

CURRICULUM OUTLINE

Industrial Mechanic (Millwright)

2017



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CURRICULUM OUTLINE

INDUSTRIAL MECHANIC (MILLWRIGHT)



STRUCTURE OF THE CURRICULUM OUTLINE

To facilitate understanding of the occupation, this standard contains the following sections:

Description of the Industrial Mechanic (Millwright) trade: An overview of the trade's duties, work environment, job requirements, similar occupations and career progression

Trends in the Industrial Mechanic (Millwright) trade: Some of the trends identified by industry as being the most important for workers in this trade

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

Task Matrix: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard

Elements of harmonization of apprenticeship training: includes number of levels of apprenticeship, total training hour and recommended apprenticeship levels

Sequencing of apprenticeship training topics and related subtasks: a chart which outlines the model for apprenticeship training sequencing and a cross-reference of the sub-tasks covered by each topic

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

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

Task Descriptor: a general description of the task

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

Recommended apprenticeship level: as part of the interprovincial discussions on harmonization, this is the recommended level of apprenticeship technical training where this sub-task would be trained

Essential Skills: The most relevant essential skills for this sub-task

Knowledge:

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

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

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

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

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

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

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

DESCRIPTION OF THE INDUSTRIAL MECHANIC (MILLWRIGHT) TRADE

“Industrial Mechanic (Millwright)” is this trade’s official Red Seal occupational title approved by the CCDA. This analysis covers tasks performed by industrial mechanics (millwrights) whose occupational title has been identified by some provinces and territories of Canada under the following names:

	NL	NS	PE	NB	QC	ON	MB	SK	AB	BC	NT	YT	NU
Industrial Mechanic (Millwright)	■	■	■	■	■		■	■		■	■	■	■
Millwright									■				
Industrial Mechanic Millwright						■							

Industrial mechanics (millwrights) work on industrial and mechanical equipment and components. This equipment may include mechanical, pneumatic, hydraulic, fuel, lubrication, cooling and exhaust systems and equipment. Some components worked on include pumps, gear boxes, fans, tanks, conveyors, presses, generators, prime movers, pneumatic and hydraulic systems, robotics and automated equipment.

Industrial mechanics (millwrights) are responsible for assembling, installing, aligning, commissioning, maintaining, repairing, diagnosing, inspecting, dismantling, moving and decommissioning equipment. Servicing may include diagnosing irregularities and malfunctions, making adjustments, and repairing or replacing parts. Cleaning and lubricating equipment are also important maintenance tasks of the trade.

Other tasks that may be performed include welding, cutting, rigging and machining as required. Industrial mechanics (millwrights) may prepare bases for equipment. In certain jurisdictions, industrial mechanics (millwrights) may assist other trades in troubleshooting and repairing other systems.

Industrial mechanics (millwrights) may refer to schematics, engineered drawings and manuals, both hard copy and electronic, to determine work procedures.

Industrial mechanics (millwrights) work with a wide variety of tools. They may use hand and power tools and access equipment in installation and repair work. Larger machine tools such as lathes, milling machines, drill presses and grinders may be used in fabrication of machine parts. Rigging, hoisting/lifting and moving equipment such as cranes, jacks and powered mobile equipment (PME) are commonly used to position large machines or machine parts.

Industrial mechanics (millwrights) are employed in all sectors of industry that involve mechanical moving equipment including mining, petrochemical, power generation, manufacturing, forestry, and processing facilities (food, service) among others. Industrial mechanics (millwrights) are involved with the installation, diagnosis, maintenance and repair of equipment and components.

The work environment for industrial mechanics (millwrights) is varied and may involve working in extreme or adverse conditions. They often work shift work. They may work in confined spaces, underground (in mines), at heights, with heavy equipment and around moving equipment. The work often requires considerable standing, kneeling and lifting of materials.

Key skills for people in this trade are mechanical aptitude, problem-solving, communication, job planning and organizing and the ability to use trade-related calculations. They have the ability to detect

malfunctions through sensory tests which are often confirmed by condition-based monitoring. Other important attributes include good coordination, manual dexterity and spatial visualization.

Industrial mechanics (millwrights) often possess overlapping skills with other tradespeople such as steamfitter/pipefitters, industrial instrument mechanics, power engineers, welders, machinists or industrial electricians. Industrial mechanics (millwrights) may work in specialized areas of the trade such as vibration analysis, thermography, tribology (fluid analysis) and laser/optical alignment. With experience, they may advance to other positions such as mentor, supervisor, planner, superintendent, manager, instructor or trainer.

TRENDS IN THE INDUSTRIAL MECHANIC (MILLWRIGHT) TRADE

There is a progression from analog to digital equipment that provides computer generated readouts and can be programmed to give accurate readings in less time. This technology allows for improved self-diagnosis and predictive maintenance and has reduced the length of mechanical outages and manpower required to complete outages. For example, the technology has reduced equipment down time for tasks such as alignment, diagnosis, assembly and repair. Industrial mechanics (millwrights) need to keep pace with changes in technology.

Advances in predictive maintenance have led to more advanced diagnostic equipment such as alignment equipment and vibration monitoring equipment. Acoustic monitoring technology is advancing rapidly. Fibre-optic scopes are increasingly used to view and troubleshoot internal components. Thermal imaging is advancing preventive maintenance based upon equipment heat signature. Ultrasound testing is becoming prevalent in the maintenance of piping systems. There is advanced diagnostic equipment for fluid power inspection such as handheld analyzers and clamp-on flowmeters.

Hydraulic tools are continuously evolving in ease of use and size. They are becoming safer and more efficient to use. Hydraulic technology is being used for broader applications such as bolt tensioning and torquing.

There is a move toward environmentally conscious hydroelectric construction projects such as “run of the river” that also minimize the human footprint. The emphasis is on building smaller units as opposed to one large unit. Windmill technology continues to advance. However in this case, the units are increasing in size to allow more production of energy. Waste management is another growing industry. These are all creating more work for industrial mechanics (millwrights) in the installation, diagnosis, maintenance and repair of these units.

The evolution of technology and the complexity of systems such as hydraulics, robotics and renewable energy systems (solar panels, wind turbines) are expanding the scope of work for industrial mechanics (millwrights).

There is a wider variety of materials available for use in the construction of machinery and components, such as new composite alloys, fibre-based composites and advanced plastics. More types of sealant and epoxy materials are available.

Preventive and predictive maintenance planning is seen as more important and scheduled shutdowns are more prevalent. The knowledge and use of a Computer Maintenance Management System (CMMS) to manage labour and cost is essential. For example, Reliability Centered Maintenance (RCM) and Total Quality Management (TQM) methodology are becoming more common because of its cost effectiveness.

Some hand and power tools are ergonomically designed to prevent repetitive strain injuries. Many power tools are now cordless with improved battery life and light-weight design, making them more ergonomically friendly, resulting in fewer injuries. There is an increased use of powered mobile equipment (PME) such as scissor lifts, aerial work platforms (AWP) and lift trucks in the trade. This equipment is incorporating more safety features. Certification of the equipment and of employees' competency is becoming mandatory. Jurisdictional regulations are becoming more stringent by requiring documentation for equipment operation and training.

Technological advances and worker education regarding personal protective equipment (PPE) has improved effectiveness and functionality, resulting in improved safety practices and procedures among tradespersons. Improved identification of hazardous materials through increased use of Safety Data Sheets (SDS) contributes to a safer work environment.

Quality assurance, reliability, maintainability and safety are critical elements of the standards for industrial mechanics (millwrights). Continuous changes in technology, environmental regulations and worker safety concerns have led to improved safe work practices.

ESSENTIAL SKILLS SUMMARY

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

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

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

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

Tools are available online or for order at: <http://www.esdc.gc.ca/eng/jobs/les/tools/index.shtml>.

The application of these skills may be described throughout this document within the competency statements which support each subtask of the trade. The following are summaries of the requirements in each of the essential skills, taken from the essential skills profile. A link to the complete essential skills profile can be found at: www.red-seal.ca.

READING

Industrial mechanics (millwrights) read texts such as short descriptions and directions on labels for products. They read bulletins, manuals, work orders, reports and procedures when installing, operating, diagnosing, maintaining and repairing equipment. They also read emails and memos from supervisors, co-workers and suppliers about ongoing work.

DOCUMENT USE

Industrial mechanics (millwrights) scan and locate data on labels, lists, tables and schedules. They may interpret graphs when monitoring equipment operation. They interpret or review schematics and engineered drawings of systems (pneumatic, mechanical, structural and hydraulic) to identify malfunctions. Industrial mechanics (millwrights) may also retrieve and study data from scale drawings to identify location of equipment to be installed and verify location. They also complete forms such as purchase orders, maintenance forms, logbooks and work orders.

WRITING

Industrial mechanics (millwrights) write brief text entries in logbooks and in forms. They may write maintenance, repair and safe work procedures. Industrial mechanics (millwrights) write emails to supervisors, co-workers about ongoing work, and suppliers about equipment specifications. They may also write incident reports and update drawings.

ORAL COMMUNICATION

Industrial mechanics (millwrights) talk to suppliers, engineers and contractors about equipment specifications and access, orders, delivery and service times. They discuss work orders, equipment malfunctions and job task coordination with co-workers. They inform supervisors about work progress and may seek guidance and approvals from them. Industrial mechanics (millwrights) may discuss work with clients, advise them about maintenance and propose equipment modifications. They also discuss safety, productivity, and procedural and policy changes at meetings with co-workers, supervisors, engineers and clients. Industrial mechanics (millwrights) communicate with other tradespeople and personnel from other departments.

NUMERACY

Industrial mechanics (millwrights) measure various physical properties of equipment. Calculations are required in multiple aspects of the industrial mechanics (millwrights) trade, such as pneumatic, mechanical, structural and hydraulic systems. They calculate distances, totals, maximums, minimums, tolerances, fits and quantities required. They also calculate loads, capacities, speeds, feeds and dimensions for mechanical components and systems. They perform calculations in order to adjust, level and align equipment according to specifications, and for diagnosing process variables. Industrial mechanics (millwrights) estimate weights and distances appropriate for rigging, hoisting, lifting and moving equipment and procedures.

THINKING

Thinking skills are critical to the industrial mechanics (millwrights) trade. They may problem solve by fabricating or adapting parts from other machines when parts needed are not available for maintenance and repairs. They may choose among refurbish, repair and replacement options for worn and defective parts such as hoses, motors, valves and bushings. They take into consideration factors such as maintenance guidelines, performance and test results, safety, efficiency and durability of replacement parts. Industrial mechanics (millwrights) evaluate conditions of parts and equipment, and the safety of their work environment. They may assess feasibility of designs for small modifications to equipment, ensuring that designs meet technical specifications, performance requirements and jurisdictional regulations.

DIGITAL TECHNOLOGY

Industrial mechanics (millwrights) may use databases to perform queries on maintenance history, regulatory items and procedures. They may also enter data from completed work orders in a computerized maintenance management system (CMMS). They may use programs to aid in the adjustment of drawings with computer-assisted design (CAD) software and to control and monitor operation of manufacturing and machining equipment. Industrial mechanics (millwrights) use hand-held computerized alignment, leveling and vibration measurement tools. They may use word processing software to write, edit and format texts such as incident reports and maintenance procedures. They may access work orders, asset information and documents on tablets, phones and other electronic devices.

WORKING WITH OTHERS

Industrial mechanics (millwrights) are required to work independently, with other industrial mechanics (millwrights) other tradespeople and personnel from other departments and jurisdictional organisations depending on the scope of the work.

CONTINUOUS LEARNING

Industrial mechanics (millwrights) read manuals and trade related documents to stay up to date on developments in their trade. They also attend training sessions (online or classroom-based) on new technologies, equipment and safety procedures. In addition, they learn informally by exchanging information with co-workers and suppliers.

INDUSTRIAL MECHANIC (MILLWRIGHT)

TASK MATRIX

A - PERFORMS COMMON OCCUPATIONAL SKILLS

19%

<p>Task A-1 Performs safety-related functions 17%</p>	<p>A-1.01 Uses personal protective equipment (PPE) and safety equipment 1,2,3,4</p>	<p>A-1.02 Maintains safe worksite 1,2,3,4</p>	<p>A-1.03 Protects the environment 1,2,3,4</p>
	<p>A-1.04 Performs lock-out/tag-out and zero-energy state procedures 1,2,3,4</p>		
<p>Task A-2 Uses tools and equipment 21%</p>	<p>A-2.01 Uses hand and portable power tools 1</p>	<p>A-2.02 Uses shop machines 1</p>	<p>A-2.03 Uses access equipment 1</p>
<p>Task A-3 Performs routine trade tasks 26%</p>	<p>A-3.01 Plans work 1,2,3,4</p>	<p>A-3.02 Fabricates work piece 1,2,3,4</p>	<p>A-3.03 Lubricates systems and components 1,2,3,4</p>
	<p>A-3.04 Performs leveling of components and systems 1,2,3,4</p>	<p>A-3.05 Uses fastening and retaining devices 1,2,3,4</p>	<p>A-3.06 Performs material identification 1,2,3,4</p>
	<p>A-3.07 Performs heat treatment of metal 1,2,3,4</p>	<p>A-3.08 Uses mechanical drawings and schematics 1,2,3,4</p>	
<p>Task A-4 Uses communication and mentoring techniques 10%</p>	<p>A-4.01 Uses communication techniques 1</p>	<p>A-4.02 Uses mentoring techniques 4</p>	

Task A-5
Performs measuring and layout
16%

A-5.01 Prepares work area, tools and materials
1

A-5.02 Measures material and components
1

A-5.03 Lays out components
1

A-5.04 Maintains precision measuring and layout tools
1

Task A-6
Performs cutting and welding operations
10%

A-6.01 Cuts material with oxy-fuel and plasma arc equipment
1

A-6.02 Joins material using oxy-fuel welding equipment
1

A-6.03 Welds material using shielded metal arc welding (SMAW) equipment
2

A-6.04 Welds material with gas metal arc welding (GMAW) equipment
2

A-6.05 Welds material with gas tungsten arc welding (GTAW) equipment (NOT COMMON CORE)
2

A-6.06 Maintains welding equipment
1

B - PERFORMS RIGGING, HOISTING/LIFTING AND MOVING 13%

Task B-7
Plans rigging, hoisting/lifting and moving
48%

B-7.01 Determines load
1,2,3,4

B-7.02 Selects rigging equipment
1,2,3,4

B-7.03 Selects hoisting/lifting and moving equipment
1,2,3,4

B-7.04 Secures area
1,2,3,4

Task B-8
Rigs, hoists/lifts and moves load
52%

B-8.01 Sets up rigging, hoisting/lifting and moving equipment
1,2,3,4

B-8.02 Performs hoist/lift and move
1,2,3,4

B-8.03 Maintains rigging, hoisting/lifting and moving equipment
1,2,3,4

C - SERVICES MECHANICAL POWER TRANSMISSION COMPONENTS AND SYSTEMS

23%

Task C-9
Services prime movers
16%

C-9.01 Installs prime movers
4

C-9.02 Diagnoses prime movers
4

C-9.03 Maintains prime movers
4

C-9.04 Repairs prime movers
4

Task C-10
Services shafts, bearings and seals
20%

C-10.01 Installs shafts, bearings and seals
2

C-10.02 Diagnoses shafts, bearings and seals
2

C-10.03 Maintains shafts, bearings and seals
2

C-10.04 Repairs shafts, bearings and seals
2

Task C-11
Services couplings, clutches and brakes
16%

C-11.01 Installs couplings, clutches and brakes
2

C-11.02 Diagnoses couplings, clutches and brakes
2

C-11.03 Maintains couplings, clutches and brakes
2

C-11.04 Repairs couplings, clutches and brakes
2

Task C-12
Services chain and belt drive systems
15%

C-12.01 Installs chain and belt drive systems
2

C-12.02 Diagnoses chain and belt drive systems
2

C-12.03 Maintains chain and belt drive systems
2

C-12.04 Repairs chain and belt drive systems
2

Task C-13
Services gear systems
16%

C-13.01 Installs gear systems
2

C-13.02 Diagnoses gear systems
2

C-13.03 Maintains gear systems
2

C-13.04 Repairs gear systems
2

Task C-14
Performs shaft alignment procedures
17%

C-14.01 Performs rough alignment
2

C-14.02 Performs dial alignment
2, 3

C-14.03 Performs laser alignment
3

D - SERVICES MATERIAL HANDLING / PROCESS SYSTEMS 18%

Task D-15
Services robotics and automated equipment
7%

D-15.01 Installs robotics and automated equipment
4

D-15.02 Diagnoses robotics and automated equipment
4

D-15.03 Maintains robotics and automated equipment
4

D-15.04 Repairs robotics and automated equipment
4

Task D-16
Services fans and blowers
17%

D-16.01 Installs fans and blowers
3

D-16.02 Diagnoses fans and blowers
3

D-16.03 Maintains fans and blowers
3

D-16.04 Repairs fans and blowers
3

Task D-17
Services pumps
21%

D-17.01 Installs pumps
3

D-17.02 Diagnoses pumps
3

D-17.03 Maintains pumps
3

Task D-18
Services compressors
20%

D-17.04 Repairs pumps
3

D-18.01 Installs compressors
3

D-18.02 Diagnoses compressors
3

D-18.03 Maintains compressors
3

D-18.04 Repairs compressors
3

Task D-19
Services process piping, tanks and containers
15%

D-19.01 Installs process tanks and containers
3

D-19.02 Installs process piping
3

D-19.03 Diagnoses process tanks and containers
3

D-19.04 Diagnoses process piping
3

D-19.05 Maintains process tanks and containers
3

D-19.06 Maintains process piping
3

D-19.07 Repairs process tanks and containers
3

D-19.08 Repairs process piping
3

Task D-20
Services conveying systems
20%

D-20.01 Installs conveying systems
4

D-20.02 Diagnoses conveying systems
4

D-20.03 Maintains conveying systems
4

D-20.04 Repairs conveying systems
4

E - SERVICES FLUID POWER SYSTEMS

15%

Task E-21
Services hydraulic systems

57%

E-21.01 Installs hydraulic systems

3

E-21.02 Diagnoses hydraulic systems

3

E-21.03 Maintains hydraulic systems

3

E-21.04 Repairs hydraulic systems

3

Task E-22
Services pneumatic and vacuum systems

43%

E-22.01 Installs pneumatic and vacuum systems

3

E-22.02 Diagnoses pneumatic and vacuum systems

3

E-22.03 Maintains pneumatic and vacuum systems

3

E-22.04 Repairs pneumatic and vacuum systems

3

F - PERFORMS PREVENTATIVE AND PREDICTIVE MAINTENANCE, COMMISSIONING AND DECOMMISSIONING

12%

Task F-23
Performs preventative and predictive maintenance

66%

F-23.01 Performs preventative maintenance activities

4

F-23.02 Performs vibration analysis procedures

4

F-23.03 Performs balancing procedures

4

F-23.04 Performs non-destructive testing (NDT) procedures

4

F-23.05 Performs fluid analysis procedures

4

F-23.06 Performs predictive maintenance activities

4

Task F-24
Commissions and decommissions equipment

34%

F-24.01 Commissions systems and components

4

F-24.02 Decommissions systems and components

4

ELEMENTS OF HARMONIZATION OF APPRENTICESHIP TRAINING

1.Trade name

The official Red Seal name for this trade is Industrial Mechanic (Millwright).

2.Number of Levels of Apprenticeship

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

3.Total Training Hours during Apprenticeship Training

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

SEQUENCING OF APPRENTICESHIP TRAINING TOPICS AND RELATED SUBTASKS

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

Level 1	Level 2	Level 3	Level 4
Safety Related Functions	Safety Related Functions	Safety Related Functions	Safety Related Functions
Routine Trade Tasks	Routine Trade Tasks	Routine Trade Tasks	Routine Trade Tasks
Drawings and Schematics	Drawings and Schematics	Drawings and Schematics	Drawings and Schematics
Safety Related Functions 1.01 Uses personal protective equipment (PPE) and safety equipment 1.02 Maintains safe worksite 1.03 Protects the environment 1.04 Performs lock-out/tag-out and zero energy procedures	Safety Related Functions 1.01 Uses personal protective equipment (PPE) and safety equipment 1.02 Maintains safe worksite 1.03 Protects the environment 1.04 Performs lock-out/tag-out and zero energy procedures	Safety Related Functions 1.01 Uses personal protective equipment (PPE) and safety equipment 1.02 Maintains safe worksite 1.03 Protects the environment 1.04 Performs lock-out/tag-out and zero energy procedures	Safety Related Functions 1.01 Uses personal protective equipment (PPE) and safety equipment 1.02 Maintains safe worksite 1.03 Protects the environment 1.04 Performs lock-out/tag-out and zero energy procedures

Level 1	Level 2	Level 3	Level 4
<p>Routine Trade Tasks</p> <p>3.01 Plans work 3.02 Fabricates workpiece 3.03 Lubricates systems and components 3.04 Performs leveling of components and systems 3.05 Uses fastening and retaining devices 3.06 Performs material identification 3.07 Performs heat treatment of metal 5.01 Prepares work area, tools and materials 7.01 Determines load 7.02 Selects rigging equipment 7.03 Selects hoisting/lifting and moving equipment 7.04 Secures area 8.01 Sets up rigging, hoisting/lifting and moving equipment 8.02 Performs hoist/lift and move 8.03 Maintains rigging, hoisting/lifting and moving equipment</p>	<p>Routine Trade Tasks</p> <p>3.01 Plans work 3.02 Fabricates workpiece 3.03 Lubricates systems and components 3.04 Performs leveling of components and systems 3.05 Uses fastening and retaining devices 3.06 Performs material identification 3.07 Performs heat treatment of metal 5.01 Prepares work area, tools and materials 7.01 Determines load 7.02 Selects rigging equipment 7.03 Selects hoisting/lifting and moving equipment 7.04 Secures area 8.01 Sets up rigging, hoisting/lifting and moving equipment 8.02 Performs hoist/lift and move 8.03 Maintains rigging, hoisting/lifting and moving equipment</p>	<p>Routine Trade Tasks</p> <p>3.01 Plans work 3.02 Fabricates workpiece 3.03 Lubricates systems and components 3.04 Performs leveling of components and systems 3.05 Uses fastening and retaining devices 3.06 Performs material identification 3.07 Performs heat treatment of metal 5.01 Prepares work area, tools and materials 7.01 Determines load 7.02 Selects rigging equipment 7.03 Selects hoisting/lifting and moving equipment 7.04 Secures area 8.01 Sets up rigging, hoisting/lifting and moving equipment 8.02 Performs hoist/lift and move 8.03 Maintains rigging, hoisting/lifting and moving equipment</p>	<p>Routine Trade Tasks</p> <p>3.01 Plans work 3.02 Fabricates workpiece 3.03 Lubricates systems and components 3.04 Performs leveling of components and systems 3.05 Uses fastening and retaining devices 3.06 Performs material identification 3.07 Performs heat treatment of metal 5.01 Prepares work area, tools and materials 7.01 Determines load 7.02 Selects rigging equipment 7.03 Selects hoisting/lifting and moving equipment 7.04 Secures area 8.01 Sets up rigging, hoisting/lifting and moving equipment 8.02 Performs hoist/lift and move 8.03 Maintains rigging, hoisting/lifting and moving equipment</p>
<p>Drawings and Schematics</p> <p>3.08 Uses mechanical drawings and schematics</p>	<p>Drawings and Schematics</p> <p>3.08 Uses mechanical drawings and schematics</p>	<p>Drawings and Schematics</p> <p>3.08 Uses mechanical drawings and schematics</p>	<p>Drawings and Schematics</p> <p>3.08 Uses mechanical drawings and schematics</p>
<p>Safety Related Functions</p> <p>1.01 Uses personal protective equipment (PPE) and safety equipment 1.02 Maintains safe worksite 1.03 Protects the environment 1.04 Performs lock-out/tag-out and zero energy procedures</p>	<p>Safety Related Functions</p> <p>1.01 Uses personal protective equipment (PPE) and safety equipment 1.02 Maintains safe worksite. 1.03 Protects the environment 1.04 Performs lock-out/tag-out and zero energy procedures</p>	<p>Safety Related Functions</p> <p>1.01 Uses personal protective equipment (PPE) and safety equipment 1.02 Maintains safe worksite 1.03 Protects the environment 1.04 Performs lock-out/tag-out and zero energy procedures</p>	<p>Safety Related Functions</p> <p>1.01 Uses personal protective equipment (PPE) and safety equipment 1.02 Maintains safe worksite 1.03 Protects the environment 1.04 Performs lock-out/tag-out and zero energy procedures</p>

Level 1	Level 2	Level 3	Level 4
<p>Tools and Equipment</p> <p>2.01 Uses hand and portable power tools 2.02 Uses shop machines 2.03 Uses access equipment 3.02 Fabricates workpiece 3.03 Lubricates systems and components 3.04 Performs leveling of components and systems 3.05 Uses fastening and retaining devices 5.04 Maintains precision measuring and layout tools</p>			
<p>Communications Techniques</p> <p>4.01 Uses communication techniques</p>			<p>Mentoring Techniques</p> <p>4.02 Uses mentoring techniques</p>
<p>Measuring and Layout</p> <p>3.02 Fabricates workpiece 3.04 Performs leveling of components and systems 5.01 Prepares work area, tools and materials 5.02 Measures material and components 5.03 Lays out components 5.04 Maintains precision measuring and layout tools</p>			
<p>Cutting and Welding</p> <p>3.02 Fabricates workpiece 3.07 Performs heat treatment of metal 5.01 Prepares work area, tools and materials 6.01 Cuts material with gas and plasma arc cutting equipment 6.02 Joins material using oxy-fuel welding equipment 6.06 Maintains welding equipment</p>	<p>Cutting and Welding</p> <p>3.02 Fabricates workpiece 3.07 Performs heat treatment of metal 5.01 Prepares work area, tools and materials 6.03 Welds material using arc welding equipment (SMAW) 6.04 Welds material with gas metal arc welding (GMAW) equipment 6.05 Welds material with gas tungsten arc welding (GTAW) equipment</p>		

Level 1	Level 2	Level 3	Level 4
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Rigging, Hoisting/Lifting and Moving
 2.03 Uses access equipment
 7.01 Determines load
 7.02 Selects rigging equipment
 7.03 Selects hoisting/lifting and moving equipment
 7.04 Secures area
 8.01 Sets up rigging, hoisting/lifting and moving equipment
 8.02 Performs hoist/lift and move
 8.03 Maintains rigging, hoisting/lifting and moving equipment

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

Couplings, Clutches and Brakes
 11.01 Installs couplings, clutches and brakes
 11.02 Diagnoses couplings, clutches and brakes
 11.03 Maintains couplings, clutches and brakes
 11.04 Repairs couplings, clutches and brakes

Level 1	Level 2	Level 3	Level 4
	<p>Chain and Belt Drive Systems</p> <p>12.01 Installs chain and belt drive systems 12.02 Diagnoses chain and belt drive systems 12.03 Maintains chains and belt drive systems 12.04 Repairs chains and belt drive systems</p>		
	<p>Gear Systems</p> <p>13.01 Installs gear systems 13.02 Diagnoses gear systems 13.03 Maintains gear systems 13.04 Repairs gear systems</p>		
	<p>Shaft Alignment Procedures (rough alignment; rim and face dial alignment)</p> <p>14.01 Performs rough alignment 14.02 Performs dial alignment</p>	<p>Shaft Alignment Procedures (cross dial and reverse [double] dial; laser)</p> <p>14.02 Performs dial alignment 14.03 Performs laser and optical alignment</p>	
			<p>Conveying Systems</p> <p>20.01 Installs conveying systems 20.02 Diagnoses conveying systems 20.03 Maintains conveying systems 20.04 Repairs conveying systems</p>
		<p>Fans and Blowers</p> <p>16.01 Installs fans and blowers 16.02 Diagnoses fans and blowers 16.03 Maintains fans and blowers 16.04 Repairs fans and blowers</p>	

Level 1	Level 2	Level 3	Level 4
		<p align="center">Pumps</p> 17.01 Installs pumps 17.02 Diagnoses pumps 17.03 Maintains pumps 17.04 Repairs pumps	
		<p align="center">Compressors</p> 18.01 Installs compressors 18.02 Diagnoses compressors 18.03 Maintains compressors 18.04 Repairs compressors	
		<p align="center">Process Piping, Tanks and Containers</p> 19.01 Installs process tanks and containers 19.02 Installs process piping 19.03 Diagnoses process tanks and containers 19.04 Diagnoses process piping 19.05 Maintains process tanks and containers 19.06 Maintains process piping 19.07 Repairs process tanks and containers 19.08 Repairs process piping	
		<p align="center">Hydraulic Systems</p> 21.01 Installs hydraulic systems 21.02 Diagnoses hydraulic systems 21.03 Maintains hydraulic systems 21.04 Repairs hydraulic systems	

Level 1	Level 2	Level 3	Level 4
		<p>Pneumatic and Vacuum Systems</p> <p>22.01 Installs pneumatic and vacuum systems</p> <p>22.02 Diagnoses pneumatic and vacuum systems</p> <p>22.03 Maintains pneumatic and vacuum systems</p> <p>22.04 Repairs pneumatic and vacuum systems</p>	
			<p>Prime Movers</p> <p>9.01 Installs prime movers</p> <p>9.02 Diagnoses prime movers</p> <p>9.03 Maintains prime movers</p> <p>9.04 Repairs prime movers</p>
			<p>Preventative and Predictive Maintenance</p> <p>23.01 Performs preventative maintenance activities</p> <p>23.02 Performs vibration analysis procedures</p> <p>23.03 Performs balancing procedures</p> <p>23.04 Performs non-destructive evaluation (NDE) procedures</p> <p>23.05 Performs fluid analysis procedures</p> <p>23.06 Performs predictive maintenance activities</p>
			<p>Commissioning and Decommissioning Equipment</p> <p>24.01 Commissions systems and components</p> <p>24.02 Decommissions systems and components</p>

Level 1	Level 2	Level 3	Level 4
			<p>Robotics and Automated Equipment</p> <p>15.01 Installs robotics and automated equipment</p> <p>15.02 Diagnoses robotics and automated equipment</p> <p>15.03 Maintains robotics and automated equipment</p> <p>15.04 Repairs robotics and automated equipment</p>

MAJOR WORK ACTIVITY A

Performs common occupational skills

TASK A-1 Performs safety-related functions

TASK DESCRIPTOR

Industrial mechanics (millwrights) use PPE and safety equipment, maintain a safe work environment and perform other procedures for the purpose of preventing personal injury, equipment damage and environmental impact.

A-1.01 Uses personal protective equipment (PPE) and safety equipment

Apprenticeship Level	1,2,3,4
Essential Skills	Reading, Document Use, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-1.01.01L	demonstrate knowledge of personal protective equipment (PPE) and safety equipment , their applications, maintenance and procedures for use	identify types of PPE and clothing, and describe their characteristics, applications and procedures for use
		identify types of safety equipment and describe their characteristics, applications and procedures for use
		describe the procedures used to care for, maintain and store PPE
		describe the procedures used to care for, maintain and store safety equipment

RANGE OF VARIABLES

PPE includes: safety glasses (face shield), respirators, hardhats, footwear, gloves, coveralls, acid suits, personal monitors, fall protection, hearing protection, high-visibility clothing

safety equipment includes: lockout devices, fire extinguishers, gas detectors, fall protection equipment and devices

jurisdictional regulations include: ISO procedures, federal (Workplace Hazardous Materials Information System [WHMIS], Canadian Nuclear Safety Commission), provincial/territorial (worker's rights and responsibilities), municipal

A-1.02**Maintains safe worksite**

Apprenticeship Level	1,2,3,4
Essential Skills	Document Use, Oral Communication, Working with Others

KNOWLEDGE**Learning Outcomes****Learning Objectives**

A-1.02.01L	demonstrate knowledge of safe work practices	define terminology associated with safety in the worksite
		identify worksite hazards and assess risks
		describe the procedures used to maintain a safe worksite
		identify hazards and describe safe work practices pertaining to rigging, hoisting/lifting and moving
		describe the procedures used to ensure the work area is safe for lifting
		identify hazards and describe safe work practices pertaining to inert gases, oxy-fuel cutting, heating, welding, brazing and soldering
		identify hazards and describe safe work practices pertaining to working in confined spaces
A-1.02.02L	demonstrate knowledge of regulatory requirements pertaining to safety	identify hazards and describe safe work practices pertaining to working at heights
		identify hazards and describe safe work practices pertaining to working around energized equipment
		interpret jurisdictional regulations related to workplace health and safety
		interpret jurisdictional regulations pertaining to rigging, hoisting/lifting and moving
		interpret jurisdictional regulations pertaining to inert gases, oxy-fuel cutting, heating, welding, brazing and soldering
		interpret jurisdictional regulations related to working in confined spaces
		interpret jurisdictional regulations related to working at heights
		interpret jurisdictional regulations related to working around energized equipment

RANGE OF VARIABLES

hazards include: poor housekeeping, improper use of **PPE**, lack of monitoring devices, improper rigging of material, improper hardware selection, poor air quality, poor ventilation, improper pre-use inspection, improper preparation for hot work, personal, workplace (electrical, chemical, potential sources of energy, sources of radiation, confined spaces, fire, heights, air quality, rotating equipment)

procedures used to ensure the work area is safe for lifting include: supervision of lift, securing work area, communication, critical lift plan, engineered lift plan, fire watch

jurisdictional regulations include: ISO procedures, federal (Workplace Hazardous Materials Information System [WHMIS], Canadian Nuclear Safety Commission), provincial/territorial (worker's rights and responsibilities), municipal

energized equipment includes: mobile equipment (e.g. loader, crane, fork truck), stationary rotating equipment, conveying systems, bus bars, motor control centre, pressurized equipment

A-1.03 Protects the environment

Apprenticeship Level	1,2,3,4
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Essential Skills	Document Use, Continuous Learning, Working with Others
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KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-1.03.01L	demonstrate knowledge of regulatory requirements pertaining to environmental safety and protection	identify environmental hazards , assess risks and describe the procedures used to protect the environment
		identify how to access current information on site specifications and jurisdictional regulations
		identify reporting requirements and procedures

RANGE OF VARIABLES

environmental hazards include: contamination (water, air, soil), hazardous materials

jurisdictional regulations include: ISO procedures, federal (Workplace Hazardous Materials Information System [WHMIS], Canadian Nuclear Safety Commission), provincial/territorial (worker's rights and responsibilities), municipal

A-1.04**Performs lock-out/tag-out and zero-energy state procedures**

Apprenticeship Level	1,2,3,4
Essential Skills	Document Use, Thinking, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-1.04.01L	demonstrate knowledge of the procedures used to perform lock-out/tag-out and zero-energy procedures	identify <i>energy potential in machines, process systems and components</i> and methods to verify zero-energy state describe the procedures used to lock-out and tag-out equipment and to return to zero-energy state
A-1.04.02L	demonstrate knowledge of potential hazards associated with lock-out/tag-out and zero-energy procedures	identify and describe potential outcomes of not following procedures used to lock-out and tag-out equipment and to return to zero-energy state

RANGE OF VARIABLES

energy potential in machines, process systems and components includes: accumulators, suspended loads, pneumatic and hydraulic equipment, gravity, piping, pipe blockages, rotating equipment, stress, strain and/or torsion/tension, material memory (e.g. coiled cable, springs), electrical, thermal, counter weights

jurisdictional regulations include: ISO procedures, federal (Workplace Hazardous Materials Information System [WHMIS], Canadian Nuclear Safety Commission), provincial/territorial (worker's rights and responsibilities), municipal

TASK A-2 Uses tools and equipment

TASK DESCRIPTOR

Industrial mechanics (millwrights) use various tools and equipment to perform their work. These subtasks include both the use of the tool as well as maintenance of the tools to ensure optimal efficiency and safe operation.

A-2.01 Uses hand and portable power tools

Apprenticeship Level	1
Essential Skills	Thinking, Numeracy, Continuous Learning

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-2.01.01L	demonstrate knowledge of hand tools and portable power tools , their applications and procedures for use	define terminology associated with hand tools and portable power tools and equipment interpret jurisdictional regulations , and manufacturers' specifications pertaining to hand tools and portable power tools identify types of hand tools and describe their applications and procedures for use identify types of portable power tools and describe their applications and procedures for use
A-2.01.02L	demonstrate knowledge of the procedures used to clean, inspect, maintain and store hand tools and portable power tools	describe the procedures used to clean, inspect, maintain and store hand tools and portable power tools
A-2.01.03L	demonstrate knowledge of safety practices related to hand tools and portable power tools and equipment	identify hazards and describe safe work practices pertaining to the use of hand tools and portable power tools and equipment

RANGE OF VARIABLES

hand tools include: wrenches, screwdrivers, measuring tools, hammers, pry bars, hand saws, pneumatic tools

portable power tools include: grinders, power metal saws, drilling machines, wrenches (hydraulic, impact), portable hydraulic unit

jurisdictional regulations include: ISO procedures, federal (Workplace Hazardous Materials Information System [WHMIS], Canadian Nuclear Safety Commission), provincial/territorial (worker's rights and responsibilities), municipal

manufacturers' specifications include: licensing, training

A-2.02**Uses shop machines**

Apprenticeship Level

1

Essential Skills

Thinking, Continuous Learning, Document Use

KNOWLEDGE**Learning Outcomes****Learning Objectives**

A-2.02.01L	demonstrate knowledge of shop machines , their applications and procedures for use	identify types of shop machines and describe their applications and procedures
A-2.02.02L	demonstrate knowledge of safety practices related to the use of shop machines	identify hazards and describe safe work practices pertaining to grinding operations
		identify hazards and describe safe work practices pertaining to power metal saws
		identify hazards and describe safe work practices pertaining to drilling operations
		identify hazards and describe safe work practices pertaining to lathe operations
		identify hazards and describe safe work practices pertaining to milling operations, materials used, and coolants
A-2.02.03L	demonstrate knowledge of ironworkers shop equipment, their applications and procedures for use	identify types of ironworkers shop equipment and describe their applications and procedures
A-2.02.04L	demonstrate knowledge of safety practices related to the use of ironworkers shop equipment	identify hazards and describe safe work practices pertaining to ironworkers equipment to slip-roll applications
		identify hazards and describe safe work practices pertaining to brakes applications
		describe the procedures used to set up ironworkers equipment
		describe the procedures used to align work pieces
		describe the procedures used to bend workpiece with brakes
		describe the procedures used to cope and notch workpiece
A-2.02.05L	demonstrate knowledge of grinders and their applications	define terminology associated with grinders
A-2.02.06L	demonstrate knowledge of the procedures used to perform grinding operations	describe the techniques used to sharpen and dress tools using grinders
		identify types of grinders and describe their characteristics and applications

		identify grinder components, accessories and attachments and describe their applications
		identify the factors to consider when selecting grinding wheels for specific operations
		describe the procedures used to change, ring test, mount and dress grinding wheels
A-2.02.07L	demonstrate knowledge of power metal saws and their applications	define terminology associated with power metal saws
A-2.02.08L	demonstrate knowledge of the procedures to perform cutting operations using power metal saws	describe the procedures used to perform and troubleshoot cutting operations using power metal saws
		identify types of power metal saws and describe their applications
		identify power metal saw components, accessories and attachments and describe their applications
		identify cutting fluids and coolants used during cutting operations
		identify the factors to consider when selecting power metal saw blades for specific operations
		describe procedures used to change power metal saw blades and tension
		describe procedures used to select power metal saw feed and speed
A-2.02.09L	demonstrate knowledge of drilling machines, their accessories and their applications	define terminology associated with drilling machines and drilling operations
A-2.02.10L	demonstrate knowledge of the procedures used to perform drilling operations, and the associated calculations	identify types of drilling machines , their components and accessories and describe their characteristics and applications
		identify types of drill bits and describe their characteristics and applications
		identify cutting fluids and coolants used during drilling operations and describe their characteristics and applications
		describe the procedures used to set up, operate and troubleshoot drilling machines
		determine and calculate speeds and feeds for drilling operations
A-2.02.11L	demonstrate knowledge of lathes, their accessories, attachments and applications	define terminology associated with lathes

A-2.02.12L	demonstrate knowledge of the procedures used to perform lathe operations, and the associated calculations	describe the procedures used to perform basic lathe operations
		describe the procedures used to align work pieces
		describe the procedures used to prevent and correct problems that occur when performing lathe operations
		identify types of lathes and describe their applications and operation
		identify lathe components, accessories and attachments , and describe their characteristics and applications
		identify types of tool holding and work holding devices, and describe their characteristics and applications
		identify types of lathe tools and describe their characteristics and applications
		describe the procedures used to sharpen lathe cutting tools
		calculate and determine speeds, feeds and depth of cut for lathe operations
		describe the procedures used to set up lathes
		identify cutting fluids and coolants used during lathe operations
A-2.02.13L	demonstrate knowledge of milling machines and their applications	define terminology associated with milling machines
A-2.02.14L	demonstrate knowledge of the procedures used to perform milling operations, and the associated calculations	describe the procedures used to align work pieces
		identify cutting fluids and coolants used during milling operations
		describe the procedures used to perform basic milling operations
		describe the procedures used to prevent and correct problems that occur when performing milling machine operations
		identify types of milling machines and describe their applications
		identify milling machine components, accessories and attachments, and describe their characteristics, applications and maintenance
		identify types of tool holding and work holding devices and describe their characteristics, applications and procedures for use

identify types of cutting tools and describe their characteristics and applications

calculate and determine speeds, feeds and depth of cut for milling operations

RANGE OF VARIABLES

shop machines include: drill presses, pedestal grinders, surface and cylindrical grinders, abrasive cutoff saw (chop saw), band saws, lathes, milling machines, ironworkers (slip-roll and brakes), sandblasters, shears

techniques used to sharpen or dress tools include: sharpening chisels, sharpening drills, conditioning grinding wheels

types of grinders include: pedestal, bench, hand, surface, die

factors to consider when selecting grinding wheels include: abrasive type, wet or dry grinding, work piece material, speed and feed requirements

types of power metal saws include: horizontal and vertical band saws, abrasive cut-off saws, reciprocating saws, portable, power hack saws

types of drilling machines include: drill press, radial arm drill press, turret drill, gang drill

accessories and **attachments** include: tool holders, knurling tools, live centers, drill chucks, taper attachments, steady rests, follower rests, tool post grinders, three and four jaw chucks

A-2.03 Uses access equipment

Apprenticeship Level

1

Essential Skills

Continuous Learning, Document Use, Thinking

KNOWLEDGE

Learning Outcomes

Learning Objectives

A-2.03.01L

demonstrate knowledge of **access equipment** and fall protection equipment, their applications, limitations and procedures for use

define terminology associated with **access equipment** and fall protection equipment

interpret **jurisdictional regulations** pertaining to **access equipment** and fall protection equipment

identify types of **access equipment** and describe their characteristics and applications

identify types of fall protection equipment and describe their applications and procedures for use

describe the procedures used to erect and dismantle ladders and scaffolding

		describe the procedures used to inspect and maintain access equipment and fall protection equipment
A-2.03.02L	demonstrate knowledge of safety practices related to access equipment and fall protection equipment	identify hazards and describe safe work practices pertaining to access equipment and fall protection equipment

RANGE OF VARIABLES

access equipment includes: powered mobile equipment (PME), ladders, scaffolds

jurisdictional regulations include: ISO procedures, federal (Workplace Hazardous Materials Information System [WHMIS], Canadian Nuclear Safety Commission), provincial/territorial (worker's rights and responsibilities), municipal

TASK A-3 Performs routine trade tasks

TASK DESCRIPTOR

Industrial mechanics (millwrights) perform routine trade tasks to optimize the efficiency and life expectancy of equipment.

A-3.01 Plans work

Apprenticeship Level	1,2,3,4
Essential Skills	Document Use, Working with Others, Reading

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.01.01L	demonstrate knowledge of job planning	define terminology associated with job planning identify sources of information relevant to job planning identify the factors to consider for determining job requirements
		explain the concept of job sequencing and describe its application and purpose in the job planning process
A-3.01.02L	demonstrate knowledge of the procedures used to plan and organize jobs	describe the procedures used to plan job tasks describe the procedures used to organize and store tools, equipment and materials on-site

RANGE OF VARIABLES

sources of information include: documentation, drawings, related professionals, clients

factors include: personnel, tools and equipment, materials, permits, environmental, time

procedures used to plan job tasks include: scheduling, estimating

A-3.02 Fabricates work piece

Apprenticeship Level	1,2,3,4
Essential Skills	Numeracy, Document Use, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.02.01L	demonstrate knowledge of shop machines , their applications and procedures for use	identify types of shop machines and describe their applications and procedures for use
A-3.02.02L	demonstrate knowledge of safety practices related to the use of shop machines	identify hazards and describe safe work practices pertaining to grinding operations, materials used and coolants
		identify hazards and describe safe work practices pertaining to power metal saws, materials used and coolants
		identify hazards and describe safe work practices pertaining to drilling operations, materials used and coolants
		identify hazards and describe safe work practices pertaining to lathe operations, materials used and coolants
		identify hazards and describe safe work practices pertaining to milling operations, materials used and coolants
A-3.02.03L	demonstrate knowledge of grinders and their applications	define terminology associated with grinders
A-3.02.04L	demonstrate knowledge of the procedures used to perform grinding operations	describe the techniques used to sharpen and dress tools using grinders
		identify types of grinders and describe their characteristics and applications
		identify grinder components, accessories and attachments and describe their applications
		identify the factors to consider when selecting grinding wheels for specific operations
		describe the procedures used to change, ring test, mount and dress grinding wheels

A-3.02.05L	demonstrate knowledge of power metal saws and their applications	define terminology associated with power metal saws
A-3.02.06L	demonstrate knowledge of the procedures to perform cutting operations using power metal saws	describe the procedures used to perform and troubleshoot cutting operations using power metal saws
		identify types of power metal saws and describe their applications
		identify power metal saw components, accessories and attachments and describe their applications
		identify cutting fluids and coolants used during cutting operations
		identify the factors to consider when selecting power metal saw blades for specific operations
		describe procedures used to change power metal saw blades and tension
		describe procedures used to select power metal saw feed and speed
A-3.02.07L	demonstrate knowledge of drilling machines, their accessories and their applications	define terminology associated with drilling machines and drilling operations
A-3.02.08L	demonstrate knowledge of the procedures used to perform drilling operations, and the associated calculations	identify types of drilling machines , their components and accessories and describe their characteristics and applications
		identify types of drill bits and describe their characteristics and applications
		identify cutting fluids and coolants used during drilling operations and describe their characteristics and applications
		describe the procedures used to set up, operate and troubleshoot drilling machines
		determine and calculate speeds and feeds for drilling operations
A-3.02.09L	demonstrate knowledge of lathes, their accessories, attachments and applications	define terminology associated with lathes
A-3.02.10L	demonstrate knowledge of the procedures used to perform lathe operations, and the associated calculations	describe the procedures used to perform basic lathe operations
		describe the procedures used to align work pieces
		describe the procedures used to prevent and correct problems that occur when performing lathe operations

		identify types of lathes and describe their applications and operation
		identify lathe components, accessories and attachments , and describe their characteristics and applications
		identify types of tool holding and work holding devices, and describe their characteristics and applications
		identify types of lathe tools and describe their characteristics and applications
		describe the procedures used to sharpen lathe cutting tools
		calculate and determine speeds, feeds and depth of cut for lathe operations
		describe the procedures used to set up lathes
		identify cutting fluids and coolants used during lathe operations
A-3.02.11L	demonstrate knowledge of milling machines and their applications	define terminology associated with milling machines
A-3.02.12L	demonstrate knowledge of the procedures used to perform milling operations, and the associated calculations	describe the procedures used to align work pieces
		identify cutting fluids and coolants used during milling operations
		describe the procedures used to perform basic milling operations
		describe the procedures used to prevent and correct problems that occur when performing milling machine operations
		identify types of milling machines and describe their applications
		identify milling machine components, accessories and attachments, and describe their characteristics, applications and maintenance
		identify types of tool holding and work holding devices and describe their characteristics, applications and procedures for use
		identify types of cutting tools and describe their characteristics and applications
		calculate and determine speeds, feeds and depth of cut for milling operations

RANGE OF VARIABLES

shop machines include: drill presses, pedestal grinders, surface and cylindrical grinders, abrasive cutoff saw (chop saw), band saws, lathes, milling machines, ironworkers, sandblasters, shears

procedures for use include: drilling, boring, reaming, counterboring, countersinking, tapping, spot facing, turning, grooving, facing, knurling, parting off, threading

techniques used to sharpen or dress tools include: sharpening chisels, sharpening drills, conditioning grinding wheels

types of grinders include: pedestal, bench, hand, surface, die

factors to consider when selecting grinding wheels include: abrasive type, wet or dry grinding, work piece material, speed and feed requirements

types of power metal saws include: horizontal and vertical band saws, abrasive cut-off saws, reciprocating saws, portable, power hack saws

types of drilling machines include: drill press, radial arm drill press, turret drill, gang drill

accessories and attachments include: tool holders, knurling tools, live centers, drill chucks, taper attachments, steady rests, follower rests, tool post grinders, three and four jaw chucks

A-3.03 Lubricates systems and components

Apprenticeship Level	1,2,3,4
Essential Skills	Document Use, Numeracy, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.03.01L	demonstrate knowledge of lubricants , lubrication systems and their components, applications and procedures for use	define terminology associated with lubricants and lubrication systems
		interpret jurisdictional regulations and specifications pertaining to lubricants and lubrication systems
		identify types of lubrication systems and describe their characteristics and applications
A-3.03.02L	demonstrate knowledge of the procedures used to handle, store, recycle and dispose of lubricants	identify maintenance and troubleshooting procedures for lubrication systems
		identify tools and equipment used with lubricants and lubrication systems, and describe their applications and procedures
		explain the principles and types of friction and their effects on surfaces in contact
		identify types of lubricants and describe their applications
		identify the properties and characteristics of lubricants

		identify the factors to consider when selecting lubricants
		explain the effects of using incorrect lubricant
		identify sources of information relating to system lubricant and lubrication requirements
		describe the effect of lubricant levels on machine operation
		identify procedures to recycle or dispose of lubricants
A-3.03.03L	demonstrate knowledge of safety practices related to lubricants and lubricant systems	identify hazards and describe safe work practices pertaining to lubricants and lubrication systems

RANGE OF VARIABLES

lubricants include: oil, grease, dry solid, water

types of lubrication systems include: once through, oil bath, oil mist, manual, enclosed circulating, pressurized, automated

properties and characteristics of lubricants include: adhesion/cohesion, viscosity, additives and inhibitors, penetration, drop point, flash point, classifications and grades

sources of information include: technical manuals, manufacturers' specifications

hazards include: environmental, personal health, fire, contamination, slipping, housekeeping issues

safe work practices include: using PPE, disposing according to jurisdictional requirements, spill response procedures, storing materials

A-3.04 Performs leveling of components and systems

Apprenticeship Level	1,2,3,4
Essential Skills	Thinking, Numeracy, Digital Technology

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.04.01L	demonstrate knowledge of the procedures used to level and align equipment	define terminology associated with equipment leveling and alignment
		interpret jurisdictional regulations and specifications pertaining to equipment leveling and alignment
		identify tools and equipment used for equipment leveling and alignment, and describe their application and procedures
		identify types of bases and describe their applications

		describe the procedures used to level and align equipment
A-3.04.02L	demonstrate knowledge of safety practices related to equipment leveling and alignment	identify hazards and describe safe work practices pertaining to equipment leveling and alignment

RANGE OF VARIABLES

procedures used to level and align equipment include: planning, interpreting drawings, fabricating component supports, installing base, shimming, positioning equipment, relieving stresses/strains, anchoring and grouting, completing documentation

tools and equipment include: theodolites, levels (optical, laser, water, spirit), piano wire, plumb bob

conditions include: weather, vibration, ground conditions

bases include: base plate, sole plate, fabricated, skid mounted, foundations

A-3.05 Uses fastening and retaining devices

Apprenticeship Level	1,2,3,4
Essential Skills	Numeracy, Document Use, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.05.01L	demonstrate knowledge of fastening and retaining devices , and their applications	define terminology associated with fastening and retaining devices
		identify tools and equipment pertaining to the use of fastening and retaining devices , and describe their applications and procedures
		identify types of fastening devices and materials, and describe their characteristics and applications
		identify strength of fasteners by grade and applications
A-3.05.02L	demonstrate knowledge of the procedures used to install and remove fastening and retaining devices	identify types of retaining devices and describe their characteristics and applications
		identify thread types and classifications and describe the procedures used for thread identification
		explain the purpose of torquing and tensioning fastening devices and describe associated procedures
		describe the procedures used to install, remove and repair fastening devices
		describe the procedures used to install and remove retaining devices

		describe the procedures used to make internal and external threads to specifications
A-3.05.03L	demonstrate knowledge of safety practices related to fastening and retaining devices	identify hazards and describe safe work practices pertaining to the use of fastening and retaining devices

RANGE OF VARIABLES

fastening devices include: mechanical, chemical

retaining devices include: snap-rings, pins, keys, set screws, locking tabs

tools and equipment include: torque wrenches, impact wrenches, hydraulic tensioning devices, hand tools (snap-ring pliers, riveting tools)

procedures used to make internal and external threads include: external threading (dies), internal threading (taps), using threading machines

A-3.06 Performs material identification

Apprenticeship Level	1,2,3,4
Essential Skills	Document Use, Reading, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.06.01L	demonstrate knowledge of metals and their characteristics	define terminology associated with metallurgy
A-3.06.02L	demonstrate knowledge of non-metallic materials and their characteristics	define terminology associated with non-metallic materials
A-3.06.03L	demonstrate knowledge of metallurgic principles	describe the properties of metals
		describe the identification systems for metals
		identify the methods and processes used in the manufacture of steel and alloys
		describe the problems that may occur when working metals
		describe the procedures used to prevent and correct problems that occur when working metals
A-3.06.04L	demonstrate knowledge of material testing procedures	identify common material testing techniques and describe their associated procedures

		describe safe work practices pertaining to identification and handling of materials
A-3.06.05L	demonstrate knowledge of structural shapes and their applications	identify structural shapes and describe their characteristics and applications

RANGE OF VARIABLES

problems include: stress, contraction, expansion, distortion, work hardening, galvanic action, fire, tensile strength

material testing techniques include: Rockwell, Brinnell, Vickers, spark, chisel, file, magnet, conductivity, visual inspection

A-3.07 Performs heat treatment of metal

Apprenticeship Level	1,2,3,4
Essential Skills	Document Use, Thinking, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.07.01L	demonstrate knowledge of metals and their characteristics	define terminology associated with metallurgy
A-3.07.02L	demonstrate knowledge of metallurgic principles	describe the properties of metals
		describe the identification systems for metals
		identify the methods and processes used in the manufacture of steel and alloys
		describe the problems that can occur when working metals
		describe the procedures used to prevent and correct problems that occur when working metals
A-3.07.03L	demonstrate knowledge of structural shapes and their applications	identify structural shapes and describe their characteristics and applications
A-3.07.04L	demonstrate knowledge of processes used in the heat treatment of metals	define terminology associated with heat treatment of metal
		interpret jurisdictional regulations pertaining to heat treatment of metal
		identify types of heat treating equipment and accessories and describe their applications

		describe the procedures used in the heating of metal
A-3.07.05L	demonstrate knowledge of safety practices related to heat treatment of metal	identify hazards and describe safe work practices pertaining to heat treatment of metal

RANGE OF VARIABLES

problems include: stress, contraction, expansion, distortion, work hardening, galvanic action

processes used in the heat treatment of metals include: stress relieving, hardening, annealing, tempering, normalizing, quenching

hazards include: personal, shop/facility, equipment, ventilation, storage

A-3.08 Uses mechanical drawings and schematics

Apprenticeship Level	1,2,3,4
Essential Skills	Document Use, Numeracy, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-3.08.01L	demonstrate knowledge of drawings , their use and interpretation	define terminology associated with drawings
		identify the views found on drawings and describe their characteristics
		interpret drawings and instructions on drawings
		interpret material specifications found on drawings
		identify the purposes for drawings
A-3.08.02L	demonstrate knowledge of calculations relevant to drawings	describe the procedures used to perform calculations relevant to drawings
		identify the metric and imperial systems of measurement and describe the procedures used to perform conversions between the systems
		identify drawing projections and describe their applications
		interpret and extract information from drawings
		explain the use of scales
A-3.08.03L	demonstrate knowledge of basic sketching techniques	demonstrate basic sketching techniques

demonstrate awareness of computer aided drawing (CAD) systems

create sketch using a blueprint/drawing as a starting point

RANGE OF VARIABLES

drawings include: civil/site, engineered, architectural, mechanical, structural, electrical, shop drawings, field drawings, sketches, as-builts, working, P&ID (piping and instrumentation diagram), installation, ITP (inspection and test plan), drawing assembly

views include: elevation, plan, section, detail

purposes for drawings include: determine location of components, determine the positioning of components, determine elevation of components

drawing projections include: orthographic, oblique, isometric, section, auxiliary

information includes: dimensions, lines, legend, symbols and abbreviations, title block, notes and specifications, tolerances/allowances, bill of materials

TASK A-4 Uses communication and mentoring techniques

TASK DESCRIPTOR

Learning in the trades is done primarily in the workplace with tradespeople passing on their skills and knowledge to apprentices, as well as sharing knowledge among themselves. Apprenticeship is, and always has been about mentoring – learning workplace skills and passing them on. Because of the importance of this to the trade, this task covers the activities related to communication in the workplace and mentoring skills.

A-4.01 Uses communication techniques

Apprenticeship Level	1
Essential Skills	Reading, Writing, Oral Communication

KNOWLEDGE

Learning Outcomes

Learning Objectives

A-4.01.01L	demonstrate knowledge of trade terminology	define terminology used in the trade
A-4.01.02L	demonstrate knowledge of effective communication practices	describe the importance of using effective verbal and non-verbal communication with people in the workplace
		identify sources of information to effectively communicate
		identify communication and learning styles

identify **personal responsibilities and attitudes** that contribute to on-the-job success

identify communication that constitutes **harassment** and **discrimination**

RANGE OF VARIABLES

communication practices include: verbal communication techniques, written communication techniques, electronic communication techniques, hand signal techniques

people in the workplace include: other tradespeople, colleagues, apprentices, supervisors, clients, manufacturers, suppliers

sources of information include: jurisdictional regulations, codes, prints, drawings, specifications, company and client documentation, job procedures, work orders, installation instructions

learning styles include: visual, verbal, tactile, individual, group

personal responsibilities and attitudes include: asking questions, working safely, accepting constructive feedback, time management and punctuality, respect for authority, good stewardship of materials, tools and property, efficient work practices, respectful workplace

harassment includes: objectionable conduct, comment or display made either on a one-time or continuous basis that demeans, belittles, or causes personal humiliation or embarrassment to the recipient

discrimination is prohibited based on: race, national or ethnic origin, colour, religion, age, sex, sexual orientation, marital status, family status, disability or conviction for which a pardon has been granted

A-4.02 Uses mentoring techniques

Apprenticeship Level	4
Essential Skills	Oral Communication, Working with Others, Continuous Learning

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-4.02.01L	identify, explain and demonstrate strategies for learning skills in the workplace	describe the importance of individual experience
		determine one's own learning styles and explain how these relate to learning new skills
		describe the importance of different types of skills in the workplace
A-4.02.02L	demonstrate knowledge of strategies for mentoring workplace skills	identify different roles played by a workplace mentor
		describe the steps involved in mentoring skills
		explain the importance of identifying the point of a task

	identify how to choose an appropriate time to explain a task
	identify the components of the skill (the context)
	describe considerations in setting up opportunities for skill practice
	explain the importance of providing feedback
	identify techniques for giving effective feedback
	describe a skills assessment
	identify methods of assessing progress
	explain how to adjust a learning opportunity to different situations

RANGE OF VARIABLES

learning styles include: visual, verbal, tactile, individual, group

strategies for mentoring workplace skills include: understanding the basic principles of instruction, developing coaching skills, being mature and patient, providing feedback

steps for mentoring skills include: identifying the point of the lesson, linking the lesson, demonstrating the skill, providing practice, giving feedback, assessing skills and progress

TASK A-5 Performs measuring and layout

TASK DESCRIPTOR

Industrial mechanics (millwrights) ensure installation of equipment by utilizing precision measuring tools and measuring practices to lay out and assemble components and systems.

A-5.01 Prepares work area, tools and materials

Apprenticeship Level	1
Essential Skills	Numeracy, Writing, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-5.01.01L	demonstrate knowledge of measuring and layout	define terminology associated with measuring and layout
		identify types of precision measuring tools and describe their applications and procedures for use

		identify types of layout tools and describe their applications and procedures for use
A-5.01.02L	demonstrate knowledge of the procedures used to maintain, calibrate and store precision measuring and layout tools	describe the procedures used to inspect, maintain, calibrate and store precision measuring and layout tools
A-5.01.03L	demonstrate knowledge of preparing a work area	identify types of tools that are required to prepare the work area and describe their applications and procedures for use
	demonstrate knowledge of safe work practices related to preparing work area, tools and materials	describe safe work practices related to precision measuring and layout tools
		describe safe work practices related to preparing work area, tools and materials

RANGE OF VARIABLES

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

layout tools include: straightedges, squares, combination sets, surface plates, scribes, hermaphrodite calipers, dividers, trammels, prick and centre punches, angle plates, parallels, v-blocks, surface gauges, layout dye

A-5.02 Measures material and components

Apprenticeship Level	1
Essential Skills	Numeracy, Writing, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-5.02.01L	demonstrate knowledge of measuring and layout and their applications	define terminology associated with measuring and layout
		identify types of precision measuring tools and describe their applications and procedures
		identify types of layout tools and describe their applications and procedures
A-5.02.02L	demonstrate knowledge of the procedures used to perform measuring operations	describe the procedures used to transfer and document measurements
		interpret information from precision measuring tools
	demonstrate knowledge of safe work practices related to measuring material and components	describe safe work practices related to precision measuring and layout tools

RANGE OF VARIABLES

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

layout tools include: straightedges, squares, combination sets, surface plates, scribes, hermaphrodite calipers, dividers, trammels, prick and centre punches, angle plates, parallels, v-blocks, surface gauges, layout dye

A-5.03 Lays out components

Apprenticeship Level 1

Essential Skills Numeracy, Digital Technology, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-5.03.01L	demonstrate knowledge of the layout of components and their applications	define terminology associated with the layout of components
		identify types of layout tools and describe their applications and procedures
A-5.03.02L	demonstrate knowledge of the procedures used to perform layout operations	describe the procedures used to lay out equipment and components
		describe precision measurement procedures
	demonstrate knowledge of safe work practices related to laying out components	describe safe work practices related to laying out components

RANGE OF VARIABLES

layout tools include: straightedges, squares, combination sets, surface plates, scribes, hermaphrodite calipers, dividers, trammels, prick and centre punches, angle plates, parallels, v-blocks, surface gauges, layout dye

A-5.04**Maintains precision measuring and layout tools**

Apprenticeship Level

1

Essential Skills

Document Use, Digital Technology, Numeracy

KNOWLEDGE**Learning Outcomes****Learning Objectives**

A-5.04.01L	demonstrate knowledge of precision measuring and layout tools , their applications and procedures	identify types of precision measuring tools and describe their applications and procedures
		identify types of layout tools and describe their applications and procedures
		describe the procedures used to clean, inspect, maintain, calibrate and store precision measuring and layout tools
A-5.04.02L	demonstrate knowledge of safety practices related to the maintenance of precision measuring and layout tools	identify hazards pertaining to the maintenance of precision measuring and layout tools
		describe safe work practices pertaining to the maintenance of precision measuring and layout tools

RANGE OF VARIABLES

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

layout tools include: straightedges, squares, combination sets, surface plates, scribes, hermaphrodite calipers, dividers, trammels, prick and centre punches, angle plates, parallels, v-blocks, surface gauges, layout dye

TASK A-6 Performs cutting and welding operations

TASK DESCRIPTOR

Industrial mechanics (millwrights) use welding and cutting equipment to heat, repair and fabricate components.

A-6.01 Cuts material using oxy-fuel and plasma arc equipment

Apprenticeship Level	1
Essential Skills	Reading, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-6.01.01L	demonstrate knowledge of oxy-fuel equipment and accessories	define terminology associated with oxy-fuel cutting
		identify types of oxy-fuel cutting equipment and accessories and describe their applications
		interpret jurisdictional regulations pertaining to oxy-fuel cutting
A-6.01.02L	demonstrate knowledge of the procedures used to cut with oxy-fuel equipment	describe the procedures used to set up, adjust and shut down oxy-fuel equipment
		describe the procedures used to inspect and maintain oxy-fuel equipment
		describe the procedures used to cut materials using oxy-fuel equipment
		describe the procedures used to prepare materials using oxy-fuel equipment
A-6.01.03L	demonstrate knowledge of safety practices related to oxy-fuel cutting	identify hazards and describe safe work practices pertaining to oxy-fuel cutting
A-6.01.04L	demonstrate knowledge of procedures used for plasma arc cutting	define terminology associated with plasma arc cutting
		interpret jurisdictional regulations pertaining to plasma arc cutting
		interpret information pertaining to plasma arc cutting found on drawings and specifications
		describe the plasma arc cutting process and its applications
A-6.01.05L	demonstrate knowledge of plasma arc equipment and accessories	describe the procedures used to prepare materials when plasma arc cutting
		identify plasma arc equipment and accessories and describe their applications

		describe the procedures used to set up, adjust and shut down plasma arc equipment
		describe the procedures used to inspect and maintain plasma arc equipment
A-6.01.06L	demonstrate knowledge of safety practices related to plasma arc cutting	identify hazards and describe safe work practices pertaining to plasma arc cutting

RANGE OF VARIABLES

hazards include: personal, shop/facility, equipment, ventilation, storage

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

A-6.02 Joins material using oxy-fuel welding equipment

Apprenticeship Level	1
Essential Skills	Reading, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-6.02.01L	demonstrate knowledge of oxy-fuel equipment and accessories	define terminology associated with oxy-fuel heating and welding
		interpret jurisdictional regulations pertaining to oxy-fuel heating, welding, brazing and soldering
		identify types of oxy-fuel heating, welding, brazing and soldering equipment and accessories and describe their applications
A-6.02.02L	demonstrate knowledge of the procedures used to heat, weld, solder and braze with oxy-fuel equipment	describe the procedures used to set up , adjust and shut down oxy-fuel equipment
		describe the procedures used to inspect and maintain oxy-fuel equipment
		describe the procedures used to heat, weld, braze and solder materials using oxy-fuel equipment
A-6.02.03L	demonstrate knowledge of safety practices related to oxy-fuel heating, welding, brazing and soldering	identify hazards and describe safe work practices pertaining to oxy-fuel heating, welding, brazing and soldering

RANGE OF VARIABLES

oxy-fuel includes: liquid petroleum gas, acetylene, oxygen

set up includes: adjusting flame characteristics (carburizing, neutral and oxidizing), assembling equipment, adjusting pressures

hazards include: personal, shop/facility, equipment, ventilation, storage

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

A-6.03 Welds material using shielded metal arc welding (SMAW) equipment

Apprenticeship Level	2
Essential Skills	Reading, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-6.03.01L	demonstrate knowledge of shielded metal arc welding (SMAW) equipment and accessories	define terminology associated with SMAW
		interpret jurisdictional regulations pertaining to SMAW
		interpret information pertaining to SMAW found on drawings and specifications
A-6.03.02L	demonstrate knowledge of procedures used to weld using SMAW equipment	identify SMAW equipment, consumables and accessories, and describe their applications
		describe the SMAW process and its applications
		describe the procedures used to set up and adjust SMAW equipment
		identify the types of welds performed using SMAW equipment
		identify welding positions and describe their applications
A-6.03.03L	demonstrate knowledge of safety practices related to SMAW	describe the procedures used to weld using SMAW equipment
		describe weld defects, their causes and prevention
		identify hazards and describe safe work practices pertaining to SMAW

RANGE OF VARIABLES

hazards include: personal, shop/facility, equipment, ventilation sparks, radiation, ultraviolet light, storage
safe work practices include: use of PPE, following confined space procedures, obtaining required permits

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

Apprenticeship Level	2
Essential Skills	Reading, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-6.04.01L	demonstrate knowledge of gas metal arc welding (GMAW) equipment and accessories	define terminology associated with GMAW
		interpret jurisdictional regulations pertaining to GMAW
		interpret information pertaining to GMAW found on drawings and specifications
		identify GMAW equipment, consumables and accessories, and describe their applications
A-6.04.02L	demonstrate knowledge of the procedures used to weld with GMAW equipment	describe the GMAW process and its applications
		describe the procedures used to set up, adjust and shut down GMAW equipment
		identify welding positions and describe their applications
		describe the procedures used to weld using GMAW equipment
A-6.04.03L	demonstrate knowledge of safety practices related to GMAW	describe weld defects, their causes and prevention
		identify hazards and describe safe work practices pertaining to GMAW

RANGE OF VARIABLES

hazards include: personal, shop/facility, equipment, ventilation
safe work practices include: use of PPE, following confined space procedures, obtaining required permits

A-6.05**Welds material with gas tungsten arc welding (GTAW) equipment (NOT COMMON CORE)****Apprenticeship Level**

2

Essential Skills

Reading, Document Use, Working with Others

KNOWLEDGE**Learning Outcomes****Learning Objectives**

A-6.05.01L	demonstrate knowledge of gas tungsten arc welding (GTAW) equipment and accessories	define terminology associated with the GTAW process
		identify the types of welds performed using GTAW equipment
		interpret jurisdictional regulations pertaining to GTAW
		interpret information pertaining to the GTAW process found on drawings and specifications
A-6.05.02L	demonstrate knowledge of the procedures used to weld with GTAW equipment	identify GTAW equipment, consumables and accessories, and describe their applications
		describe the procedures used to set up, adjust and shut down GTAW equipment
		describe the procedures used to weld using GTAW equipment
		identify welding positions and describe their applications
A-6.05.03L	demonstrate knowledge of safety practices related to the GTAW process	describe weld defects, their causes and prevention
		identify hazards and describe safe work practices pertaining to the GTAW process

RANGE OF VARIABLES

hazards include: personal, shop/facility, equipment, ventilation, sparks, radiation, ultraviolet light, storage

safe work practices include: use of PPE, following confined space procedures, obtaining required permits

A-6.06**Maintains welding equipment****Apprenticeship Level**

1

Essential Skills

Reading, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-6.06.01L	demonstrate knowledge of different types of welding equipment and accessories	identify types of welding equipment and describe their applications and procedures
		identify types of oxy-fuel cutting, heating, welding, brazing and soldering equipment and accessories and describe their applications
		identify SMAW equipment, consumables and accessories , and describe their applications
		identify GMAW equipment, consumables and accessories , and describe their applications
		identify GTAW equipment, consumables and accessories , and describe their applications
A-6.06.02L	demonstrate knowledge of the procedures used to maintain welding equipment	describe the procedures used to inspect, maintain and repair oxy-fuel equipment
		describe the procedures used to inspect, maintain and repair SMAW equipment
		describe the procedures used to inspect, maintain and repair GMAW equipment
		describe the procedures used to inspect, maintain and repair GTAW equipment
A-6.06.03L	demonstrate knowledge of safety practices related to the maintenance of welding equipment	identify hazards and describe safe work practices pertaining to the maintenance of welding equipment

RANGE OF VARIABLES**accessories** include: flashback arrestors, fire extinguishers, emergency shut-off switches**hazards** include: personal, shop/facility, equipment, ventilation, storage**safe work practices** include: use of PPE, safe disposal of fuels, lock-out and tag-out

MAJOR WORK ACTIVITY B

Performs rigging, hoisting/lifting and moving

TASK B-7 Plans rigging, hoisting/lifting and moving

TASK DESCRIPTOR

Industrial mechanics (millwrights) determine load and select appropriate rigging, hoisting/lifting and moving equipment to ensure proper and safe lifts of machinery. For the purpose of this task, lifts include hoisting, lifting and moving of equipment, materials and components.

B-7.01	Determines load
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Apprenticeship Level	1,2,3,4
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Essential Skills	Numeracy, Working with Others, Thinking
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KNOWLEDGE		
	Learning Outcomes	Learning Objectives
B-7.01.01L	demonstrate knowledge of rigging, hoisting/lifting and moving equipment, their applications, limitations and procedures for use	define terminology associated with rigging, hoisting/lifting and moving
		interpret jurisdictional regulations pertaining to rigging, hoisting/lifting and moving
		identify types of rigging equipment and accessories, and describe their applications, limitations and procedures
		identify types of hoisting and lifting equipment and accessories, and describe their applications, limitations and procedures
		identify types of moving equipment and accessories, and describe their applications, limitations and procedures

B-7.01.02L	demonstrate knowledge of calculations required when performing hoisting and lifting operations	identify the factors to consider when selecting rigging, hoisting/lifting and moving equipment
		describe the procedures used to determine the weight and weight distribution of loads

RANGE OF VARIABLES

factors include: weight (dry or wet), material, dimensions, sling angles, centre of gravity, environmental conditions

procedures used to determine the weight and weight distribution of loads include: reference load charts, determine types of loads, engineered lifts

B-7.02 Selects rigging equipment

Apprenticeship Level	1,2,3,4
Essential Skills	Document Use, Numeracy, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
A-7.02.01L	demonstrate knowledge of rigging equipment, its applications, limitations and procedures	define terminology associated with rigging equipment
		interpret jurisdictional regulations pertaining to rigging equipment
		identify types of rigging equipment and accessories, and describe their applications, limitations and procedures
A-7.02.02L	demonstrate knowledge of the procedures used to rig material or equipment for lifting	identify the factors to consider when selecting rigging equipment
		describe the procedures used to rig material or equipment for lifting
A-7.02.03L	demonstrate knowledge of safety practices related to rigging equipment	identify hazards and describe safe work practices pertaining to rigging equipment

RANGE OF VARIABLES

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations, hazard identification

B-7.03**Selects hoisting/ lifting and moving equipment**

Apprenticeship Level	1,2,3,4
Essential Skills	Numeracy, Thinking, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-7.03.01L	demonstrate knowledge of hoisting/lifting and moving equipment, their applications, limitations and procedures	define terminology associated with hoisting/lifting and moving equipment
		interpret jurisdictional regulations pertaining to hoisting/lifting and moving equipment
		identify types of hoisting/lifting equipment and accessories, and describe their applications, limitations and procedures
		describe inspection requirements for hoisting/lifting and moving equipment and accessories
		identify types of moving equipment and accessories, and describe their applications, limitations and procedures
		explain sling angle when preparing for hoisting/lifting operations
		identify the factors to consider when selecting hoisting/lifting and moving equipment
B-7.03.02L	demonstrate knowledge of safety practices related to hoisting/lifting and moving equipment	identify hazards and describe safe work practices pertaining to hoisting/lifting and moving equipment
		identify hazards and describe safe work practices pertaining to mobile and overhead cranes

RANGE OF VARIABLES

factors include: weight (dry or wet), material, dimensions, sling angles, centre of gravity, environmental conditions

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations, hazard identification

B-7.04**Secures area**

Apprenticeship Level	1,2,3,4
Essential Skills	Oral Communication, Writing, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-7.04.01L	demonstrate knowledge of rigging, hoisting/lifting and moving equipment, their applications, limitations and procedures	define terminology associated with rigging, hoisting/lifting and moving equipment
		interpret jurisdictional regulations pertaining to rigging, hoisting/lifting and moving equipment
		identify types of rigging equipment and accessories, and describe their applications, limitations and procedures
		identify types of hoisting and lifting equipment and accessories, and describe their applications, limitations and procedures
		identify types of moving equipment and accessories, and describe their applications, limitations and procedures
		describe the <i>procedures used to ensure the work area is safe for lifting</i>
B-7.04.02L	demonstrate knowledge of safety practices related to rigging, hoisting/lifting and moving operations	identify hazards and describe <i>safe work practices</i> pertaining to rigging, hoisting/lifting and moving
		identify hazards and describe <i>safe work practices</i> pertaining to mobile and overhead cranes

RANGE OF VARIABLES

procedures used to ensure the work area is safe for lifting include: barriers installed and tagged, assessment of ground conditions, non-congestion of the work area, approach limits, obtain required permits

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations, hazard identification

TASK B-8 Rigs, hoists/lifts and moves load

TASK DESCRIPTOR

Rigging, hoisting/lifting and moving loads are hazardous activities and care must be taken to ensure the safety of all personnel and prevent damage to equipment. Industrial mechanics (millwrights) must be skilled in the proper procedures for rigging, hoisting, lifting, drifting, dragging (using rollers) loads.

B-8.01 Sets up rigging, hoisting/lifting and moving equipment

Apprenticeship Level	1,2,3,4
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.01.01L	demonstrate knowledge of rigging, hoisting/lifting and moving equipment, their applications, limitations and procedures	define terminology associated with rigging, hoisting/lifting and moving equipment
		interpret jurisdictional regulations pertaining to rigging, hoisting/lifting and moving
		identify types of rigging equipment and accessories, and describe their applications, limitations and procedures
		identify types of hoisting and lifting equipment and accessories, and describe their applications, limitations and procedures
		identify types of moving equipment and accessories, and describe their applications, limitations and procedures
B-8.01.02L	demonstrate knowledge of the procedures used to perform rigging, hoisting/lifting and moving operations	identify types of knots, hitches and bends, and describe their applications
		describe the procedures used to rig material or equipment for hoisting/lifting and moving operations
		explain sling angle when preparing for rigging, hoisting/lifting and moving operations

B-8.01.03L	demonstrate knowledge of safety practices related to rigging, hoisting/lifting and moving operations	identify hazards and describe safe work practices pertaining to rigging, hoisting/lifting and moving equipment
		identify hazards and describe safe work practices pertaining to mobile and overhead cranes

RANGE OF VARIABLES

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations, hazard identification

B-8.02 Performs hoist/lift and move

Apprenticeship Level	1,2,3,4
Essential Skills	Oral Communication, Working with Others, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.02.01L	demonstrate knowledge of hoisting/lifting and moving equipment, their applications, limitations and procedures	define terminology associated with hoisting/lifting and moving
		interpret jurisdictional regulations pertaining to hoisting/lifting and moving
		identify types of hoisting and lifting equipment and accessories, and describe their applications, limitations and procedures
		identify types of moving equipment and accessories, and describe their applications, limitations and procedures
B-8.02.02L	demonstrate knowledge of the procedures used to perform hoisting/lifting and moving operations	describe the procedures used to perform a lift
B-8.02.03L	demonstrate knowledge of the use of standard hand signals	describe procedures used to communicate during hoisting/lifting and moving operations
		perform standard hand signals
B-8.02.04L	demonstrate knowledge of calculations required when performing hoisting/lifting and moving operations	describe the procedures used to determine the weight and weight distribution of loads

B-8.02.05L	demonstrate knowledge of safety practices related to hoisting/lifting and moving operations	identify hazards and describe safe work practices pertaining to hoisting/lifting and moving operations
		identify hazards and describe safe work practices pertaining to mobile and overhead cranes

RANGE OF VARIABLES

procedures used to perform a lift include: planning, environment analysis, load determination, communication methods, pre-lift checks, placement of load, post-lift inspection, supervision of lift, securing work area

procedures used to communicate include: verbal, radio, visual (hand signals)

procedures used to determine the weight and weight distribution of loads include: reference load charts, determine types of loads, engineered lifts, engineered drawings, nameplates, calculations, scales

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations, hazard identification

B-8.03 Maintains rigging, hoisting/lifting and moving equipment

Apprenticeship Level	1,2,3,4
Essential Skills	Thinking, Document Use, Writing

KNOWLEDGE

	Learning Outcomes	Learning Objectives
B-8.03.01L	demonstrate knowledge of rigging, hoisting/lifting and moving equipment, their applications, limitations and procedures	define terminology associated with rigging, hoisting/lifting and moving equipment
		interpret jurisdictional regulations pertaining to rigging, hoisting/lifting and moving equipment
		identify types of rigging equipment and accessories, and describe their applications, limitations and procedures
		identify types of hoisting and lifting equipment and accessories, and describe their applications, limitations and procedures
		identify types of moving equipment and accessories, and describe their applications, limitations and procedures
B-8.03.02L	demonstrate knowledge of the procedures used to maintain rigging, hoisting/lifting and moving equipment	describe the procedures used to inspect, maintain and store rigging, hoisting/lifting and moving equipment

B-8.03.03L	demonstrate knowledge of safety practices related to rigging, hoisting/lifting and moving equipment	identify hazards and describe safe work practices pertaining to rigging, hoisting/lifting and moving
		identify hazards and describe safe work practices pertaining to mobile and overhead cranes

RANGE OF VARIABLES

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations, hazard identification

MAJOR WORK ACTIVITY C

Services mechanical power transmission components and systems

TASK C-9 Services prime movers

TASK DESCRIPTOR

Prime movers are the driver of the mechanical system and include equipment such as electric motors, turbines (for example wind, water, gas or steam) and internal combustion engines. They must be installed correctly and maintained properly to provide optimum power and torque to the driven systems and to ensure reliability of the prime mover. Servicing includes installing, diagnosing, maintaining and repairing.

C-9.01 Installs prime movers

Apprenticeship Level	4
Essential Skills	Numeracy, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-9.01.01L	demonstrate knowledge of prime movers , their components and operation	define terminology associated with prime movers identify types of prime movers and their components and accessories, and describe their purpose, applications and operation
C-9.01.02L	demonstrate knowledge of safety practices related to prime movers	identify hazards and describe safe work practices associated with prime movers interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of prime movers
C-9.01.03L	demonstrate knowledge of the procedures used to install prime movers	identify tools and equipment used to install prime movers and describe their applications and procedures describe the procedures used to install prime movers and their components

RANGE OF VARIABLES

prime movers include: electric motors, turbines (for example wind, water, gas or steam), internal combustion engines

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

C-9.02 Diagnoses prime movers

Apprenticeship Level 4

Essential Skills Thinking, Oral Communication, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-9.02.01L	demonstrate knowledge of prime movers , their components and operation	define terminology associated with prime movers
		identify types of prime movers and their components and accessories, and describe their purpose, applications and operation
C-9.02.02L	demonstrate knowledge of safety practices related to prime movers	identify hazards and describe safe work practices associated with prime movers
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of prime movers
C-9.02.03L	demonstrate knowledge of the procedures used to diagnose prime movers	identify tools and equipment used to diagnose prime movers and describe their applications and procedures
		describe the procedures used to inspect prime movers and their components
		describe the procedures used to diagnose prime movers and their components
		identify the factors to consider when determining if prime movers need to be repaired or replaced

RANGE OF VARIABLES

prime movers include: electric motors, turbines (for example wind, water, gas or steam), internal combustion engines

components include: couplings, sheaves, sprockets, gear boxes, drive shafts, drive belts, chain drives, fluid drives, bearings

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

C-9.03**Maintains prime movers**

Apprenticeship Level

4

Essential Skills

Thinking, Working with Others, Document Use

KNOWLEDGE**Learning Outcomes****Learning Objectives**

C-9.03.01L	demonstrate knowledge of prime movers , their components and operation	define terminology associated with prime movers
		identify types of prime movers and their components and accessories, and describe their purpose, applications and operation
C-9.03.02L	demonstrate knowledge of safety practices related to prime movers	identify hazards and describe safe work practices associated with prime movers
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of prime movers
C-9.03.03L	demonstrate knowledge of the procedures used to maintain prime movers	identify tools and equipment used to maintain prime movers and describe their applications and procedures
		identify the factors to consider when determining if prime movers or their components need to be repaired or replaced
		describe the procedures used to maintain prime movers and their components

RANGE OF VARIABLES

prime movers include: electric motors, turbines (for example wind, water, gas or steam), internal combustion engines

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

C-9.04**Repairs prime movers**

Apprenticeship Level

4

Essential Skills

Thinking, Working with Others, Document Use

KNOWLEDGE**Learning Outcomes****Learning Objectives**

C-9.04.01L	demonstrate knowledge of prime movers , their components and operation	define terminology associated with prime movers identify types of prime movers and their components and accessories, and describe their purpose, applications and operation
C-9.04.02L	demonstrate knowledge of safety practices related to prime movers	identify hazards and describe safe work practices associated with prime movers interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of prime movers
C-9.04.03L	demonstrate knowledge of the procedures used to repair prime movers	identify tools and equipment used to repair prime movers and describe their applications and procedures identify the factors to consider when determining if prime movers or their components need to be repaired or replaced describe the procedures used to repair prime movers and their components

RANGE OF VARIABLES

prime movers include: electric motors, turbines (for example wind, water, gas or steam), internal combustion engines

components include: housings, machine guarding, collars, covers, safety controls

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: torque wrenches, dial indicators, precision levels, optical or laser alignment equipment, piano wire, sound mic, hand tools

TASK C-10 Services shafts, bearings and seals

TASK DESCRIPTOR

Shafts transmit power and torque from the prime mover to the driven equipment. Bearings maintain the shaft centerline and allow rotary or linear shaft movement with minimal friction. Seals prevent contamination of other components and ensure lubrication and coolant containment. Servicing includes installing, diagnosing, maintaining and repairing these components.

C-10.01 Installs shafts, bearings and seals

Apprenticeship Level	2
Essential Skills	Document Use, Numeracy, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-10.01.01L	demonstrate knowledge of shafts, bearings and seals , their components and operation	define terminology associated with shafts, bearings and seals
		identify types of shafts, bearings and seals and their components and accessories, and describe their purpose, applications and operation
C-10.01.02L	demonstrate knowledge of safety practices related to shafts, bearings and seals	identify hazards and describe safe work practices associated with shafts, bearings and seals
C-10.01.03L	demonstrate knowledge of the procedures used to install shafts, bearings and seals	identify tools and equipment used with shafts, bearings and seals and describe their applications and procedures
		describe the procedures used to install shafts, bearings and seals and their components

RANGE OF VARIABLES

shafts include: drive, counter, jack, hollow, shaft accessories (keys, pins, taper bushings, retaining rings, adapter and withdrawal sleeves)

bearings include: plain (friction), anti-friction (rolling element)

seals include: static, dynamic, mechanical, non-contacting (labyrinth/annulus)

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

C-10.02 Diagnoses shafts, bearings and seals

Apprenticeship Level	2
Essential Skills	Oral Communication, Thinking, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-10.02.01L	demonstrate knowledge of shafts, bearings and seals , their components and operation	define terminology associated with shafts, bearings and seals identify types of shafts, bearings and seals and their components and accessories, and describe their purpose, applications and operation
C-10.02.02L	demonstrate knowledge of safety practices related to shafts, bearings and seals	identify hazards and describe safe work practices associated with shafts, bearings and seals
C-10.02.03L	demonstrate knowledge of the procedures used to diagnose shafts, bearings and seals	identify tools and equipment used with shafts, bearings and seals and describe their applications and procedures describe the procedures used to inspect shafts, bearings and seals and their components describe the procedures used to diagnose shafts, bearings and seals and their components identify the factors to consider when determining if shafts, bearings and seals need to be repaired or replaced

RANGE OF VARIABLES

shafts include: drive, counter, jack, hollow, shaft accessories (keys, pins, taper bushings, retaining rings, adapter and withdrawal sleeves)

bearings include: plain (friction), anti-friction (rolling element)

seals include: static, dynamic, mechanical, non-contacting (labyrinth/annulus)

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

C-10.03 Maintains shafts, bearings and seals

Apprenticeship Level	2
Essential Skills	Oral Communication, Thinking, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-10.03.01L	demonstrate knowledge of shafts, bearings and seals , their components and operation	define terminology associated with shafts, bearings and seals
		identify types of shafts, bearings and seals and their components and accessories, and describe their purpose, applications and operation
C-10.03.02L	demonstrate knowledge of safety practices related to shafts, bearings and seals	identify hazards and describe safe work practices associated with shafts, bearings and seals
C-10.03.03L	demonstrate knowledge of the procedures used to maintain shafts, bearings and seals	identify tools and equipment used to maintain shafts, bearings and seals and describe their applications and procedures
		identify the factors to consider when determining if shafts, bearings and seals or their components need to be repaired or replaced
		describe the procedures used to maintain shafts, bearings and seals and their components

RANGE OF VARIABLES

shafts include: drive, counter, jack, hollow shaft accessories (keys, pins, taper bushings, retaining rings, adapter and withdrawal sleeves)

bearings include: plain (friction), anti-friction (rolling element)

seals include: static, dynamic, mechanical, non-contacting (labyrinth/annulus)

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

C-10.04 Repairs shafts, bearings and seals

Apprenticeship Level	2
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-10.04.01L	demonstrate knowledge of shafts, bearings and seals , their components and operation	define terminology associated with shafts, bearings and seals
		identify types of shafts, bearings and seals and their components and accessories, and describe their purpose, applications and operation
C-10.04.02L	demonstrate knowledge of safety practices related to shafts, bearings and seals	identify hazards and describe safe work practices associated with shafts, bearings and seals
C-10.04.03L	demonstrate knowledge of the procedures used to repair shafts, bearings and seals	identify tools and equipment used to repair shafts, bearings and seals and describe their applications and procedures
		identify the factors to consider when determining if shafts, bearings and seals or their components need to be repaired or replaced
		describe the procedures used to repair shafts, bearings and seals and their components

RANGE OF VARIABLES

shafts include: drive, counter, jack, hollow

shaft accessories include: keys, pins, taper bushings, retaining rings, sleeves

bearings include: plain (friction), anti-friction (rolling element)

seals include: static, dynamic, mechanical, non-contacting (labyrinth/annulus)

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

TASK C-11 Services couplings, clutches and brakes

TASK DESCRIPTOR

Couplings transfer torque, power, and rotary and linear motion from one shaft to another. Clutches allow engagement and disengagement of power and torque. Brakes slow or stop the motion. They must be installed correctly and maintained properly to provide optimum power and torque to the driven systems and to ensure reliability. Servicing includes installing, diagnosing, maintaining and repairing.

C-11.01 Installs couplings, clutches and brakes

Apprenticeship Level	2
Essential Skills	Document Use, Thinking, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-11.01.01L	demonstrate knowledge of <i>couplings, clutches</i> and <i>brakes</i> , their components and operation	define terminology associated with <i>couplings, clutches</i> and <i>brakes</i>
		identify types of <i>couplings, clutches</i> and <i>brakes</i> , their components and accessories, and describe their purpose, applications and operation
C-11.01.02L	demonstrate knowledge of safety practices related to <i>couplings, clutches</i> and <i>brakes</i>	identify hazards and describe <i>safe work practices</i> associated with <i>couplings, clutches</i> and <i>brakes</i>
C-11.01.03L	demonstrate knowledge of the procedures used to remove and install <i>couplings, clutches</i> and <i>brakes</i>	interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of <i>couplings, clutches</i> and <i>brakes</i>
		identify <i>tools and equipment</i> used to install <i>couplings, clutches</i> and <i>brakes</i> and describe their applications and procedures
		describe the procedures used to remove and install <i>couplings, clutches</i> and <i>brakes</i> and their components

RANGE OF VARIABLES

couplings include: rigid, elastomeric, grid, mechanical, fluid

clutches include: overrunning, friction, positive contact, fluid, electromagnetic

brakes include: friction, fluid/wet disc, electromagnetic

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: torque wrenches, feeler gauges, straight edges, micrometers, calipers, presses, pullers, laser alignment equipment, hand tools, dial indicators

C-11.02 Diagnoses couplings, clutches and brakes

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.02.01L	demonstrate knowledge of couplings, clutches and brakes , their components and operation	define terminology associated with couplings, clutches and brakes
		identify types of couplings, clutches and brakes , their components and accessories, and describe their purpose, applications and operation
C-11.02.02L	demonstrate knowledge of safety practices related to couplings, clutches and brakes	identify hazards and describe safe work practices associated with couplings, clutches and brakes
C-11.02.03L	demonstrate knowledge of the procedures used to diagnose couplings, clutches and brakes	interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of couplings, clutches and brakes
		identify tools and equipment used to diagnose couplings, clutches and brakes and describe their applications and procedures
		describe the procedures used to inspect couplings, clutches and brakes and their components
		identify the factors to consider when determining if couplings, clutches and brakes need to be repaired or replaced

RANGE OF VARIABLES

couplings include: rigid, elastomeric, grid, mechanical, fluid

clutches include: overruning, friction, positive contact, fluid, electromagnetic

brakes include: friction, fluid/wet disc, electromagnetic

tools and equipment include: vernier calipers, feeler gauges, taper gauges, thermal imaging equipment, laser alignment equipment, strobe light, dial indicators

C-11.03 Maintains couplings, clutches and brakes

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Writing

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.03.01L	demonstrate knowledge of couplings, clutches and brakes , their components and operation	define terminology associated with couplings, clutches and brakes
		identify types of couplings, clutches and brakes , their components and accessories, and describe their purpose, applications and operation
C-11.03.02L	demonstrate knowledge of safe work practices related to couplings, clutches and brakes	identify hazards and describe safe work practices associated with couplings, clutches and brakes
C-11.03.03L	demonstrate knowledge of the procedures used to maintain couplings, clutches and brakes	interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of couplings, clutches and brakes
		identify tools and equipment used to maintain couplings, clutches and brakes and describe their applications and procedures
		identify the factors to consider when determining if couplings, clutches and brakes their components need to be repaired or replaced
		describe the procedures used to maintain couplings, clutches and brakes and their components

RANGE OF VARIABLES

couplings include: rigid, elastomeric, grid, mechanical, fluid

clutches include: overrunning, friction, positive contact, fluid, electromagnetic

brakes include: friction, fluid/wet disc, electromagnetic

coupling, clutch and brake components include: springs, grids, elastomeric elements, friction pads, diaphragms

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: micrometers, hydraulic rams, pullers, torque wrenches, dial indicators, vernier calipers, laser alignment equipment, hand tools

C-11.04 Repairs couplings, clutches and brakes

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Writing

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-11.04.01L	demonstrate knowledge of couplings, clutches and brakes , their components and operation	define terminology associated with couplings, clutches and brakes
		identify types of couplings, clutches and brakes , their components and accessories, and describe their purpose, applications and operation
C-11.04.02L	demonstrate knowledge of safe work practices related to couplings, clutches and brakes	identify hazards and describe safe work practices associated with couplings, clutches and brakes
C-11.04.03L	demonstrate knowledge of the procedures used to repair couplings, clutches and brakes	interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of couplings, clutches and brakes
		identify tools and equipment used to repair couplings, clutches and brakes and describe their applications and procedures
		identify the factors to consider when determining if couplings, clutches and brakes or their components need to be repaired or replaced
		describe the procedures used to repair couplings, clutches and brakes and their components

RANGE OF VARIABLES

couplings include: rigid, elastomeric, grid, mechanical, fluid

clutches include: overruning, friction, positive contact, fluid, electromagnetic

brakes include: friction, fluid/wet disc, electromagnetic

safe work practices include: company policies and procedures, jurisdictional regulations

coupling, clutch and brake components include: springs, grids, elastomeric elements, friction pads, diaphragms

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: micrometers, hydraulic rams, pullers, torque wrenches, dial indicators, vernier calipers, laser alignment equipment, hand tools

TASK C-12 Services chain and belt drive systems

TASK DESCRIPTOR

Chain and belt drive systems may be a component of a larger power transmission system. They transmit power and motion from one shaft to another and may be used to increase or reduce speed. Proper installation, alignment and maintenance are key to increasing the reliability of the system. Servicing includes installing, diagnosing, maintaining and repairing.

C-12.01 Installs chain and belt drive systems

Apprenticeship Level	2
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-12.01.01L	demonstrate knowledge of chain and belt drive systems , their components and operation	define terminology associated with chain and belt drive systems
		identify types of chain and belt drive systems and their components and accessories, and describe their purpose, applications and operation
C-12.01.02L	demonstrate knowledge of safety practices related to chain and belt drive systems	identify hazards and describe safe work practices associated with chain and belt drive systems
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of chain and belt drive systems
C-12.01.03L	demonstrate knowledge of the procedures used to install and align chain and belt drive systems	identify tools and equipment used to install and align chain and belt drive systems and describe their applications and procedures
		describe the procedures used to install chain and belt drive systems and their components
C-12.01.04L	demonstrate knowledge of formulae and calculations pertaining to chain and belt drive systems	identify the factors to consider and required calculations to determine chain and belt drive systems requirements
		identify formulae and perform calculations

RANGE OF VARIABLES

chain drive systems include: roller, silent, composite, lube free

belt drive systems include: v-belt, cog belt, timing, flat belt

specifications include: torque, horsepower, loads, temperatures, rpm, shaft angles (incline or flat)

tools and equipment include: presses, tensioners, chain breakers, ropes, pullers, torque wrenches, straight edges, parallel shaft alignment tools, hand tools, belt tensioning tools

formulae include: belt/chain lengths, speed and torque ratios, belt tension

safety devices include: light curtains, pressure sensitive matting, keyed switches, lock-outs, physical guards, shear pins

components include: sprockets and sheaves, taper bushing, link (half link, off-set)

C-12.02 Diagnoses chain and belt drive systems

Apprenticeship Level	2
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-12.02.01L	demonstrate knowledge of chain and belt drive systems , their components and operation	define terminology associated with chain and belt drive systems
		identify types of chain and belt drive systems and their components and accessories, and describe their purpose, applications and operation
C-12.02.02L	demonstrate knowledge of safety practices related to chain and belt drive systems	identify hazards and describe safe work practices associated with chain and belt drive systems
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of chain and belt drive systems
C-12.02.03L	demonstrate knowledge of the procedures used to diagnose chain and belt drive systems	identify tools and equipment used to diagnose chain and belt drive systems and describe their applications and procedures
		describe the procedures used to inspect and diagnose chain and belt drive systems and their components
		identify the factors to consider when determining if chain and belt drive systems need to be repaired or replaced

C-12.02.04L	demonstrate knowledge of formulae and calculations pertaining to chain and belt drive systems	identify the factors to consider and required calculations to determine chain and belt drive systems requirements
		identify formulae and perform calculations

RANGE OF VARIABLES

chain drive systems include: roller, silent, composite, lube free, sprockets

belt drive systems include: v-belt, cog belt, timing, flat belt, sheaves

components include: sprockets and sheaves, taper bushing, link (half link, off-set)

tools and equipment include: straight edges, parallel shaft alignment tools, condition-based monitoring tools, hand tools, belt tensioning tools

formulae include: belt/chain lengths, speed and torque ratios, belt tension

C-12.03 Maintains chain and belt drive systems

Apprenticeship Level	2
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-12.03.01L	demonstrate knowledge of chain and belt drive systems , their components and operation	define terminology associated with chain and belt drive systems
		identify types of chain and belt drive systems , their components , accessories, and describe their purpose, applications and operation
C-12.03.02L	demonstrate knowledge of safety practices related to chain and belt drive systems	identify hazards and describe safe work practices associated with chain and belt drive systems
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of chain and belt drive systems
C-12.03.03L	demonstrate knowledge of the procedures used to maintain chain and belt drive systems	identify tools and equipment used to maintain chain and belt drive systems and describe their applications and procedures
		identify the factors to consider when determining if chain and belt drive systems or their components need to be repaired, replaced or re-aligned
		describe the procedures used to maintain chain and belt drive systems and their components

		identify formulae and perform calculations
C-12.03.04L	demonstrate knowledge of formulae and calculations pertaining to chain and belt drive systems	identify the factors to consider and required calculations to determine chain and belt drive systems requirements
		identify formulae and perform calculations

RANGE OF VARIABLES

chain drive systems include: roller, silent, composite, lube free

belt drive systems include: v-belt, cog belt, timing, flat belt

components include: sprockets and sheaves, taper bushing, link (half link, off-set)

formulae include: belt/chain lengths, speed and torque ratios, belt tension

C-12.04 Repairs chain and belt drive systems

Apprenticeship Level	2
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-12.04.01L	demonstrate knowledge of chain and belt drive systems , their components and operation	define terminology associated with chain and belt drive systems
		identify types of chain and belt drive systems and their components and accessories, and describe their purpose, applications and operation
C-12.04.02L	demonstrate knowledge of safety practices related to chain and belt drive systems	identify hazards and describe safe work practices associated with chain and belt drive systems
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of chain and belt drive systems
C-12.04.03L	demonstrate knowledge of the procedures used to repair chain and belt drive systems	identify tools and equipment used to repair chain and belt drive systems and describe their applications and procedures
		identify the factors to consider when determining if chain and belt drive systems or their components need to be repaired or replaced
		describe the procedures used to repair chain and belt drive systems and their components

		identify formulae and perform calculations
C-12.04.04L	demonstrate knowledge of formulas and calculations pertaining to chain and belt drive systems	identify the factors to consider and required calculations to determine chain and belt drive systems requirements
		identify formulae and perform calculations

RANGE OF VARIABLES

chain drive systems include: roller, silent, composite, lube free

belt drive systems include: v-belt, cog belt, timing, flat belt, high torque drive (HTD)

components include: sprockets and sheaves, taper bushing, link (half link, off-set)

formulae include: belt/chain lengths, speed and torque ratios, belt tension

TASK C-13 Services gear systems

TASK DESCRIPTOR

Gear systems transmit torque, power, and rotary and linear movement from one component to another and may be used to increase or reduce speed and change rotational direction. Gear systems are used when there is a need for greater versatility such as speed control, shaft orientation and timing requirements. Servicing includes installing, diagnosing, maintaining and repairing.

C-13.01 Installs gear systems

Apprenticeship Level	2
Essential Skills	Numeracy, Working with Others, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-13.01.01L	demonstrate knowledge of gears and gear drives , their components and operation	define terminology associated with gears and gear drives
		identify types of gears and gear drives and their components and accessories, and describe their purpose, applications and operation
C-13.01.02L	demonstrate knowledge of safety practices related to gears and gear drives	identify hazards and describe safe work practices associated with gears and gear drives
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of gears and gear drives

C-13.01.03L	demonstrate knowledge of the procedures used to install and align gears and gear drives	identify tools and equipment used to install gears and gear drives and describe their applications and procedures
		describe the procedures used to install and align gears and gear drives and their components
C-13.01.04L	demonstrate knowledge of gear engagement procedures	identify tools and equipment used to set backlash and tooth contact
		describe the procedures used to set backlash and tooth contact
C-13.01.05L	demonstrate knowledge of formulae and calculations pertaining to gears and gear drives	identify the factors to consider and required calculations to determine gears and gear drives requirements
		identify formulae and perform calculations

RANGE OF VARIABLES

gears include: spur, bevel, spiral, herringbone, helical, worm

gear drives include: planetary, worm, parallel shaft, crown and pinion, rack and pinion

tools and equipment include: presses, hydraulic jacks, torque wrenches, jacks, alignment tools, mechanics' blue, plasti-gauge, dial indicators, calipers, micrometers, hand tools, strobe lights

formulae include: diametrical pitch, pitch diameter, gear ratios

C-13.02 Diagnoses gear systems

Apprenticeship Level	2
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-13.02.01L	demonstrate knowledge of gears and gear drives , their components and operation	define terminology associated with gears and gear drives
		identify types of gears and gear drives and their components and accessories, and describe their purpose, applications and operation
C-13.02.02L	demonstrate knowledge of safety practices related to gears and gear drives	identify hazards and describe safe work practices associated with gears and gear drives
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of gears and gear drives

C-13.02.03L	demonstrate knowledge of the procedures used to diagnose gears and gear drives	identify tools and equipment used to diagnose gears and gear drives and describe their applications and procedures
		describe the procedures used to inspect gears and gear drives and their components
		describe the procedures used to diagnose gears and gear drives and their components
		identify the factors to consider when determining if gears, gear drives or their components need to be repaired or replaced
C-13.02.04L	demonstrate knowledge of formulae and calculations pertaining to gears and gear drives	identify the factors to consider and required calculations to determine gears and gear drives requirements
		identify formulae and perform calculations

RANGE OF VARIABLES

gears include: spur, bevel, spiral, herringbone, helical, worm

gear drives include: planetary, worm, parallel shaft, crown and pinion

factors include: condition-based monitoring reports (worn bearings, gear pass frequency, tribology)

formulae include: diametrical pitch, pitch diameter, gear ratios

C-13.03 Maintains gear systems

Apprenticeship Level	2
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-13.03.01L	demonstrate knowledge of gears and gear drives , their components and operation	define terminology associated with gears and gear drives
		identify types of gears and gear drives and their components and accessories, and describe their purpose, applications and operation
C-13.03.02L	demonstrate knowledge of safety practices related to gears and gear drives	identify hazards and describe safe work practices associated with gears and gear drives

		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of gears and gear drives
C-13.03.03L	demonstrate knowledge of the procedures used to maintain gears and gear drives	identify tools and equipment used to maintain gears and gear drives and describe their applications and procedures
		identify the factors to consider when determining if gears and gear drives or their components need to be repaired or replaced
		describe the procedures used to maintain gears and gear drives and their components
C-13.03.04L	demonstrate knowledge of formulae and calculations pertaining to gears and gear drives	identify the factors to consider and required calculations to determine gears and gear drives requirements
		identify formulae and perform calculations

RANGE OF VARIABLES

gears include: spur, bevel, spiral, herringbone, helical, worm

gear drives include: planetary, worm, parallel shaft, crown and pinion, rack and pinion

tools and equipment include: dial indicators, feeler gauges, laser alignment tool, micrometer, plasti-gauge, mechanics' blue, lead wire, hand tools

factors include: condition-based monitoring reports (worn bearings, tribology, gear pass frequency)

formulae include: diametrical pitch, pitch diameter, gear ratios

C-13.04 Repairs gear systems

Apprenticeship Level 2

Essential Skills Working with Others, Thinking, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-13.04.01L	demonstrate knowledge of gears and gear drives , their components and operation	define terminology associated with gears and gear drives
		identify types of gears and gear drives and their components and accessories, and describe their purpose, applications and operation
C-13.04.02L	demonstrate knowledge of safety practices related to gears and gear drives	identify hazards and describe safe work practices associated with gears and gear drives

		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of gears and gear drives
C-13.04.03L	demonstrate knowledge of the procedures used to repair gears and gear drives	identify tools and equipment used to repair gears and gear drives and describe their applications and procedures
		identify the factors to consider when determining if gears and gear drives or their components need to be repaired or replaced
		describe the procedures used to repair gears and gear drives and their components
C-13.04.04L	demonstrate knowledge of formulae and calculations pertaining to gears and gear drives	identify the factors to consider and required calculations to determine gears and gear drives requirements
		identify formulae and perform calculations

RANGE OF VARIABLES

gears include: spur, bevel, spiral, herringbone, helical, worm

gear drives include: planetary, worm, parallel shaft, crown and pinion, rack and pinion

tools and equipment include: torque wrenches, jacks, alignment tools, feeler gauges, mechanics' blue, plasti-gauge, hand tools

factors include: condition-based monitoring reports (worn bearings, tribology, gear pass frequency)

TASK C-14 Performs shaft alignment procedures

TASK DESCRIPTOR

Alignment procedures are performed to ensure the three dimensional geometry and increase the operating lifespan of rotating equipment. For the purpose of this standard, this task only addresses shaft collinear alignment as the rotational alignment of equipment is performed throughout their respective installation and maintenance tasks.

C-14.01 Performs rough alignment

Apprenticeship Level	2
Essential Skills	Thinking, Document Use, Oral Communication

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
C-14.01.01L	demonstrate knowledge of shaft alignment	define terminology associated with shaft alignment methods
		identify tools and equipment used for shaft alignment methods , and describe their applications and procedures
		describe the procedures used to determine shaft misalignment
C-14.01.02L	demonstrate knowledge of the procedures used to align shafts	identify the types of rough alignment methods and describe their applications and limitations
		describe the procedures used to calculate shims for hot or cold alignment
		describe the procedures used to align shafts using the straight edge and feeler gauge method
C-14.01.03L	demonstrate knowledge of safety practices related to shaft alignment	identify hazards and describe safe work practices pertaining to shaft alignment

RANGE OF VARIABLES

shaft alignment is **only** collinear alignment

shaft alignment methods include: rough, dial, laser

procedures include: pre-alignment checks, selecting tools and equipment, making adjustments

C-14.02 Performs dial alignment

Apprenticeship Level	2,3
Essential Skills	Numeracy, Document Use, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-14.02.01L	demonstrate knowledge of shaft alignment	define terminology associated with shaft alignment methods
		identify tools and equipment used for dial alignment methods , and describe their applications and procedures
		describe the procedures used to determine shaft misalignment
C-14.02.02L	demonstrate knowledge of the procedures used to align shafts by methods	identify the types of dial alignment methods and describe their applications and limitations
		describe the procedures used to calculate shims for hot or cold alignment
		describe the procedures used to align shafts using the dial alignment methods
C-14.02.03L	demonstrate knowledge of safety practices related to shaft alignment	identify hazards and describe safe work practices pertaining to shaft alignment

RANGE OF VARIABLES

shaft alignment methods include: rough, dial, laser, optical alignment

dial alignment tools include: mag bases, dial indicators, contact points, feeler gauges, straightedges, tape measure

procedures include: doing pre-alignment checks, selecting tools and equipment, performing calculations, making adjustments

dial alignment methods include: rim and face, reverse dial, cross dial

C-14.03 Performs laser alignment

Apprenticeship Level	3
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
C-14.03.01L	demonstrate knowledge of shaft alignment	define terminology associated with shaft alignment methods
		identify tools and equipment used for shaft alignment methods , and describe their applications and procedures
		describe the procedures used to determine shaft misalignment
C-14.03.02L	demonstrate knowledge of the procedures used to align shafts	identify the types of laser alignment methods and describe their applications and limitations
		describe the procedures used to calculate shims for hot or cold alignment
		describe the procedures used to align shafts using the laser methods
C-14.03.03L	demonstrate knowledge of safety practices related to shaft alignment	identify hazards and describe safe work practices pertaining to shaft alignment

RANGE OF VARIABLES

shaft alignment methods include: rough, dial, laser

procedures include: doing pre-alignment checks, selecting tools and equipment, performing calculations, making adjustments

MAJOR WORK ACTIVITY D

Services material handling / process systems

TASK D-15 Services robotics and automated equipment

TASK DESCRIPTOR

Robotics and automated equipment are machines that can be used in dangerous environments, under heavy loads, high repetition in manufacturing processes. They include a wide range of components and sub-components designated by type of movement (degrees of freedom after application), application (manufacturing process), architecture (serial or parallel), and brand. They must be installed correctly and maintained properly to provide specialized automated services. Servicing includes installing, diagnosing, maintaining and repairing.

D-15.01 Installs robotics and automated equipment

Apprenticeship Level	4
Essential Skills	Thinking, Numeracy, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-15.01.01L	demonstrate knowledge of robotics and automated equipment , their components and operation	define terminology associated with robotics and automated equipment identify classifications for robotics and automated equipment and their components , and auxiliary equipment , and describe their purpose, applications and operation
D-15.01.02L	demonstrate knowledge of safety practices related to robotics and automated equipment	identify hazards and describe safe work practices associated with robotics and automated equipment interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of robotics and automated equipment

D-15.01.03L	demonstrate knowledge of the procedures used to install robotics and automated equipment	identify tools and equipment used to install robotics and automated equipment and describe their applications and procedures
		describe the procedures used to install robotics and automated equipment and their components

RANGE OF VARIABLES

robotics include: 3-axis, 6-axis, 7-axis, end of arm tooling (EOAT), grippers and effectors, SCARA, side entry

automated equipment includes: equipment for various processes (pick and place, welding, material handling, palletizing, painting, measuring, assembly, packing, warehousing)

components include: servo motors, fluid power hoses and pistons, sensors, encoders

classifications for robotics and automated equipment include: type of movement (degrees of freedom after application), application (manufacturing process), architecture (serial or parallel), brand

auxiliary equipment includes: wire feeders, articulating fingers, filtering systems

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: rigging and hoisting equipment, hand tools, alignment tools

D-15.02 Diagnoses robotics and automated equipment

Apprenticeship Level	4
Essential Skills	Digital Technology, Thinking, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-15.02.01L	demonstrate knowledge of robotics and automated equipment , their components and operation	define terminology associated with robotics and automated equipment identify classifications for robotics and automated equipment and their components and describe their purpose, applications and operation
D-15.02.02L	demonstrate knowledge of safety practices related to robotics and automated equipment	identify hazards and describe safe work practices associated with robotics and automated equipment interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of robotics and automated equipment
D-15.02.03L	demonstrate knowledge of the procedures used to diagnose robotics and automated equipment	identify tools and equipment used to maintain robotics and automated equipment and describe their applications and procedures

	describe the procedures used to inspect robotics and automated equipment and their components
	describe the procedures used to diagnose robotics and automated equipment and their components
	identify the factors to consider when determining if robotics and automated equipment need to be repaired or replaced

RANGE OF VARIABLES

robotics include: 3-axis, 6-axis, 7-axis, end of arm tooling (EOAT), grippers and effectors, SCARA, side entry

automated equipment includes: equipment for various processes (pick and place, welding, material handling, palletizing, painting, measuring, assembly, packing, warehousing)

components include: servo motors, fluid power hoses and cylinders, sensors, encoders, transducers

classifications for robotics and automated equipment include: type of movement (degrees of freedom after application), application (manufacturing process), architecture (serial or parallel), brand

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: (varies based on the size and type of robotic equipment) rigging and hoisting equipment, hand tools, alignment tools

D-15.03 Maintains robotics and automated equipment

Apprenticeship Level	4
Essential Skills	Digital Technology, Numeracy, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-15.03.01L	demonstrate knowledge of robotics and automated equipment , their components and operation	define terminology associated with robotics and automated equipment identify classifications for robotics and automated equipment and their components , and describe their purpose, applications and operation
D-15.03.02L	demonstrate knowledge of safety practices related to robotics and automated equipment	identify hazards and describe safe work practices associated with robotics and automated equipment interpret jurisdictional regulations, site and manufacturers' specifications pertaining to the use of robotics and automated equipment

D-15.03.03L	demonstrate knowledge of the procedures used to maintain and diagnose robotics and automated equipment	identify tools and equipment used to maintain robotics and automated equipment and describe their applications and procedures
		identify the factors to consider when determining if robotics and automated equipment or their components need to be repaired or replaced
		describe the procedures used to maintain robotics and automated equipment and their components
		describe the procedures used to diagnose robotics and automated equipment and their components

RANGE OF VARIABLES

robotics include: 3-axis, 6-axis, 7-axis, end of arm tooling (EOAT), grippers and effectors, SCARA, side entry

automated equipment includes: equipment for various processes (pick and place, welding, material handling, palletizing, painting, measuring, assembly, packing, warehousing)

classifications for robotics and automated equipment include: type of movement (degrees of freedom after application), application (manufacturing process), architecture (serial or parallel), brand

components include: servo motors, fluid power hoses and pistons, sensors, encoders

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

auxiliary equipment includes: wire feeders, articulating fingers, filtering systems

D-15.04 Repairs robotics and automated equipment

Apprenticeship Level	4
Essential Skills	Numeracy, Thinking, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-15.04.01L	demonstrate knowledge of robotics and automated equipment , their components and operation	define terminology associated with robotics and automated equipment
		identify classifications for robotics and automated equipment and their components , and describe their purpose, applications and operation
D-15.04.02L	demonstrate knowledge of safety practices related to robotics and automated equipment	identify hazards and describe safe work practices associated with robotics and automated equipment

		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of robotics and automated equipment
D-15.04.03L	demonstrate knowledge of the procedures used to repair robotics and automated equipment	identify tools and equipment used to repair robotics and automated equipment and describe their applications and procedures
		identify the factors to consider when determining if robotics and automated equipment or their components need to be repaired or replaced
		describe the procedures used to repair robotics and automated equipment and their components

RANGE OF VARIABLES

robotics include: 3-axis, 6-axis, 7-axis, end of arm tooling (EOAT), grippers and effectors, SCARA, side entry

automated equipment includes: equipment for various processes (pick and place, welding, material handling, palletizing, painting, measuring, assembly, packing, warehousing)

classifications for robotics and automated equipment include: type of movement (degrees of freedom after application), application (manufacturing process), architecture (serial or parallel), brand

components include: servo motors, fluid power hoses and pistons, sensors, encoders

safe work practices include: zero-energy state, immobilization and isolation procedures

tools and equipment include: (varies based on the size and type of robotic equipment) rigging and hoisting equipment, hand tools, alignment tools

factors include: component lifecycle, time, fatigue, maintenance history

TASK D-16 Services fans and blowers

TASK DESCRIPTOR

Fans move air and material from various sources such as fresh air, and heating and cooling applications. Blowers supply pressurized air to transfer product such as woodchips, waste, exhaust gases and dust. The failure of fans and blowers can result in safety issues and lost productivity when not installed, maintained and repaired properly. Servicing includes installing, diagnosing, maintaining and repairing.

D-16.01 Installs fans and blowers

Apprenticeship Level	3
Essential Skills	Document Use, Thinking, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-16.01.01L	demonstrate knowledge of fans and blowers, their components and operation	define terminology associated with fans and blowers
D-16.01.02L	demonstrate knowledge of safe work practices related to fans and blowers	identify hazards and describe safe work practices pertaining to fans and blowers
D-16.01.03L	demonstrate knowledge of the procedures used to remove and install fans and blowers	interpret jurisdictional regulations and manufacturers' specifications pertaining to fans and blowers
		identify tools and equipment used to remove and install fans and blowers, and describe their applications and procedures
		identify types of fans and blower systems, and describe their components and operation
		identify types of fan blades and describe their applications
		describe the procedures used to remove and install fans and blowers
		describe the procedures used to regulate output for fans and blowers
		describe the procedures used to balance fans and blowers

RANGE OF VARIABLES

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: hand tools, dial indicators, precision levels, optical or laser alignment equipment, hydraulic rams, rigging/lifting equipment

D-16.02 Diagnoses fans and blowers

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-16.02.01L	demonstrate knowledge of fans and blowers, their components and operation	define terminology associated with fans and blowers
D-16.02.02L	demonstrate knowledge of safe work practices related to fans and blowers	identify hazards and describe safe work practices pertaining to fans and blowers
D-16.02.03L	demonstrate knowledge of the procedures used to diagnose fans and blowers	interpret jurisdictional regulations and manufacturers' specifications pertaining to fans and blowers
		identify tools and equipment used to diagnose fans and blowers, and describe their applications and procedures
		identify types of fans and blower systems, and describe their components and operation
		identify types of fan blades and describe their applications
		describe the procedures used to diagnose fans and blowers
		describe the procedures used to inspect fans and blowers
		identify the factors to consider when determining if fans and blowers need to be repaired or replaced

RANGE OF VARIABLES

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: hand tools, dial indicators, precision levels, optical or laser alignment equipment, hydraulic rams, rigging/lifting equipment

D-16.03 Maintains fans and blowers

Apprenticeship Level	3
Essential Skills	Document Use, Thinking, Writing

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-16.03.01L	demonstrate knowledge of fans and blowers, their components and operation	define terminology associated with fans and blowers
D-16.03.02L	demonstrate knowledge of safe work practices related to fans and blowers	identify hazards and describe safe work practices pertaining to fans and blowers
D-16.03.03L	demonstrate knowledge of the procedures used to maintain fans and blowers	interpret jurisdictional regulations and manufacturers' specifications pertaining to fans and blowers
D-16.03.04L	demonstrate knowledge of the procedures used to maintain fans and blowers	identify tools and equipment used to maintain fans and blowers, and describe their applications and procedures
		identify types of fans and blower systems, and describe their components and operation
		identify types of fan blades and describe their applications
		describe the procedures used to maintain fans and blowers
		identify the factors to consider when determining if fans and blowers need to be repaired or replaced
		describe the procedures used to regulate output for fans and blowers
		describe the procedures used to balance fans and blowers

RANGE OF VARIABLES

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: tachometers, thermal imaging equipment, laser alignment equipment, strobe light

D-16.04 Repairs fans and blowers

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-16.04.01L	demonstrate knowledge of fans and blowers, their components and operation	define terminology associated with fans and blowers, their components and operation
D-16.04.02L	demonstrate knowledge of safe work practices related to fans and blowers	identify hazards and describe safe work practices pertaining to fans and blowers
D-16.04.03L	demonstrate knowledge of the procedures used to maintain fans and blowers, and their components	interpret jurisdictional regulations and manufacturers' specifications pertaining to fans and blowers, and their components
D-16.04.04L	demonstrate knowledge of the procedures used to maintain fans and blowers, and their components	identify tools and equipment used to repair fans and blowers, and their components, and describe their applications and procedures
		identify types of fans and blower systems, and describe their components and operation
		identify types of fan blades and describe their applications
		identify the factors to consider when determining if fans and blowers need to be repaired or replaced
		describe the procedures used to repair fans and blowers
		describe the procedures used to regulate output for fans and blowers
		describe the procedures used to balance fans and blowers

RANGE OF VARIABLES

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: laser alignment equipment, strobe light, hand tools, rigging and lifting/hoisting equipment

TASK D-17 Services pumps

TASK DESCRIPTOR

Pumps are used to move fluid and other media by positive or non-positive displacement. Proper and safe servicing practices ensure machine reliability and efficiency. This task includes installation, diagnosis, repair and maintenance of pumps. Servicing includes installing, diagnosing, maintaining and repairing.

D-17.01 Installs pumps

Apprenticeship Level	3
Essential Skills	Numeracy, Digital Technology, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-17.01.01L	demonstrate knowledge of pumps , their components and operation	define terminology associated with pumps
		identify types of pumps and their components and accessories, and describe their purpose, applications and operation
		identify the types of seals and gaskets and describe their applications
D-17.01.02L	demonstrate knowledge of safety practices related to pumps	explain the method used to interpret pump curves
		identify hazards and describe safe work practices associated with pumps and their components and accessories
D-17.01.03L	demonstrate knowledge of the procedures used to remove and install pumps	interpret jurisdictional regulations, site and manufacturers' specifications pertaining to the use of pumps
		identify tools and equipment used to remove and install pumps and describe their applications and procedures
		describe the procedures used to remove and install pumps and their components and accessories

RANGE OF VARIABLES

pumps include: non-positive (centrifugal), positive displacement (reciprocating), API pumps

components include: filters, gaskets, wear sleeves, seals, impeller, shafts, wear rings, stuffing box assembly, rotating assembly, bearings

seals include: packings, O-Rings, mechanical seal, V-rings

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: hand tools, levelling and alignment tools, measuring tools, monitoring equipment, rigging and hoisting equipment, manual for troubleshooting

D-17.02 Diagnoses pumps

Apprenticeship Level 3

Essential Skills Thinking, Oral Communication, Digital Technology

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-17.02.01L	demonstrate knowledge of pumps , their components and operation	define terminology associated with pumps
		identify types of pumps and their components and accessories, and describe their purpose, applications and operation
		identify the types of seals and gaskets and describe their applications
		explain the method used to interpret pump curves
D-17.02.02L	demonstrate knowledge of safety practices related to pumps	identify hazards and describe safe work practices associated with pumps
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of pumps
D-17.02.03L	demonstrate knowledge of the procedures used to diagnose pumps	identify tools and equipment used to diagnose pumps and describe their applications and procedures
		describe the procedures used to inspect pumps and their components
		describe the procedures used to diagnose pumps and their components
		identify the factors to consider when determining if pumps need to be repaired or replaced

RANGE OF VARIABLES

pump includes: non-positive (centrifugal), positive displacement (reciprocating)

components include: filters, gaskets, wear sleeves, seals, impeller, shafts, wear rings, stuffing box assembly, rotating assembly, bearings

seals include: packings, O-Rings, mechanical seal, V-rings

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-17.03 Maintains pumps

Apprenticeship Level 3

Essential Skills Thinking, Working with Others, Digital Technology

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-17.03.01L	demonstrate knowledge of pumps , their components and operation	define terminology associated with pumps
		identify types of pumps and their components and accessories, and describe their purpose, applications and operation
		identify the types of seals and gaskets and describe their applications
		explain the method used to interpret pump curves
D-17.03.02L	demonstrate knowledge of safety practices related to pumps	identify hazards and describe safe work practices associated with pumps
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of pumps
D-17.03.03L	demonstrate knowledge of the procedures used to maintain pumps	identify tools and equipment used to maintain pumps and describe their applications and procedures
		identify the factors to consider when determining if pumps or their components need to be repaired or replaced
		components describe the procedures used to maintain pumps and their components

RANGE OF VARIABLES

pump includes: non-positive (centrifugal), positive displacement (reciprocating)

components include: filters, gaskets, wear sleeves, seals, impeller, shafts, wear rings, stuffing box assembly, rotating assembly, bearings

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-17.04 Repairs pumps

Apprenticeship Level 3

Essential Skills Working with Others, Thinking, Digital Technology

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-17.04.01L	demonstrate knowledge of pumps , their components and operation	define terminology associated with pumps
		identify types of pumps and their components and accessories, and describe their purpose, applications and operation
		identify the types of seals and gaskets and describe their applications
D-17.04.02L	demonstrate knowledge of safety practices related to pumps	explain the method used to interpret pump curves
		identify hazards and describe safe work practices associated with pumps
D-17.04.03L	demonstrate knowledge of the procedures used to repair pumps	interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of pumps
		identify tools and equipment used to repair pumps and describe their applications and procedures
		identify the factors to consider when determining if pumps or their components need to be repaired or replaced
		describe the procedures used to repair pumps and their components

RANGE OF VARIABLES

pump includes: non-positive (centrifugal), positive displacement (reciprocating)

components include: filters, gaskets, wear sleeves, seals, impeller, shafts, wear rings, stuffing box assembly, rotating assembly, bearings

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

repair includes: rebuild pump, replace components of pump, replace auxiliary components of pump, align pump

TASK D-18 Services compressors

TASK DESCRIPTOR

Compressors are used to supply air or other gases at an increased pressure. The failure of compressors can result in safety issues and lost productivity when not installed, repaired and maintained properly. Servicing includes installing, diagnosing, maintaining and repairing.

D-18.01 Installs compressors

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-18.01.01L	demonstrate knowledge of compressors , their components and operation	define terminology associated with compressors
		identify classifications and types of compressors
D-18.01.02L	demonstrate knowledge of safety practices related to compressors	identify hazards and describe safe work practices associated with compressors
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of compressors
D-18.01.03L	demonstrate knowledge of the procedures used to remove, install and align compressors	identify tools and equipment used to install compressors and describe their applications and procedures
		describe the procedures used to remove, install and align compressors and their components

RANGE OF VARIABLES

compressors include: dynamic/centrifugal, positive displacement (reciprocating, radial, screw, vane)

components include: filters, pressure relief valves, temperature controllers, regulators, unloading valve

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: straight edge, hand tools, impact wrenches, dial indicators, precision levels, optical or laser alignment equipment, rigging/lifting equipment, grouting equipment

D-18.02 Diagnoses compressors

Apprenticeship Level 3

Essential Skills Reading, Thinking, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-18.02.01L	demonstrate knowledge of compressors , their components and operation	define terminology associated with the operation of compressors and their components
		identify compressors , their components and accessories , and describe their purpose and operation
		describe the procedure to diagnose compressors and their components
D-18.02.02L	demonstrate knowledge of safety practices related to compressors and their components	identify hazards and describe safe work practices associated with compressors and their components
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of compressors and their components
D-18.02.03L	demonstrate knowledge of the procedures used to diagnose compressors and their components	identify tools and equipment used to diagnose compressors and their components and describe their applications and procedures
		describe the procedures used to inspect compressors and their components
		describe the procedures used to diagnose compressors and their components
		identify the factors to consider when determining if compressors and their components need to be repaired or replaced

RANGE OF VARIABLES

compressors include: dynamic/centrifugal, positive displacement (reciprocating, radial, screw, vane)

components include: temperature gauges, sheaves, piping, valves, bearings, belts, filters, pressure relief valves, temperature controllers, regulators, unloading valve

accessories include: silencers, filters, air dryers, lubricators, scrubbers

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

factors include: condition-based monitoring reports (worn bearings, oil analysis, vibration analysis, temperature analysis), Reliability Centered Maintenance (RCM)

D-18.03 Maintains compressors

Apprenticeship Level 3

Essential Skills Document use, Thinking, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-18.03.01L	demonstrate knowledge of compressors, their components and operation	define terminology associated with compressors and their components
		identify compressors, their components and accessories, and describe their purpose, applications and operation
		describe the procedure to repair compressors and their components
D-18.03.02L	demonstrate knowledge of safety practices related to compressors and their components	identify hazards and describe safe work practices associated with compressors and their components
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of compressors and their components
D-18.03.03L	demonstrate knowledge of the procedures used to maintain, diagnose and repair compressors and their components	identify tools and equipment used to maintain compressors and their components and describe their applications and procedures
		identify the factors to consider when determining if compressors or their components need to be repaired or replaced
		describe the procedures used to maintain compressors and their components

describe the procedures used to diagnose compressors and their **components**

describe the procedures used to repair compressors and their **components**

RANGE OF VARIABLES

components include: filters, pressure relief valves, temperature controllers, regulators, unloading valve

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: tachometers, alignment tools, wrenches

factors include: condition-based monitoring reports (worn bearings, oil analysis, vibration analysis, temperature analysis), RCM

D-18.04 Repairs compressors

Apprenticeship Level 3

Essential Skills Document Use, Thinking, Numeracy

KNOWLEDGE

Learning Outcomes

Learning Objectives

D-18.04.01L demonstrate knowledge of compressors, their **components** and operation

define terminology associated with compressors and their **components**

identify compressors, their **components** and **accessories**, and describe their purpose, applications and operation

describe the procedure to repair compressors and their **components**

D-18.04.02L demonstrate knowledge of safety practices related to compressors and their **components**

identify hazards and describe **safe work practices** associated with compressors and their **components**

interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of compressors and their **components**

D-18.04.03L demonstrate knowledge of the procedures used to repair compressors and their **components**

identify **tools and equipment** used to repair compressors and their **components** and describe their applications and procedures

identify the **factors** to consider when determining if compressors or their **components** need to be repaired or replaced

describe the procedures used to repair compressors and their **components**

RANGE OF VARIABLES

components include: filters, pressure relief valves, temperature controllers, regulators, unloading valve

accessories include: silencers, air dryers, lubricators, scrubbers

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: rigging/hoisting equipment, plasti-gauge, blueing, measuring tools, tachometers, alignment tools, wrenches

factors include: condition-based monitoring reports (worn bearings, oil analysis, vibration analysis, temperature analysis)

TASK D-19 Services process piping, tanks and containers

TASK DESCRIPTOR

Process piping, tanks and containers are usually used to transport, store and mix materials. Tanks and containers may be pressurized or open to atmosphere. This task includes installation, diagnosis, maintenance and repair of process tanks and containers such as bins and hoppers, and process piping. Servicing includes installing, diagnosing, maintaining and repairing.

D-19.01 Installs process tanks and containers

Apprenticeship Level

3

Essential Skills

Document Use, Numeracy, Reading

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-19.01.01L	demonstrate knowledge of process tanks and containers , their components and application	define terminology associated with process tanks and containers
		identify types of process tanks and containers and their components and accessories, and describe their purpose, applications and operation
D-19.01.02L	demonstrate knowledge of safety practices related to process tanks and containers	identify hazards and describe safe work practices associated with process tanks and containers
D-19.01.03L	demonstrate knowledge of the procedures used to remove and install	interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of process tanks and containers and their components
D-19.01.03L	demonstrate knowledge of the procedures used to install process tanks and containers	identify tools and equipment used with process tanks and containers and describe their applications and procedures

		describe the procedures used to install process tanks and containers and their components
D-19.01.04L	demonstrate knowledge of the procedures used to test and inspect process tanks and containers and their components	describe the procedures used to test and inspect process tanks and containers and their components

RANGE OF VARIABLES

process tanks and containers include: bins, hoppers, receivers, thickeners, reservoirs, storage tanks
components include: agitators, impellers, scrapers, mixers, spargers, level indicators, skimmers, valves
safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-19.02 Installs process piping

Apprenticeship Level	3
Essential Skills	Document Use, Working with Others, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-19.02.01L	demonstrate knowledge of process piping , components and application	define terminology associated with process piping identify types of process piping and their components and accessories, and describe their purpose, applications and operation
D-19.02.02L	demonstrate knowledge of safety practices related to process piping	identify hazards and describe safe work practices associated with process piping
D-19.02.03L	demonstrate knowledge of the procedures used to remove and install	interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of process piping and their components
D-19.02.04L	demonstrate knowledge of the procedures used to remove and install process piping	identify tools and equipment used to install process piping and describe their applications and procedures describe the procedures used to remove and install process piping and their components
D-19.02.05L	demonstrate knowledge of the procedures used to test and inspect process piping and their components	describe the procedures used to test and inspect process piping and their components

RANGE OF VARIABLES

process piping includes: ABS [acrylonitrile butadiene styrene], HDPE [high-density polyethylene], PVC [polyvinyl chloride], stainless, composite, carbon steel, tubing, copper

process piping components include: fittings, valves, strainers, gaskets, connectors

hazards include: residual materials, pressure, heat, weight, acidic (caustic/corrosive) level of product (pH), cyanide, poisonous substances

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-19.03 Diagnoses process tanks and containers

Apprenticeship Level 3

Essential Skills Thinking, Document Use, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-19.03.01L	demonstrate knowledge of process tanks and containers , their components and operation	define terminology associated with process tanks and containers
		identify types of process tanks and containers and their components and accessories, and describe their purpose, applications and operation
D-19.03.02L	demonstrate knowledge of safety practices related to process tanks and containers	identify hazards and describe safe work practices associated with process tanks and containers
D-19.03.03L	demonstrate knowledge of the procedures used to diagnose	interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of process tanks and containers
D-19.03.04L	demonstrate knowledge of the procedures used to diagnose process tanks and containers	identify tools and equipment used to diagnose process tanks and containers and their components , describe their applications and procedures
		describe the procedures used to diagnose process tanks and containers and their components
		identify the factors to consider when determining if process tanks and containers and their components need to be repaired or replaced

RANGE OF VARIABLES

process tanks and containers include: bins, hoppers, receivers, thickeners, reservoirs, storage tanks

process tanks and container components include: agitators, impellers, scrapers, mixers, spargers, level indicators, skimmers, valves

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-19.04 Diagnoses process piping

Apprenticeship Level

3

Essential Skills

Thinking, Document Use, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-19.04.01L	demonstrate knowledge of process piping , their components and operation	define terminology associated with process piping identify types of process piping and their components and accessories, and describe their purpose, applications and operation
D-19.04.02L	demonstrate knowledge of safety practices related to diagnosing process piping	identify hazards and describe safe work practices associated with diagnosing process piping interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of process piping
D-19.04.03L	demonstrate knowledge of the procedures used to diagnose process piping	identify tools and equipment used to diagnose process piping and describe their applications and procedures describe the procedures used to diagnose process piping and their components identify the factors to consider when determining if process piping needs to be repaired or replaced

RANGE OF VARIABLES

process piping includes: ABS [acrylonitrile butadiene styrene], HDPE [high-density polyethylene], PVC [polyvinyl chloride], stainless, composite, carbon steel, tubing, copper

process piping components include: fittings, valves, strainers, gaskets, connectors

hazards include: residual materials, pressure, heat, weight, acidic (caustic/corrosive) level of product (pH), cyanide, poisonous substances

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-19.05 Maintains process tanks and containers

Apprenticeship Level	3
Essential Skills	Document Use, Thinking, Reading

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-19.05.01L	demonstrate knowledge of process tanks and containers , their components and operation	define terminology associated with process tanks and containers identify types of process tanks and containers and their components and accessories, and describe their purpose, applications and operation
D-19.05.02L	demonstrate knowledge of safety practices related to process tanks and containers	identify hazards and describe safe work practices associated with process tanks and containers
D-19.05.03L	demonstrate knowledge of the procedures used to maintain and repair	interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of process tanks and containers
D-19.05.04L	demonstrate knowledge of the procedures used to maintain process tanks and containers	identify tools and equipment used to maintain process tanks and containers and describe their applications and procedures identify the factors to consider when determining if process tanks and containers or their components need to be repaired or replaced describe the procedures used to maintain process tanks and containers and their components

RANGE OF VARIABLES

process tanks and containers include: bins, hoppers, receivers, thickeners, reservoirs, storage tanks

process tanks and container components include: agitators, impellers, scrapers, mixers, spargers, level indicators, skimmers, valves

hazards include: residual materials, pressure, heat, weight, acidic (caustic/corrosive) level of product (pH), cyanide, poisonous substances

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-19.06 Maintains process piping

Apprenticeship Level	3
Essential Skills	Document Use, Thinking, Oral Communication

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-19.06.01L	demonstrate knowledge of process piping , their components and operation	<p>define terminology associated with process piping</p> <p>identify types of process piping and their components and accessories, and describe their purpose, applications and operation</p> <p>identify process piping supports and describe their purpose, applications and operation</p>
D-19.06.02L	demonstrate knowledge of safety practices related to process piping	<p>identify hazards and describe safe work practices associated with process piping</p> <p>interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of process piping</p>
D-19.06.03L	demonstrate knowledge of the procedures used to maintain process piping	<p>identify tools and equipment used to maintain process piping and describe their applications and procedures</p> <p>identify the factors to consider when determining if process piping or their components need to be repaired or replaced</p> <p>describe the procedures used to maintain process piping and their components</p>

RANGE OF VARIABLES

process piping includes: ABS [acrylonitrile butadiene styrene], HDPE [high-density polyethylene], PVC [polyvinyl chloride], stainless, composite, carbon steel, tubing, copper

process piping components include: fittings, valves, strainers, gaskets, connectors

supports include: stands, hangers, brackets

hazards include: residual materials, pressure, heat, weight, acidic (caustic/corrosive) level of product (pH), cyanide, poisonous substances, confined spaces

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-19.07 Repairs process tanks and containers

Apprenticeship Level	3
Essential Skills	Thinking, Working with Others, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-19.07.01L	demonstrate knowledge of process tanks and containers their components and operation	define terminology associated with process tanks and containers identify types of process tanks and containers and their components and accessories, and describe their purpose, applications and operation
D-19.07.02L	demonstrate knowledge of safety practices related to process tanks and containers	identify hazards and describe safe work practices associated with process tanks and containers interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of tanks and containers
D-19.07.03L	demonstrate knowledge of the procedures used to repair process tanks and containers	identify tools and equipment used to repair process tanks and containers and describe their applications and procedures identify the factors to consider when determining if process tanks and containers or their components need to be repaired or replaced describe the procedures used to repair process tanks and containers and their components

RANGE OF VARIABLES

process tanks and containers include: bins, hoppers, receivers, thickeners, reservoirs, storage tanks

process tanks and containers components include: agitators, impellers, scrapers, mixers, spargers, level indicators, skimmers, valves, manholes

hazards include: residual materials, pressure, heat, weight, acidic (caustic/corrosive) level of product (pH), cyanide, poisonous substances, confined spaces

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: layout, levelling tools, lifting and moving equipment

D-19.08 Repairs process piping

Apprenticeship Level	3
Essential Skills	Thinking, Working with Others, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-19.08.01L	demonstrate knowledge of process piping , their components and operation	define terminology associated with process piping identify types of process piping and their components and accessories, and describe their purpose, applications and operation identify process piping supports and describe their purpose, applications and operation
D-19.08.02L	demonstrate knowledge of safety practices related to process piping	identify hazards and describe safe work practices associated with process piping and the removal of process piping interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of process piping
D-19.08.03L	demonstrate knowledge of the procedures used to repair process piping	identify tools and equipment used to repair process piping and describe their applications and procedures identify the factors to consider when determining if process piping or their components need to be repaired or replaced describe the procedures used to repair process piping and their components

RANGE OF VARIABLES

process piping includes: ABS [acrylonitrile butadiene styrene], HDPE [high-density polyethylene], PVC [polyvinyl chloride], stainless, composite, carbon steel, tubing, copper

supports include: stands, hangers, brackets

hazards include: residual materials, pressure, heat, weight, acidic (caustic/corrosive) level of product (pH), cyanide, poisonous substances

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: layout, levelling tools, lifting and moving equipment

TASK D-20 Services conveying systems

TASK DESCRIPTOR

Conveying systems are used to transfer products safely and efficiently. Servicing includes installing, diagnosing, maintaining and repairing of conveying systems.

D-20.01 Installs conveying systems

Apprenticeship Level	4
Essential Skills	Numeracy, Thinking, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
D-20.01.01L	demonstrate knowledge of conveying systems , their components and operation	define terminology associated with conveying systems
		identify types of conveying systems and their components and accessories, and describe their purpose, applications and operation
D-20.01.02L	demonstrate knowledge of safety practices related to conveying systems	identify hazards and describe safe work practices associated with conveying systems
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of conveying systems
D-20.01.03L	demonstrate knowledge of the procedures used to install conveying systems	identify tools and equipment used to install conveying systems and describe their applications and procedures
		describe the procedures used to install conveying systems and their components
		identify the factors to consider and required calculations to determine conveying system requirements
		describe the procedures used to splice a conveyor belt

RANGE OF VARIABLES

conveying systems include: pneumatic, belt, rollers, chain, screw, bucket, flume/water

conveying system components include: bearings, pulleys, rollers, gear reduction units, take-ups, scrapers

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-20.02 Diagnoses conveying systems

Apprenticeship Level 4

Essential Skills Thinking, Document Use, Oral Communication

KNOWLEDGE**Learning Outcomes****Learning Objectives**

D-20.02.01L demonstrate knowledge of **conveying systems**, their **components** and operation

define terminology associated with **conveying systems**identify types of **conveying systems** and their **components** and accessories, and describe their purpose, applications and operation

D-20.02.02L demonstrate knowledge of safety practices related to **conveying systems**

identify hazards and describe **safe work practices** associated with **conveying systems**

interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of **conveying systems**

D-20.02.03L demonstrate knowledge of the procedures used to diagnose **conveying systems**

identify **tools and equipment** used to diagnose **conveying systems** and describe their applications and procedures

describe the procedures used to inspect **conveying systems** and their **components**

describe the procedures used to diagnose **conveying systems** and their **components**

identify the factors to consider when determining if **conveying systems** needs to be repaired or replaced

identify the factors to consider and required calculations to determine **conveying system** requirements

describe the procedures used to splice a conveyor belt

RANGE OF VARIABLES

conveying systems include: pneumatic, belt, rollers, chain, screw, bucket, flume/water

components include: limit switches, gear reduction units, emergency stops, couplings, magnets, pulleys, rollers, bearings, sheaves, sprockets, chains and belts

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

tools and equipment include: hand tools, gauges, levelling and alignment equipment

D-20.03 Maintains conveying systems

Apprenticeship Level	4
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
D-20.03.01L	demonstrate knowledge of conveying systems , their components and operation	define terminology associated with conveying systems
		identify types of conveying systems and their components and accessories, and describe their purpose, applications and operation
D-20.03.02L	demonstrate knowledge of safety practices related to conveying systems	identify hazards and describe safe work practices associated with conveying systems
		interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of conveying systems
D-20.03.03L	demonstrate knowledge of the procedures used to maintain conveying systems	identify tools and equipment used to maintain conveying systems and describe their applications and procedures
		identify the factors to consider when determining if conveying systems or their components need to be repaired or replaced
		describe the procedures used to maintain conveying systems and their components
		identify the factors to consider and required calculations to determine conveying system requirements

describe the procedures used to splice a conveyor belt

describe the procedures used to track a conveyor belt

RANGE OF VARIABLES

conveying systems include: pneumatic, belt, rollers, chain, screw, bucket, flume/water

components include: limit switches, emergency stops, magnets, pulleys, rollers, bearings

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

D-20.04 Repairs conveying systems

Apprenticeship Level 4

Essential Skills Thinking, Document Use, Numeracy

KNOWLEDGE

Learning Outcomes

Learning Objectives

D-20.04.01L demonstrate knowledge of **conveying systems**, their **components** and operation

define terminology associated with **conveying systems**

identify types of **conveying systems** and their **components** and accessories, and describe their purpose, applications and operation

D-20.04.02L demonstrate knowledge of safety practices related to **conveying systems**

identify hazards and describe **safe work practices** associated with **conveying systems**

interpret jurisdictional regulations and manufacturers' specifications pertaining to the use of **conveying systems**

D-20.04.03L demonstrate knowledge of the procedures used to repair **conveying systems**

identify tools and equipment used to repair **conveying systems** and describe their applications and procedures

identify the factors to consider when determining if **conveying systems** or their components need to be repaired or replaced

identify the factors to consider and required calculations to determine **conveying system** requirements

describe the procedures used to splice a conveyor belt

describe the procedures used to track a conveyor belt

RANGE OF VARIABLES

conveying systems include: pneumatic, belt, rollers, chain, screw, bucket, flume/water

components include: limit switches, emergency stops, magnets, pulleys, rollers, bearings

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

MAJOR WORK ACTIVITY E

Services fluid power systems

TASK E-21 Services hydraulic systems

TASK DESCRIPTOR

Hydraulic systems are versatile systems that use high pressure, non-compressible fluids to transmit power in a variety of industries. Industrial mechanics (millwrights) service these systems to ensure proper and efficient operation. Servicing includes installing, diagnosing, maintaining and repairing.

E-21.01 Installs hydraulic systems

Apprenticeship Level	3
Essential Skills	Numeracy, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-21.01.01L	demonstrate knowledge of the principles and applications of fluid power	explain the <i>principles and theories of fluid power</i>
E-21.01.02L	demonstrate knowledge of hydraulic system related calculations	describe units of measure as they relate to hydraulic systems
		identify formulae related to hydraulic systems and describe their applications
		describe the calculations used to select and install hydraulic systems and <i>components</i>
		perform hydraulic related calculations
E-21.01.03L	demonstrate knowledge of engineered drawings and schematics, their use and interpretation	identify symbols and abbreviations related to hydraulic systems found on engineered drawings and schematics
		describe hydraulic systems engineered drawings and schematics and their applications
		interpret engineered drawings and schematics to determine the operation of hydraulic systems
		interpret information pertaining to piping systems found on engineered drawings and schematics

E-21.01.04L	demonstrate knowledge of safety practices related to hydraulic systems	identify hazards and describe safe work practices pertaining to hydraulic systems and components
		identify hazards and describe safe work practices pertaining to piping systems
E-21.01.05L	demonstrate knowledge of hydraulic systems, their components and operation	define terminology associated with the installation of hydraulic systems and components
		identify types of hydraulic systems and describe their applications and operation
		identify hydraulic systems components and describe their purpose and operation
		interpret jurisdictional regulations and manufacturers' specifications pertaining to installation of hydraulic systems and components
		identify tools and equipment used to install hydraulic systems and components , and describe their applications and procedures
E-21.01.06L	demonstrate knowledge of the procedures used to install hydraulic systems and components	describe the procedures used to install hydraulic systems and components
E-21.01.07L	demonstrate knowledge of piping systems, their components and operation	define terminology associated with piping systems
E-21.01.08L	demonstrate knowledge of the procedures used to install piping systems and their components	interpret jurisdictional regulations and manufacturers' specifications pertaining to piping systems
		identify types of piping systems and describe their applications
		identify types of piping, tubing, and hoses and describe their compatibility, characteristics and applications
		identify types of fittings and describe their characteristics and applications
		identify piping system accessories and describe their characteristics and applications
		identify types of valves used in piping systems and describe their applications and operation
		describe the procedures used to install pipe, tubing and hoses

RANGE OF VARIABLES

principles and theories of fluid power include: Pascal's law, Boyle's law, Charles' law, Gay-Lussac's law, Bernoulli's principle

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

components include: pumps, valves, actuators, reservoirs, hoses, seals, fittings, strainers, filters, accumulators, motors

E-21.02 Diagnoses hydraulic systems

Apprenticeship Level	3
Essential Skills	Numeracy, Document Use, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-21.02.01L	demonstrate knowledge of the principles and applications of fluid power	explain the principles and theories of fluid power
E-21.02.02L	demonstrate knowledge of hydraulic system related calculations	describe units of measure as they relate to hydraulic systems identify formulae related to hydraulic systems and describe their applications describe the calculations used during the diagnosis of hydraulic systems and components
E-21.02.03L	demonstrate knowledge of engineered drawings, schematics and P&IDs, their use and interpretation	identify symbols and abbreviations related to hydraulic systems found on engineered drawings, schematics and P&IDs describe hydraulic systems engineered drawings, schematics and P&IDs and their applications interpret engineered drawings, schematics and P&IDs to determine the operation of hydraulic systems interpret information pertaining to piping systems found on engineered drawings, schematics and P&IDs
E-21.02.04L	demonstrate knowledge of safety practices related to hydraulic systems	identify hazards and describe safe work practices pertaining to hydraulic systems and components
E-21.02.05L	demonstrate knowledge of hydraulic systems, their components and operation	define terminology associated with the diagnosis of hydraulic systems and components identify types of hydraulic systems and describe their applications and operation

		identify hydraulic system components and describe their purpose and operation
		interpret jurisdictional regulations and manufacturers' specifications pertaining to hydraulic systems and components
		identify tools and equipment used to diagnose hydraulic systems and components , and describe their applications and procedures
E-21.02.06L	demonstrate knowledge of the procedures used to diagnose hydraulic systems and components	describe the procedures used to diagnose hydraulic systems and components
		describe the procedures used to inspect hydraulic systems and components
		identify the factors to consider when determining if hydraulic system components need to be repaired or replaced

RANGE OF VARIABLES

principles and theories of fluid power include: Pascal's law, Boyle's law, Charles' law, Gay-Lussac's law, Bernoulli's principle

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

components include: pumps, valves, actuators, reservoirs, hoses, seals, fittings, strainers, filters, accumulators, motors

inspection procedures include: condition-based monitoring and sensory inspection

E-21.03 Maintains hydraulic systems

Apprenticeship Level

3

Essential Skills

Thinking, Document Use, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-21.03.01L	demonstrate knowledge of the principles and applications of fluid power	explain the principles and theories of fluid power
E-21.03.02L	demonstrate knowledge of hydraulic systems related calculations	describe units of measure as they relate to hydraulic systems
		identify formulae related to hydraulic systems and describe their applications
		describe the calculations used during the maintenance of hydraulic systems and components

E-21.03.03L	demonstrate knowledge of engineered drawings and schematics, their use and interpretation	identify symbols and abbreviations related to hydraulic systems found on engineered drawings and schematics
		describe hydraulic systems engineered drawings and schematics and their applications
		interpret engineered drawings and schematics to determine the operation of hydraulic systems
		interpret information pertaining to piping systems found on engineered drawings, and schematics
E-21.03.04L	demonstrate knowledge of safety practices related to hydraulic systems	identify hazards and describe safe work practices pertaining to hydraulic systems and components
E-21.03.05L	demonstrate knowledge of hydraulic systems, their components and operation	define terminology associated with the maintenance of hydraulic systems and components
		identify types of hydraulic systems and describe their applications and operation
		identify hydraulic system components and describe their purpose and operation
		interpret jurisdictional regulations and manufacturers' specifications pertaining to hydraulic systems and components
		identify tools and equipment used to maintain hydraulic systems and components , and describe their applications and procedures
E-21.03.06L	demonstrate knowledge of the procedures used to maintain and repair hydraulic systems and components	describe the procedures used to inspect and maintain hydraulic systems and components
		identify the factors to consider when determining if hydraulic system components need to be repaired or replaced

RANGE OF VARIABLES

fluid power includes: hydraulic, pneumatic, vacuum

principles and theories of fluid power include: Pascal's law, Boyle's law, Charles' law, Gay-Lussac's law, Bernoulli's principle

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

components include: pumps, motors, actuators, valves, accumulators, filters and strainers, fluid conductors

procedures used to inspect and maintain include: check hoses, piping and tubing, check fluids (condition and level), check/change filters, determine operating parameters, adjust system pressure, temperature and flow

E-21.04 Repairs hydraulic systems

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-21.04.01L	demonstrate knowledge of the principles and applications of fluid power	explain the principles and theories of fluid power
E-21.04.02L	demonstrate knowledge of hydraulic systems related calculations	describe units of measure as they relate to hydraulic systems identify formulae related to hydraulic systems and describe their applications describe the calculations used during the repair of hydraulic systems and components
E-21.04.03L	demonstrate knowledge of engineered drawings, schematics, and P&IDs their use and interpretation	identify symbols and abbreviations related to hydraulic systems found on engineered drawings, schematics, and P&IDs describe hydraulic systems engineered drawings, schematics, and P&IDs and their applications interpret engineered drawings, schematics, and P&IDs to determine the operation of hydraulic systems interpret information pertaining to piping systems found on engineered drawings, schematics, and P&IDs
E-21.04.04L	demonstrate knowledge of safety practices related to hydraulic systems	identify hazards and describe safe work practices pertaining to hydraulic systems and components
E-21.04.05L	demonstrate knowledge of hydraulic systems, their components and operation	define terminology associated with the repair of hydraulic systems and components identify types of hydraulic systems and describe their applications and operation identify hydraulic system components and describe their purpose and operation interpret jurisdictional regulations and manufacturers' specifications pertaining to hydraulic systems and components identify tools and equipment used to repair hydraulic systems and components , and describe their applications and procedures

E-21.04.06L	demonstrate knowledge of the procedures used to repair hydraulic systems and components	describe the procedures used to repair hydraulic systems and components
		identify the factors to consider when determining if hydraulic system components need to be repaired or replaced

RANGE OF VARIABLES

fluid power includes: hydraulic, pneumatic, vacuum

principles and theories of fluid power include: Pascal's law, Boyle's law, Charles' law, Gay-Lussac's law, Bernoulli's principle

components include: pumps, motors, actuators, valves, accumulators, filters and strainers, fluid conductors

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

procedures used to repair include: replacing hoses, piping and tubing, fluids, check/change filters, adjust system pressure, temperature and flow

TASK E-22 Services pneumatic and vacuum systems

TASK DESCRIPTOR

Pneumatic and vacuum systems provide control and power for mechanical and process systems. Industrial mechanics (millwrights) are responsible for the installation, diagnosis, repair and maintenance of these systems. Servicing includes installing, diagnosing, maintaining and repairing.

E-22.01 Installs pneumatic and vacuum systems

Apprenticeship Level	3
Essential Skills	Numeracy, Document Use, Working with Others

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-22.01.01L	demonstrate knowledge of the principles and applications of fluid power	explain the principles and theories of fluid power
E-22.01.02L	demonstrate knowledge of pneumatic and vacuum systems related calculations	describe units of measure as they relate to pneumatic and vacuum systems identify formulae related to pneumatic and vacuum systems and describe their applications describe the calculations used to select and install pneumatic and vacuum systems and components

		perform pneumatic and vacuum related calculations
E-22.01.03L	demonstrate knowledge of engineered drawings and schematics, their use and interpretation	identify symbols and abbreviations related to pneumatic and vacuum systems found on engineered drawings and schematics
		describe pneumatic and vacuum systems engineered drawings and schematics and their applications
		interpret engineered drawings and schematics to determine the operation of pneumatic and vacuum systems
		interpret information pertaining to piping systems found on engineered drawings and schematics
E-22.01.04L	demonstrate knowledge of safety practices related to pneumatic and vacuum systems	identify hazards and describe safe work practices pertaining to pneumatic and vacuum systems and components
		identify hazards and describe safe work practices pertaining to piping systems
E-22.01.05L	demonstrate knowledge of pneumatic and vacuum systems, their components and operation	define terminology associated with the installation of pneumatic and vacuum systems and components
		identify types of pneumatic and vacuum systems and describe their applications and operation
		identify pneumatic and vacuum systems components and describe their purpose and operation
		interpret jurisdictional regulations and manufacturers' specifications pertaining to installation of pneumatic and vacuum systems and components
		identify tools and equipment used to install pneumatic and vacuum systems and components , and describe their applications and procedures
		describe the methods of air treatment in pneumatic systems
E-22.01.06L	demonstrate knowledge of the procedures used to install pneumatic and vacuum systems and components	describe the procedures used to install pneumatic and vacuum systems and components
E-22.01.07L	demonstrate knowledge of piping systems, their components and operation	define terminology associated with piping systems
E-22.01.08L	demonstrate knowledge of the procedures used to install piping systems and their components	interpret jurisdictional regulations and manufacturers' specifications pertaining to piping systems
		identify types of piping systems and describe their applications

	identify types of piping, tubing, and hoses and describe their compatibility, characteristics and applications
	identify types of fittings and describe their characteristics and applications
	identify piping system accessories and describe their characteristics and applications
	identify types of valves used in piping systems and describe their applications and operation
	describe the procedures used to install pipe, tubing and hoses

RANGE OF VARIABLES

fluid power includes: pneumatic, vacuum

principles and theories of fluid power include: Pascal's law, Boyle's law, Charles' law, Gay-Lussac's law, Bernoulli's principle

components include: hoses, seals, fittings, strainers, filter regulator lubricator (FRL), piping, receivers, tanks for pneumatic and vacuum systems, blower, pumps, motors, actuators, valves

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

air treatment includes: dryers, after-coolers, de-icers

E-22.02 Diagnoses pneumatic and vacuum systems

Apprenticeship Level	3
Essential Skills	Numeracy, Document Use, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-22.02.01L	demonstrate knowledge of the principles and applications of fluid power	explain the principles and theories of fluid power
E-22.02.02L	demonstrate knowledge of pneumatic and vacuum system related calculations	describe units of measure as they relate to pneumatic and vacuum systems identify formulae related to pneumatic and vacuum systems and describe their applications describe the calculations used during the diagnosis of pneumatic and vacuum systems and components
E-22.02.03L	demonstrate knowledge of engineered drawings and schematics, their use and interpretation	identify symbols and abbreviations related to pneumatic and vacuum systems found on engineered drawings and schematics

		describe pneumatic and vacuum systems engineered drawings and schematics and their applications
		interpret engineered drawings and schematics to determine the operation of pneumatic and vacuum systems
		interpret information pertaining to piping systems found on engineered drawings, and schematics
E-22.02.04L	demonstrate knowledge of safety practices related to pneumatic and vacuum systems	identify hazards and describe safe work practices pertaining to pneumatic and vacuum systems and components
E-22.02.05L	demonstrate knowledge of pneumatic and vacuum systems, their components and operation	define terminology associated with the diagnosis of pneumatic and vacuum systems and components
		identify types of pneumatic and vacuum systems and describe their applications and operation
		identify pneumatic and vacuum systems components and describe their purpose and operation
		interpret jurisdictional regulations and manufacturers' specifications pertaining to pneumatic and vacuum systems and components
		identify tools and equipment used to diagnose pneumatic and vacuum systems and components , and describe their applications and procedures
		describe the methods of air treatment in pneumatic systems
E-22.02.06L	demonstrate knowledge of the procedures used to diagnose pneumatic and vacuum systems and components	describe the procedures used to diagnose pneumatic and vacuum systems and components
		describe the procedures used to inspect pneumatic and vacuum systems and components
		identify the factors to consider when determining if pneumatic and vacuum systems components need to be repaired or replaced

RANGE OF VARIABLES

fluid power includes: pneumatic, vacuum

principles and theories of fluid power include: Pascal's law, Boyle's law, Charles' law, Gay-Lussac's law, Bernoulli's principle

components include: hoses, seals, fittings, strainers, filter regulator lubricator (FRL), piping, receivers, tanks for pneumatic and vacuum systems, blower, pumps, motors, actuators, valves

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

air treatment includes: dryers, after-coolers, de-icers

E-22.03 Maintains pneumatic and vacuum systems

Apprenticeship Level 3

Essential Skills Thinking, Document Use, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-22.03.01L	demonstrate knowledge of the principles and applications of fluid power	explain the principles and theories of fluid power
E-22.03.02L	demonstrate knowledge of pneumatic and vacuum systems related calculations	describe units of measure as they relate to pneumatic and vacuum systems identify formulae related to pneumatic and vacuum systems and describe their applications describe the calculations used during the maintenance of pneumatic and vacuum systems and components
E-22.03.03L	demonstrate knowledge of engineered drawings and schematics, their use and interpretation	identify symbols and abbreviations related to pneumatic and vacuum systems found on engineered drawings and schematics describe pneumatic and vacuum systems engineered drawings and schematics and their applications interpret engineered drawings and schematics to determine the operation of pneumatic and vacuum systems interpret information pertaining to piping systems found on engineered drawings, and schematics
E-22.03.04L	demonstrate knowledge of safety practices related to pneumatic and vacuum systems	identify hazards and describe safe work practices pertaining to pneumatic and vacuum systems and components
E-22.03.05L	demonstrate knowledge of pneumatic and vacuum systems, their components and operation	define terminology associated with the maintenance of pneumatic and vacuum systems and components

		identify types of pneumatic and vacuum systems and describe their applications and operation
		identify pneumatic and vacuum systems components and describe their purpose and operation
		interpret jurisdictional regulations and manufacturers' specifications pertaining to pneumatic and vacuum systems and components
		identify tools and equipment used to maintain pneumatic and vacuum systems and components , and describe their applications and procedures
		describe the methods of air treatment in pneumatic systems
E-22.03.06L	demonstrate knowledge of the procedures used to maintain pneumatic and vacuum systems and components	describe the procedures used to inspect and maintain pneumatic and vacuum systems and components
		identify the factors to consider when determining if pneumatic and vacuum systems components need to be repaired or replaced

RANGE OF VARIABLES

fluid power includes: pneumatic, vacuum

principles and theories of fluid power include: Pascal's law, Boyle's law, Charles' law, Gay-Lussac's law, Bernoulli's principle

components include: hoses, seals, fittings, strainers, filter regulator lubricator (FRL), piping, receivers, tanks for pneumatic and vacuum systems, blowers, pumps, motors, actuators, valves

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

air treatment includes: dryers, after-coolers, de-icers

procedures used to inspect and maintain include: check hoses, piping and tubing, check lubricating fluids (condition and level), check/change filters, determine operating parameters, adjust system pressure, temperature and flow

E-22.04 Repairs pneumatic and vacuum systems

Apprenticeship Level	3
Essential Skills	Thinking, Document Use, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
E-22.04.01L	demonstrate knowledge of the principles and applications of fluid power	explain the principles and theories of fluid power
E-22.04.02L	demonstrate knowledge of pneumatic and vacuum systems related calculations	describe units of measure as they relate to pneumatic and vacuum systems identify formulae related to pneumatic and vacuum systems and describe their applications describe the calculations used during the repair of pneumatic and vacuum systems and components
E-22.04.03L	demonstrate knowledge of engineered drawings and schematics, their use and interpretation	identify symbols and abbreviations related to pneumatic and vacuum systems found on engineered drawings and schematics describe pneumatic and vacuum systems, engineered drawings and schematics and their applications interpret engineered drawings and schematics to determine the operation of pneumatic and vacuum systems interpret information pertaining to piping systems found on engineered drawings, and schematics
E-22.04.04L	demonstrate knowledge of safety practices related to pneumatic and vacuum systems	identify hazards and describe safe work practices pertaining to pneumatic and vacuum systems and components
E-22.04.05L	demonstrate knowledge of pneumatic and vacuum systems, their components and operation	define terminology associated with the repair of pneumatic and vacuum systems and components identify types of pneumatic and vacuum systems and describe their applications and operation identify pneumatic and vacuum systems components and describe their purpose and operation interpret jurisdictional regulations and manufacturers' specifications pertaining to pneumatic and vacuum systems and components

		identify tools and equipment used to repair pneumatic and vacuum systems and components , and describe their applications and procedures
		describe the methods of air treatment in pneumatic systems
E-22.04.06L	demonstrate knowledge of the procedures used to repair pneumatic and vacuum systems and components	describe the procedures used to repair pneumatic and vacuum systems and components
		identify the factors to consider when determining if pneumatic and vacuum systems components need to be repaired or replaced

RANGE OF VARIABLES

principles and theories of fluid power include: Pascal's law, Boyle's law, Charles' law, Gay-Lussac's law, Bernoulli's principle

components include: hoses, seals, fittings, strainers, filter regulator lubricator (FRL), piping, receivers, tanks for pneumatic and vacuum systems, blowers, pumps, motors, actuators, valves

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

air treatment include: dryers, after-coolers, de-icers

procedures used to repair include: replacing hoses, piping and tubing, fluids, check/change filters, adjust system pressure, temperature and flow

MAJOR WORK ACTIVITY F

Performs preventative and predictive maintenance, commissioning and decommissioning

TASK F-23 Performs preventative and predictive maintenance

TASK DESCRIPTOR

Industrial mechanics (millwrights) may perform preventative and predictive maintenance tasks to ensure functional and consistent performance of machinery and equipment.

Preventative maintenance involves the routine scheduling of maintenance activities based on past history and manufacturers' recommendations as well as jurisdictional regulations. It is done to increase reliability of the equipment.

Predictive maintenance involves the application of predictive maintenance technologies for early detection of equipment defects that could lead to unplanned downtime or unnecessary expenditures.

This may include vibration analysis, balancing and alignment, NDT and fluid analysis. It is important to perform these tasks to optimize longevity and reliability of the equipment.

F-23.01 Performs preventative maintenance activities

Apprenticeship Level	4
Essential Skills	Digital Technology, Document Use, Thinking

KNOWLEDGE		
	Learning Outcomes	Learning Objectives
F-23.01.01L	demonstrate knowledge of preventative maintenance	define terminology associated with preventative maintenance
		interpret jurisdictional regulations, site and manufacturers' specifications pertaining to preventative maintenance procedures
		identify tools and equipment used for preventative maintenance, and describe their applications and procedures
		identify types of maintenance and describe their purpose and applications
		identify sources of information used to develop maintenance history

F-23.01.02L	demonstrate knowledge of the procedures used to perform preventative maintenance	identify preventative maintenance practices , and describe their applications
		describe the procedures used to perform preventative maintenance activities
		describe the procedures used to record preventative maintenance data
		describe the procedures used to schedule preventative maintenance activities
F-23.01.03L	demonstrate knowledge of safety practices related to preventative maintenance procedures	identify hazards and describe safe work practices pertaining to preventative maintenance procedures

RANGE OF VARIABLES

tools and equipment include: hand tools, gauges, strobe lights

types of maintenance include: breakdown, preventative, predictive, proactive, corrective, RCM

sources of information used to develop maintenance history include: reports, checklists, manufacturers' specifications, root cause analysis, equipment history (work order)

preventative maintenance practices include: non-destructive testing, fluid analysis, balancing, thermography, motor current analysis, reactive, scheduled overhauls, scheduled replacement, running preventative maintenance (PM's)

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

F-23.02 Performs vibration analysis procedures

Apprenticeship Level	4
Essential Skills	Reading, Digital Technology, Document Use

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-23.02.01L	demonstrate knowledge of the procedures used to perform vibration analysis	define terminology associated with vibration analysis
		identify tools and equipment used for vibration analysis and describe their applications and procedures
		identify and interpret sources of information pertaining to vibration analysis
		identify causes of vibration
		identify vibration analysis methods and describe their applications
		describe the procedures used to perform vibration analysis

		record and interpret data collected using vibration analysis equipment
F-23.02.02L	demonstrate knowledge of safety practices related to vibration analysis	identify hazards and describe safe work practices pertaining to vibration analysis

RANGE OF VARIABLES

tools and equipment include: data collector, probes, vibration pen, strobe, online monitor, transducers
sources of information pertaining to vibration analysis include: manufacturers' specifications, vibration standards and charts, Canadian Machinery Vibration Association (CMVA) interpretations and guidelines

causes of vibration include: eccentricity, misalignment, shaft faults, mechanical looseness, mechanical frequencies, natural frequencies, imbalance

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

F-23.03 Performs balancing procedures

Apprenticeship Level	4
Essential Skills	Document Use, Digital Technology, Numeracy

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-23.03.01L	demonstrate knowledge of balancing procedures	define terminology associated with balancing
		identify tools and equipment required for balancing and describe their applications and procedures
		identify and interpret sources of information pertaining to balancing
		identify the conditions of imbalance and describe their characteristics
		identify the types of balancing methods and describe their applications
		describe balancing procedures
		perform calculations required for balancing
F-23.03.02L	demonstrate knowledge of safety practices related to balancing procedures	identify hazards and describe safe work practices pertaining to balancing procedures

RANGE OF VARIABLES

tools and equipment include: hand tools, weights, polar graphing charts, protractor, balancing equipment (hand-held devices, shop balancing machines, knife edges, strobe)

sources of information pertaining to balancing include: manufacturers' specifications, vibration standards and charts, Canadian Machinery Vibration Association (CMVA) interpretations and guidelines

conditions of imbalance include: static, couple, quasi-static, dynamic

balancing methods include: single-plane, multi-plane

balancing procedures include: static, dynamic, multi-plane

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

F-23.04 Performs non-destructive testing (NDT) procedures

Apprenticeship Level	4
Essential Skills	Digital Technology, Document Use, Reading

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-23.04.01L	demonstrate knowledge of the procedures used to perform NDT methods	define terminology associated with NDT methods
		demonstrate an awareness of jurisdictional regulations pertaining to NDT methods
		identify tools and equipment used for NDT methods , and describe their applications and procedures
		identify types of NDT methods and describe their applications
		describe the procedures used to perform NDT methods
F-23.04.02L	demonstrate knowledge of safety practices related to NDT methods	record and interpret data collected using NDT methods
		identify hazards and describe safe work practices pertaining to NDT methods

RANGE OF VARIABLES

non-destructive testing methods include: dye penetrant, magnetic particle, radiography, ultrasonic, visual, thermography, air or water pressure testing, eddy current analysis

tools and equipment include: hand tools, dye penetrant tool kit, ultrasonic thickness tester, thermographic camera, pressure gauges

F-23.05 Performs fluid analysis procedures

Apprenticeship Level	4
Essential Skills	Digital Technology, Document Use, Reading

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-23.05.01L	demonstrate knowledge of fluid analysis	define terminology associated with fluid analysis interpret fluid sampling results according to jurisdictional regulations identify tools and equipment used for fluid sampling, and describe their applications and procedures identify fluid contaminants and describe their causes and remedies
F-23.05.02L	demonstrate knowledge of the procedures used to collect and test fluid samples	describe the procedures used to collect and test fluid samples from systems record and interpret data from fluid analysis
F-23.05.03L	demonstrate knowledge of safety practices related to fluid sampling	identify hazards and describe safe work practices pertaining to fluid sampling

RANGE OF VARIABLES

tools and equipment include: hot plate, viscometer (viscosimeter), litmus paper, infrared, sample bottles, hand tools

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

F-23.06 Performs predictive maintenance activities

Apprenticeship Level	4
Essential Skills	Digital Technology, Document Use, Thinking

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-23.06.01L	demonstrate knowledge of predictive maintenance procedures	define terminology associated with predictive maintenance interpret site and manufacturers' specifications and jurisdictional regulations pertaining to predictive maintenance procedures

		identify tools and equipment used for predictive maintenance, and describe their applications and procedures
		identify types of maintenance and describe their purpose and applications
		identify sources of information used to develop maintenance history
F-23.06.02L	demonstrate knowledge of the procedures used to perform predictive maintenance	identify predictive maintenance practices and describe their applications
		describe the procedures used to schedule predictive maintenance activities
		describe the procedures used to perform predictive maintenance activities
		describe the procedures used to record predictive maintenance data
F-23.06.03L	demonstrate knowledge of safety practices related to predictive maintenance procedures	identify hazards and describe safe work practices pertaining to predictive maintenance procedures

RANGE OF VARIABLES

tools and equipment include: hand tools, dye penetrant tool kit, ultrasonic thickness tester, thermographic camera, pressure gauges, vibration analysis tools, balancing tools

types of maintenance include: breakdown, preventive, predictive, proactive, corrective

sources of information used to develop maintenance history include: reports, checklists, manufacturers' specifications, root cause analysis, spectrums, graphs, logbooks, lab reports, images, work order history, inspection reports

predictive maintenance practices include: vibration analysis, non-destructive testing, fluid analysis, balancing, thermography, motor current analysis, ultrasonic

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

TASK F-24 Commissions and decommissions equipment

TASK DESCRIPTOR

After installation or repair, industrial mechanics (millwrights) commission equipment to ensure that it operates to specifications. Steps include startup, assessment and adjustment, and determining baseline operating specifications when necessary. Once a piece of equipment is removed from active service, a formal process of decommissioning is required.

F-24.01 Commissions systems and components

Apprenticeship Level	4
Essential Skills	Document Use, Digital Technology, Reading

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-24.01.01L	demonstrate knowledge of commissioning and its purpose	define terminology associated with commissioning
		explain the purpose of commissioning and identify the types of mechanical systems and components
		explain the purpose of commissioning and identify the types of fluid power systems and components
F-24.01.02L	demonstrate knowledge of safety practices related to commissioning	interpret information sources and documentation pertaining to commissioning
		identify hazards and describe safe work practices pertaining to commissioning mechanical systems and components
F-24.01.03L	demonstrate knowledge of the procedures used to commission systems and components	identify hazards and describe safe work practices pertaining to the commissioning of fluid power systems and components
		describe the procedures used to commission mechanical systems and components
		describe the procedures used to commission fluid power systems and components

RANGE OF VARIABLES

mechanical systems and components include: internal combustion engines, electric motors, conveying systems, positive displacement pumps, centrifugal pumps, reciprocating compressors, gear drives, turbines

fluid power systems and components include: hydraulic, pneumatic, vacuum

safety components include: guards, emergency stops, interlocks, over speed trips, pressure relief

information sources and documentation include: manufacturers' specifications, operating parameters, jurisdictional codes and regulations

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

F-24.02 Decommissions systems and components

Apprenticeship Level	4
Essential Skills	Document Use, Digital Technology, Reading

KNOWLEDGE

	Learning Outcomes	Learning Objectives
F-24.02.01L	demonstrate knowledge of decommissioning and its purpose	define terminology associated with decommissioning explain the purpose of decommissioning and identify the types of systems and components that need to be decommissioned interpret information sources and documentation pertaining to the decommissioning of systems, components and parts
F-24.02.02L	demonstrate knowledge of safety practices related to decommissioning systems or components	identify hazards and describe safe work practices pertaining to decommissioning systems or components
F-24.02.03L	demonstrate knowledge of the procedures used to decommission systems and components	describe the procedures used to decommission mechanical systems and components describe the procedures used to decommission fluid power systems and components describe the procedures used to conduct an environmental assessment

RANGE OF VARIABLES

information sources and documentation include: manufacturers' specifications, operating parameters, jurisdictional codes and regulations (transportation of dangerous goods (TDG), WHMIS, environmental assessment)

safe work practices include: company policies, site procedures, jurisdictional regulations, manufacturers' recommendations

mechanical systems and components include: internal combustion engines, electric motors, conveying systems, positive displacement pumps, centrifugal pumps, reciprocating compressors, gear drives

fluid power systems include: hydraulic, pneumatic, vacuum

APPENDIX A

ACRONYMS

ABS	acrylonitrile butadiene styrene
AC / DC	alternating current / direct current
CAD	computer aided drawing/design
CMMS	computerized maintenance management system
EOAT	end of arm tooling
FCAW	flux-cored arc welding
GMAW	gas metal arc welding (also known as metal inert gas [MIG] welding)
GPS	Global Positioning System
GTAW	gas tungsten arc welding (also known as tungsten inert gas [TIG] welding)
HDPE	high-density polyethylene
ITP	Inspection and Test Plan
MCAW	metal-cored arc welding
MIG	See GMAW
NDT	non-destructive testing
P&ID	piping and instrumentation diagram
PLC	programmable logic controller
PME	powered mobile equipment
PPE	personal protective equipment
PVC	polyvinyl chloride
RCM	reliability-centered maintenance
SCARA	Selective Compliance Assembly Robot Arm
SDS	Safety Data Sheets
SMAW	shielded metal arc welding
SOP	standard operating procedures
TDG	transportation of dangerous goods
TIG	See GTAW
WHMIS	Workplace Hazardous Materials Information System
WLL	working load limit

APPENDIX B

TOOLS AND EQUIPMENT

Hand Tools

adjustable wrenches
hex keys
brushes (wire, cleaning, etc.)
calculators
clamps (C-Clamps)
chisels
drill bits
files
grease gun
hacksaw
hammer, ball peen
hammer, claw
hammer, dead blow
hammer, sledge
hammer, soft faced
hammer, rubber
hammer, chipping
honing stone
levels (machinist, torpedo, spirit, etc.)
alignment bars
locking pliers
locks
nibblers
oil can
parallel bars
piano wire
pipe and tube cutters
pipe wrenches
pliers
plumb bob
pop riveter
pry bars
pullers
scraper
screwdrivers
scribers
socket wrenches
tap and dies
tap extractors
reamers
thread chasers
threading accessories
grease guns (ultrasonic, cordless, air, etc)
tin snip
torque wrench
beam trammel
trowels
tube benders
wheel dresser
wrenches

Measuring and Layout Tools

bevel protractor
bore gauge
center gauge
chalk lines
combination square set
deflection gauge
outside calipers
pi-tape
plasti-gauge
precision level
precision straightedge
radius gauge

Measuring and Layout Tools (*continued*)

depth gauge	rulers
dial indicator	sheave gauge
dividers	sine bar
engineers' square (machinists' square)	small hole gauge
feeler gauge	solid square
gauge blocks	string line
gear pitch gauge	surface gauge
height gauge	tape measures
indicator gauge	taper gauge
inside calipers	telescopic gauge
laser alignment equipment	tension gauge
lead wire	transit
micrometers	V-block
optical levels	vernier calipers

Portable Power Tools

right angle drill	impact gun (rivet)
angle grinder	impact wrench
chainsaw	jack hammer
chop saw	jig saw
circular saw	portable bender
die grinder	portable drill
hammer drill	explosive-actuated tool
heat gun	portable band saw
hydraulic ram	portable threader
hydraulic nuts	routers
hydraulic wrenches	reciprocating saw
impact drill	tube rollers

Shop Tools and Equipment

band saw	lathe
bearing heater (induction, oil bath, oven)	milling machine
pedestal grinder	parts washer
brake press	sand blaster
chop saw	shears

Shop Tools and Equipment (*continued*)

drill press (bench, radial arm, upright)
hydraulic press (horizontal, vertical)
iron worker

surface grinder
vices
cribbing (dunnage)

Welding and Cutting Equipment

arc welding equipment
oxy-acetylene equipment
metal inert gas welding (MIG) equipment
plasma arc cutting equipment

rod ovens
tungsten inert gas welding (TIG) equipment
welding machines

Testing Equipment

balancing equipment
borescope
computers
dye penetrant test equipment
fluid analysis equipment
hardness test equipment
hydraulic gauge
laser alignment equipment
magnetic particle test equipment
multimeter
pressure/vacuum gauge

printers
radio transmitter
scales
strobe light
tachometer
theodolite
thermographic test equipment
ultrasonic test equipment
ultrasound test equipment
vibration analysis equipment

Access, Rigging, Hoisting and Lifting Equipment

aerial lifts
air bags
air jack
air tuggers
block and tackle
cable hoists
grip hoist (tirfor)
hydraulic blocks
hydraulic jack
ladders
lever actuated chain hoist
lifting eyes

power chain blocks
scaffolds
scissor lift
screw jack
shackles
sheave blocks
slings
snatch block
spreader bar
trolleys
equipment handling rollers (Hilman™)
chains

Access, Rigging, Hoisting and Lifting Equipment (*continued*)

mobile crane	chain fall
outrigger	dolly
overhead crane	fibre rope
pinch bar	gantry crane

Personal Protective Equipment and Safety Equipment

apron	gloves
arm bands (signalling sleeve)	hearing protection
breathing protection (paper filter masks to self-contained breathing apparatus)	hard hat
coveralls - all types (acid/chemical/fire resistant, etc.)	life jackets
eye wash station	safety footwear
eye protection (face shields, safety glasses, goggles)	safety harness & fall arresting devices
first aid kit	safety vests
gauntlet (forearm protector)	welding blinds

Resource Materials

American Gear Manufacturers Association (AGMA)	National Building Code
American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)/ American Society of Testing & Materials (ASTM) Standards	National Grease Lubrication Institute (NGLI)
blueprints	Occupational Health and Safety (OH&S) regulations
Canadian Standards Association (CSA) documents	rigging and hoisting manuals
Canadian Welding Bureau materials	schematics
industry/contractors safety manual (handbook)	sketches
industry manuals such as IPT's Handbooks and Machinery's Handbook	manufacturers' specifications
Internet resources	standards documentation
International Standards Organization (ISO)	Transportation of Dangerous Goods (TDG)
local licensing data	technical manuals
Safety Data Sheets (SDS)	WHMIS labels

APPENDIX C

GLOSSARY

agitator	a device which keeps material moving in a tank or vessel; the movement may be required to prevent settling and to mix material
arc of contact	surface contact between the sheave, the pulley and the belt, or the sprocket and the chain
axial flow	to flow along the axis of a fan or a pump
babbitt	material used in plain friction bearings (usually lead-based)
backlash	amount of clearance between mating teeth
bearing	device that allows two parts to rotate or move in contact with each other
blower	device that moves air at low or high pressures and volumes
centrifugal flow	to flow 90 degrees to the axis of a fan or a pump away from the centre
clutch	device used to engage or disengage a driver to a driven unit
condition-based monitoring methods	methods to identify issues not realized by sensory inspection, real-time data
conveying systems	system used to move material (usually solid) from one place to another
couplings	parts used to connect a driver to a driven unit
elastomeric element	flexible element used to join couplings and dampen energy
engineered lift	consulting an engineer for an approved design of a lifting apparatus or lifting procedure without exceeding the rated capacity of the rigging equipment; it should be noted that this is generally done when unusual circumstances of a lift dictate deviations from normal accepted trade practices
fans	device used to create air movement
ferrography	wear analysis of machine bearing surfaces by collection of ferrous (or nonferrous) wear particles from lubricating oil in a ferrograph analyzer
fluid	substance (either a liquid or gas) material that has the ability to flow
gear system	combination of gears used to alter the speed and power from a driver to a driven unit
hypoid gear	set of gearing whose shafts intersect on a different plane
maintain	keeping a machine or system running efficiently with a minimum amount of down-time; for use in this analysis the term “maintain” can encompass: checking for worn parts, lubrication, adjustment, inspection and modification
manufacturers’ specifications	refers to the performance and engineering standards for a particular machine as detailed by the manufacturer; this information is usually available from drawings, manuals and bulletins provided by the manufacturer
multi-plane balancing	to balance a rotating part on more than two planes; multi-plane balancing is usually performed with computer software that is usually provided with vibration analysis and balancing instruments

non-destructive testing (NDT)	evaluation procedures that do not damage the material being tested; these may include magnetic particle testing, dye penetrant testing, and fluid sampling
positive displacement	transfer by pump without loss of pressure or material
predictive maintenance	activities utilizing information from past and current performance records to objectively predict mechanical problems; predictive maintenance is a proactive monitoring approach rather than a time-based or reactive approach
preventive maintenance	activities based on a periodic sampling and inspections; it normally involves the routine scheduling of maintenance activities; this schedule is based on past experience and manufacturers' recommendations
prime mover	driver of the machine; it may be an electric, steam, gas or diesel powered
sensory inspection	inspecting through the senses (visual, hearing, feeling, smell)
service	for use in this analysis the term "service" refers to installing, diagnosing, repairing and maintaining
thermographic equipment	equipment that displays the temperatures of components by measuring infrared radiation
tooth contact	amount of engagement and pattern formed by mating teeth
tribology	the study of friction, wear, lubrication, and the design of bearings; the science of interacting surfaces in relative motion.
vibration analysis	the process of monitoring the condition of equipment and the diagnosis of faults in equipment through the measurement and analysis of vibration within that equipment