Plan of Training

Industrial Mechanic (Millwright)

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

March 2017

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Approved by:

Chairperson, Provincial Apprenticeship and Certification Board

Date: March 30, 2017

Preface

This curriculum standard is based on the 2017 edition of the Red Seal Occupational Standard for the Industrial Mechanic (Millwright) trade. It describes the curriculum content for the Industrial Mechanic (Millwright) pre-employment training program.

Acknowledgements

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

We offer a sincere thank you.

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A. Transfer Matrix

2017 PROGRAM STRUCTURE			2010 PROGRAM STRUCTURE			Course Matrix	
2017 COURSE NUMBER	2017 COURSE TITLE	2017 COURSE HOURS	2010 COURSE NUMBER	2010 COURSE TITLE	2010 COURSE HOURS	MATRIXED (Y/N)	NOTES
MW1621	Metal Lathe	60	MW1620	Metal Lathe	100	Y	Moved from Level III to Pre-employment. Hours reduced.
MW1630	Milling Machines	40	MW1630	Milling Machines	40	Y	Moved from Level III to pre-employment.
OT1150	Workplace Exposure	80	OT1190	Workplace Exposure	90	Y	Replaced 90 hour course with 80 hour course to meet industry standard 40 hour workplace week.

B. Program Structure

For each and every course, a formal assessment is required for which 70% is the pass mark. A mark of 70% must be attained in both the theory examination and the practical project assignment, where applicable as documented on an official transcript.

The order of course delivery within each block can be determined by the educational agency, as long as pre-requisite conditions are satisfied.

Upon completion of an entry level program, individuals may be required to complete other certifications (employer or job site specific) in order to gain employment.

Pre-Employment				
Course No.	**AACS No.**	**Course Name**	**Hours**	**Pre-Requisite(s)**
TS1510	-	OH&S	6	None
TS1520	-	WHMIS	6	None
TS1530	-	Standard First Aid	14	None
MS1230	-	Hand Tools	20	TS1510; TS1520; TS1530
MW1240	-	Portable Power Tools	20	MS1230
MW1251	-	Blueprint Reading and Sketching	15	-
MW1261	-	Equipment Assembly Blueprints	15	MW1251
MW1270	-	Mechanical Installation Blueprints	15	MW1261
MW1281	-	Schematics Advanced	15	MW1251
MW1291	-	Rigging	30	MW1240
MW1450	-	Drills, Taps and Reamers	30	MW1240

Pre-Employment				
Course No.	**AACS No.**	**Course Name**	**Hours**	**Pre-Requisite(s)**
MW1460	-	Measuring and Layout	60	MS1230
MW1621	-	Metal Lathe	60	MW1450
MW1630	-	Milling Machines	40	MW1620
MW1470	-	Piping Components	30	MW1460
MW1511	-	Power Metal Saws	15	MW1460
MW1521	-	Pedestal Grinders	15	MW1511
MW1530	-	Bearings	40	MW1580
MW1541	-	Fasteners	9	MS1230
MW1550	-	Metallurgy	30	WD1330
MW1580	-	Static and Dynamic Seals	30	MW1650
MW1591	-	Coupling and Clutches	20	MW1640
MW1360	-	Shafts and Shaft Alignment	20	MW1591
MW1610	-	Belt and Chain Drive Systems	45	MW1530
MW1640	-	Gear Drive Systems	50	MW1610
MW1650	-	Lubrication Practices	20	MS1230
MW1670	-	Non-Positive Displacement Pumps	40	MW1591
MW1690	-	Positive Displacement Pumps	50	MW1670
MW1730	-	Electrical Fundamentals	30	MW2150
MW2150	-	Hydraulics I	30	MW1690

Pre-Employment				
Course No.	**AACS No.**	**Course Name**	**Hours**	**Pre-Requisite(s)**
WD1330	-	Oxy-Fuel Welding	30	MS1230
OT1150	-	Workplace Exposure	80	-
AP1101	-	Introduction to Apprenticeship	15	None
*AM1100	-	Math Essentials	30	None
AM1180	-	Industrial Math Fundamentals	30	AM1100
CM2160	-	Communication Essentials	45	None
SD1760	-	Workplace Essentials	45	None
MC1060	-	Computer Essentials	15	None
Total Hours			1110	

***A student who can meet the mathematics requirement through an ACUPLACER® test may be exempted from AM1100 - Math Essentials. Please check with your training institution**.

Required Work Experience

Level 2			
NL Course No.	**Course Name**	**Hours**	**Pre-requisites**
MW1560	Coupling Alignment	45	MW1591
MW1660	Material Handling Systems	60	MW1591
MW2160	Hydraulics II	35	MW2150
MW2170	Pneumatics	40	MW2160
WD1380	Electric Arc Welding	60	WD1330
Total Hours		**240**	

Required Work Experience

Level 3			
NL Course No.	**Course Name**	**Hours**	**Pre-requisites**
MW1620	Metal Lathe	100	MW1450
MW1630	Milling Machines	40	MW1620
MW2180	Compressors	40	MW2170
MW2190	Machinery Installation and Alignment	60	MW1560
Total Hours		**240**	

Required Work Experience

Level 4			
NL Course No.	**Course Name**	**Hours**	**Pre-requisites**
MW1680	Dynamic Balancing	45	MW2230
MW1740	Preventative and Predictive Maintenance	35	MW2180
MW1480	Tanks, Fans and Blowers	30	MW1690
MW2210	Prime Movers I (Internal Combustion Engines)	45	MW1580
MW2220	Prime Movers II (Turbines)	45	MW2210
MW2230	Vibration Analysis	40	MW1740
Total Hours		**240**	

Total Course Credit Hours	**1740**

PRE-EMPLOYMENT

TS1510 Occupational Health and Safety

Learning Outcomes:

- Demonstrate knowledge of interpreting the Occupational Health and Safety Act, laws and regulations.
- Demonstrate knowledge of understanding the designated responsibilities within the laws and regulations such as the right to refuse dangerous work; and the importance of reporting accidents.
- Demonstrate knowledge of how to prevent accidents and illnesses.
- Demonstrate knowledge of how to improve health and safety conditions in the workplace.

Duration: 6 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Interpret the Occupational Health and Safety Act laws and regulations.
   i. explain the scope of the act
      - application of the act
      - Federal/Provincial jurisdictions
      - Canada Labour Code
      - rules and regulations
      - private home application
      - conformity of the Crown by the Act

2. Explain responsibilities under the Act and Regulations.
   i. duties of employer, owner, contractors, sub-contractors, employees, and suppliers

3. Explain the purpose of joint health and safety committees.
   i. formation of committee
   ii. functions of committee
   iii. legislated rights
   iv. health and safety representation
   v. reporting endangerment to health
   vi. appropriate remedial action
   vii. investigation of endangerment
   viii. committee recommendation
   ix. employer's responsibility in taking remedial action

4. Examine right to refuse dangerous work.
   i. reasonable grounds for refusal
   ii. reporting endangerment to health
   iii. appropriate remedial action
   iv. investigation of endangerment
   v. committee recommendation
   vi. employer's responsibility to take appropriate remedial action
   vii. action taken when employee does not have reasonable grounds for refusing dangerous work
   viii. employee's rights
   ix. assigning another employee to perform duties
   x. temporary reassignment of employee to perform other duties
   xi. collective agreement influences
   xii. wages and benefits

5. State examples of work situations where one might refuse work.

6. Describe discriminatory action.
   i. definition
   ii. filing a complaint procedure
   iii. allocated period of time a complaint can be filed with the Commission
   iv. duties of an arbitrator under the Labour Relations Act
   v. order in writing inclusion
   vi. report to commission Allocated period of time to request Arbitrator to deal with the matter of the request
   vii. notice of application
   viii. failure to comply with the terms of an order
   ix. order filed in the court

7. Explain duties of commission officers.
    i. powers and duties of officers
    ii. procedure for examinations and inspections
    iii. orders given by officers orally or in writing
    iv. specifications of an order given by an officer to owner of the place of employment, employer, contractor, sub-contractor, employee, or supplier
    v. service of an order
    vi. prohibition of persons towards an officer in the exercise of his/her power or duties
    vii. rescinding of an order
    viii. posting a copy of the order
    ix. illegal removal of an order

8. Interpret appeals of others.
    i. allocated period of time for appeal of an order
    ii. person who may appeal order
    iii. action taken by Commission when person involved does not comply with the order
    iv. enforcement of the order
    v. notice of application
    vi. rules of court

9. Explain the process for reporting of accidents.
    i. application of act
    ii. report procedure
    iii. reporting notification of injury
    iv. reporting accidental explosion or exposure
    v. posting of act and regulations

Practical Requirements:

1. Conduct an interview with someone in your occupation on two or more aspects of the act and report results.

2. Conduct a safety inspection of shop area.

TS1520 Workplace Hazardous Materials Information System (WHMIS)

Learning Outcomes:

- Demonstrate knowledge of interpreting and applying the Workplace Hazardous Materials Information System (WHMIS) Regulation under the Occupational Health and Safety Act.

Duration: 6 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define WHMIS safety.
   - i. rational and key elements
   - ii. history and development of WHMIS
   - iii. WHMIS legislation
   - iv. WHMIS implementation program
   - v. definitions of legal and technical terms

2. Examine hazard identification and ingredient disclosure.
   - i. prohibited, restricted and controlled products
   - ii. classification and the application of WHMIS information requirements
   - iii. responsibilities for classification
     - the supplier
     - the employer
     - the worker - Classification: rules and criteria
     - information on classification
     - classes, divisions and subdivision in WHMIS
     - general rules for classification
     - class A - compressed gases
     - class B - flammable and combustible materials
     - class C - oxidizing material
     - class D - poisonous and infectious material
     - class E - corrosive material
     - class F - dangerously reactive material

iv. products excluded from the application of WHMIS legislation
- consumer products
- explosives
- cosmetics, drugs, foods and devices
- pest control products
- radioactive prescribed substances
- wood or products made of wood
- manufactured articles
- tobacco or products of tobacco
- hazardous wastes
- products handled or transported pursuant to the Transportation of Dangerous Goods (TDG) Act

v. comparison of classification systems - WHMIS and TDG
vi. general comparison of classification categories
vii. detailed comparison of classified criteria

3. Explain labeling and other forms of warning.
   i. definition of a WHMIS label
      - supplier label
      - workplace label
      - other means of identification
   ii. responsibility for labels
      - supplier responsibility
      - employer responsibility
      - worker responsibility
   iii. introduce label content, design and location
      - supplier labels
      - workplace labels
      - other means of identification

4. Introduce material safety data sheets (MSDS).
   i. definition of a material safety data sheet
   ii. purpose of the data sheet
   iii. responsibility for the production and availability of data sheets
      - supplier responsibility
      - employer responsibility
      - workers responsibility

Practical Requirements:

1. Locate WHMIS label and interpret the information displayed.

2. Locate a MSDS sheet for a product used in the workplace and determine what personal protective equipment and other precautions are required when handling this product.

TS1530 Standard First Aid

Learning Outcomes:

- Demonstrate knowledge of recognizing situations requiring emergency action.
- Demonstrate knowledge of making appropriate decisions concerning first aid.

Duration: 14 Hours

Pre-Requisite(s): None

Practical Requirements:

1. Complete a **St. John Ambulance or Canadian Red Cross** Standard First Aid Certificate course.

MS1230 Hand Tools

Learning Outcomes:

- Demonstrate an understanding of safety practices in the use and care of hand tools.
- Demonstrate the ability to select, operate and maintain hand tools properly.

Duration: 20

Pre-requisite(s):

TS1510	Occupational Health & Safety
TS1520	WHMIS
TS1530	Standard First Aid

Objectives and Content:

1. Describe hazards and safe work practices pertaining to the use of tools and equipment.

2. Describe and identify cutting and non-cutting hand tools.
    i. proper tool selection
    ii. open end, boxed end, and combination wrenches
    iii. pliers and their use
    iv. snips and their use
    v. screwdrivers and their use
    vi. ratchets, sockets and power bars
    vii. allen wrenches
    viii. torque wrenches and torque multipliers: hydraulic and mechanical
    ix. hammers
    x. hacksaws
        - blade selection
    xi. file types, sizes and selection
    xii. chisels and punches
    xiii. oil and honing stones
    xiv. scrapers

3. Explain two uses of arbour presses.
   i. arbour press classification
   ii. safe use
   iii. broach sets

4. Describe torque and its importance.
   i. definition of torque
   ii. purposes
   iii. torque wrench types
   iv. torque charts
   v. torque wrench adjustment
   vi. torque wrench accuracy

Practical Requirements:

1. Cut metal using a hacksaw.

2. Debur metal using proper file selection.

3. Cut metal using tin snips and chisels.

4. Torque bolts to specifications.

MW1240 Portable Power Tools

Learning Outcomes:

- Demonstrate an understanding of safe practices in the use and care of pneumatic and electric portable power tools.
- Demonstrate the ability to select, operate and maintain pneumatic and electric portable power tools properly.

Duration: 20 Hours

Pre-requisite(s): MS1230 Hand Tools

Objectives and Content:

1. Describe the procedures used to select the proper power tool for a specific task.
   i. proper tool selection based on job requirements
   ii. drill types and classification
   iii. portable grinders and grinding wheel types and classification
   iv. power screwdriver classification, and clutch mechanisms
   v. circular saw classification
   vi. reciprocating saw classification
   vii. pipe threading machines and their uses

2. Describe the procedures used to operate portable power tools.
   i. safe practices for the operation of shears, nibblers, drills, circular and reciprocating saws, power screwdrivers, grinders and impact tools
   ii. current flow through electric tools
   iii. over current protection and double insulated tools

3. Describe the procedures used to inspect and maintain portable power tools.
   i. operating principles of various electrical and pneumatic tools
   ii. proper methods of lubricating pneumatic tools
   iii. power cord inspection
   iv. airline inspection
   v. designed operating pressure
   vi. pressure loss in lines
   vii. filters, regulators and lubricators

4. Describe powder (explosive) actuated tools and their applications.
   i. power loads
   ii. fastener spacing
   iii. maintenance

Practical Requirements:

1. Replace a power cord on an electric portable tool.

2. Replace a disc on a portable grinder.

3. Replace power saw blades.

4. Operate power tools listed in objectives and content section.

5. Cut thread pipe.

MW1251 Blueprint Reading and Sketching

Learning Outcomes:

- Demonstrate an understanding of blueprint reading.
- Demonstrate the ability to make freehand sketches.
- Demonstrate the ability to extract pertinent information from basic blueprints.

Duration: 15 Hours

Pre-requisite(s): None

Objectives and Content:

1. Describe the principles of basic blueprint reading and the components involved.
   i. visualization
   ii. interpretation of the print

2. Describe the procedures used to develop freehand sketches.
   i. drawing production
   ii. accepted sketching methods
   iii. drawing to scale
   iv. proportion in sketching

3. Describe orthographic projection.
   i. definition of orthographic projection
   ii. projection and selection of views
   iii. rules of procedure for the visualization of objects
   iv. identification of lines and surfaces
   v. matching views
   vi. sketching orthographic views

4. Describe the use of different lines: visible, hidden, section, centre, dimension, extension, cutting plane, break and phantom lines.

5. Describe basic machining symbols used on blueprints.
   i. ANSI and ASME standards
   ii. welding/weld
   iii. surface finishes

6. Describe the methods of dimensioning.
   i. size and location dimensions
   ii. dimension and extension lines
   iii. placement of dimensions

7. Describe the procedures use to read drawings in order to extract relevant information.
   i. basis for interpreting drawings
   ii. sectional views
   iii. tolerances and allowances
   iv. removed and revolved sections
   v. inclined surfaces
   vi. circular features

8. Identify the functions of a CAD system.

Practical Requirements:

1. Develop freehand sketches as per instructor's directives.

2. Complete assignment drawings as per instructor's directives.

3. Operate a CAD system.

MW1261 Equipment Assembly Blueprints

Learning Outcomes:

- Demonstrate the ability to use blueprints to establish assembly procedures in order to install equipment and machinery.

Duration: 15 Hours

Pre-requisite(s): MW1251 Blueprint Reading and Sketching

Objectives and Content:

1. Identify the procedures used to interpret and use equipment assembly blueprints, to determine the assembly procedures for equipment components.
   - i. purpose of detail drawings
   - ii. purpose of assembly drawings
   - iii. sub-assembly, working assembly, diagram assembly, installation assembly and exploded pictorial assembly drawings
   - iv. identify terms used in dimensioning
   - v. identifying various types of dimensions
   - vi. identifying spur, bevel and worm gears
   - vii. identifying splines and serrations
   - viii. recognizing basic weld and welding symbols

2. Identify various views and their arrangement.
   - i. auxiliary views
   - ii. sectional views
   - iii. full, half, offset, aligned, broken out, revolved, removed, partial and outlined
   - iv. sections

3. Identify steel specifications found on the blueprints.
   - i. ANSI and ASME methods of identifying steel by code

Practical Requirements:

1. Interpret and use equipment assembly blueprints as per instructor s directives.

2. Complete assignment drawings as per instructor's directives.

MW1270 Mechanical Installation Blueprints

Learning Outcomes:

- Demonstrate the ability use mechanical drawings to determine the location, position and elevation of trade related pieces of equipment or one of its components.

Duration: 15 Hours

Pre-requisite(s): MW1261 Equipment Assembly Blueprints

Objectives and Content:

1. Identify the procedures used to read and interpret mechanical drawings to determine the location, the position and the elevation of various pieces of equipment, electrical components, mechanical components or piping components.
   i. purpose of blueprints
   ii. purpose of schematics
   iii. purpose of drawings
   iv. partial views and their uses
   v. piping components, valves and fittings
      - schematics and symbols

Practical Requirements:

1. Interpret and use mechanical blueprints to confirm equipment location and installation procedures.

MW1281 Schematics Advanced

Learning Outcomes:

- Demonstrate the ability to recognize schematic symbols for hydraulic and pneumatic systems.
- Demonstrate the ability to develop schematic drawings.
- Demonstrate the ability to use schematics to troubleshoot hydraulic and pneumatic systems.

Duration: 15 Hours

Pre-requisite(s): MW1251 Blueprint reading and sketching

Objectives and Content:

1. Identify schematic symbols found on drawings and describe their use in troubleshooting hydraulic and pneumatic systems.
   i. types and uses of schematic symbols

2. Identify schematic symbols.
   i. understand the language of schematic symbols
   ii. sequence of operation of a system
   iii. understand what the system is supposed to do
   iv. follow oil/air flow through various components
   v. understand systems using schematic symbols

Practical Requirements:

1. Develop a hydraulic schematic by hand or by computer.

MW1291 Rigging

Learning Outcomes:

- Demonstrate the ability to safely use different rigging apparatus to lift and move equipment and machinery.
- Demonstrate the ability to erect ladders and scaffolding.
- Demonstrate the ability to use safety harnesses.

Duration: 30 Hours

Pre-requisite(s): MW1240 Portable Power Tools

Objectives and Content:

1. Describe proper method of erecting and installing ladders.
   i. 100% tie off

2. Describe proper use of safety harnesses and lanyards.

3. Describe proper method of erecting scaffolding.
   i. limits in accordance with regulations
   ii. 100 % tie off

4. Identify and describe the types, construction and use of fibre rope.
   i. construction of wire rope
      - lays
      - cores
   ii. grades of wire rope
   iii. preformed wire rope
   iv. classification of wire rope
   v. wire rope size
   vi. fleet angles
   vii. lubrication of wire rope
   viii. storing and handling
   ix. determining rope anchorage on a drum
   x. natural fibre ropes
   xi. synthetic fibre ropes
   xii. fibre rope size

5. Identify safety factors pertaining to rigging.
    i. determine safe working loads of ropes and slings at various angles
    ii. determine weight of lifted objects
    iii. determine of gravity

6. Identify various types of knots used in rigging equipment for lifting or moving.
    i. figure eight knot
    ii. reef knot
    iii. bowline
    iv. bowline on the bight
    v. clove hitch
    vi. rolling hitch
    vii. sheep shank
    viii. sheet bend

7. Describe the procedures used to select the appropriate sling to perform a given task.
    i. single vertical hitch
    ii. bridle hitch
    iii. single and double basket hitch
    iv. single and double choker hitch
    v. endless slings
    vi. synthetic web slings
    vii. metal mesh slings
    viii. chain slings

8. Describe the procedure for lifting, moving and securing equipment.
    i. safety considerations
    ii. hand signals
    iii. jacks

9. Describe the procedures used to select and use various chain blocks and come-a-longs.
   i. blocks and block types
   ii. mechanical advantage
   iii. snatch blocks
   iv. chain hoists
   v. inspection of chain hoists
   vi. tirfor
   vii. jacks

10. Describe the different types of lifting accessories and their uses.
   i. poured sockets
   ii. wedge sockets
   iii. swaged sockets
   iv. cable clips
   v. thimbles
   vi. hooks
   vii. shackles
   viii. eye bolts
   ix. turnbuckles
   x. spreader and equalizer beams

11. Describe forklifts, mobile and overhead cranes and their uses.

Practical Requirements:

1. Erect ladders.

2. Erect scaffolding as per instructor's directives.

3. Demonstrate proper use of safety harnesses and lanyards.

4. Tie various types of knots used with rigging equipment.

5. Prepare rigging attachments for moving a piece of equipment and conduct safety inspection using hand signals.

6. Lift and move a piece of equipment using rigging methods and procedures, demonstrating hand signals.

7. Choose and install cable clips required to join a section of wire cable as listed in the manufacturer specifications.

MW1450 Drills, Taps, and Reamers

Learning Outcomes:

- Demonstrate the ability to operate and maintain drilling machines and reamers in a safe and efficient manner.
- Demonstrate the ability to sharpen twist drills.
- Demonstrate and understanding of proper speed and feed while using drilling machines and reamers.
- Demonstrate the ability to properly use dies.
- Demonstrate the ability to drill, ream, counter bore, countersink and tap hole.

Duration: 30 Hours

Pre-requisite(s): MW1240 Portable Power Tools

Objectives and Content:

1. Describe the different types of drilling machines and their uses.
   i. types and application of drilling machines

2. Identify accepted safety practices when operating drilling machines.

3. Describe the procedures used to calculate speeds and feeds for efficient drilling of different metals.
   i. definition of cutting speed
   ii. purpose of using recommended cutting speeds
   iii. factors governing cutting speeds
   iv. rpm
   v. definition of feed
   vi. expression of feed rates
   vii. feeds and feed charts

4. Describe the procedures used to select the proper cutting fluids used for machining various metals.
   i. purpose of cutting fluids
   ii. fluids for ferrous and non-ferrous metals

5. Describe the different parts of a twist drill and their purpose.
   i. shanks (straight and tapered)
   ii. body
      - flutes, margins, lands and cutting lips
   iii. point
      - cutting edge, heel, body clearance and chisel edge

6. Describe the procedures used to calculate the tap drill size using the formula.
   iv. purpose of the proper tap drill size
   v. tap drill formulas for imperial and metric sizes
   vi. tap drill charts

7. Describe the different taps in a set and the purpose of each.
   i. taper, plug and bottoming taps
   ii. tap extractors
   iii. tap handles
   iv. tapping procedures
   v. special tap attachments

8. Describe procedures to sharpen a twist drill for various materials.
   i. drill point characteristics
   ii. drill point angles for various materials
   iii. cutting lip length
   iv. web thickness
   v. clearance angles
   vi. chisel point
   vii. grinding procedures
   viii. web thinning
   ix. drill point angle measurement
   x. problems caused by improperly sharpened drills
   xi. relieving cutting for soft material

9. Describe the different types of threading dies.
   i. purpose of dies
   ii. solid die
   iii. adjustable split die
   iv. adjustable screw plate die
   v. die stocks
   vi. threading procedures

10. Describe the different types of hand and machine reamers and describe their purpose.
    i. purpose of reaming
    ii. solid hand reamer
    iii. expansion hand reamer
    iv. adjustable hand reamer
    v. taper reamers
    vi. straight and helical fluted reamers
    vii. rose reamers
    viii. shell reamers

11. Describe the procedures used to determine tolerances, speeds and feeds for reaming.
    i. reaming allowances for hand and machine reamers
    ii. cutting speeds for various metals
    iii. recommended feed rates for hand and machine reaming

12. Describe different types of drill bits and their purpose.
    i. straight and tapered shank twist drills
    ii. high helix drills
    iii. core drills
    iv. oil hole drills
    v. straight fluted drills
    vi. deep hole drills
    vii. spade drills
    viii. step drills
    ix. hole saws

13. Describe procedures to countersink, counterbore holes and spot face.
    i. purpose of countersinking and counterboring holes
    ii. counterbore styles
    iii. speeds and feeds procedures
    iv. countersink angles
    v. speeds and feeds for countersinking
    vi. spot facing

14. Describe pipe taps and dies and their uses.
    i. special tap attachments

Practical Requirements:

1. Drill, tap, ream, counter-bore and counter-sink holes as directed by the instructor.

2. Sharpen a twist drill at various angles.

3. Mix cutting fluids.

MW1460 Measuring and Layout

Learning Outcomes:

- Demonstrate the ability to make accurate measurements with precision and semi-precision measuring tools.

Duration: 60 Hours

Pre-requisite(s): MS1230 Hand Tools

Objectives and Content:

1. Identify measuring tools in the imperial and metric systems.
   - i. comparison and direct reading measuring tools
   - ii. fractional, decimal, and metric steel rules
   - iii. calipers
   - iv. micrometers
   - v. vernier calipers
   - vi. protractors
   - vii. dial indicators
   - viii. vernier height gauges
   - ix. surface places
   - x. squares
   - xi. small hole gauges
   - xii. telescoping gauges
   - xiii. dial bore gauges
   - xiv. gage blocks
   - xv. feeler gauges
   - xvi. universal bevel protractors
   - xvii. plug, ring and snap gauges
   - xviii. thread gauge

2. Describe the procedures used to select the appropriate layout tools needed to perform a layout for a specific job.
   - i. layout solutions
   - ii. layout tables
   - iii. surface plates

iv. scribers
v. combination sets
vi. hermaphrodite calipers
vii. dividers
viii. trammels
ix. prick and centre punches
x. angle plates
xi. parallels
xii. V-blocks
xiii. surface gauges

3. Describe the procedures used to accurately lay out straight and irregular profile lines.
   i. layout procedures

4. Describe the principles of operation that apply to precision measuring tools.
   i. principle of the imperial and metric micrometer
   ii. differences between imperial and metric micrometers
   iii. parts of the micrometer
   iv. inside, outside and depth micrometers
   v. vernier micrometer
   vi. adjusting micrometers
   vii. specialty micrometers
   viii. vernier calipers
   ix. parts of the vernier caliper

5. Describe the procedures used to properly store and maintain measuring and layout tools.
   i. calibration of precision measuring tools
   ii. sharpening of layout tools

Practical Requirements:

1. Perform several measuring tasks as directed by the instructor, using tools outlined in objectives and content section.

2. Lay out and fabricate a drill point gauge to specifications.

MW1621 Metal Lathe

Learning Outcomes:

- Demonstrate the ability to identify parts and accessories, calculate correct speeds and feeds, calculate thread depth, and perform turning, facing, and boring / threading operations.

Duration: 60 Hours

Pre-requisite(s): MW1450 Drills, Taps and Reamers

Objectives and Content:

1. Describe procedures to perform basic lathe functions such as turning, facing, boring and threading.
   - i. lathe size and capacity
   - ii. lathe parts and their function
     - bed
     - head stock
       - spindle
       - feed reverse lever
     - quick change gear box
       - top lever
       - tumbler lever
       - lead screw and feed rod
     - carriage
       - saddle
       - cross-slide and compound rest
       - apron hand wheel, automatic feed lever and
       - feed change lever
     - tailstocks
       - tailstocks clamp lever, spindle and spindle lock, offsetting screw and centre
   - iii. work holding devices
     - spindle nose types
     - lathe centres
     - jaw, 4 jaw, collett, magnetic chucks, face plates and lathe dogs

- mounting chucks
- mounting jaws in chucks
- mounting work in chucks
- trueing work in a 4 jaw chuck with a dial indicator
  - steady rest and follow rest

iv. cutting tool holders
- left and right hand offset tool holders
- parting tool holders
- boring bars
- standard tool post
- quick change tool holders

v. mounting, removing and aligning lathe centres
vi. facing and machining between centres and in chucks
vii. facing to accurate length
- rough and finish cut
- turning to a shoulder
- filing and polishing in a lathe
- knurling and form turning
- cutting off work in a chuck
- drilling, boring, reaming and tapping on the lathe

2. Describe the procedures used to calculate correct speeds and feeds.
   i. definition of speeds and feeds for lathes
   ii. formulas for speeds and feeds and depth of cut
   iii. sheer pins and slip clutches
   iv. graduated micrometer collars

3. Describe the procedures used to calculate thread depths and perform thread cutting operations.
   i. thread cutting on the lathe
   ii. terminology
   iii. thread forms
   iv. fits and classifications
   v. thread pitch and depth of cut calculations
   vi. thread chasing dial
   vii. set up procedures for thread cutting
   viii. thread cutting operations
   ix. resetting a threading tool
   x. thread measurement
   xi. multiple threads

4. Describe procedures to turn a taper.
    i. tapers and taper turning
    ii. types of tapers
    iii. taper calculations
    iv. taper turning methods
    v. tailstock offset, taper attachments and compound rest method

5. Describe a mandrel.

Practical Requirements:

1. Sharpen a tool bit.

2. Perform the following operations using a lathe:
    i. straight turning
    ii. facing
    iii. boring
    iv. threading
    v. taper

MW1630 Milling Machines

Learning Outcomes:

- Demonstrate the ability to calculate correct speeds and feeds, perform set up and safely, and execute basic milling operations.

Duration: 40 Hours

Pre-requisite(s): MW1621 Metal Lathe

Objectives and Content:

Identify safety hazards involved in operating a milling machine.

1. Describe the principles of operation of milling machines.
   i. horizontal and vertical milling machines
   ii. knee and column mills
   iii. parts of the milling machine
   iv. milling machine attachments
      - vertical milling attachment
      - slotting attachment
      - arbors, collets and adapters
      - vises

2. Describe the procedures used to perform calculations involved in using a milling machine.
   i. definition of speed and feeds
   ii. calculations for feed, speed and depth of cut
   iii. keyseat depth calculations

3. Describe set-up procedures.
   i. direction of feed
   ii. climb and conventional milling

4. Describe the procedures used to select cutters in order to perform specific tasks.
   i. plain mill cutters
   ii. face mill cutters
   iii. end mills
   iv. woodruff keyseat cutter
   v. fly cutters

5. Describe the procedures for centering cutters on shafts.

Practical Requirements:

1. Complete a project using a milling machine, as assigned by instructor.

MW1470 Piping Components

Learning Outcomes:

- Demonstrate the ability to thread, install and maintain pipes, tubing, valves and fittings.

Duration: 30 Hours

Pre-requisite(s): MW1460 Measuring and Layout

Objectives & Content:

1. Identify various types of pipe fittings that are related to the Industrial Mechanic (Millwright) occupation and their uses.
   i. pressure ratings for valves and fittings
   ii. pipe fittings and joints

2. Describe procedures to cut, thread and assemble pipe and tubing.
   i. pipe sizing methods
   ii. pipe hangers and supports
   iii. cutting, reaming and threading pipe
   iv. cutting fluids
   v. pipe thread sealants
   vi. tubing and tube fittings

3. Identify various types and uses of valves.
   i. identification of codes on valves and fittings
   ii. gate valves
   iii. globe valves
   iv. check valves
   v. needle valves
   vi. relief valves
   vii. steam traps purpose
   viii. steam separators
   ix. low pressure steam control valve
   x. ball valve

xi. butterfly
xii. diaphragm valves
xiii. wing valves
xiv. disk valves

4. Describe procedures to maintain valves.
   i. gate valves
   ii. globe valves
   iii. check valves
   iv. needle valves
   v. relief valves
   vi. steam traps
   vii. steam separators
   viii. low pressure steam control valve
   ix. ball valves
   x. butterfly valves
   xi. bypass valves

5. Describe electrolysis.

6. Describe the detrimental effect of electrolysis on piping.
   i. dissimilar piping
   ii. incompatible pipe hanger
   iii. underground installations of liquid and gas lines

Practical Requirements:

1. Fabricate a screwed piping project as per instructor's directives.

2. Repack a valve.

3. Cut, thread by hand and by machines.

4. Complete a flared tubing project.

5. Assemble and disassemble valves.

MW1511 Power Metal Saws

Learning Outcomes:

- Demonstrate the ability to cut metal with band, reciprocating and abrasive wheel cut off saws.
- Demonstrate the ability to maintain power metal saws.

Duration: 15 Hours

Pre-requisite(s): MW1460 Measuring and Layout

Objectives and Content:

1. Describe the procedures used to cut metal with a band saw.
   i. methods of cutting off material
   ii. saw types and operation
   iii. speeds and feeds
   iv. contour saw operations

2. Describe the procedures used to select the proper band saw blade for a specific task.
   i. saw blade classification
   ii. speeds and feeds
   iii. set
   iv. blade pattern
   v. pitch
   vi. tooth form
   vii. width and gauge
   viii. blade length calculations
   ix. blade installation

3. Describe the procedures used to weld band saw blades.
   i. blade preparation
   ii. machine settings
   iii. annealing

4. Describe the procedures used to cut metal with a reciprocating saw.
   i. blade classification
   ii. blade installation

5. Describe the procedures used to cut metal with an abrasive wheel cut off saw.
   i. theory of operation
   ii. wheel selection
   iii. safety hazard

6. Describe maintenance procedures for power metal saws.
   i. lubrication methods
   ii. coolant systems

Practical Requirements:

1. Cut metal with a band saw and/or cut metal with a reciprocating saw.

2. Cut metal with an abrasive wheel cut off saw.

3. Weld band saw blade.

4. Layout and use a contour saw to complete a project as assigned by the instructor.

MW1521 Pedestal Grinders

Learning Outcomes:

- Demonstrate the ability to operate and maintain pedestal grinders in a safe, efficient and responsible manner.

Duration: 15 Hours

Pre-requisite(s): MW1511 Power Metal Saws

Objectives and Content:

1. Describe the procedures used to select the proper type of wheel to grind a specific metal.
   i. theory of operation of pedestal grinders
   ii. abrasive types
   iii. bonds
   iv. coarse and fine wheels
   v. hard and soft wheels
   vi. mounted grinding wheels
   vii. rotary files and burrs

2. Describe the procedures used to change, mount and dress wheels on a pedestal grinder.
   i. safe dismantling procedures
   ii. blotters and flanges and their purpose
   iii. ring test
   iv. safe operating speeds for wheels
   v. dressing tools and their purpose
   vi. adjustment of tool rest

3. Identify the code systems found on grinding wheels.

4. Describe the techniques used to sharpen different tools.
   i. techniques for grinding chisels, twist drills and punches

Practical Requirements:

1. Inspect, dress and true a grinding wheel.

2. Sharpen a cold chisel.

3. Sharpen a twist drill.

4. Dismantle and replace a grinding wheel.

MW1530 Bearings

Learning Outcomes:

- Demonstrate the ability to select, install, remove and maintain bearings.
- Demonstrate an understanding of the purpose of different types of bearings and their proper uses.
- Demonstrate the ability to determine the proper clearance and fits for bearings.

Duration: 40 Hours

Pre-requisite(s): MW1580 Static and Dynamic Seals

Objectives and Content:

1. Identify the classification, uses, styles and purpose of friction bearings.
   - i. bearing housings
   - ii. dimensions of friction bearings
   - iii. styles of friction bearings
   - iv. joint design
   - v. liner materials
     - metallic and non-metallic liner material
     - babbitt
   - vi. keys
   - vii. mandrels
   - viii. pouring babbitt
   - ix. preformed liners
   - x. bushings
   - xi. thrust control
   - xii. Kingsbury thrust bearings
   - xiii. guide bearings

2. Describe friction bearing clearances and fits.
   - i. fitting process for contact
   - ii. chamfering, relieving and oil grooves
   - iii. clearance in a bearing
   - iv. shims

3. Describe the different types of anti-friction bearings (rolling elements) and their applications.
   i. basic parts of a bearing
   ii. common bearing types
   iii. rolling elements
   iv. shielded and sealed bearings
   v. types of load for bearings
   vi. service weight of a bearing
   vii. separable and non-separable bearings
   viii. non-aligning and self-aligning bearings
   ix. straight and tapered bore bearings

4. Describe the numbering and lettering in the bearing code.
   i. information supplied in the code
   ii. four and five figure codes and their meanings
   iii. code prefixes and suffixes and their meaning
   iv. codes for tapered bore bearings
   v. definition of bearing clearance terms

5. Describe the procedures to remove and install anti-friction bearings.
   i. shaft and housing checks
   ii. push fit
   iii. creep
   iv. interference fit
   v. examples of fits and clearances
   vi. press fits
   vii. procedures for pressing bearings on shafts
   viii. shrink fits
   ix. methods of heating and chilling a bearing
   x. installing a hot bearing
   xi. installing bearing outer rings in split or bored housings
   xii. axial positioning
   xiii. positive positioning of the inner race
   xiv. positive positioning of the outer race
   xv. floating and fixed bearings
   xvi. methods of thrust adjustment
   xvii. arrangement of angular contact bearings
   xviii. mounting spherical roller bearings
   xix. non-destructive bearing removal methods
   xx. withdrawal sleeves

xxi. adapter sleeves
xxii. destructive bearing removal methods
xxiii. hydraulic removal procedures
xxiv. pillow block installation and removal methods
xxv. mounting flange, needle and thrust bearings

6. Describe maintenance procedures for anti-friction bearings.
   i. keeping bearings clean
   ii. cleaning bearings
   iii. storing bearings
   iv. preventing contamination
   v. checking for bearing wear
   vi. checking for bearing failure
   vii. choosing correct lubrication
   viii. cooper split bearings

Practical Requirements:

1. Remove and install an anti-friction bearing.

2. Check a friction bearing for clearance.

3. Check a surface contact using machine blue.

4. Install and remove a taper bore bearing with taper lock.

MW1541 Fasteners

Learning Outcomes:

- Demonstrate the ability to select and install fastening devices.

Duration: 9 Hours

Pre-requisite(s): MS1230 Hand Tools

Objectives and Content:

1. Describe the types, sizes, classification and uses of threaded and non-threaded fastening devices.
   - i. purpose of threads
   - ii. screw thread terms and systems
   - iii. thread designation
   - iv. thread series
   - v. thread size
   - vi. thread measurement
   - vii. right and left hand threads
   - viii. nuts, bolts, cap screws and machine screws
   - ix. multiple threads keys
   - x. keyways
   - xi. splines
   - xii. class of fit
   - xiii. flat washers
   - xiv. lock washer styles and application
   - xv. lock nuts

2. Describe the procedures used to select the proper fastening device for use in metal, wood and concrete.
   - i. wood screw classification
   - ii. sheet metal screws
   - iii. self-drilling screws
   - iv. rivets
   - v. taper pins
   - vi. cotter pins

vii. dowel pins
viii. shear pins
ix. spring pins
x. clevis pins
xi. spring locking pins
xii. toggle bolt styles
xiii. expansion shields
xiv. concrete anchor types
xv. reasons for failure during installation
xvi. thread adhesives

3. Describe the procedures used to identify the grade of cap screws and nuts.
   i. classification methods for fasteners
   ii. tensile strength
   iii. grade markings

4. Describe the installation procedure for various fastening devices.
   i. threaded and non-threaded fasteners
   ii. hammer drill use
   iii. pop rivet installation
   iv. thread inserts
   v. broken stud removal methods
   vi. preloading fasteners
   vii. lock wires
   viii. resins

5. Describe the procedure to torque fastening devices to specifications.
   i. definition and purpose of torque
   ii. torque wrenches
   iii. torque multipliers
   iv. torque charts
   v. wet and dry torque
   vi. proper sequence

Practical Requirements:

1. Install various fastening devices
   i. threaded and non-threaded fasteners
   ii. hammer drill
   iii. pop rivet tools

2. Torque fastening devices as per instructor's directives.

3. Install fasteners using a powder (explosive actuated) actuated tool.

MW1550 Metallurgy

Learning Outcomes:

- Demonstrate an understanding of basic metallurgy principles.

Duration: 30 Hours

Pre-requisite(s): WD1330 Oxy-fuel Welding

Objectives and Content:

1. Identify and describe the various properties of metals.
   i. chemical, physical and mechanical properties
   ii. brittleness, ductility, elasticity, hardness, malleability, tensile strength and toughness

2. Identify the classification of steel and describe the numbering system for steel.
   i. hot rolled and cold rolled steel
   ii. alloy steels
   iii. plain, medium and high carbon steels
   iv. Identifying steel using the SAE and ANSI classification systems

3. Define heat treatment terms.
   i. definition of heat treatment
   ii. upper and lower critical temperature
   iii. critical range
   iv. hardening
   v. tempering
   vi. annealing
   vii. normalizing
   viii. case hardening
   ix. induction hardening
   x. flame hardening

4. Describe the properties and uses of various non-ferrous metals.
   i. definition of non-ferrous metals
   ii. aluminum

iii. copper and copper base alloys
iv. lead and lead based alloys
v. tin and tin alloys
vi. zinc
vii. leaded bronzes
viii. Babbitt
ix. magnesium

5. Define terms and describe methods and procedures used in hardness testing.
   i. definition of hardness
   ii. Rockwell Hardness Tester
   iii. Brinnell Hardness Tester
   iv. conversion charts

6. Identify structural steel shapes and how they are sized.
   i. angle iron
   ii. flat bar
   iii. channel
   iv. I beam
   v. H beam
   vi. structural tubing
   vii. sheet stock
   viii. expanded metal
   ix. perforated metal
   x. checker plate

Practical Requirements:

1. Fabricate, heat treat and sharpen a cold chisel as per instructor s directives.

2. Perform a hardness test.

3. Perform a spark test analysis.

MW1580 Static and Dynamic Seals

Learning Outcomes:

- Demonstrate the ability to select, install, remove and maintain gaskets, seals and packing.
- Demonstrate an understanding of different types of gaskets, seals and packing and identify their proper use.

Duration: 30 Hours

Pre-requisite(s): MW1650 Lubrication Practices

Objectives and Content:

1. Describe hazards and safe work practices pertaining to seals and gaskets.

2. Describe the principles of operation and classification of static and dynamic seals.
   - i. definition of static and dynamic seals
   - ii. using gaskets to seal housings
   - iii. gasket and flange arrangements
   - iv. gasket compression
   - v. O-rings used as gaskets
   - vi. dynamic seals
   - vii. contact and clearance seals
   - viii. packing
   - ix. inside and outside packed installations
   - x. compression packing removal and installation methods
   - xi. lantern rings
   - xii. V-ring packing uses, installation and adjustment procedures
   - xiii. U-ring packing uses, installation procedures
   - xiv. cup packing uses and installation procedures
   - xv. O-rings used as dynamic seals
   - xvi. anti-extrusion rings
   - xvii. piston rings
   - xviii. lip seal
     - inclusion and exclusive

- installation procedures

xix. inclusion and exclusion seals
xx. lip seal installation procedures
xxi. emergency shaft repairs
xxii. wipers, boots, bellows and diaphragm seals
xxiii. mechanical seal theory of operation
xxiv. flushing and quenching mechanical seals
xxv. mechanical seal maintenance
xxvi. bushings
xxvii. annulus, slinger and labyrinth seals

3. Describe the procedures used to select the proper sealant for different applications.
   ii. definition of sealants
   iii. hardening and non-hardening sealants
   iv. tapes

4. Describe the procedures used to select the proper gasket material for specific applications.
   ii. requirements of gasket materials
   iii. metallic and non-metallic gaskets
   iv. making and installing gaskets

5. Describe the procedures used to inspect, remove, and replace gaskets, seals and packing.

Practical Requirements:

1. Make a gasket using gasket material and hand tools.

2. Remove and install
   ii. a mechanical seal
   iii. static seal
   iv. dynamic seal

3. Fabricate an O-ring.

MW1591 Couplings and Clutches

Learning Outcomes:

- Demonstrate the ability to remove, install and maintain couplings and clutches.
- Demonstrate an understanding of the different types of couplings and clutches and their proper use.

Duration: 20 Hours

Pre-requisite(s): MW1640 Gear Drive Systems

Objectives and Content:

1. Describe the theory of operation of various types of couplings and clutches.
   i. purpose of couplings
   ii. types of couplings
   iii. purpose of clutches

2. Identify the various types of couplings and explain their application.
   i. rigid couplings
   ii. sleeve, flanged, compression and clamp couplings
   iii. flexible coupling
   iv. mechanically flexible couplings
   v. jaw and slider, gear, chain, metallic grid and metallic disc couplings
   vi. elastomeric couplings
   vii. jaw, clamped and unclamped doughnut, rubber tire and bushed pin couplings
   viii. failure of flexible couplings
   ix. universal joints
   x. centrifugal couplings
   xi. clutch style couplings
   xii. fluid couplings
   xiii. dry fluid couplings
   xiv. clutches and brakes
   xv. mechanical clutches: positive contact, friction, and over-running
   xvi. disc clutches and brakes
   xvii. torque limiting clutch

xviii. drum clutches and brakes
xix. cone clutches and brakes
xx. over-running clutches
xxi. sprag, wrap spring, roller ramp types
xxii. electromagnetic clutches and brakes
xxiii. actuation methods for clutches and brakes
xxiv. mechanical, electrical, pneumatic, hydraulic and self-activating

3. Describe the procedures used to select the proper lubrication for the various clutches and couplings.
   i. types of couplings that require lubrication
   ii. lubricant choice criteria

Practical Requirements:

1. Broach a keyway in a hub and fit a key in the keyway.

2. Install a coupling or a clutch.

MW1360 Shafts and Shaft Alignment

Learning Outcomes:

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

Duration: 20 Hours

Pre-requisite(s): None

Objectives and Content:

1. Identify the different types of keys and keyways and their purpose.
   - ii. types and purpose of keys
     - parallel keys
     - square and rectangular keys
     - stepped keys
     - saddle keys
     - boxed keys
     - gib headed keys
     - tapered keys
     - woodruff keys
   - iii. ANSI code numbering system for woodruff keys
   - iv. keyseats in shafts
     - parallel and boxed keyseats
   - v. measurement of keyseats and keys
     - woodruff keyseats
   - vi. keyways in attachments
   - vii. tapered key
   - viii. cutting keyseats
     - end mills
     - broach and arbor press
   - ix. installing and fitting keys
   - x. securing keys with adhesives and setscrews
     - types of set screws for various applications
     - set screw location

xi. types of adhesive
xii. removing keys

2. Describe the specific use of various types of shafts and attachments.
   ii. terms and definitions relating to shafts
   iii. types of shafting
   iv. uses of shafts
   v. identifying shafting
   vi. shaft stresses and their sources
   vii. stress reduction
   viii. bearing replacement
   ix. shaft maintenance
      - alignment
      - shaft centres
      - critical speed
      - types of run-out
      - shaft repair methods
   x. shaft attachment
      - bearings, hubs, couplings and gears
   xi. installing attachments
   xii. definition of tolerances and fits
      - types of tolerance
      - types of fit
      - methods of assembly
      - shrink, forced and expansion fitting
   xiii. assembly and disassembly equipment
      - presses
      - pullers and bearing splitters

3. Identify the different types of misalignment.
   i. parallel
   ii. angular
   iii. combination

4. Describe pre-alignment checks.

5. Describe soft foot.

6. Describe the procedure to align a coupling using a straight edge and feeler gauges.

Practical Requirements:

1. Perform alignment using straight edge and feeler gauges.

MW1610 Belt and Chain Drive Systems

Learning Outcomes:

- Demonstrate an understanding of the operation of belt and chain drive systems.
- Demonstrate the ability to install and maintain belt and chain drive systems.

Duration: 45 Hours

Pre-requisite(s): MW1530 Bearings
MW1360 Shafts and Shaft Alignment

Objectives and Content:

1. Describe the principles of operation of belt and chain drive systems.
   - i. belt drive principles
   - ii. area of contact
   - iii. belt and pulley materials
   - iv. definition of installed and effective tension
   - v. methods for checking tension
   - vi. slip and creep in belts
   - vii. v-belt advantages and construction
     - standard, heavy duty and double angle belts
     - straight and concave sidewalls
     - notched belt
     - endless and joined belts
   - viii. pulleys and sheaves
     - diameters and rim speed
   - ix. idler purpose and location
   - x. pulley and sheave hubs
   - xi. determining pulley width

2. Describe the various classifications of belts and chains.
   - i. v-belt types, sizes and codes
     - conventional and high capacity belts
     - light duty and double angle belts
     - wide belts
     - positive drive belts

- linked belts
- poly belts
- power band belts
- matched belts

ii. crowned and flanged pulleys
iii. V-flat drives
iv. variable speed belt drives
- adjustable and fixed centres
- sheave action

v. chain drive components
- types of links
- standard roller chain
- connecting links
- offset links

vi. definition of roller chain dimensions
- pitch, width, roller and pin diameter, and link plate thickness

vii. roller chain code numbers
- ANSI code number interpretation
- ISO code numbers

viii. types of roller chain and their application
- multiple strand chain
- double pitch chain
- silent chain

ix. sprocket types and their application
- type A, B, C, and D sprockets
- sprocket sizing
- sprockets for double pitch chain
- single and double cut sprockets

x. advantages of roller chain drives
xi. drive design
- shaft centre distances
- drive and driven sprockets

xii. determining proper amounts of chain slack for horizontal and vertical drives
xiii. idler sprocket purpose and location

3. Describe the procedures used to perform calculations required for the installation and maintenance of belt and chain drive systems.
   i. approximate and exact belt length calculations
   ii. arc of contact calculations

iii. recommended speed ratios for sheaves and sprockets
iv. rim speed calculation for belt drives
v. chain pitch, width, roller and pin diameter calculations
vi. calculating chain length in inches and pitches
vii. chain speed calculations

4. Describe the procedures to remove, install and align sheaves and sprockets.
   i. installation and alignment methods
   ii. belt storage
   iii. sheaves for V-belts
   iv. groove angle
   v. troubleshooting belt drives
   vi. aligning shafts and sprockets for chain drives
   vii. roller chain lubrication
      - oil grades
      - lubrication methods
   viii. chain drive misalignment
   ix. chain wear due to stretch and pin wear
   x. sprocket wear
   xi. causes of excessive slack
   xii. procedures for roller chain replacement
      - sprocket condition
      - new chain length
      - breaking and joining the chain
   xiii. troubleshooting tips for chain drives
   xiv. chain maximum speed

Practical Requirements:

1. Remove, install and align v-belts, sheaves and chain, sprockets.

MW1640 Gear Drive Systems

Learning Outcomes:

- Demonstrate the ability to calculate correct speeds and feeds.
- Demonstrate the ability to perform repair and maintenance on gear drive units.
- Demonstrate the ability to operate gear drive units.

Duration: 50 Hours

Pre-requisite(s): MW1610 Belt and Chain Drive Systems

Objectives and Content:

1. Describe principle of operation of gear drive units.
    - i. purpose of gears
    - ii. gear terminology
        - addendum and dedundum
        - circular pitch and diametral pitch
        - working depth and clearance
    - iii. conditions for gear meshing
    - iv. tooth profile and action
    - v. backlash
    - vi. gear material
    - vii. shaft arrangement
    - viii. gear types
        - internal and external spur gears
        - helical gears
            - single and double helical gears
            - left and right hand gears
            - thrust
        - girth gears
    - ix. bevel and angular and spiral bevel gears
        - mounting distance
    - x. mitre gears
    - xi. hypoid gears
    - xii. worm and worm gears

- non-throated, single and double throated worm and worm gear sets

xiii. gear types and shaft arrangements

2. Describe the procedures used to perform gear calculations.
   i. formulas used for drive system calculations
      - speed of driver or driven
      - calculating for reducer ratio
      - single and compound gear reductions

3. Describe speed reducers of their various designs, their uses and their operation.
   i. overdrive and reduction units
      - PIV drives
      - worm gear reduction units
        - internal parts and their purpose
        - shimming for bearing clearance
        - fitting for proper mesh
        - single and multiple reduction and recommended speed ranges for each
      - helical and herringbone reducers
        - fitting
      - planetary gear reduction units
        - sun gears, ring gear and carrier
      - installing and maintaining drive units
      - lubrication methods used in reducers

4. Describe the procedures used to commission gear drives.

Practical Requirements:

1. Dismantle, inspect and reassemble speed reducers to specifications.

MW1650 Lubrication Practices

Learning Outcomes:

- Demonstrate the ability to select the proper lubricant and lubrication methods and apply proper lubricants where required.

Duration: 20 Hours

Pre-requisite(s): MS1230 Hand Tools

Objectives and Content:

1. Identify the purpose and use of lubricants.
   i. sliding, rolling and fluid friction

2. Define lubrication related terminology.
   i. boundary and full film lubrication
   ii. hydraulic lock

3. Describe various lubrication systems.
   i. once through lubricating systems
   ii. enclosed lubricating systems
      - ring oiler lubrication
      - splash lubrication
      - oil bath lubrication
      - recirculating lubrication
      - pressurized system
      - oil mist lubrication
   iii. visual oil quality checks
   iv. pour point and flash point

4. Describe different properties of lubricants.
   i. adhesion and cohesion
   ii. oiliness
   iii. viscosity and its effects on lubrication
   iv. viscosity measurement
   v. viscosity index

vi. oil wedge theory of lubrication
vii. additives and inhibitors
- air, water and load capacity control

viii. properties of grease
ix. grease types
- simple, mixed and complex soap greases
- extreme pressure grease

x. penetration numbers for grease
xi. dropping point
xii. grease lubricating systems
- hand packing bearings
- greasing with a grease gun
- greasing with a spring compression cup
- automatic lubricators
- lubricating open and enclosed gears

xiii. oil and grease comparison
xiv. cutting oils
xv. safe storage handling and disposal of lubricants

5. Identify the classifications of lubricants and their specific uses.

6. Describe the procedures used to select the proper lubricant for specific applications.
   i. technical manuals
   ii. manufacturers specifications

Practical Requirements:

1. Apply the proper lubricant for a specific application.

2. Repack a bearing.

3. Drain and refill an oil reservoir according to manufacturer's specifications.

MW1670 Non-Positive Displacement Pumps

Learning Outcomes:

- Demonstrate the ability to inspect, maintain, repair and assemble non-positive displacement pumps.

Duration: 40 Hours

Pre-requisite(s): MW1591 Coupling and Clutches

Objectives and Content:

1. Identify and describe the parts of dynamic pumps and their purpose.
   i. casing styles
   ii. impeller styles
   iii. stuffing box
   iv. packing
   v. mechanical seals
   vi. shaft sleeves
   vii. packing glands
   viii. wear rings and plates
   ix. suction strainer

2. Describe the principles of operation of centrifugal pumps.
   i. non-positive displacement pump theory
   ii. pump types and their use
   iii. centrifugal and axial flow
   iv. terms and definitions
   v. volute and diffuser pumps
   vi. multi-stage pumps and their purpose

3. Identify the different terms associated with the operation of the pump.
   i. pump head
   ii. suction head
   iii. suction lift
   iv. velocity head
   v. internal and external sealing

vi. slip
vii. displacement
viii. pump speed (rpm)
ix. pump capacity
x. outlet pressure
xi. discharge head
xii. total static head
xiii. operating life

4. Describe the procedures used to troubleshoot and correct problems encountered with pumps.
   i. vapour binding
   ii. cavitation
   iii. failure to deliver product
   iv. reduced capacity or pressure
   v. pump vibration
   vi. casing wear/damage
   vii. excessive packing wear
   viii. over speeding
   ix. storage requirements
   x. start-up and shut-down procedures

5. Describe procedures to disassemble, inspect, repair and reassemble centrifugal pumps.
   i. pump isolation and lock out
   ii. pump casings
   iii. impeller design and mounting
   iv. wear rings and plates
   v. hydraulic balancing devices
   vi. seals and packing
   vii. bearings

Practical Requirements:

1. Disassemble, inspect, repair and reassemble centrifugal pumps.

MW1690 Positive Displacement Pumps

Learning Outcomes:

- Demonstrate the ability to inspect, maintain, repair, and assemble positive displacement pumps.

Duration: 40 Hours

Pre-requisite(s): MW1670 Non-Positive Displacement Pumps

Objectives and Content:

1. Describe the principles of operation of a positive displacement pump.
   - i. theory of operation of positive displacement pumps
   - ii. classification and uses of positive displacement pumps
   - iii. volumetric efficiency
   - iv. positive displacement
   - v. variable displacement
   - vi. pressure, volume, velocity
   - vii. pressure compensation
   - viii. valve operation
   - ix. determine capacity

2. Describe the different types of positive displacement pumps.
   - i. plunger and piston pumps
   - ii. diaphragm pumps
   - iii. metering pumps
   - iv. rotary pumps
   - v. axial and radial piston pumps
   - vi. gear and vane pumps
   - vii. cavitation
   - viii. pump calibration
   - ix. storage requirements
   - x. gear backlash

3. Identify safety precautions when working with positive displacement pumps.
   i. achieve zero energy state
   ii. pressure relief valves
   iii. accumulators

4. Identify parts of the pump and state their purpose.
   i. packing and seals

5. Describe the procedures used to troubleshoot and repair common positive displacement pumps.
   ii. external leakage
   iii. pressure and flow loss
   iv. noisy pump operation
   v. describe start up and shut down procedures
      - checking for rotation
      - priming
      - checking for proper operating temperature
      - draining before maintenance

6. Describe the procedures used to maintain positive displacement pumps.
   i. dismantling procedures
   ii. visual inspection
   iii. packing procedures

Practical Requirements:

1. Disassemble, inspect, reassemble and align positive displacement pumps.

2. Troubleshoot problems with positive displacement pumps.

MW1730 Electrical Fundamentals

Learning Outcomes:

- Demonstrate an understanding of basic electrical principles.
- Demonstrate an understanding of basic PLC s (Programmable Logic Controllers).
- Demonstrate an understanding of the Provincial Public Safety Act as it relates to electrical work.

Duration: 30 Hours

Pre-requisite(s): MW2150 Hydraulics I

Objectives and Content:

1. Define electron theory, Ohms Law and associated formulae.

2. Define electrical terminology.
   - i. cycle
   - ii. hertz
   - iii. wattage
   - iv. AC voltage
   - v. AC current
   - vi. ampere
   - vii. resistance
   - viii. ohm
   - ix. DC voltage
   - x. DC current
   - xi. Circuits
     - series
     - parallel
     - series parallel

3. Describe the characteristics of conductors and insulators and their applications.

4. Describe the causes of excessive current.

5. Describe overload protection circuits.

6. Describe the procedures used for troubleshooting and repair of electric motors.

7. Describe procedures to follow when using a multi meter.

8. Describe and identify basic PLC's.
   i. introduction to PLC's
   ii. fundamentals

Practical Requirements:

1. Write a synopsis of the Public Safety Act as it relates to electrical work.

MW2150 Hydraulics I

Learning Outcomes:

- Demonstrate an understanding of basic hydraulic principles of operation and hydraulic formulae.
- Demonstrate the ability to identify components, parts and accessories.

Duration: 30 Hours

Pre-requisite(s): MW1690 Positive Displacement Pumps

Objectives and Content:

1. Describe Pascal's Law as it applies to hydraulics.
   i. pressure
   ii. force
   iii. area
   iv. work and power
   v. horsepower and torque

2. Describe Bernoulli's Principle as it applies to hydraulics.
   i. velocity
   ii. pressure drop and flow

3. Describe the procedures used to solve problems using hydraulic formulas.
   i. force, pressure and area formula
   ii. cylinder rod speed formula
   iii. sizing hydraulic reservoirs
   iv. mechanical advantage

4. Identify the basic components used to make up a hydraulic system.

5. Describe the operation of various components used in hydraulic systems and safety considerations that would apply to them.
   i. reservoirs
   ii. hydraulic fluid
   iii. piping and sealing

iv. pumps
v. cylinders
vi. filters and strainers
vii. motors
viii. accumulators
ix. intensifiers
x. pressure switches
xi. hydraulic hose and fittings
xii. pipe and tubing
xiii. solenoids
xiv. cavitation
xv. deceleration valves
xvi. relief valves
xvii. schematics
xviii. poppet valves
xix. gauges and flow meters
xx. counterbalance valves
xxi. heat exchangers
xxii. flow control valves
xxiii. actuator rods and pistons
xxiv. sequence valves

Practical Requirements:

1. Build a simple hydraulic circuit as per instructors' specifications.

WD1330 Oxy-Fuel Welding

Learning Outcomes:

- Demonstrate the ability to operate oxy-fuel equipment to cut metals, perform basic welding procedures, and perform basic brazing and soldering procedures.

Duration: 30 Hours

Pre-requisite(s): MS1230 Hand Tools

Objectives and Content:

1. Describe the purpose of various safety devices and the precautions to follow when using oxy-fuel equipment.
   - i. safety
     - transportation of oxy-fuel equipment
     - handling and storage
     - operating pressure
   - ii. regulators and gauges (single stage and two stage)
   - iii. fusible plugs
   - iv. flashback arresters
   - v. properties of oxygen and fuel

2. Describe proper procedures to set up oxy-fuel equipment.
   - i. regulator installation
     - left and right hand threads
     - hazards of oil or grease in contact with oxy-fuel equipment
   - ii. different gases
   - iii. securing cylinders
   - iv. proper order of operations when opening cylinder valves
   - v. proper regulator adjustment

3. Describe the procedures used to select the proper tips for various cutting and welding jobs on different metals.
   - i. numbering system for tips
   - ii. heating tips

4. Describe the procedures used to perform basic burning operations using oxy-fuel equipment.
   i. safety hazards present when using oxy-fuel equipment
   ii. check torch valves and regulator pressure screws
   iii. open cylinder valves and adjust regulator pressures
   iv. checking for leaks
   v. torch lighting procedures
   vi. types of oxy-acetylene flames and their purpose
      - proper torch use

5. Describe brazing techniques.
   i. brazing rods
   ii. purpose of fluxes and pastes

6. Describe soldering techniques.
   i. soft solder
   ii. purpose of fluxes and pastes

7. Describe procedures for cutting metal with oxy-fuel equipment.

8. Describe procedures to prepare a hot work permit.

Practical Requirements:

1. Properly set up oxy-acetylene equipment for the purpose of cutting metal.

2. Perform cutting operations and shut down equipment.

3. Solder a cap on the end of a copper pipe.

4. Braze a lap joint.

5. Prepare a hot work permit.

OT1150 Workplace Exposure

Learning Outcomes:

- Demonstrate knowledge of theory and practical application of trade skills, safe work practices, appropriate workplace behaviour, and time management through exposure to the trade in an authentic work environment.

NOTE: The pre-apprentice must be supervised at the workplace. Supervision staff must be appropriately qualified to undertake that role – preferably a certified Journeyperson for the trade.

Duration: 80 Hours

Pre-requisite(s): None

AP1101 Introduction to Apprenticeship

Learning Outcomes:

- Demonstrate knowledge of how to become a registered apprentice.
- Demonstrate knowledge of the steps to complete an apprenticeship program.
- Demonstrate knowledge of various stakeholders in the apprenticeship process.
- Demonstrate knowledge of the Red Seal Program.

Duration: 15 Hours

Pre-Requisite(s): None

Objectives and Content:

1. Define the following terms:
   i. apprenticeship
   ii. apprentice vs. registered apprentice
   iii. Journeyperson vs. Certified Journeyperson
   iv. Certificate of Apprenticeship
   v. Certificate of Qualification
   vi. Recognition of Prior Learning
   vii. dual certification

2. Explain the apprenticeship system in Newfoundland and Labrador and the roles and responsibilities of those involved.
   i. registered apprentice
   ii. training institution
   iii. employer
   iv. Journeyperson
   v. Department of Advanced Education and Skills
      - Industrial Training Section
      - Standards and Curriculum Section
   vi. Provincial Trade Advisory Committees
   vii. Provincial Apprenticeship and Certification Board

3. Identify the Conditions Governing Apprenticeship.

4. Describe the training and educational requirements.
   i. pre-employment (entry level) training
   ii. block release
   iii. on-the-job

5. Explain the steps in the registered apprenticeship process.
   i. criteria for eligibility
      - entrance requirements as per Conditions of Apprenticeship
      - employment
   ii. registration process
      - application requirements
   iii. Memorandum of Understanding
      - probation period
      - cancellation
   iv. Record of Occupational Progress (Logbook)
      - signing off skills
      - recording hours
      - updating PDO on progress
   v. class calls
      - schedule
      - EI Eligibility
      - Direct Entry
      - advanced level
   vi. Block Exams
   vii. progression
      - schedule
      - wage rates
   viii. cancellation of apprenticeship
   ix. Practical Examinations
   x. Provincial and Interprovincial examinations
   xi. certification
      - Certification of Apprenticeship
      - Certification of Qualification
      - Provincial certification
      - Interprovincial Red Seal endorsement

6. Explain the Interprovincial Standards Red Seal Program.
   i. designated Red Seal trade
   ii. the National Occupational Analysis (NOA)
   iii. Interprovincial (IP) Red Seal Endorsement Examination
   iv. relationship of NOA to IP Examination
   v. qualification recognition and mobility

7. Identify the current financial incentives available to apprentices.

8. Explain the NL apprenticeship and trades certification division's out-of- province apprenticeship policy.

Practical Requirements:

1. Use the Provincial Apprenticeship and Trades Certification web site at www.gov.nl.ca/app to:
   i. locate, download, and complete the Application for Apprenticeship and Memorandum of Understanding (MOU)
   ii. locate, download, and complete the Out of Province registration forms
      - Application for Apprenticeship (out of province)
      - Letter of Understanding (LOU)
      - Acceptance of Conditions Letter
   iii. locate, download, and complete the Work Experience Credits form
   iv. identify the locations of all Industrial Training offices
   v. locate and review the following learning resources relevant to the trade:
      - Study Guide
      - Exam Preparation Guide
      - Plan of Training

2. Use a logbook for this trade to:
   i. identify the hours for the trade (in-school and on-the-job)
   ii. identify the number of blocks
   iii. identify the courses in each block
   iv. identify the workplace skills to be completed and verified

3. Use the Red Seal Web site, http://www.red-seal.ca to retrieve the National Occupational Analyses (NOA) for this trade.
   i. identify the following components of the NOA:
      - Trends
      - Scope
      - Key Competencies
      - Blocks
      - Tasks
      - Subtasks
      - Pie Charts
      - Table of Specifications

AM1100 Math Essentials

Note: It is recommended that AM1100 be delivered in the first semester of the Entry Level training program.

Learning Outcomes:

- Demonstrate knowledge of the numeracy skills required to begin the 2nd level math course.
- Demonstrate knowledge of mathematics as a critical element of the trade environment.
- Demonstrate knowledge of mathematical principles in trade problem solving situations.
- Demonstrate the ability to solve simple mathematical word problems.

Duration: 30 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor should use trade specific examples to reinforce the course objectives

1. Use multiplication tables from memory.

2. Perform whole number operations.
   i. read, write, count, round off, add, subtract, multiply and divide whole numbers

3. Apply the order of operations in math problems.

4. Perform fraction and mixed number operations.
   i. read, write, add, subtract, multiply and divide fractions

5. Perform decimal operations.
   i. read, write, round off, add, subtract, multiply and divide decimals

6. Perform percent/decimal/fraction conversion and comparison.
   i. convert between fractions, decimals and percentages

7. Perform percentage operations.
   i. read and write percentages
   ii. calculate base, rates and percentages

8. Perform ratio and proportion operations.
   i. use a ratio comparing two quantities with the same units
   ii. use a proportion comparing two ratios

9. Use the imperial measurement system in math problems.
   i. identify units of measurement for:
      - length
      - mass
      - area
      - volume
      - capacity

10. Use the metric measurement system in math problems.
    i. identify units of measurement for:
       - length
       - mass
       - area
       - volume
       - capacity

Practical Requirements:

1. To emphasize or further develop specific knowledge objectives, students will be asked to complete practical demonstrations which confirm proper application of mathematical theory to job skills.

AM1180 Industrial Math Fundamentals

Learning Outcomes:

- Demonstrate knowledge of mathematical concepts in the performance of trade practices.
- Demonstrate knowledge of mathematics as a critical element of the trade environment.
- Demonstrate knowledge of solving mathematical word problems.
- Demonstrate knowledge of mathematical principles for the purposes of problem solving, job and materials estimation, measurement, calculation, system conversion, diagram interpretation and scale conversions, formulae calculations, and geometric applications.

Duration: 30 Hours

Pre-Requisite(s): AM1100

Objectives and Content:

The instructor is required to use trade specific examples to reinforce the course objectives.

1. Employ percent/decimal/fraction conversion and comparison in trade specific situations.

2. Apply ratios and proportions to trade specific problems.

3. Use the Imperial Measurement system in trade specific applications.

4. Use the Metric Measurement system in trade specific applications.

5. Complete Imperial/Metric conversions in trade specific situations.
   i. convert between imperial and metric measurements
   ii. convert to another unit within the same measurement system

6. Manipulate formulas using cross multiplication, dividing throughout, elimination, and substitution to solve trade specific problems, such as:
   i. right angle triangles
   ii. area
   iii. volume
   iv. perimeter

7. Perform calculations involving geometry that are relevant to the trade, such as:
   i. angle calculations
   ii. circle calculations

8. Use practical math skills to complete administrative trade tasks.
   i. material estimation
   ii. material costing
   iii. time & labour estimates
   iv. taxes & surcharges
   v. markup & projecting revenue

Practical Requirements:

1. To emphasize or further develop specific knowledge objectives, students will be asked to complete practical demonstrations which confirm proper application of mathematical theory to job skills.

Note:

This course has been designated as NON-TRANSFERABLE to other trades programs, and NOT ELIGIBLE FOR PRIOR LEARNING ASSESSMENT. Students completing training in this trade program are required to complete this math course.

CM2160 Communication Essentials

Learning Outcomes:

- Demonstrate knowledge of the importance of well-developed writing skills in the workplace and in career development.
- Demonstrate knowledge of the purpose of various types of workplace correspondence.
- Demonstrate knowledge of the principles of effective workplace writing.
- Demonstrate knowledge of standard formats for letters and memos.
- Demonstrate knowledge of principles related to writing effective letters and memos.
- Demonstrate the ability to prepare and deliver an oral presentation.
- Demonstrate knowledge of the importance of effective interpersonal skills in the workplace.

Duration: 45 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor is expected to use trade specific examples to reinforce the course objectives.

1. Identify the principles for writing clear, concise, complete sentences and paragraphs which adhere to the conventions of grammar, punctuation, and mechanics.

2. Identify the principles of effective workplace writing.
   i. describe the value of well-developed writing skills to career success
   ii. discuss the importance of tone, and language or word choice in workplace communication, regardless of the circumstances
   iii. demonstrate an awareness of cultural differences when preparing workplace correspondence
   iv. describe the writing process as it applies to workplace communication
      - planning
      - writing

- editing/revising

v. identify the parts of a business letter and memo, and when each should be used in the workplace

vi. identify the standard formats for business letters and memos

vii. identify guidelines for writing sample letters and memos which convey:

- acknowledgment
- routine request
- routine response
- complaint
- refusal
- persuasive request
- letters of appeal

3. Identify types of informal workplace documents.

i. identify types & purposes of reports

- incident
- process
- progress

ii. identify common trade specific forms

iii. describe primary and secondary methods used to gather information

iv. discuss the importance of accuracy and completeness in reports and forms

4. Identify the elements of presentations used in the workplace.

i. identify presentation types

- impromptu
- informative
- demonstration
- persuasive

ii. identify the components of an effective presentation

- eye contact
- body language
- vocal qualities
- audience analysis
- multimedia tools
- keeping on topic

5. Demonstrate an understanding of interpersonal communications in the workplace.
   i. identify listening techniques
   ii. demonstrate an understanding of group dynamics
   iii. describe the importance of contributing information and expertise in the workplace
   iv. describe the importance of respectful and open communication in the workplace
   v. identify methods to accept and provide feedback in a constructive and considerate manner
   vi. explain the role of conflict in a group to reach solutions

6. Identify acceptable workplace uses of communication technologies.
   i. cell / Smart Phone etiquette
   ii. voice mail
   iii. e-mail
   iv. teleconferencing / videoconferencing for meetings and interviews
   v. social networking
   vi. other emerging technologies

Practical Requirements:

1. Write well-developed, coherent, unified paragraphs.

2. Write sample letters and memos.

3. Write one short informal report.

4. Complete a selection of at least 3 trade-related forms.

5. Deliver an effective oral presentation.

SD1760 Workplace Essentials

Note: It is recommended that SD1760 be delivered in the second half of the Entry Level training program.

Learning Outcomes:

- Demonstrate knowledge of workplace essentials in the areas of meetings, unions, workers compensation, workers' rights, and human rights.
- Demonstrate knowledge of good customer service practices.
- Demonstrate knowledge of effective job search techniques.

Duration: 45 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor is expected to use trade specific examples to reinforce the course objectives.

1. Identify common practices related to workplace meetings.
   i. identify and discuss meeting format and preparation required for a meeting
   ii. explain the purpose of an agenda
   iii. explain the expected roles, responsibilities, and etiquette of meeting participants

2. Define unions and identify their role in the workplace.
   i. identify the purpose of unions
   ii. identify a common union structure
   iii. identify the function of unions in this trade

3. Demonstrate an understanding of the Worker's Compensation process.
   i. describe the aims, objectives, regulations and benefits of the Workplace Health, Safety and Compensation Commission
   ii. explain the role of the Workers Advisor
   iii. explain the internal review process

4. Demonstrate an understanding of workers' rights.
   i. define labour standards
   ii. identify regulations, including:
      - hours of work & overtime
      - termination of employment
      - minimum wages & allowable deductions
      - statutory holidays, vacation time, and vacation pay

5. Demonstrate an understanding of Human Rights issues.
   i. examine the Human Rights Code and explain the role of the Human Rights Commission
   ii. define harassment in various forms and identify strategies for prevention
      - direct
      - systemic
      - adverse effect
   iii. identify gender and stereotyping issues in the workplace
   iv. define basic concepts and terms related to workplace diversity including age, race, culture, religion, socio-economic status, and sexual orientation

6. Demonstrate an understanding of quality customer service.
   i. explain why quality service is important
   ii. identify barriers to quality customer service
   iii. identify customer needs & common methods for meeting them
   iv. identify and discuss the characteristics & importance of a positive attitude
   v. identify the importance of demonstrating good communication skills including body language, listening, questioning, and when using electronic communication devices
   vi. identify techniques for interacting with challenging customers to address complaints and resolve conflict

7. Demonstrate an understanding of effective job search techniques.
   i. identify and explain employment trends, opportunities, and sources of employment
   ii. identify and discuss essential skills for the trades as outlined by Human Resources and Skills Development Canada
   iii. review job ads and identify the importance of fitting qualifications to job requirements
   iv. identify the characteristics of effective resumes, the types of resumes, and principles of resume formatting
   v. identify the characteristics of an effective cover letter
   vi. identify the components of a portfolio, and discuss the value of establishing and maintaining a personal portfolio
   vii. identify the common characteristics of the job interview process:
      - pre-interview preparation
      - interview conduct
      - post-interview follow up

Practical Requirements:

1. Create a resume.

2. Create a cover letter.

3. Participate in a mock job interview.

MC1060 Computer Essentials

Learning Outcomes:

- Demonstrate knowledge of computer systems and their operation.
- Demonstrate knowledge of popular software packages and their applications.
- Demonstrate knowledge of security issues related to computers.

Duration: 15 Hours

Pre-Requisite(s): None

Objectives and Content:

Wherever possible, the instructor is expected to use trade specific examples to reinforce the course objectives.

1. Identify the major external components of a microcomputer system.
   i. input devices
   ii. output devices
   iii. central control unit

2. Use operating system software.
   i. start and quit a program
   ii. use the help function
   iii. use the find function
   iv. maximize and minimize a window
   v. use the task bar
   vi. adjust desktop settings such as screen savers, screen resolution, and backgrounds
   vii. shut down a computer

3. Perform file management commands.
   i. create folders
   ii. copy files and folders
   iii. move files and folders
   iv. rename files and folders
   v. delete files and folders

4. Use word processing software to create documents.
   i. enter text
   ii. indent and tab text
   iii. change text attributes (bold, underline, font, etc.)
   iv. change layout format (margins, alignment, line spacing)
   v. spell check and proofread
   vi. edit text
   vii. save document
   viii. print document
   ix. close document
   x. retrieve documents

5. Use spreadsheet software to create spreadsheets.
   i. enter data in cells
   ii. create formulas to add, subtract, multiply and divide
   iii. save spreadsheet
   iv. print spreadsheet
   v. close spreadsheet
   vi. retrieve spreadsheet

6. Access the Internet.
   i. access websites using the world wide web(www)
   ii. identify examples of web browsers
   iii. use search engines with common searching techniques
   iv. describe security issues

7. Use electronic mail.
    i. describe e-mail etiquette
        - grammar and punctuation
        - privacy and legal issues when sharing and forwarding e-mail
        - work appropriate content
        - awareness of employer policies
    ii. manage e-mail using the inbox, sent, and deleted folders
    iii. send an e-mail message with attachment(s)
    iv. print e-mail

Practical Requirements:

None.

LEVEL II

MW1560 Coupling Alignment

Learning Outcomes:

- Demonstrate the ability to align couplings using standard alignment methods, reverse dial alignment method, and the laser alignment method

Duration: 45 Hours

Prerequisites: MW1591 Couplings and Clutches

Objectives and Content:

Standard Alignment

1. Identify the different types of misalignment.
    i. conditions of misalignment
    ii. planes of misalignment
    iii. results of misalignment

2. Describe the procedures used to perform pre-alignment checks.
    i. piping strains
    ii. concentricity of coupling and shaft
    iii. tools and shims

3. Describe the procedure for checking and correction for soft foot.

4. Describe the procedure to align a coupling using a straight edge and feeler gauges.

5. Describe the procedure to align a coupling utilizing dial indicators and the rim and face method.
    i. use of dial indicators
    ii. rim and face readings
    iii. recording readings- soft foot
    iv. fixtures
    v. total run out
    vi. explanation of formulas

vii. bar sag
viii. thermal growth
ix. methods of moving equipment to be aligned
x. jacking devices
xi. corrections

Reverse Dial Alignment

1. Identify the advantages of the reverse dial alignment method compared to the rim and face method.

2. Describe how to determine and compensate for bar sag.

3. Describe the procedures used to calculate shims required for alignment using the graph method.
   i. soft foot
   ii. bar sag
   iii. using graph paper and graphs
   iv. definitions of target and sight
   v. target and sight indicator lines
   vi. hot alignment lines
   vii. cold alignment lines
   viii. shaft misalignment lines
   ix. thermal growth
   x. plotting the different lines on graph paper
   xi. using the calculator method
   xii. setting up the dial indicators
   xiii. checking and recording bar sag
   xiv. obtaining accurate readings

4. Describe the procedures used to calculate shims required for alignment using calculator method.

Laser Coupling Alignment

1. Identify the different accessories used in alignment with the optical alignment system.
   i. safety with laser-optic equipment
   ii. lasers and detectors
   iii. use of beam finder

iv. inclinometer/level
v. installation of brackets
vi. connecting the system

2. Describe procedures to obtain misalignment readings.
   i. adjusting the prism
   ii. adjusting the reflected beam
   iii. measurement procedure (zero-zero alignment)
   iv. entering measurements of the machine to be moved

3. Describe procedures to correct for misalignment using shims.
   i. vertical and horizontal adjustment

Practical Requirements:

1. Perform alignment per instructor's requirements.
   i. standard
   ii. rim and face
   iii. reverse dial
   iv. laser

2. Calculate requirements for thermal expansion.

MW1660 Material Handling Systems

Learning Outcomes:

- Demonstrate the ability to assemble, install, operate, repair and maintain

Duration: 60 Hours

Prerequisites: MW1591 Coupling and Clutches

Objectives and Content:

1. Describe the operating principles of belt conveyors.
   - i. types of belts
     - construction
     - uses
   - ii. troughed conveyors
   - iii. idlers and their use
   - iv. pulley terms and types
   - v. loading chutes

2. Describe the procedures used to calculate belt length, surface speeds forces, arc of contact, and belt loading.
   - i. formulas and their specific applications

3. Describe the various types of conveyor systems and their uses.
   - i. slide conveyors
   - ii. troughed conveyors
   - iii. roller conveyors
   - iv. bucket elevators
   - v. chain conveyors
   - vi. screw conveyors
   - vii. pneumatic conveyors
   - viii. food handling conveyors
   - ix. slurry systems
   - x. apron feeders
   - xi. overhead conveyors

4. Describe the purpose for various attachments and accessories used in conveyor systems.

i. belt take up methods
ii. loading and unloading methods
iii. scrapers and cleaners
iv. magnetic pulleys and Electromagnetic belt conveyors
v. backstops and braking methods for inclined conveyors
vi. take up devices
vii. plow
viii. skirting

5. Describe the joining and splicing of belts.
   i. belt installation
   ii. methods of joining belts
      - vulcanization (hot Splice)
      - chemical
      - mechanical fasteners
      - cold splices

6. Describe procedures to troubleshoot belt and conveyor problems.
   i. alignment and training a conveyor belt
   ii. belt slip
   iii. belt stretch
   iv. belt breakage
   v. belt deterioration
   vi. excessive belt wear
   vii. rapid drive wear

7. Describe the operating principles, the classification and the uses of chain, screw and pneumatic conveyors.
   i. theory of operation of chain conveyors
   ii. flight conveyors
   iii. drag conveyors
   iv. transfer tables
   v. head and tail end details
      - roll cases
   vi. trough conveyors
   vii. theory of operation and classification of screw conveyors
   viii. screw conveyor components
   ix. theory of operation of pneumatic conveyors
   x. vacuum conveying systems
   xi. feeders

xii. flow regulation
xiii. low, medium and high pressure systems
xiv. cyclones
xv. air slide systems
xvi. blowers and fans
xvii. bulk conveyors
xviii. angle of repose
xix. transfer cases
xx. S-drives
xxi. chain classes
xxii. fluid couplings

8. Describe the maintenance procedures for chain, screw, and pneumatic conveyors.
   i. dismantling
   ii. inspection
   iii. repair procedures
   iv. reassembly methods for conveyors.
   v. lockout

Practical Requirements:

1. Perform a belt splice.
   i. cold
   ii. mechanical

2. Train a belt; inspect and troubleshoot.

3. Calculate belt speed in surface feet per minute (SFPM).

MW2160 Hydraulics II

Learning Outcomes:

- Demonstrate the ability to use hydraulic controls, use schematics to identify components of hydraulic systems, test hydraulic system faults, identify hydraulic parts, components and accessories

Duration: 35 Hours

Prerequisites: MW2150 Hydraulics I

Objectives and Content:

1. Identify the various valves used in hydraulic systems.

2. Describe the operation and purpose of various valves used in hydraulic systems.
   i. directional control valves
   ii. pressure control valves
   iii. volume control valves
   iv. needle valves
   v. unloading valves
   vi. exhaust valves
   vii. deceleration valves
   viii. pilot operated check valves
   ix. sequence valves
   x. brake valves
   xi. thermal relief valves

3. Explain how to use schematics to determine the series of operation and locate problems in a system.
   i. understanding the language of symbols
   ii. following fluid flow in a hydraulic circuit

4. Identify various components of a system on a schematic.

5. Describe preventive maintenance procedures.
   i. cleaning suction strainers
   ii. changing filters

iii. changing hydraulic fluids
iv. changing tubing
v. leak checks
vi. motor rotation

6. Explain how to use testing equipment to determine system faults.
   i. troubleshooting practices
   ii. pressure gauges and flow meters

Practical Requirements:

1. Complete a linear motion project from a schematic on the simulator.

2. Complete a rotary motion project from a schematic on the simulator.

3. Complete a sequence project from a schematic on the simulator.

4. Use schematics & testing equipment to troubleshoot a system.

5. Set-up a filter, regulator and lubricator system.

6. Fabricate a hydraulic hose using crimped, and/or reusable fittings.

MW2170 Pneumatics

Learning Outcomes:

- Demonstrate the ability to install, maintain, trouble shoot and repair pneumatic systems
- Demonstrate an understanding of components, parts and accessories in pneumatic systems
- Demonstrate an understanding of components, parts and accessories in vacuum systems
- Demonstrate the ability to maintain and repair vacuum systems

Duration: 40 Hours

Prerequisites: MW2160 Hydraulics II

Objectives and Content:

1. Describe gas laws as they pertain to pneumatics.
   i. atmospheric pressure
   ii. gauge and absolute pressure
   iii. force, pressure, area
   iv. Boyle's law
   v. Charles's law
   vi. Guy-Lusac's law
   vii. Bernoulli's principle
   viii. relative humidity
   ix. dew point

2. Classify the various components of a system by the functions they perform.
   i. compressors
   ii. pressure control valves
   iii. directional control valves
   iv. packed bore
   v. packed spool
   vi. volume control valves
   vii. quick exhaust and shuttle valves
   viii. filters
   ix. lubricators

x. regulators
xi. coolers and heat exchanger
xii. receivers
xiii. dryers
xiv. pressure relief valves
xv. muffler
xvi. actuators
xvii. cylinder cushions
xviii. blowers
xix. air contaminants
xx. steel tubing (sizing)
xxi. pneumatic motors
xxii. output horsepower
xxiii. time delay switches

3. Explain the differences in operating principles in vacuum systems compared to pneumatics.
   i. pressure
   ii. plumbing
   iii. valves
   iv. cylinders
   v. pumps/blowers
   vi. manifolds

4. Describe the procedures used to determine the series of operation of a system from a schematic.
   i. schematics
   ii. symbols
   iii. schematic development

5. Describe procedures to troubleshoot and repair various components of a pneumatic system using testing equipment and schematics.
   i. using schematics to troubleshoot systems
   ii. pressure gauges
   iii. flow metres

Practical Requirements:

1. Use schematics to troubleshoot and repair pneumatic systems.

2. Complete a sequence project from a schematic on a simulator.

3. Set up a filter, regulator, lubricator system.

WD1380 Electric Arc Welding

Learning Outcomes:

- Demonstrate the ability to set up arc welding equipment
- Demonstrate an understanding of the different types of electrodes and their purpose
- Demonstrate an understanding of the different types of joints
- Demonstrate the ability to perform basic arc welding procedures

Duration: 60 Hours

Prerequisites: WD1330 Oxy-Fuel Welding

Objectives and Content:

1. Describe how to set up and operate arc welding equipment.
   i. AC and DC machines
   ii. straight and reverse polarity
   iii. proper grounding methods
   iv. electrode holders
   v. amperage settings for various electrodes

2. Describe the numbering system for electrodes.
   i. electrode numbering system
      - tensile strength
      - welding position recommended for the electrode
      - penetration

3. Define terms involved in electric arc welding.
   i. duty cycle
   ii. arc blow
   iii. polarity
   iv. spatter

4. Demonstrate a working knowledge of the different types of joints encountered.
   i. in welding
   ii. butt, tee, lap, corner, edge joints

5. Describe procedures for welding in the flat, vertical and horizontal positions.

6. Describe procedures to weld with GMAW (MIG).
    i. setting up GMAW equipment
    ii. basic operation of GMAW equipment

7. Describe procedures to weld with GTAW (TIG).
    i. setting up GTAW equipment
    ii. basic operation of GTAW equipment

8. Describe procedures used in cutting with the plasma arc process.

Practical Requirements:

1. Perform the following types of welds: butt, tree, lap, corner & edge joints.

2. Set-up and MIG a tee joint.

3. Set- up and cut various metal using the plasma arc process.

LEVEL III

MW1620 Metal Lathe

Learning Outcomes:

- Demonstrate the ability to identify parts and accessories, calculate correct speeds and feeds, calculate thread depth, perform turning, facing, and boring / threading operations

Duration: 100 Hours

Prerequisites: MW1450 Drills, Taps and Reamers

Objectives and Content:

1. Describe procedures to perform basic lathe functions such as turning, facing, boring and threading.
    i. lathe size and capacity
    ii. lathe parts and their function
        - bed
        - head stock
            - spindle
            - feed reverse lever
        - quick change gear box
            - top lever
            - tumbler lever
            - lead screw and feed rod
        - carriage
            - saddle
            - cross-slide and compound rest
            - apron hand wheel, automatic feed lever and
            - feed change lever
        - tailstocks
            - tailstocks clamp lever, spindle and spindle lock, offsetting screw and centre

    iii. work holding devices
        - spindle nose types

- lathe centres
- jaw, 4 jaw, collett, magnetic chucks, face plates and lathe dogs
- mounting chucks
- mounting jaws in chucks
- mounting work in chucks
- trueing work in a 4 jaw chuck with a dial indicator
    - steady rest and follow rest

iv. cutting tool holders
- left and right hand offset tool holders
- parting tool holders
- boring bars
- standard tool post
- quick change tool holders

v. mounting, removing and aligning lathe centres

vi. facing and machining between centres and in chucks
facing to accurate length
- rough and finish cut
- turning to a shoulder
- filing and polishing in a lathe
- knurling and form turning
- cutting off work in a chuck
- drilling, boring, reaming and tapping on the lathe

2. Describe the procedures used to calculate correct speeds and feeds.
   i. definition of speeds and feeds for lathes
   ii. formulas for speeds and feeds and depth of cut
   iii. sheer pins and slip clutches
   iv. graduated micrometer collars

3. Describe the procedures used to calculate thread depths and perform thread cutting operations.
   i. thread cutting on the lathe
   - terminology
   - thread forms
   - fits and classifications
   - thread pitch and depth of cut calculations
   - thread chasing dial
   - set up procedures for thread cutting
   - thread cutting operations
   - resetting a threading tool

- thread measurement
- multiple threads

4. Describe procedures to turn a taper.
    i. tapers and taper turning
    ii. types of tapers
    iii. taper calculations
    iv. taper turning methods
    v. tailstock offset, taper attachments and compound rest method

5. Describe a mandrel.

Practical Requirements:

1. Sharpen a tool bit.

2. Perform the following operations using a lathe:
    i. straight turning
    ii. facing
    iii. boring
    iv. threading
    v. taper

MW1630 Milling Machines

Learning Outcomes:

- Demonstrate the ability to calculate correct speeds and feeds, perform set up and safely, and execute basic milling operations

Prerequisites: MW1620 Metal Lathe

Objectives and Content:

1. Identify safety hazards involved in operating a milling machine.

2. Describe the principles of operation of milling machines.
   i. horizontal and vertical milling machines
   ii. knee and column mills
   iii. parts of the milling machine
   iv. milling machine attachments
      - vertical milling attachment
      - slotting attachment
      - arbors, collets and adapters
      - vises

3. Describe the procedures used to perform calculations involved in using a milling machine.
   i. definition of speed and feeds
   ii. calculations for feed, speed and depth of cut
   iii. keyseat depth calculations

4. Describe set-up procedures.
      - direction of feed
      - climb and conventional milling

5. Describe the procedures used to select cutters in order to perform specific tasks.
    i. plain mill cutters
    ii. face mill cutters
    iii. end mills
    iv. woodruff keyseat cutter
    v. flycutters

6. Describe the procedures for centering cutters on shafts.

Practical Requirements:

1. Complete a project using a milling machine, as assigned by instructor.

MW2180 Compressors

Learning Outcomes:

- Demonstrate an understanding of the operating principles of compressors
- Demonstrate the ability to maintain compressors and their assembly

Duration: 40 Hours

Prerequisites: MW2170 Pneumatics

Objectives and Content:

1. Describe the principles of operation of reciprocating and rotary compressors.
   i. reciprocating and access compressor
   ii. rotary compressor
   iii. screw compressor
   iv. vane compressor
   v. diaphragm compressor
   vi. wet screw compressor
   vii. dry screw compressor
   viii. positive displacement
   ix. pre-start and inspection

2. Identify gas laws and apply them to compressors.
   i. Boyle's Law
   ii. Charles's Law
   iii. Lusac's Law

3. Identify and describe the parts and accessories for compressors.
   i. regulators
   ii. lubricators
   iii. filters
   iv. receivers
   v. valves
   vi. pistons
   vii. connecting rods
   viii. crankshafts

ix. rotors
x. vanes
xi. crossheads
xii. cylinders
xiii. maximum pressure control devices
xiv. pressure relief valve on receiver
xv. discharge lines
xvi. clearance pockets
xvii. mufflers
xviii. timing gears
xix. non-ferrous metals and heat conductivity

4. Describe methods of maximum pressure control on a compressor.
   i. unloading devices
   ii. stop start method
   iii. throttling intake
   iv. variable speed drives
   v. centrifugal pressure relief valves
   vi. atmospheric pressure
      - less than

5. Describe maintenance procedures for compressors.
   i. air treatment
   ii. separators
   iii. lubrication methods
   iv. intercoolers
   v. aftercoolers
   vi. receivers
   vii. air dryers
   viii. regulators
   ix. lubricators
   x. start-up procedure

Practical Requirements:

1. Perform a preventative check on compressors.

2. Disassemble, inspect and assemble a reciprocating compressor.

MW2190 Machinery Installation and Alignment

Learning Outcomes:

- Demonstrate the ability to perform machinery set-up procedures
- Demonstrate the ability to locate and lay out machinery

Duration: 60 Hours

Prerequisites: MW1560 Coupling Alignment

Objectives and Content:

1. Describe set-up procedures for using transits and levels.
    i. precision levels
    ii. builders level
    iii. water level
    iv. transits and theodolites
    v. lasers
    vi. effects of temperature on optical alignment (reflection/refraction)
    vii. optical tooling and accessories

2. Describe procedures to construct foundations for equipment.
    i. concrete terms
    ii. controlling vibration
    iii. anchor bolt types and applications
    iv. mechanical expansion anchors
    v. chemical adhesive anchors
    vi. positioning and setting anchors bolts
    vii. tools required to build a form

3. Describe procedures to properly place and level a piece of equipment on its base or foundation.
    i. base plate and sole plate purpose and installation procedure
    ii. levelling and jacking screws
    iii. shims
    iv. wedges
    v. precision levelling the base plate
    vi. dementitious and polymeric grout and their purpose

vii. placing grout
viii. preventing and filling voids
ix. dowelling

4. Describe procedures to locate and lay out a form from a blueprint.
    i. building tie-in
    ii. reference lines
    iii. center lines
    iv. benchmarks and datums
    v. brass plugs
    vi. establishing references lines
    vii. mechanical methods
    viii. optical methods

Practical Requirements:

1. Locate and lay out a form from a blueprint.

2. Transfer elevations using levels and lasers.

3. Level soleplates using optical tooling.

4. Perform bucking in.

5. Using the optical level, perform leveling and alignment projects as per instructor's directives.

LEVEL IV

MW1680 Dynamic Balancing

Learning Outcomes:

- Demonstrate the ability to collect data, use a computer to execute balancing calculations, and use balancing techniques to correct vibration problems

Duration: 45 Hours

Prerequisites: MW2230 Vibration Analysis

Objectives and Content:

1. Define unbalance.
   i. types of unbalance: static, couple, quasi-static, dynamic
   ii. list the most common causes of unbalance
      - causes of vibration
      - causes of unbalance
      - shaft axis and central principle axis

2. Identify and define terms associated with vibration.

3. Describe the procedures used to perform the necessary operations, calculations and weight corrections to balance in one plane.
   i. transducer mounting and reading locations
   ii. data collection, amplitude and phase
   iii. selecting safe trial weights
   iv. vector techniques and calculations
   v. single and two plane balancing techniques
   vi. static couple derivation
   vii. balancing standards
      - use weight removal charts

4. Describe the use of personal computers and system software for balancing calculations and record keeping.
   i. software and a personal computer to perform the following:

- one plane balance
- no phase balance
- safe trial weights
- combine weights
- split weight
- utilities

Practical Requirements:

1. Perform single plane balancing operations as per instructor's direction.

MW1740 Preventative and Predictive Maintenance

Learning Outcomes:

- Demonstrate the ability to perform preventative maintenance and maintain proper records
- Demonstrate an understanding of the procedures used to plan and organize jobs

Duration: 35 Hours

Prerequisites: MW2180 Compressors

Objectives and Content:

1. Describe various maintenance styles.
    i. breakdown maintenance
    ii. preventive maintenance
    iii. predictive maintenance
    iv. proactive maintenance
    v. total productive maintenance
    vi. preventive engineering
    vii. reliability engineering
    viii. productive maintenance
    ix. corrective maintenance

2. Describe the basic components of a preventive maintenance program.
    i. equipment record files
    ii. equipment repair history
    iii. inspection reports
    iv. priority system
    v. work order
    vi. equipment manuals
    vii. specification
    viii. troubleshooting charts
    ix. blueprints
    x. personal operator input

3. Describe basic procedures followed under preventative maintenance programs.
    i. vibration analysis
    ii. key frequency and rpm
    iii. dynamic balancing
    iv. non-destructive testing
        - types
        - visual inspection
        - dye penetrate inspection
        - magnetic particle inspection
        - eddy current inspection
        - ultrasonic inspection
        - radiographic inspection

4. Describe the purpose of lube oil analysis.
    i. particle analysis
    ii. gravimetric level analysis
    iii. spectrographic oil analysis
    iv. ferromagnetic analysis
    v. total base number tests
    vi. total acid number tests
    vii. infrared tests
    viii. water content tests
    ix. computerized lubrication management system
    x. capable employees
    xi. component wear rate
    xii. operating conditions when taking samples
    xiii. oil system types

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

Practical Requirements:

1. Design a preventative maintenance sheet on a piece of equipment.

2. Perform a dye penetrants inspection.

3. Collect and interpret data on equipment.

MW1480 Tanks, Fans and Blowers

Learning Outcomes:

- demonstrate an understanding of process tanks and containers, their components and applications
- demonstrate an understanding of fans and blowers, their components and operation
- demonstrate the ability to remove install, maintain, troubleshoot, repair and commission fans and blowers

Duration : 30 Hours

Prerequisites: MW1690 Positive Displacement Pumps

Objectives and Content:

1. Identify the classification of fans and blowers, blade designs, and describe their specific uses.
   i. axial and radial flow fans
   ii. forward and backward curved, and straight fans and their application
   iii. single and double width fans
   iv. single and double inlet fans

2. Define terminology associated with fans and blowers.

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

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

5. Identify the procedures used to inspect and maintain fans and blowers.

6. Identify the procedures used to troubleshoot fans and blowers.

7. Identify the procedures used to repair fans and blowers.

8. Identify the procedures used to regulate output for fans and blowers

9. Identify the procedures used to commission fans and blowers.

10. Define terminology associated with process tanks and containers.

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

12. Identify and interpret codes and regulations pertaining to process tanks and containers.

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

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

Practical Requirements:

1. Identify various types of fans.

MW2210 Prime Movers 1 (Internal Combustion Engines)

Learning Outcomes:

- Demonstrate the ability to install and maintain internal combustion engines

Duration: 45 Hours

Prerequisites: MW1580 Static and Dynamic Seals

Objectives and Content:

1. Describe the principles of operation of an internal combustion engine.
    i. stroke cycle engines principles for gas and diesel engines
    ii. stroke cycle engines principles for gas and diesel engines
    iii. differences between 2 stroke and 4 stroke engines
    iv. differences between gas and diesel engines
    v. fuel injection
    vi. lubrication methods

2. Describe the internal parts and list their functions.
    i. crankshaft
    ii. main bearings
    iii. flywheels
    iv. cylinder head
    v. camshafts, lifters and pushrods
    vi. engine block
    vii. pistons, rings and connecting rods
    viii. valve trains
    ix. aspiration
    x. turbo-chargers
    xi. superchargers
    xii. glow plug
    xiii. injectors
        - safety
    xiv. governors

3. Describe the procedures used to troubleshoot internal combustion engine performance problems.
    i. routine maintenance practices
    ii. shut down

4. Describe the principles of operation for diesel engines.
    i. compression ignition
    ii. fuel injection
        - safety
    iii. turbocharges and superchargers

Practical Requirements:

1. Participate in the disassembling, inspecting and reassembling of an internal combustion engine. (Subject to availability of equipment)

2. Perform a compression test on an engine and analyze the results

MW2220 Prime Movers II (Turbines)

Learning Outcomes:

- Demonstrate an awareness of turbine types
- Demonstrate the ability to maintain steam and gas turbines

Duration: 45 Hours

Prerequisites: MW2210 Prime Movers I (Internal Combustion Engines)

Objectives and Content:

1. Identify the types of turbines
    i. steam
    ii. gas
    iii. hydro
    iv. wind

2. Describe the principles of operation of steam turbine drives.
    i. uses for steam turbines
    ii. definitions and construction
    iii. steam flow through a turbine
    iv. axial and radial flow turbines
    v. back pressure turbines
    vi. back pressure / extraction turbines
    vii. condensing turbines
    viii. extracting / condensing turbines

3. Describe the components and accessories used on steam turbines.
    i. impulse and reaction blades
    ii. shaft attachments
    iii. shrouds
    iv. journal bearings
    v. thrust bearings
    vi. steam chests and nozzle blocks
    vii. diaphragms and steam nozzles
    viii. disc and drum rotor diaphragms
    ix. shaft seal purpose

x. carbon seals
xi. labyrinth seals
xii. shaft steam - seal system
xiii. turbine condenser and hot well
xiv. main stop valves
xv. exhaust valves
xvi. throttle valves
xvii. overspeed trips
xviii. governors valves
xix. extraction valves
xx. governor types and operation
xxi. lubricating systems
xxii. turning gears
xxiii. jacking pumps

4. Describe the principles of operation for gas turbines.
   i. differences between gas and steam turbines
   ii. types of gas turbines
   iii. classifying gas turbines by cycle
      - simple open cycle
      - complex cycle
   iv. classifying gas turbines by shaft arrangement
      - single shaft turbines
      - two shaft turbines

5. Describe gas turbine components and their purpose.
   i. compressor types
   ii. combustion
      - ignitor
      - fuel atomizer
      - flame tube
   iii. turbines
      - blade cooling
      - blade shapes and roots
      - bearings and shaft seals
   iv. governors
   v. lubrication systems

Practical Requirements:

1. Participate in the disassembling, inspecting and reassembling of a steam and/or gas turbine.

MW2230 Vibration Analysis

Learning Outcomes:

- Demonstrate the ability to collect data used in vibration analysis, analyze causes of unbalances, and detect and diagnose vibration levels

Duration: 40 Hours

Prerequisites: MW1740 Preventative and Predictive Maintenance

Objectives and Content:

1. Identify benefits of vibration analysis.

2. Describe safety precautions regarding rotating equipment.

3. Describe differences between the corrective, preventive and predictive maintenance methods.
   i. corrective, preventive and predictive maintenance methods
      - organizing a predictive maintenance program
   ii. design an equipment route

4. Describe the causes of vibration.
   i. terminology
   ii. characteristics of vibration

5. Describe vibration data collection procedures.
   i. information provided by vibration frequency, amplitude and phase measurements
   ii. when to use velocity, displacement or acceleration methods
   iii. phase information
   iv. common types of measurements
   v. using a strobe light for diagnosis
   vi. common pitfalls in vibration measurements
   vii. using data collectors for collecting predictive maintenance data
   viii. how to build load and unload route

6. Describe procedures to detect and diagnose vibration data to determine causes of vibration.
    i. assessing vibration severity
    ii. harmonic identification methods
    iii. waveform measurement and analysis
    iv. data interpretation and general analysis procedures
    v. detecting and diagnosing vibration due to unbalance, misalignment eccentricity, rolling element bearings, sleeve bearings, mechanical looseness, drive belts, gear problems, electrical faults, resonance, harmonics, aerodynamic and hydraulic forces, reciprocating action and rubbing

7. Describe procedures when using hand held data collectors.
    i. data acquisition - routine checks, baseline measurements, pre and post overhaul checks, machine troubleshooting

8. Describe procedures when using personal computers and system software to generate reports and analyse data.
    i. downloading from data collectors to personal computers with system software
    ii. using system software to generate schedule reports, data collection routes, PUMP reports, analysis reports, file modifications and alarm and inspection reports.

9. Describe fundamental procedures for determining:
    i. unbalance
    ii. misalignment
    iii. ball pass frequency
    iv. gear mesh
    v. line frequency
    vi. mechanical looseness
    vii. harmonics
    viii. ball pass inner race (BPIR)
    ix. ball pass outer race (BPOR)
    x. ball spin frequency (BSF)
    xi. fundamental train frequency (FTF)

Practical Requirements:

1. Build an equipment route.

2. Load and unload route data.

3. Use data collectors.

4. Use personal computers and system software to generate reports and analyse data.

C. Conditions Governing Apprenticeship Training

1.0 General

The following general conditions apply to all apprenticeship training programs approved by the Provincial Apprenticeship and Certification Board (PACB) in accordance with the *Apprenticeship Training and Certification Act (1999)*. If an occupation requires additional conditions, these will be noted in the specific Plan of Training for the occupation. In no case should there be a conflict between these conditions and the additional requirements specified in a certain Plan of Training. All references to Memorandum of Understanding will also apply to Letter of Understanding (LOU) agreements.

2.0 Entrance Requirements

2.1 Entry into the occupation as an apprentice requires:

Indenturing into the occupation by an employer who agrees to provide the appropriate training and work experiences as outlined in the Plan of Training.

2.2 Notwithstanding the above, each candidate must have successfully completed a high school program or equivalent, and in addition may be required to have completed certain academic subjects as specified in a particular Plan of Training. Mature students, at the discretion of the Director of Apprenticeship and Trades Certification, may be registered. A mature student is defined as one who has reached the age of 19 and who can demonstrate the ability and the interest to complete the requirements for certification.

2.3 At the discretion of the Director of Apprenticeship and Trades Certification, credit toward the apprenticeship program may be awarded to an apprentice for previous work experience and/or training as validated through prior learning assessment.

2.4 An Application for Apprenticeship form must be duly completed along with a Memorandum of Understanding as applicable to be indentured into an Apprenticeship. The Memorandum of Understanding must contain signatures of

an authorized employer representative, the apprentice and an official representing the Provincial Apprenticeship and Certification Board to be valid.

2.5 A new Memorandum of Understanding must be completed for each change in an employer during the apprenticeship term.

3.0 Probationary Period

The probationary period for each Memorandum of Understanding will be six months or 900 employment credit hours. Within that period the memorandum may be terminated by either party upon giving the other party and the PACB one week notice in writing.

4.0 Termination of a Memorandum of Understanding

After the probationary period referred to in Section 3.0, the Memorandum of Understanding may be terminated by the PACB by mutual consent of the parties involved, or cancelled by the PACB for proper and sufficient cause in the opinion of the PACB, such as that stated inSection14.

5.0 Apprenticeship Progression Schedule and Wage Rates

Progression Schedule

INDUSTRIAL MECHANIC (MILLWRIGHT)		7200 Hours	
APPRENTICESHIP LEVEL AND WAGES			
Year	Wage Rate At This Level	Requirements for progression to next level of apprenticeship	When requirements are met, the apprentice will progress to…
1st	60 %	▪ Completion of pre-employment training ▪ Registration as an apprentice ▪ Minimum 1800 hours of combined relevant work experience and training	2nd Year
2nd	70%	▪ Completion of Level 2 training ▪ Pass Level 2 exam ▪ Minimum 3600 hours of combined relevant work experience and training	3rd Year
3rd	80%	▪ Completion of Level 3 training ▪ Pass Level 3 exam ▪ Minimum 5400 hours of combined relevant work experience and training	4th Year
4th	90%	▪ Completion of Level 4 training ▪ Pass Level 4 exam ▪ Minimum 7200 hours of combined relevant work experience and training ▪ Sign-off of all workplace skills in apprentice logbook ▪ Pass certification exam	Journeyperson Certification

Wage Rates

- Rates are percentages of the prevailing journeyperson's wage rate in the place of employment of the apprentice.
- Rates must not be less than the wage rate established by the Labour standards Act (1990), as now in force or as hereafter amended, or by other order, as amended from time to time replacing the first mentioned order.
- Rates must not be less than the wage rate established by any collective agreement which may be in force at the apprentice's workplace.
- Employers are free to pay wage rates above the minimums specified.

Level Exams

- This program may not currently contain level exams, in which case this requirement will be waived until such time as level exams are available.

INDUSTRIAL MECHANIC (MILLWRIGHT)		7200 Hours
CLASS CALLS *(AFTER APPRENTICESHIP REGISTRATION)*		
Call Level	Requirements for Class Call	Hours awarded for In-School Training
Level 2	▪ Minimum of 3000 hours of relevant work experience and training	240
Level 3	▪ Minimum of 5000 hours of relevant work experience and training	240
Level 4	▪ Minimum of 7000 hours of relevant work experience and training	240
Class calls at Minimum Hours ▪ Class calls may not always occur at the minimum hours indicated. Some variation is permitted to allow for the availability of training resources and apprentices.		

6.0 Tools

Apprentices shall be required to obtain their own hand tools applicable for the designated occupation of registration or tools as specified by the PACB.

7.0 Periodic Examinations and Evaluation

7.1 Every apprentice shall submit to such occupational tests and examinations as the PACB shall direct. If after such occupational tests and examinations the apprentice is found to be making unsatisfactory progress, his/her apprenticeship level and rate of wage shall not be advanced as provided in Section 5 until his/her progress is satisfactory to the Director of Apprenticeship and Trades Certification and his/her date of completion shall be deferred accordingly. Persistent failure to pass required tests shall be a cause for revocation of his/her Memorandum of Understanding.

7.2 Upon receipt of reports of accelerated progress of the apprentice, the PACB may shorten the term of apprenticeship and advance the date of completion accordingly.

7.3 For each and every course, a formal assessment is required for which 70% is the pass mark. A mark of 70% must be attained in both the theory examination and the practical project assignment, where applicable as documented on an official transcript.

7.4 Course credits may be granted through the use of a PACB approved matrix which identifies course equivalencies between designated trades and between current and historical Plans of Training for the same trade.

8.0 Granting of Certificates of Apprenticeship

Upon the successful completion of apprenticeship, the PACB shall issue a Certificate of Apprenticeship.

9.0 Hours of Work

Any hours employed in the performance of duties related to the designated occupation will be credited towards the completion of the term of apprenticeship. Appropriate documentation of these hours must be provided.

10.0 Copies of the Registration for Apprenticeship

The Director of Apprenticeship and Trades Certification shall provide copies of the Registration for Apprenticeship form to all signatories to the document.

11.0 Ratio of Apprentices to Journeypersons

Under normal practice, the ratio of apprentices to journeypersons shall not exceed two apprentices to every one journeyperson employed. Other ratio arrangements would be determined and approved by the PACB.

12.0 Relationship to a Collective Bargaining Agreement

Where applicable in Section 5 of these conditions, Collective Agreements take precedence.

13.0 Amendments to a Plan of Apprenticeship Training

A Plan of Training may be amended at any time by the PACB.

14.0 Employment, Re-Employment and Training Requirements

14.1 The Plan of Training requires apprentices to regularly attend their place of employment.

14.2 The Plan of Training requires apprentices to attend training for that occupation as prescribed by the PACB.

14.3 Failure to comply with Sections 14.1 and/or 14.2 will result in cancellation of the Memorandum of Understanding. Apprentices may have their MOUs reinstated by the PACB but would be subject to a commitment to complete the entire program as outlined in the General Conditions of Apprenticeship. Permanent cancellation in the said occupation is the result of non-compliance.

14.4 Cancellation of the Memorandum of Understanding to challenge journeyperson examinations, if unsuccessful, would require an apprentice to serve a time penalty of two (2) years before reinstatement as an apprentice or qualifying to receive a class call to training as a registered Trade Qualifier. Cancellation must be mutually agreed upon by the employer and the apprentice.

14.5 An employer shall ensure that each apprentice is under the direct supervision of an approved journeyperson supervisor who is located at the same worksite as the apprentice, and that the apprentice is able to communicate with the journeyperson with respect to the task, activity or function that is being supervised.

14.6 Under the Plan of Training the employer is required to keep each apprentice employed as long as work is available, and if the apprentice is laid off due to lack of work, to give first opportunity to be hired before another is hired.

14.7 The employer will permit each apprentice to attend training programs as prescribed by the PACB.

14.8 Apprentices who cannot acquire all the workplace skills at their place of employment will have to be evaluated in a simulated work environment at a PACB authorized training institution and have sign-off done by instructors to meet the requirements for certification.

15.0 Appeals to Decisions Based on Conditions Governing Apprenticeship Training

Persons wishing to appeal any decisions based on the above conditions must do so in writing to the Minister of Advanced Education and Skills within 30 days of the decision.

D. Requirements for Red Seal Endorsement

1. Evidence the required work experiences outlined in this Plan of Training have been obtained. This evidence must be in a format clearly outlining the experiences and must be signed by an appropriate person or persons attesting that these experiences have been obtained to the level required.

2. Successful completion of all required courses in the program.

3. A combination of training from an approved training program and suitable work experience totaling 7200 hours.

   Or

   A total of 9000 hours of suitable work experience.

4. Completion of a National Red Seal examination, to be set at a place and time determined by the Apprenticeship and Trades Certification Division.

E. Roles and Responsibilities of Stakeholders in the Apprenticeship Process

The apprenticeship process involves a number of stakeholders playing significant roles in the training of apprentices. This section outlines these roles and the responsibilities resulting from them.

The Apprentice:

- completes all required technical training courses as approved by the PACB.
- finds appropriate employment.
- completes all required work experiences in combination with the required hours.
- ensures work experiences are well documented.
- approaches apprenticeship training with an attitude and commitment that fosters the qualities necessary for a successful career as a qualified journeyperson.
- obtains the required hand tools as specified by the PACB for each period of training of the apprenticeship program.

The Employer:

- provides high quality work experiences in an environment conducive to learning.

- remunerates apprentices as set out in the Plan of Training or Collective Agreements.

- provides feedback to training institutions, Apprenticeship and Trades Certification Division and apprentices in an effort to establish a process of continuous quality improvement.

- where appropriate, releases apprentices for the purpose of returning to a training institution to complete the necessary technical courses.

- ensures work experiences of the apprentice are documented.

- ensures a certified journeyperson is currently on staff in the same trade area as the apprentice and whose certification is recognized by the NL Department of Advanced Education and Skills.

The Training Institution:

- provides a high quality learning environment.

- provides the necessary student support services that will enhance an apprentice's ability to be successful.

- participates with other stakeholders in the continual updating of programs.

The Apprenticeship and Trades Certification Division:

- establishes and maintains program advisory committees under the direction of the PACB.

- promotes apprenticeship training as a viable career option to prospective apprentices and other appropriate persons involved, such as career guidance counsellors, teachers, parents, etc.

- establishes and maintains a protocol with training institutions, employers and other appropriate stakeholders to ensure the quality of apprenticeship training programs.

- ensures all apprentices are appropriately registered and records are maintained as required.

- schedules all necessary technical training periods for apprentices to complete requirements for certification.

- administers block, provincial and interprovincial examinations.

The Provincial Apprenticeship and Certification Board:

- sets policies to ensure the provisions of the *Apprenticeship and Certification Act (1999)* are implemented.

- ensures advisory and examination committees are established and maintained.

- accredits institutions to deliver apprenticeship training programs.

- designates occupations for apprenticeship training and/or certification.