) facing
    v) knurling
    vi) parting off
    vii) drilling
    viii) threading

12. Describe the procedures used to prevent and correct problems that occur when performing lathe operations.

IMM-275 Milling Machines

Learning Outcomes:

- Demonstrate knowledge of milling machines and their applications.
- Demonstrate knowledge of the procedures used to perform milling operations, and the associated calculations.

2013 National Occupational Analysis Reference:

2.05 Uses shop machines.
3.02 Fabricates workpiece.

Objectives and Content:

1. Define terminology associated with milling machines.

2. Identify hazards and describe safe work practices pertaining to milling operations, materials used, and coolants.

3. Identify types of milling machines and describe their applications.

4. Identify milling machine components, accessories and attachments, and describe their characteristics, applications and maintenance.

5. Identify types of tool holding and work holding devices and describe their characteristics, applications and procedures for use.

6. Identify types of cutting tools and describe their characteristics and applications.

7. Calculate and determine speeds, feeds and depth of cut for milling operations.

8. Describe the procedures used to align workpieces.

9. Identify cutting fluids and coolants used during milling operations.

10 Describe the procedures used to perform basic milling operations.

11. Describe the procedures used to prevent and correct problems that occur when performing milling machine operations.

LEVEL 3

IMM-300 Shaft Alignment II

Learning Outcomes:

- Demonstrate knowledge of the procedures used for shaft alignment using the reverse dial method.
- Demonstrate knowledge of the procedures used for shaft alignment using the cross dial method.
- Demonstrate knowledge of the procedures used for shaft alignment using the laser method.

2013 National Occupational Analysis Reference:

21.03 Performs alignment procedures.

Objectives and Content:

1. Define terminology associated with the reverse dial, cross dial and laser methods of shaft alignment.

2. Identify hazards and describe safe work practices pertaining to the use of the reverse dial, cross dial and laser methods for shaft alignment.

3. Interpret codes and regulations pertaining to the use of the reverse dial, cross dial and laser methods of shaft alignment.

4. Identify tools and equipment used for shaft alignment, and describe their applications and procedures for use.

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

6. Describe the procedures used to align shafts using the reverse dial method.
   i) pre-alignment checks
   ii) select tools and equipment
   iii) perform calculations
   iv) make adjustments

7. Describe the procedures used to align shafts using the cross dial method.
   i) pre-alignment checks

ii) select tools and equipment
iii) perform calculations
iv) make adjustments

8. Describe the procedures used to align shafts using the laser method.
   i) pre-alignment checks
   ii) select tools and equipment
   iii) perform calculations
   iv) make adjustments

IMM-305 Introduction to Fluid Power

Learning Outcomes:

- Demonstrate knowledge of the principles and applications of fluid power.

2013 National Occupational Analysis Reference:

18.01 Installs hydraulic systems.
18.02 Diagnoses hydraulic systems.
18.03 Repairs hydraulic systems.
18.04 Maintains hydraulic systems.
19.01 Installs pneumatic and vacuum systems.
19.02 Diagnoses pneumatic and vacuum systems.
19.03 Repairs pneumatic and vacuum systems.
19.04 Maintains pneumatic and vacuum systems.

Objectives and Content:

1. Define terminology associated with fluid power.
   i) hydraulic
   ii) pneumatic
   iii) vacuum

2. Identify hazards and describe safe work practices pertaining to fluid power.

3. Explain the principles and theories of fluid power.
   i) Pascal's law
   ii) Boyle's law
   iii) Charles' law
   iv) Guy-Lusac's law
   v) Bernoulli's principle

4. Describe units of measure as they relate to fluid power.

5. Identify formulae related to fluid power and describe their applications.

6. Identify symbols and abbreviations related to fluid power found on drawings and schematics.

IMM-310 Hydraulic Systems I

Learning Outcomes:

- Demonstrate knowledge of hydraulic systems, their components and operation.
- Demonstrate knowledge of schematics, their use and interpretation.
- Demonstrate knowledge of hydraulic related calculations.

2013 National Occupational Analysis Reference:

18.01 Installs hydraulic systems.
18.02 Diagnoses hydraulic systems.
18.03 Repairs hydraulic systems.
18.04 Maintains hydraulic systems.

Objectives and Content:

1. Define terminology associated with hydraulic systems.

2. Identify hazards and describe safe work practices pertaining to hydraulic systems.

3. Interpret codes, regulations and specifications pertaining to hydraulic systems.

4. Identify types of hydraulic systems and describe their applications and operation, including fluid types.

5. Identify hydraulic system components and describe their purpose and operation.
   i) pumps
   ii) motors
   iii) actuators
   iv) valves
   v) accumulators
   vi) filters and strainers
   vii) fluid conductors

6. Describe hydraulic system schematics and their applications.

7. Interpret information and symbols found on schematics to determine the operation of a hydraulic system.

8. Perform hydraulic calculations.

IMM-315 Pneumatic Systems I

Learning Outcomes:

- Demonstrate knowledge of pneumatic systems, their components and operation.
- Demonstrate knowledge of schematics, their use and interpretation.
- Demonstrate knowledge of pneumatic related calculations.

2013 National Occupational Analysis Reference:

19.01 Installs pneumatic and vacuum systems.
19.02 Diagnoses pneumatic and vacuum systems.
19.03 Repairs pneumatic and vacuum systems.
19.04 Maintains pneumatic and vacuum systems.

Objectives and Content:

1. Define terminology associated with pneumatic systems.

2. Identify hazards and describe safe work practices pertaining to pneumatic systems.

3. Interpret codes, regulations and specifications pertaining to pneumatic systems.

4. Identify types of pneumatic systems and describe their applications and operation.

5. Identify pneumatic system components and describe their purpose and operation.
   i) pumps
   ii) motors
   iii) actuators
   iv) valves
   v) accumulators

6. Describe the methods of air treatment in pneumatic systems.
   i) filters
   ii) dryers
   iii) after-coolers

iv) de-icers
v) receivers

7. Describe pneumatic system schematics and their applications.

8. Interpret schematics to determine the operation of a pneumatic system.

9. Perform pneumatic related calculations.

IMM-320 Piping Systems

Learning Outcomes:

- Demonstrate knowledge of piping systems, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install piping systems and their components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair piping systems and their components.

2013 National Occupational Analysis Reference:

18.01 Installs hydraulic systems.
19.01 Installs pneumatic and vacuum systems.

Objectives and Content:

1. Define terminology associated with piping systems.

2. Identify hazards and describe safe work practices pertaining to piping systems.

3. Interpret codes and regulations pertaining to piping systems.

4. Interpret information pertaining to piping systems found on drawings, specifications and schematics.

5. Identify types of piping systems and describe their applications.

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

7. Identify types of fittings and describe their characteristics and applications.

8. Identify piping system accessories and describe their characteristics and applications.

9. Identify types of valves used in piping systems and describe their applications and operation.

10. Describe the procedures used to remove and install pipe, tubing and hoses.

11. Describe the procedures used to inspect and maintain piping systems and their components.

12. Describe the procedures used to troubleshoot piping systems and components.

13. Identify the factors to consider when if piping systems or their components need to be repaired or replaced.

14. Describe the procedures used to repair piping systems and components.

IMM-325 Process Tanks and Containers

Learning Outcomes:

- Demonstrate knowledge of process tanks and containers, their components and applications.
- Demonstrate knowledge of the procedures used to remove and install process tanks and containers.
- Demonstrate knowledge of the procedures used to maintain and repair process tanks and containers.

2013 National Occupational Analysis Reference:

17.01 Installs process tanks and containers.
17.02 Diagnoses process tanks and containers.
17.03 Repairs process tanks and containers.
17.04 Maintains process tanks and containers.

Objectives and Content:

1. Define terminology associated with process tanks and containers.

2. Identify hazards and describe safe work practices associated with process tanks and containers.

3. Interpret codes and regulations pertaining to process tanks and containers.

4. Interpret information pertaining to process tanks and containers found on drawings, specifications and schematics.

5. Identify tools and equipment used to remove, install, maintain and repair process tanks and containers, and describe their applications and procedures for use.

6. Identify types of process tanks and containers, and describe their applications and operation.
   i) bins
   ii) hoppers
   iii) receivers

7. Identify process tank and container components and describe their applications.
   i) agitators
   ii) mixers

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

9. Describe the procedures used to inspect and maintain process tanks, containers and their components.

10. Identify the factors to consider when determining if process tanks, containers or their components need to be repaired or replaced.

11. Describe the procedures used to repair process tanks, containers and their components.

IMM-330 Compressors II

Learning Outcomes:

- Demonstrate knowledge of vane, screw, radial and centrifugal compressors, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install vane, screw, radial and centrifugal compressors.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair vane, screw, radial and centrifugal compressors.
- Demonstrate knowledge of the procedures used to commission vane, screw, radial and centrifugal compressors.

2013 National Occupational Analysis Reference:

14.01 Installs compressors.
14.02 Diagnoses compressors.
14.03 Repairs compressors.
14.04 Maintains compressors.

Objectives and Content:

1. Define terminology associated with vane, screw, radial and centrifugal compressors.

2. Identify hazards and describe safe work practices pertaining to vane, screw, radial and centrifugal compressors.

3. Interpret codes, regulations and specifications pertaining to vane, screw, radial and centrifugal compressors.

4. Identify tools and equipment used to remove, install, maintain, troubleshoot and repair compressors, and describe their applications and procedures for use.

5. Identify vane, screw, radial and centrifugal compressor components and accessories, and describe their purpose and operation.

6. Describe the procedures used to remove and install vane, screw, radial and centrifugal compressors and their components.

7. Describe the procedures used to inspect and maintain vane, screw, radial and centrifugal compressors and their components.

8. Describe the procedures used to troubleshoot vane, screw, radial and centrifugal compressors and their components.

9. Identify the factors to consider when determining if vane, screw, radial and centrifugal compressors need to be repaired or replaced.

10. Describe the procedures used to repair vane, screw, radial and centrifugal compressors and their components.

11. Describe the procedures used to commission vane, screw, radial and centrifugal compressors.

IMM-335 Centrifugal Pumps

Learning Outcomes:

- Demonstrate knowledge of centrifugal pumps, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install centrifugal pumps.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair centrifugal pumps.
- Demonstrate knowledge of the procedures used to commission centrifugal pumps.

2013 National Occupational Analysis Reference:

15.01 Installs pumps.
15.02 Diagnoses pumps.
15.03 Repairs pumps.
15.04 Maintains pumps.
22.01 Commissions mechanical systems and components, and material handling/process systems.

Objectives and Content:

1. Define terminology associated with centrifugal pumps.

2. Identify hazards and describe safe work practices associated with centrifugal pumps.

3. Interpret codes, regulations and specifications pertaining to centrifugal pumps.

4. Identify tools and equipment used to remove, install, maintain, troubleshoot and repair centrifugal pumps, and describe their applications and procedures for use.

5. Identify types of centrifugal pumps and their components, and describe their applications and operation.

6. Identify the types of seals and packing and describe their applications.

7. Explain the method used to interpret pump curve.

8. Describe the procedures used to remove and install centrifugal pumps.

9. Describe the procedures used to inspect and maintain centrifugal pumps.

10. Describe the procedures used to troubleshoot centrifugal pumps.

11. Identify the factors to consider when determining if centrifugal pumps need to be repaired or replaced.

12. Describe the procedures used to repair centrifugal pumps.

13. Describe the procedures used to commission centrifugal pumps.

IMM-340 Positive Displacement Pumps

Learning Outcomes:

- Demonstrate knowledge of positive displacement pumps, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install positive displacement pumps.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair positive displacement pumps.
- Demonstrate knowledge of the procedures used to commission positive displacement pumps.

2013 National Occupational Analysis Reference:

15.01 Installs pumps.
15.02 Diagnoses pumps.
15.03 Repairs pumps.
15.04 Maintains pumps.
22.01 Commissions mechanical systems and components, and material handling/process systems.

Objectives and Content:

1. Define terminology associated with positive displacement pumps.

2. Identify hazards and describe safe work practices associated with positive displacement pumps.

3. Interpret codes, regulations and specifications pertaining to positive displacement pumps.

4. Identify tools and equipment used to remove, install, maintain, troubleshoot and repair positive displacement pumps, and describe their applications and procedures for use.

5. Identify types of positive displacement pumps and their components, and describe their applications and operation.

6. Describe the procedures used to remove and install positive displacement pumps.

7. Describe the procedures used to inspect and maintain positive displacement pumps.

8. Describe the procedures used to troubleshoot positive displacement pumps.

9. Identify the factors to consider when determining if positive displacement pumps need to be repaired or replaced.

10. Describe the procedures used to repair positive displacement pumps.

11. Describe the procedures used to commission positive displacement pumps.

IMM-345 Conveying Systems

Learning Outcomes:

- Demonstrate knowledge of conveying systems, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install conveying systems.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair conveying systems.
- Demonstrate knowledge of the procedures used to commission conveying systems.

2013 National Occupational Analysis Reference:

16.01 Installs conveying systems.
16.02 Diagnoses conveying systems.
16.03 Repairs conveying systems.
16.04 Maintains conveying systems.
22.01 Commissions mechanical systems and components, and material handling/process systems.

Objectives and Content:

1. Define terminology associated with conveying systems.

2. Identify hazards and describe safe work practices associated with conveying systems.

3. Interpret codes, regulations and specifications pertaining to conveying systems.

4. Identify tools and equipment used to remove, install, maintain, troubleshoot and repair conveying systems and components, and describe their applications and procedures for use.

5. Identify types of conveying systems and describe their applications and operation.
   i) pneumatic
   ii) belt
   iii) rollers

iv) chain
v) screw
vi) bucket
vii) flume/water

6. Identify conveying system components and accessories, and describe their purpose and operation.

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

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

9. Describe the procedures used to inspect and maintain conveying systems and components.

10. Describe the procedures used to troubleshoot conveying systems and their components.

11. Identify the factors to consider when determining if conveying systems need to be repaired or replaced.

12. Describe the procedures used to repair conveying systems and their components.

13. Describe the procedures used to splice a conveyor belt.

14. Describe the procedures used to commission conveying systems.

LEVEL 4

IMM-400 Hydraulic Systems II

Learning Outcomes:

- Demonstrate knowledge of the calculations used to select hydraulic systems.
- Demonstrate knowledge of the procedures used to remove and install hydraulic systems and components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair hydraulic systems and components.
- Demonstrate knowledge of the procedures used to commission hydraulic systems.

2013 National Occupational Analysis Reference:

18.01 Installs hydraulic systems.
18.02 Diagnoses hydraulic systems.
18.03 Repairs hydraulic systems.
18.04 Maintains hydraulic systems.
22.02 Commissions hydraulic, pneumatic and vacuum systems.

Objectives and Content:

1. Define terminology associated with the removal, installation, maintenance and repair of hydraulic systems and components.

2. Identify hazards and describe safe work practices pertaining to the removal, installation, maintenance and repair of hydraulic systems and components.

3. Interpret codes, regulations and specifications pertaining to hydraulic systems.

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

5. Identify the types of fluids used in hydraulics systems, and describe their characteristics and applications.

6. Explain the importance of cleanliness of hydraulic systems.

7. Describe the calculations used to select hydraulic systems and components.

8. Describe the procedures used to remove and install hydraulic systems and components.

9. Describe the procedures used to inspect and maintain hydraulic systems and components.
   i) check hoses, piping and tubing
   ii) check fluids (condition and level)
   iii) check/change filters
   iv) determine operating parameters
   v) adjust system pressure, temperature and flow

10. Describe the procedures used to troubleshoot hydraulic systems and components.

11. Identify the factors to consider when determining if hydraulic system components need to be repaired or replaced.

12. Describe the procedures used to repair hydraulic systems and components.

13. Describe the procedures used to commission hydraulic systems.

IMM-405 Pneumatic Systems II

Learning Outcomes:

- Demonstrate knowledge of the calculations used to select pneumatic systems and components.
- Demonstrate knowledge of the procedures used to remove and install pneumatic systems and components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair pneumatic systems and components.
- Demonstrate knowledge of the procedures used to commission pneumatic systems.

2013 National Occupational Analysis Reference:

19.01 Installs pneumatic and vacuum systems.
19.02 Diagnoses pneumatic and vacuum systems.
19.03 Repairs pneumatic and vacuum systems.
19.04 Maintains pneumatic and vacuum systems.
22.02 Commissions hydraulic, pneumatic and vacuum systems.

Objectives and Content:

1. Define terminology associated with the removal, installation, maintenance and repair of pneumatic systems and components.

2. Identify hazards and describe safe work practices pertaining to the removal, installation, maintenance and repair of pneumatic systems and components.

3. Interpret codes, regulations and specifications pertaining to the removal, installation, maintenance and repair of pneumatic systems and components.

4. Identify tools and equipment used to install, maintain, troubleshoot and repair pneumatic systems and components, and describe their applications and procedures for use.

5. Describe the calculations used to select pneumatic systems and components.

6. Describe the procedures used to remove and install pneumatic systems and components.

7. Describe the procedures used to inspect and maintain pneumatic 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, temperature and flow

8. Describe the procedures used to troubleshoot pneumatic systems and components.

9. Identify the factors to consider when determining if pneumatic system components need to be repaired or replaced.

10. Describe the procedures used to repair pneumatic systems and components.

11. Describe the procedures used to commission pneumatic systems.

IMM-410 Vacuum Systems

Learning Outcomes:

- Demonstrate knowledge of vacuum systems, their components and operation.
- Demonstrate knowledge of the calculations used to select and install vacuum systems and components.
- Demonstrate knowledge of the procedures used to remove and install vacuum systems and components.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair vacuum systems and components.
- Demonstrate knowledge of the procedures used to commission vacuum systems.

2013 National Occupational Analysis Reference:

19.01 Installs pneumatic and vacuum systems.
19.02 Diagnoses pneumatic and vacuum systems.
19.03 Repairs pneumatic and vacuum systems.
19.04 Maintains pneumatic and vacuum systems.
22.02 Commissions hydraulic, pneumatic and vacuum systems

Objectives and Content:

1. Define terminology associated with vacuum systems.

2. Identify hazards and describe safe work practices pertaining to vacuum systems.

3. Interpret codes, regulations and specifications pertaining to vacuum systems.

4. Identify tools and equipment used to install, maintain, troubleshoot and repair vacuum systems, and describe their applications and procedures for use.

5. Identify types of vacuum systems and describe their applications and operation.

6. Identify vacuum system components and describe their purpose and operation.

7. Describe the calculations used to select and install vacuum systems and components.

8. Describe the procedures used to remove and install vacuum systems and components.

9. Describe the procedures used to inspect and maintain vacuum systems and components.
   i) check hoses, piping and tubing
   ii) check/change filters
   iii) determine operating parameters
   iv) adjust system vacuum, temperature, cycling and flow

10. Describe the procedures used to troubleshoot vacuum systems and components.

11. Identify the factors to consider when determining if vacuum system components need to be repaired or replaced.

12. Describe the procedures used to repair vacuum systems and components.

13. Describe the procedures used to commission vacuum systems.

14. Perform vacuum related calculations.

IMM-415 Electrical Principles

Learning Outcomes:

- Demonstrate knowledge of the basic concepts of electricity.
- Demonstrate knowledge of electrical components and equipment.

** *The content of the electrical section in this course outline is not to suggest a Journeyperson Industrial Mechanic (Millwright) should complete tasks normally performed by Journeyperson Electricians. The intent is to provide the Industrial Mechanic (Millwright) with enough electrical knowledge so that safe decisions may be made when working on or around electrical equipment.*

Objectives and Content:

1. Define terminology associated with electricity.

2. Identify hazards and describe safe work practices pertaining to working on or around electrical equipment and sources.

3. Explain the basic principles of electricity.

4. Explain the principles of magnetism and electromagnetism.

5. Describe the types of electric current, phases and cycles.

6. Explain the mathematical relationship between amperes, volts, ohms and watts.

7. Identify electrical devices and describe their purpose.
   i) circuit breakers
   ii) disconnects
   iii) overload heaters
   iv) ground fault interrupters
   v) fuses
   vi) contactors
   vii) transformers
   viii) interlocks
   ix) programmable logic controllers (PLC's)

x) motors
xi) switches

8. Describe series and parallel circuits.

9. Identify the types of electrical test meters and describe their applications and procedures for use.

10. Explain the purpose of the electrical code.

IMM-420 Prime Movers (Electric Motors)

Learning Outcomes:

- Demonstrate knowledge of electric motors, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install electric motors.
- Demonstrate knowledge of the procedures used to inspect, maintain, troubleshoot and repair electric motors.
- Demonstrate knowledge of the procedures used to commission electric motors.

2013 National Occupational Analysis Reference:

8.01 Installs prime movers.
8.02 Diagnoses prime movers.
8.03 Repairs prime movers.
22.01 Commissions mechanical systems and components, and material handling/process systems.

Objectives and Content:

1. Define terminology associated with electric motors.

2. Identify hazards and describe safe work practices pertaining to electric motors.

3. Interpret codes, regulations and specifications pertaining to electric motors.

4. Identify tools and equipment used to install, maintain, troubleshoot and repair electric motors, and describe their applications and procedures for use.

5. Identify the types of electric motors and their components, and describe their applications.

6. Describe the factors to consider when installing electric motors.

7. Describe the procedures used to remove and install electric motors.

8. Describe the procedures used to inspect and maintain bearings in electric motors.

9. Describe the procedures used to troubleshoot electric motors.

10. Identify the factors to consider when determining if electric motors need to be repaired or replaced.

11. Describe the procedures used to repair electric motors.

12. Describe the procedures used to commission electric motors.

IMM-425 Prime Movers (Internal Combustion Engines)

Learning Outcomes:

- Demonstrate knowledge of internal combustion engines, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install internal combustion engines.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair internal combustion engines.
- Demonstrate knowledge of the procedures used to commission internal combustion engines.

2013 National Occupational Analysis Reference:

8.01 Installs prime movers.
8.02 Diagnoses prime movers.
8.03 Repairs prime movers.
22.01 Commissions mechanical systems and components, and material handling/process systems.

Objectives and Content:

1. Define terminology associated with internal combustion engines.

2. Identify hazards and describe safe work practices pertaining to internal combustion engines.

3. Interpret codes, regulations and specifications pertaining to internal combustion engines.

4. Identify tools and equipment used to install, maintain, troubleshoot and repair internal combustion engines, and describe their applications and procedures for use.

5. Identify the types of internal combustion engines and describe their operation.

6. Identify internal combustion engine components and describe their purpose and operation.

7. Describe the factors to consider when installing internal combustion engines.
   i) manufacturers' specifications
   ii) job site specifications
   iii) location drawings
   iv) auxiliary systems
   v) sequence of installation

8. Describe the procedures used to remove and install internal combustion engines and their components.

9. Describe the procedures used to inspect and maintain internal combustion engines and their components.

10. Describe the procedures used to troubleshoot internal combustion engines and their components.

11. Identify the factors to consider when determining if internal combustion engine components need to be repaired or replaced.

12. Describe the procedures used to repair internal combustion engines and their components.

13. Describe the procedures used to commission internal combustion engines.

IMM-430 Prime Movers (Turbines)

Learning Outcomes:

- Demonstrate knowledge of turbines, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install turbines.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair turbines.
- Demonstrate knowledge of the procedures used to commission turbines.

2013 National Occupational Analysis Reference:

8.01 Installs prime movers.
8.02 Diagnoses prime movers.
8.03 Repairs prime movers.
22.01 Commissions mechanical systems and components, and material handling/process systems.

Objectives and Content:

1. Define terminology associated with turbines.

2. Identify hazards and describe safe work practices pertaining to turbines.

3. Interpret codes, regulations and specifications pertaining to turbines.

4. Identify tools and equipment used to install, maintain, troubleshoot and repair turbines, and describe their applications and procedures for use.

5. Identify the types of turbines and describe their operation.
   i) steam
   ii) gas
   iii) hydro
   iv) wind

6. Explain the principles and operation of boilers.

7. Identify turbine components and describe their purpose and operation.

8. Describe the factors to consider when installing turbines.
   i) manufacturers' specifications
   ii) job site specifications
   iii) location drawings
   iv) auxiliary systems
   v) sequence of installation

9. Describe the procedures used to remove and install turbines and their components.

10. Describe the procedures used to inspect and maintain turbines and their components.
    i) manufacturers' specifications
       - manufacturers' representative
       - technical manuals

11. Describe the procedures used to troubleshoot turbines and their components.

12. Identify the factors to consider when determining if turbine components need to be repaired or replaced.

13. Describe the procedures used to repair turbines and their components.

14. Describe the procedures used to commission turbines.

IMM-435 Fans and Blowers

Learning Outcomes:

- Demonstrate knowledge of fans and blowers, their components and operation.
- Demonstrate knowledge of the procedures used to remove and install fans and blowers.
- Demonstrate knowledge of the procedures used to maintain, troubleshoot and repair fans and blowers.
- Demonstrate knowledge of the procedures used to commission fans and blowers.

2013 National Occupational Analysis Reference:

13.01 Installs fans and blowers.
13.02 Diagnoses fans and blowers.
13.03 Repairs fans and blowers.
13.04 Maintains fans and blowers.
22.01 Commissions mechanical systems and components, and material handling/process systems.

Objectives and Content:

1. Define terminology associated with fans and blowers.

2. Identify hazards and describe safe work practices pertaining to fans and blowers.

3. Interpret codes, regulations and specifications pertaining to fans and blowers.

4. Identify tools and equipment used to remove, install, maintain, troubleshoot and repair fans and blowers, and describe their applications and procedures for use.

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

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 inspect and maintain fans and blowers.

9. Describe the procedures used to troubleshoot fans and blowers.

10. Identify the factors to consider when determining if fans and blowers need to be repaired or replaced.

11. Describe the procedures used to repair fans and blowers.

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

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

14. Describe the procedures used to commission fans and blowers.

IMM-440 Mechanical Installation Drawings

Learning Outcomes:

- Demonstrate knowledge of mechanical installation drawings, their use and interpretation.
- Demonstrate knowledge of calculations relevant to mechanical installations based on drawings.

2013 National Occupational Analysis Reference:

3.08 Uses mechanical drawings and schematics.

Objectives and Content:

1. Define terminology associated with mechanical installation drawings.

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

3. Identify the views found on mechanical installation drawings and describe their characteristics.

4. Interpret mechanical installation drawings.

5. Describe the procedures used to perform calculations relevant to mechanical installations based on drawings.

IMM-445 Equipment Installation and Alignment

Learning Outcomes:

- Demonstrate knowledge of the procedures used to install, level and align equipment.
- Demonstrate knowledge of the procedures used to commission equipment.

2013 National Occupational Analysis Reference:

3.02 Fabricates workpiece.
3.04 Performs leveling of components and systems.
21.03 Performs alignment procedures.

Objectives and Content:

1. Define terminology associated with equipment installation, leveling and alignment.

2. Identify hazards and describe safe work practices pertaining to equipment installation, leveling and alignment.

3. Interpret codes, regulations and specifications pertaining to equipment installation, leveling and alignment.

4. Identify tools and equipment used for equipment installation, leveling and alignment, and describe their application and procedures for use.
   i) theodolites
   ii) optical levels
   iii) piano wire
   iv) water level
   v) laser

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

6. Describe the procedures used to install, level and align equipment.
   i) planning
   ii) interpret drawings
   iii) fabricate component supports
   iv) install base
   v) position equipment
   vi) relieve stresses/strains
   vii) anchor and grout
   viii) complete documentation

7. Describe the procedures used to commission equipment.

IMM-450 Preventive and Predictive Maintenance

Learning Outcomes:

- Demonstrate knowledge of preventive and predictive maintenance procedures.

2013 National Occupational Analysis Reference:

20.01 Performs preventive maintenance activities.
20.02 Performs predictive maintenance activities.
20.03 Schedules preventive and predictive maintenance.

Objectives and Content:

1. Define terminology associated with preventive and predictive maintenance.

2. Identify hazards and describe safe work practices pertaining to preventive and predictive maintenance procedures.

3. Interpret codes, regulations and specifications pertaining to preventive and predictive maintenance procedures.

4. Identify tools and equipment used for preventive and predictive maintenance, and describe their applications and procedures for use.

5. Identify types of maintenance and describe their purpose and applications.
   i) breakdown
   ii) preventive
   iii) predictive
   iv) proactive
   v) corrective

6. Identify sources of information used to develop maintenance history.
   i) reports and checklists
   ii) manufacturers' specifications
   iii) root cause analysis

7. Identify preventive and predictive maintenance practices, and describe their applications.
   i) vibration analysis
   ii) non-destructive testing
   iii) fluid analysis
   iv) balancing
   v) thermography
   vi) motor current analysis

8. Describe the procedures used to schedule preventive and predictive maintenance activities

9. Describe the procedures used to perform preventive and predictive maintenance activities.

10. Describe the procedures used to record preventive and predictive maintenance data.

IMM-455 Vibration Analysis

Learning Outcomes:

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

2013 National Occupational Analysis Reference:

21.01 Performs vibration analysis procedures.

Objectives and Content:

1. Define terminology associated with vibration analysis.

2. Identify hazards and describe safe work practices pertaining to vibration analysis.

3. Identify tools and equipment used for vibration analysis and describe their applications and procedures for use.

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

5. Identify causes of vibration.

6. Identify vibration analysis methods and describe their applications.

7. Describe the procedures used to perform vibration analysis.

8. Record and interpret data collected using vibration analysis.

IMM-460 Balancing

Learning Outcomes:

- Demonstrate knowledge of balancing procedures.

2013 National Occupational Analysis Reference:

21.02 Performs balancing procedures.

Objectives and Content:

1. Define terminology associated with balancing.

2. Identify hazards and describe safe work practices pertaining to balancing.

3. Identify tools and equipment required for balancing and describe their applications and procedures for use.

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

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

6. Identify the types of balancing methods and describe their applications.
   i) single-plane
   ii) multi-plane

7. Describe balancing procedures.
   i) static
   ii) dynamic

8. Perform calculations required for balancing.

IMM-465 Fluid Analysis

Learning Outcomes:

- Demonstrate knowledge of the procedures used to collect and test fluid samples.

2013 National Occupational Analysis Reference:

21.05 Performs fluid analysis procedures.

Objectives and Content:

1. Define terminology associated with fluid analysis.

2. Identify hazards and describe safe work practices pertaining to fluid sampling.

3. Interpret codes and regulations pertaining to fluid sampling.

4. Identify tools and equipment used for fluid sampling, and describe their applications and procedures for use.

5. Identify fluid contaminants and describe their causes and remedies.

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

7. Record and interpret data from fluid analysis.

IMM-470 Job Planning

Learning Outcomes:

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

2013 National Occupational Analysis Reference:

3.01 Plans work.

Objectives and Content:

1. Define terminology associated with job planning.

2. Identify sources of information relevant to job planning.
   i) documentation
   ii) drawings
   iii) related professionals
   iv) clients

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

4. Explain the concept of bar charting and describe 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.

IMM-475 Non-Destructive Testing

Learning Outcomes:

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

2013 National Occupational Analysis Reference:

21.04 Performs non-destructive testing (NDT) procedures.

Objectives and Content:

1. Define terminology associated with non-destructive testing.

2. Identify hazards and describe safe work practices pertaining to non-destructive testing.

3. Demonstrate an awareness of codes and regulations pertaining to non-destructive testing.

4. Identify tools and equipment used for non-destructive testing, and describe their applications and procedures for use.

5. Identify types of non-destructive tests and describe their applications.
   i) dye penetrant
   ii) magnetic particle
   iii) radiography
   iv) ultrasonic
   v) visual

6. Describe the procedures used to perform dye penetrant and magnetic particle testing.

7. Record and interpret data collected using non-destructive testing.