

---

# Plan of Training

## INDUSTRIAL MECHANIC (MILLWRIGHT)



Government of Newfoundland and Labrador  
Department of Education  
Institutional and Industrial Education Division

September 2009

# PLAN OF TRAINING

## INDUSTRIAL MECHANIC (MILLWRIGHT)

SEPTEMBER 2009



Government of Newfoundland and Labrador  
Department of Education  
Institutional and Industrial Education Division

Approved by:

A handwritten signature in black ink, appearing to read "Pauline Hood".

---

Chairperson, Provincial Apprenticeship and Certification Board

Date: Sept 23/09

## Plan of Training – Industrial Mechanic (Millwright)

---

The Joint Planning Committee (JPC) recognizes this Interprovincial Program Guide as the national curriculum for the occupation of Industrial Mechanic (Millwright).

### Preface

This Apprenticeship Standard is based on the 1999 edition of the National Occupational Analysis for Industrial Mechanic (Millwright) trade.

This document describes the curriculum content for the Industrial Mechanic (Millwright) apprenticeship training program and outlines each of the technical training units necessary for the completion of apprenticeship.

### Acknowledgements

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

We offer you a sincere thank you.

### Contact Information

Department of Education  
Institutional and Industrial Education Division  
Tel: 709-729-2729 / 1-877-771-3737  
Email: [app@gov.nl.ca](mailto:app@gov.nl.ca)  
Web: [www.gov.nl.ca/app](http://www.gov.nl.ca/app)

Document Status	Date Distributed	Mandatory Implementation Date	Comments
Approved	September 2009	September 2010	

## Table of Contents

<i>A. Conditions Governing Apprenticeship Training .....</i>	<i>5</i>
<i>B. Requirements for Red Seal Certification .....</i>	<i>12</i>
<i>C. Roles and Responsibilities of Stakeholders in the Apprenticeship Process .....</i>	<i>13</i>
<i>D. Program Outcomes .....</i>	<i>16</i>
<i>E. Program Structure .....</i>	<i>18</i>
<b>Entry Level – Block 1.....</b>	<b>22</b>
TS1510   Occupational Health and Safety .....	22
TS1520   Workplace Hazardous Materials Information System.....	25
TS1530   Standard First Aid .....	28
MS1230   Hand Tools .....	29
MW1240   Portable Power Tools .....	31
MW1250   Blueprint Reading and Sketching.....	33
MW1260   Equipment Assembly Blueprints.....	35
MW1270   Mechanical Installation Blueprints.....	37
MW1280   Schematics Advanced .....	38
MW1290   Rigging.....	39
MW1450   Drills, Taps, and Reamers .....	42
MW1460   Measuring and Layout.....	46
MW1470   Piping Components .....	49
MW1510   Power Metal Saws .....	52
MW1520   Pedestal Grinders .....	54
MW1530   Bearings .....	56
MW1540   Fasteners.....	59
MW1550   Metallurgy .....	62
MW1580   Static and Dynamic Seals .....	64
MW1590   Couplings and Clutches .....	66
MW1610   Belt and Chain Drive Systems .....	70
MW1640   Gear Drive Systems.....	73
MW1650   Lubrication Practices .....	75
MW1670   Non-Positive Displacement Pumps .....	77
MW1690   Positive Displacement Pumps .....	80
MW1730   Electrical Fundamentals .....	82
MW2150   Hydraulics I.....	84
WD1330   Oxy-Fuel Welding .....	86
AP1100   Introduction to Apprenticeship .....	89

## Plan of Training – Industrial Mechanic (Millwright)

---

MA1060	Basic Math.....	94
CM2150	Workplace Communications .....	96
MR1220	Customer Service.....	99
SP2330	Quality Assurance/Quality Control.....	102
MC1050	Introduction to Computers.....	105
SD1700	Workplace Skills .....	110
SD1710	Job Search Techniques.....	113
SD1720	Entrepreneurial Awareness.....	115
<b>Block 2.....</b>		<b>117</b>
MW1660	Material Handling Systems.....	117
MW2160	Hydraulics II .....	121
MW2170	Pneumatics .....	123
MW2180	Compressors .....	126
WD1380	Electric Arc Welding.....	129
<b>Block 3.....</b>		<b>131</b>
MW1560	Coupling Alignment.....	131
MW1620	Metal Lathe.....	134
MW1630	Milling Machines.....	137
MW2190	Machinery Installation and Alignment.....	139
<b>Block 4.....</b>		<b>141</b>
MW1680	Dynamic Balancing .....	141
MW1740	Preventative and Predictive Maintenance .....	143
MW2200	Boilers.....	145
MW2210	Prime Movers 1 (Internal Combustion Engines).....	147
MW2220	Prime Movers II (Turbines) .....	149
MW2230	Vibration Analysis.....	151

## **A. 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 certain Plan of Training.

### **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 particular Plan of Training. Mature students, at the discretion of the Director of Institutional and Industrial Education, 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 Institutional and Industrial Education, 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.

### **3.0 Probationary Period**

The probationary period for each Memorandum of Understanding will be six months. 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.

### **5.0 Apprenticeship Progression Schedule and Wage Rates**

#### **5.1 Progression Schedule**

<b>7200 Hour Programs</b>	<b>Requirements for Progression</b>	<b>Progress To</b>
First Year Apprentice	Completion of entry level (Block 1) courses, plus relevant work experience totaling a minimum of 1800 hours *	Second Year
Second Year Apprentice	Completion of advanced level (Block 2) courses, plus relevant work experience totaling a minimum of 3600 hours	Third Year
Third Year Apprentice	Completion of advanced level (Block 3) courses, plus relevant work experience totaling a minimum of 5400 hours	Fourth Year
Fourth Year Apprentice	Completion of advanced level (Block 4) courses and (Blocks 5 & 6) <i>if applicable</i> , plus sign-off of workplace skills required for certification totaling a minimum of 7200 hours**	Write Certification Examination

## Plan of Training – Industrial Mechanic (Millwright)

<b>5400 Hour Programs</b>	<b>Requirements for Progression</b>	<b>Progress To</b>
First Year Apprentice	Completion of entry level (Block 1) courses, plus relevant work experience totaling a minimum of 1800 hours *	Second Year
Second Year Apprentice	Completion of advanced level (Block 2) courses, plus relevant work experience totaling a minimum of 3600 hours	Third Year
Third Year Apprentice	Completion of advanced level (Block 3) courses, plus sign-off of workplace skills required for certification totaling a minimum of 5400 hours	Write Certification Examination

<b>4800 Hour Programs</b>	<b>Requirements for Progression</b>	<b>Progress To</b>
First Year Apprentice	Completion of entry level courses (Block 1) courses, plus relevant work experience totaling a minimum of 1600 hours *	Second Year
Second Year Apprentice	Completion of advanced level (Block 2) courses, plus relevant work experience totaling a minimum of 3200 hours	Third Year
Third Year Apprentice	Completion of advanced level (Block 3) courses, plus sign-off of workplace skills required for certification totaling a minimum of 4800 hours	Write Certification Examination

\* All direct entry apprentices must meet the **Requirements for Progression** either through Prior Learning Assessment and Recognition or course completion before advancing to the next year.

\*\* Apprentices in a 7200 hour program which incorporates more than four blocks of training are considered fourth year apprentices pending completion of 100% course credits and workplace skills requirements.

5.2 For the duration of each Apprenticeship Training Period, the apprentice who is not covered by a collective agreement, shall be paid a progressively increased schedule of wages.

## Plan of Training – Industrial Mechanic (Millwright)

Program Duration	Wage Rates		Comments
7200 Hours	1 <sup>st</sup> Year	60%	These wage rates are percentages of the prevailing journeyperson's wage rate in the place of employment of the apprentice. No apprentice shall be paid less than the wage rate established by the Labour Standards Act (1988), as now in force or as hereafter amended, or by other Order, as amended from time to time replacing the first mentioned Order.
	2 <sup>nd</sup> Year	70%	
	3 <sup>rd</sup> Year	80%	
	4 <sup>th</sup> Year	90%	
5400 Hours and 4800 Hours	1 <sup>st</sup> Year	60%	
	2 <sup>nd</sup> Year	75%	
	3 <sup>rd</sup> Year	90%	
4000 Hours			(Hairstylist Program) - The apprentice shall be paid no less than the minimum wage for hours worked and a commission agreed upon between the apprentice and the employer.

## 6.0 Tools

Apprentices shall be required to obtain hand tools as and when 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 rate of wage shall not be advanced as provided in Section 5 until his/her progress is satisfactory to the Director of Institutional and Industrial Education 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. At the discretion of the instructor, the summative mark may be for completion of a theory examination or a combination of the theory examination and an assigned practical project.

## **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 Institutional and Industrial Education shall provide copies of the Registration for Apprenticeship form to all signatories to the document.

## **11.0 Ratio of Apprentices to Journeypersons**

The ratio of apprentices to journeypersons shall not exceed two apprentices to every one journeyperson employed, with the condition that one of these be a final year apprentice.

## **12.0 Relationship to a Collective Bargaining Agreement**

Collective agreements take precedence over the conditions outlined in the Plan of Training.

## **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 regularly attend training programs 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. An apprentice will be required to pay a reinstatement fee. 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 registering as a Trade Qualifier.
- 14.5 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.
- 14.6 The employer will permit each apprentice to regularly attend training programs as prescribed by the PACB.
- 14.7 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 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 Education within 30 days of the decision.

## **B. Requirements for Red Seal Certification**

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

### **OR**

A total of 9000 hours of suitable work experience in the occupation accompanied by sign-off of required work competencies.

4. Completion of a National Red Seal examination, to be set at a place and time determined by the Institutional and Industrial Education Division.
5. Payment of the appropriate examination fee.

## **C. 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, Institutional and Industrial Education Division and apprentices in an effort to establish a process of continuous quality improvement.

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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.

### **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 Institutional and Industrial Education 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 provincial/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.

## D. Program Outcomes

Upon completion of the Industrial Mechanic (Millwright) Apprenticeship Program, apprentices will have the knowledge and skills required to perform the following tasks:

- Task 1 Identifies task requirements.
- Task 2 Identifies labour requirements.
- Task 3 Identifies parts and material requirements for equipment installation.
- Task 4 Determines safety, lock-out procedures and personal protection.
- Task 5 Uses precision measuring tools.
- Task 6 Uses layout tools.
- Task 7 Uses hand tools.
- Task 8 Uses portable power tools.
- Task 9 Uses shop machines.
- Task 10 Uses fastening devices.
- Task 11 Determines rigging, hoisting and load requirements.
- Task 12 Installs, troubleshoots and maintains lifting, rigging and hoisting equipment.
- Task 13 Safely operates rigging and hoisting equipment.
- Task 14 Inspects work area for safety.
- Task 15 Selects, tests and processes metals.
- Task 16 Welds, brazes and cuts metal using gas welding equipment.
- Task 17 Welds metal using arc welding equipment.
- Task 18 Welds metal using metal inert gas (MIG) equipment.
- Task 21 Installs safety guards and rails.
- Task 22 Performs lubrication practices.
- Task 23 Performs alignment practices.
- Task 24 Installs, troubleshoots and maintains power transmission systems.
- Task 25 Installs, troubleshoots and maintains material moving systems.
- Task 26 Installs, troubleshoots and maintains shafts, bearings and seals.
- Task 27 Installs, troubleshoots and maintains pumps.
- Task 28 Installs, troubleshoots and maintains prime movers.
- Task 29 Installs, troubleshoots and maintains fans and blowers.
- Task 30 Installs, troubleshoots and maintains tanks and containers.
- Task 31 Performs start up and commissioning of equipment.
- Task 32 Installs, troubleshoots and maintains hydraulic systems.
- Task 33 Installs, troubleshoots and maintains pneumatic systems.

## Plan of Training – Industrial Mechanic (Millwright)

---

- Task 34      Installs, troubleshoots and maintains vacuum systems.
- Task 35      Determines and performs preventative and predictive maintenance tasks.
- Task 36      Performs dynamic balancing and vibration analysis.
- Task 38      Documents maintenance performed using manual and computer entry methods.

## E. Program Structure

For each and every course, a formal assessment is required for which 70% is the pass mark. At the discretion of the instructor, the summative mark may be for completion of a theory examination or a combination of the theory examination and an assigned practical project.

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

Entry Level – Block 1			
NL Course No.	Course Name	Hours	Pre-requisites
TS1510	Occupational Health & Safety	6	
TS1520	WHMIS	6	
TS1530	Standard First Aid	14	
MS1230	Hand Tools	20	TS1510; TS1520; TS1530
MW1240	Portable Power Tools	20	MS1230
MW1250	Blueprint Reading and Sketching	20	
MW1260	Equipment Assembly Blueprints	20	MW1250
MW1270	Mechanical Installation Blueprints	15	MW1260
MW1280	Schematics Advanced	20	MW1250
MW1290	Rigging	30	MW1240
MW1450	Drills, Taps and Reamers	30	MW1240
MW1460	Measuring and Layout	60	MS1230
MW1470	Piping Components	30	MW1460

## Plan of Training – Industrial Mechanic (Millwright)

---

Entry Level – Block 1			
NL Course No.	Course Name	Hours	Pre-requisites
MW1510	Power Metal Saws	20	MW1460
MW1520	Pedestal Grinders	20	MW1510
MW1530	Bearings	40	MW1580
MW1540	Fasteners	9	MS1230
MW1550	Metallurgy	30	WD1330
MW1580	Static and Dynamic Seals	30	MW1650
MW1590	Coupling and Clutches	30	MW1640
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	MW1590
MW1690	Positive Displacement Pumps	50	MW1670
MW1730	Electrical Fundamentals	30	MW2150
MW2150	Hydraulics I	30	MW1690
WD1330	Oxy-Fuel Welding	30	MS1230
OT1190	Workplace Exposure	90	
AP1100	Introduction to Apprenticeship	15	
*MA1060	Basic Math	60	
CM2150	Workplace Communications	45	
MR1220	Customer Service	30	
SP-2330	Quality Assurance/Quality	30	

Plan of Training – Industrial Mechanic (Millwright)

---

Entry Level – Block 1			
NL Course No.	Course Name	Hours	Pre-requisites
	Control		
MC1050	Introduction to Computers	30	
SD1700	Workplace Skills	30	
SD1710	Job Search Techniques	15	MC1050
SD1720	Entrepreneurial Awareness	15	
<b>Total Hours</b>		<b>1125</b>	

**Required Work Experience**

Block 2			
NL Course No.	Course Name	Hours	Pre-requisites
MW1660	Material Handling Systems	60	MW1590
MW2160	Hydraulics II	35	WD1380
MW2170	Pneumatics	40	MW2160
MW2180	Compressors	40	MW2170
WD1380	Electric Arc Welding	60	WD1330
<b>Total Hours</b>		<b>235</b>	

**Required Work Experience**

Plan of Training – Industrial Mechanic (Millwright)

---

<b>Block 3</b>			
<b>NL Course No.</b>	<b>Course Name</b>	<b>Hours</b>	<b>Pre-requisites</b>
MW1560	Coupling Alignment	45	MW1590
MW1620	Metal Lathe	100	MW1450
MW1630	Milling Machines	40	MW1620
MW2190	Machinery Installation and Alignment	60	MW1560
<b>Total Hours</b>		<b>245</b>	

**Required Work Experience**

<b>Block 4</b>			
<b>NL Course No.</b>	<b>Course Name</b>	<b>Hours</b>	<b>Pre-requisites</b>
MW1680	Dynamic Balancing	45	MW2230
MW1740	Preventative and Predictive Maintenance	35	MW2180
MW2200	Boilers	30	MW1690
MW2210	Prime Movers I (Internal Combustion Engines)	45	MW1580
MW2220	Prime Movers II (Turbines)	45	MW2210
MW2230	Vibration Analysis	40	MW1740
<b>Total Hours</b>		<b>240</b>	

**Total Course Credit Hours** 1845

\* A student who can meet the Mathematics requirement through an ACUPLACER® test may be exempted from Mathematics 1060. Please check with your training institution.

## **Entry Level – Block 1**

### **TS1510 Occupational Health and Safety**

#### **Description:**

This course is designed to give participants the knowledge and skills necessary to interpret the Occupational Health and Safety Act, laws and regulations; understand the designated responsibilities within the laws and regulations; the right to refuse dangerous work; and the importance of reporting accidents.

**Pre-Requisites:** None

#### **Course Outcomes:**

Upon successful completion of this unit, the apprentice will be able to:

- prevent accidents and illnesses
- improve health and safety conditions in the workplace

#### **Theory:**

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 & 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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

## Plan of Training – Industrial Mechanic (Millwright)

---

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:**

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)**

### **Description:**

This course is designed to give participants the knowledge and skills necessary to define WHMIS, examine hazard identification and ingredient disclosure, explain labeling and other forms of warning, and introduce material safety data sheets (MSDS).

**Pre-Requisites:** None

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- interpret and apply the Workplace Hazardous Materials Information System (WHMIS) Regulation under the Occupational Health & Safety Act.

### **Required Knowledge and Skills:**

1. Define WHMIS safety.
  - i. rational and key elements
  - ii. history and development of WHMIS
  - iii. WHMIS legislation
  - iv. WHMIS implementation
  - 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 subdivisions in WHMIS
    - general rules for classification

## Plan of Training – Industrial Mechanic (Millwright)

---

- class A – compresses 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 WHMIS label
  - supplier label
  - workplace label
  - other means of identification
- ii. responsibilities 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- ii. purpose of the data sheet
- iii. responsibility for the production and availability of data sheets
  - supplier responsibility
  - employer responsibility
  - workers responsibility

### **Practical:**

Practical skills enhance the apprentices' ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick.

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.

### **SUGGESTED RESOURCES:**

1. WHMIS Regulation.
2. Sample MSDS sheets.

## **TS1530 Standard First Aid**

### **Description:**

This course is designed to give the apprentice the ability to recognize situations requiring emergency action and to make appropriate decisions concerning first aid.

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

**Pre-Requisites:** None

## **MS1230 Hand Tools**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- develop safety practices in the use and care of hand tools
- select, operate and maintain hand tools properly

**Prerequisites:**      TS1510      Occupational Health & Safety  
                          TS1520      WHMIS  
                          TS1530      Standard First Aid

### **Objectives and Content:**

1. 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
2. Explain two uses of arbour presses.
  - i. arbour press classification
  - ii. safe use
  - iii. broach sets
3. Describe torque and its importance.

## Plan of Training – Industrial Mechanic (Millwright)

---

- i. definition of torque
- ii. purposes
- iii. torque wrench types
- iv. torque charts
- v. torque wrench adjustment
- vi. torque wrench accuracy

### **Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Cut metal using a hacksaw.
2. Deburr metal using proper file selection.
3. Cut metal using tin snips and chisels.
4. Torque bolts to specifications.

## **MW1240 Portable Power Tools**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- develop safe practices in the use and care of pneumatic and electric portable power tools
- select, operate and maintain pneumatic and electric portable power tools properly

**Prerequisites:** 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. air line inspection
  - v. designed operating pressure
  - vi. pressure loss in lines
  - vii. filters, regulators and lubricators

## Plan of Training – Industrial Mechanic (Millwright)

---

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

### **Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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.

## **MW1250 Blueprint Reading and Sketching**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- demonstrate understanding of blueprint reading
- make freehand sketches
- extract pertinent information from basic blueprints

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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. Explain the functions of a CAD system.

### **Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Develop freehand sketches as per instructor's directives.
2. Complete assignment drawings as per instructor's directives.
3. Operate a CAD system.

## **MW1260 Equipment Assembly Blueprints**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- use blueprints to establish assembly procedures in order to install equipment and machinery

**Prerequisites:** MW1250 Blueprint Reading and Sketching

### **Objectives and Content:**

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

## Plan of Training – Industrial Mechanic (Millwright)

### **Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

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

**Prerequisites:** MW1260      Equipment Assembly Blueprints

### **Objectives and Content:**

1. Describe the procedures used to read and interpret mechanical drawings to determine the location, the position and the elevation of various equipment, electrical components, mechanical component 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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

## **MW1280 Schematics Advanced**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- recognize schematic symbols for hydraulic and pneumatic systems
- develop schematic drawings
- use schematics to troubleshoot hydraulic and pneumatic systems

**Prerequisites:** MW1250 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. Recognize 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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

## **MW1290 Rigging**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

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

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

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

## Plan of Training – Industrial Mechanic (Millwright)

---

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 and their uses

**Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- operate drilling machines and reamers in a safe and efficient manner
- maintain drilling machines and reamers
- sharpen twist drills
- identify proper speed and feed while using drilling machines and reamers
- properly use dies
- drill, ream, counterbore, countersink and tap hole

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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

## Plan of Training – Industrial Mechanic (Millwright)

---

### Practical:

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Drill, tap, ream, counterbore and countersink holes as directed by the instructor.
2. Sharpen a twist drill at various angles.
3. Mix cutting fluids.

## **MW1460 Measuring and Layout**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- make accurate measurements with precision and semi-precision measuring tools

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- iii. surface plates
- iv. scribes
- 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

## Plan of Training – Industrial Mechanic (Millwright)

---

### Practical:

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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.

## **MW1470 Piping Components**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- thread and install pipes, tubing, valves and fittings
- maintain valves

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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. Define and explain 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

## Plan of Training – Industrial Mechanic (Millwright)

---

### **Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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 & disassemble valves.

## **MW1510 Power Metal Saws**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- cut metal with band and reciprocating saws
- cut metal with abrasive wheel cut off saws
- maintain power metal saws

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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.

## **MW1520 Pedestal Grinders**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- operate pedestal grinders in a safe, efficient and responsible manner
- maintain pedestal grinders

**Prerequisites:** MW1510 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. Explain 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- select, install, remove and maintain bearings
- identify the purpose of different types of bearings and identify their proper use
- determine the proper clearance and fits for bearings

**Prerequisites:**      MW1580      Bearings

### **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

## Plan of Training – Industrial Mechanic (Millwright)

---

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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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.

## **MW1540 Fasteners**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- select and install fastening devices

**Prerequisites:** 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 threadskeys
  - 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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

## Plan of Training – Industrial Mechanic (Millwright)

---

### **Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Install various fastening devices using:
  - 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**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- understand basic metallurgy principles

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- select, install, remove and maintain gaskets, seals and packing
- identify the purpose of different types of gaskets, seals and packing and identify their proper use

**Prerequisites:** MW1650 Lubrication Practices

### **Objectives and Content:**

1. 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- xxiii. mechanical seal theory of operation
- xxiv. flushing and quenching mechanical seals
- xxv. mechanical seal maintenance
- xxvi. bushings
- xxvii. annulus, slinger and labyrinth seals

2. Describe the procedures used to select the proper sealant for different applications.
  - i. definition of sealants
  - ii. hardening and non-hardening sealants
  - iii. tapes
3. Describe the procedures used to select the proper gasket material for specific applications.
  - i. requirements of gasket materials
  - ii. metallic and non-metallic gaskets
  - iii. making and installing gaskets
4. Describe the procedures used to inspect, remove, and replace gaskets, seals and packing.

### **Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Make a gasket using gasket material and hand tools.
2. Remove and install
  - i. a mechanical seal
  - ii. static seal
  - iii. dynamic seal
3. Fabricate an O-ring.

## **MW1590 Couplings and Clutches**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- remove, install and maintain couplings and clutches
- identify the purpose of different types of couplings and clutches and identify their proper use

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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. Identify the different types of keys and keyways and their purpose.

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

4. Describe the procedures used to select the proper lubrication for the various clutches and couplings.

- i. types of couplings that require lubrication

## Plan of Training – Industrial Mechanic (Millwright)

---

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

## Plan of Training – Industrial Mechanic (Millwright)

---

### **Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Cut a keyseat on a shaft.
2. Broach a keyway in a hub and fit a key in the keyway.
3. Install a coupling or a clutch.

## **MW1610 Belt and Chain Drive Systems**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- demonstrate understanding of the operation of belt and chain drive systems
- install belt and chain drive systems
- maintain belt and chain drive systems

**Prerequisites:** MW1530 Bearings

### **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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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.

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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:

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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

## **MW1640 Gear Drive Systems**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- calculate correct speeds and feeds
- perform repair and maintenance on gear drive units
- operate gear drive units

**Prerequisites:** 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 dedendum
    - 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
  - 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

Practical:

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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

## **MW1650 Lubrication Practices**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- select the proper lubricant and lubrication methods
- apply proper lubricants where required

Prerequisites: 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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.

### Practical:

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- inspect, maintain, repair and assemble non-positive displacement pumps

**Prerequisites:** MW1590 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. Define 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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. overspeeding
- 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

## Plan of Training – Industrial Mechanic (Millwright)

---

### Practical:

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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

## **MW1690 Positive Displacement Pumps**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- inspect, maintain, repair, and assemble positive displacement pumps

**Prerequisites:** 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. pressure relief valves
  - ii. 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:

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Disassemble, inspect, reassemble and align positive displacement pumps.
2. Troubleshoot problems with positive displacement pumps.

## **MW1730 Electrical Fundamentals**

### **Course Outcomes:**

Upon completion of this course, the participant will be able to:

- demonstrate an understanding of basic electrical principles
- demonstrate an understanding of basic PLCs (Programmable Logic Controllers)
- demonstrate an understanding of the Provincial Public Safety Act as it relates to electrical work

**Prerequisites:** MW2150 Hydraulics I

### **Objectives and Content:**

1. Explain electron theory, Ohm's Law and associated formulae.
2. Explain 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.

## Plan of Training – Industrial Mechanic (Millwright)

---

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

## **MW2150 Hydraulics I**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- understand basic hydraulic principles of operation
- use hydraulic formulae
- identify components, parts and accessories

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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

## **WD1330 Oxy-Fuel Welding**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- operate oxy-fuel equipment to cut metals
- operate oxy-fuel equipment to execute basic welding procedures
- operate oxy-fuel equipment to execute basic brazing and soldering procedures

**Prerequisites:** 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

## Plan of Training – Industrial Mechanic (Millwright)

---

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.
  - vii. brazing rods
  - viii. 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Properly set up oxy-acetylene equipment for the purpose of cutting metal.
2. Perform cutting operations and shut down equipment.

## Plan of Training – Industrial Mechanic (Millwright)

---

3. Soft solder a cap on the end of a copper pipe.
4. Braze a lap joint.
5. Prepare a hot work permit.

## **AP1100     Introduction to Apprenticeship**

### **Description:**

This course is designed to give participants the knowledge base and skills necessary to understand and successfully navigate the apprenticeship/red seal program.

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- identify the requirements for registering in an Apprenticeship Program
- describe the registration process
- explain the steps to complete the Apprenticeship Program
- articulate the roles of the Apprentice, Journeyperson, Training Institutions, Industry and Governing Bodies in the Apprentice Program
- explain the significance of the Red Seal Program

**Pre-Requisites:** None

### **Objective and Content:**

1. Define apprenticeship.
  - i. define Apprenticeship and Red Seal Certification
  - ii. discuss the definition of Apprenticeship and Red Seal Certification
  - iii. distinguish between Red Seal and Provincial Certification
2. Explore how apprenticeship is governed and administered.
  - i. explain who is responsible for administrating apprenticeship
    - Department of Education
    - Provincial Apprenticeship and Certification Board
3. Explore the roles and responsibilities of those involved in the apprenticeship process.
  - i. apprentice
  - ii. employer/journeyperson

## Plan of Training – Industrial Mechanic (Millwright)

---

- iii. Industrial Training Division
  - explain when and where to take the in-class portion of advance training
  - discuss class calls
- iv. Training Institutions
  - various delivery methods
- v. Provincial Apprenticeship and Certification Board

4. List and explain the steps in the apprenticeship process.

- i. explain the registration process
- ii. describe apprenticeship as an agreement between employee, employer and Provincial government
- iii. review a Memorandum of Understanding
- iv. legal document
- v. review an application of apprenticeship
  - original high school certificate or equivalent
  - original transcript from the applicant's training institution
- vi. describe the roles of Institutional and Industrial Education Division of the Department of Education in apprenticeship
- vii. explain the role of the Program Development Officer
  - define probation period
  - discusses what constitutes a cancellation of apprenticeship
  - explain the consequences of an apprenticeship cancellation
  - discuss the purpose of the Record of Occupational Progress (Log Book)
  - explore how to maintain your log book
  - discuss who is responsible for tracking and signing-off on trade skills
  - explain how and where to record hours worked
  - identify the importance of updating your file with the Program Development Officer
- viii. differentiate between provincial and interprovincial exams

5. Describe the training and education requirements.

- i. discuss the factors affecting on-the-job and in class portions of your training
- ii. define in school and on the job training
  - review a Plan of Training
  - identify the percentage of on-the-job and in class training time
  - current labour market implications on completing an apprenticeship program

## Plan of Training – Industrial Mechanic (Millwright)

---

6. Explain Plans of Training.
  - i. identify what is included in the Plan of Training
    - entrance requirements
    - duration of in-school and on-the-job training
    - course content
    - entry level or advanced level
  - ii. explain how a Journeyperson Certificate is achieved
    - discuss Certificate of Qualification.
    - discuss Certificate of Apprenticeship.
    - discuss Red Seal endorsement
7. Discuss the Red Seal Program.
  - i. define designated trade
  - ii. explore the National Occupational Analysis for your trade
  - iii. explain Interprovincial Standards Red Seal Program and how it works.
    - labor mobility
    - qualification recognition
  - iv. discuss the range of careers possible in your chosen trade
8. Explain apprenticeship progression schedule and wage rates.
  - i. review a Record of Occupational Progress (Log Book)
  - ii. hours per program
  - iii. requirements for progression
  - iv. wage rates per year of apprenticeship
9. Identify the examinations and evaluation process used in Apprenticeship.
  - i. discuss occupational tests and examinations as directed by the Provincial Apprenticeship and Certification Board
    - theory
    - practical
  - ii. explain formal assessment and the pass mark of 70%
10. Examine some of the financial incentives available to apprentices.
  - i. Employment Insurance (E.I.) Benefits
  - ii. government sponsored student loans
  - iii. apprenticeship incentive Federal and Provincial

## Plan of Training – Industrial Mechanic (Millwright)

---

### iv. scholarships

11. Continuing training outside the Province of Newfoundland Labrador.
  - i. training in other provinces and territories
    - procedure for registration and recognition of hours and skills in other provinces
  - ii. options for dual certification
    - transfer of credits
  
12. Review and define the following terms:
  - i. Apprenticeship Program Accreditation
  - ii. Cancellation of Apprenticeship
  - iii. Certificate of Apprenticeship
  - iv. Certificate of Qualification
  - v. Certification Renewal
  - vi. Criteria for Eligibility
  - vii. Journeyperson
  - viii. Practical Examination
  - ix. Prior Learning
  - x. Record of Occupational Progress (Logbook)
  - xi. Red Seal Certification
  - xii. Registered Apprentice
  - xiii. Theoretical Examination
  - xiv. National Occupational Analysis (NOA)
  - xv. Class Call
  - xvi. Dual certification

### Practical:

1. Review the Provincial Apprenticeship web site: [www.gov.nl.ca/app](http://www.gov.nl.ca/app).
  - i. identify the requirements for registering as an apprentice and the registration process
  - ii. explain the steps to complete an apprenticeship program
  - iii. identify who is responsible for tracking and signing-off on trade skills
  - iv. identify the nearest Industrial Training Office to your community
  - v. identify the current incentives available to apprentices

## Plan of Training – Industrial Mechanic (Millwright)

---

2. Review a plan of training on the Provincial Apprenticeship web site.
  - i. identify the hours for your trade (in-school and on-the-job)
  - ii. explain the roles and responsibilities of the following stakeholders in the apprenticeship process: employer, apprentice, training institution and the Industrial Training Division
3. Visit the Red Seal Web site <http://www.red-seal.ca>, review the National Occupational Analyses for your trade.
  - i. review the scope of work for your occupation and identify the industry sectors and job types requiring your trade
  - ii. identify the trends of your trade
  - iii. provide a list of personal protective equipment required for your trade

## **MA1060 Basic Math**

### **Description:**

This course in Basic Math requires knowledge of general mathematical concepts and processes to enable trades persons to function in the institutional setting by developing numeracy skills required for technical courses. This math course should also provide a foundation for experiential learning through knowledge of math relating to on-the-job skills and practices. A detailed course outline is available from Institutional and Industrial Education, Standards and Curriculum Division to training institutions upon request.

### **Course Outcomes:**

- to develop numeracy skills and knowledge required for institutional and on-the-job learning
- to develop the capability to apply mathematical concepts in the performance of trade practices
- to develop an appreciation for mathematics as a critical element of the learning environment
- to use mathematical principles accurately for the purposes of problem solving, job and materials estimation, measurement, calculation, system conversion, diagram interpretation and scale conversions, formulae calculations, and geometric applications

**Pre-Requisites:** None

### **Course Objectives (Knowledge):**

1. Define and calculate using whole number operations.
2. Define and demonstrate use of correct orders of operations.
3. Demonstrate examples of operations with fractions and mixed numbers.

## Plan of Training – Industrial Mechanic (Millwright)

---

4. Demonstrate examples of operations with decimals.
5. Demonstrate examples of operations with percentages.
6. Employ percent/decimal/fraction conversion and comparison.
7. Define and calculate with ratios and proportions.
8. Use the Imperial Measurement system in relevant trade applications.
9. Use the Metric Measurement system in relevant trade applications.
10. Perform Imperial/Metric conversions.
11. Define and demonstrate the formulation of variables.
12. Demonstrate and define the various properties of angles and make relevant calculations.

### **Major Tasks/Sub-tasks (Skills):**

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

## **CM2150    Workplace Communications**

### **Description:**

This course is designed to introduce students to the principles of effective communication including letters, memos, short report writing, oral presentations and interpersonal communications.

### **Course Outcomes:**

Upon completion of the course, students will be able to:

- understand and apply communication skills as outlined in the Employability Skills 2000, Conference Board of Canada
- understand the importance of well-developed writing skills in business and in career development
- understand the purpose of the various types of business correspondence
- examine the principles of effective business writing
- examine the standard formats for letters and memos
- write effective letters and memos
- examine the fundamentals of informal reports and the report writing procedure
- produce and orally present an informal report
- examine effective listening skills and body language in communication

**Pre-Requisites:**   None

### **Objectives and Content:**

1. Apply rules and principles for writing clear, concise, complete sentences which adhere to the conventions of grammar, punctuation, and mechanics.
2. Explain the rules of subject-verb agreement.
3. Define and describe the major characteristics of an effective paragraph.

## Plan of Training – Industrial Mechanic (Millwright)

---

4. Examine the value of business writing skills.
  - i. describe the importance of effective writing skills in business
  - ii. describe the value of well-developed writing skills to career success as referenced in the Employability Skills
5. Examine principles of effective business writing.
  - i. discuss the rationale and techniques for fostering goodwill in business communication, regardless of the circumstances
  - ii. review the importance of revising and proofreading
  - iii. differentiate between letter and memo applications in the workplace and review samples
  - iv. identify the parts of a business letter and memo
  - v. review the standard formats for business letters and memos
  - vi. examine samples of well-written and poorly written letters and memos
  - vii. examine guidelines for writing sample letters and memos which convey: acknowledgment, routine request, routine response, complaint, refusal, persuasive request and letters of appeal
6. Examine the fundamentals of informal business reports.
  - i. identify the purpose of the informal report
  - ii. identify the parts and formats of an informal report
  - iii. identify methods of information gathering
  - iv. describe the methods of referencing documents
  - v. review the importance of proof reading and editing
7. Examine types of presentations.
  - i. review and discuss components of an effective presentation
  - ii. review and discuss delivery techniques
  - iii. review and discuss preparation & use of audio/visual aids
  - iv. discuss and participate in confidence building exercises used to prepare for giving presentations
8. Interpersonal communications.
  - i. examine and apply listening techniques
  - ii. discuss the importance of body language

**Practical:**

1. Write well-developed, coherent, unified paragraphs which illustrate the following: a variety of sentence arrangements; conciseness and clarity; and adherence to correct and appropriate sentence structure, grammar, punctuation, and mechanics.
2. Write sample letters and memos which convey: acknowledgment, routine request, routine response, complaint, refusal, persuasive request and letters of appeal.
3. Gather pertinent information, organize information into an appropriate outline and write an informal report with documented resources.
  - i. edit, proofread, and revise the draft to create an effective informal report and present orally using visual aids
  - ii. participate in confidence building exercises
4. Present an effective presentation.
5. Evaluate presentations.

## **MR1220 Customer Service**

### **Description:**

This course focuses on the role of providing quality customer service. It is important to have a positive attitude and the necessary skills to effectively listen and interpret customer concerns about a product, resolve customer problems, and determine customer wants and needs. Students will be able to use the skills and knowledge gained in this course to effectively provide a consistently high level of service to the customer.

### **Course Outcomes:**

Upon successful completion of this course, students will be able to:

- define customer service
- explain why service is important
- describe the relationship between “service” and “sales”
- demonstrate an understanding of the importance of a positive attitude
- demonstrate methods of resolving customer complaints

**Pre-Requisites:** None

### **Objectives and Content:**

1. Define quality service.
  - i. identify and discuss elements of customer service
  - ii. explain the difference between service vs. sales or selling
  - iii. explain why quality service is important
  - iv. identify the various types of customers and challenges they may present
  - v. describe customer loyalty
  - vi. examine barriers to quality customer service
2. Explain how to determine customer’s wants and needs.
  - i. identify customer needs

## Plan of Training – Industrial Mechanic (Millwright)

---

- ii. explain the difference between customer wants and needs
- iii. identify ways to ensure repeat business

3. Demonstrate an understanding of the importance of having a positive attitude.

- i. identify & discuss the characteristics of a positive attitude
- ii. explain why it is important to have a positive attitude
- iii. explain how a positive attitude can improve a customer's satisfaction
- iv. define perception and explain how perception can alter us and customers
- v. describe methods of dealing with perception

4. Communicating effectively with customers.

- i. describe the main elements in the communication process
- ii. identify some barriers to effective communication
- iii. explain why body language is important
- iv. define active listening and state why it is important
- v. identify and discuss the steps of the listening process
- vi. identify and discuss questioning techniques

5. Demonstrate using the telephone effectively.

- i. explain why telephone skills are important
- ii. describe the qualities of a professional telephone interaction

6. Demonstrate an understanding of the importance of asserting oneself.

- i. define assertiveness
- ii. discuss assertive techniques
- iii. explain the use of assertiveness when dealing with multiple customers

7. Demonstrate techniques for interacting with challenging customers in addressing complaints and resolving conflict.

- i. examine and discuss ways to control feelings
- ii. examine and discuss ways to interact with an upset customer
- iii. examine and discuss ways to resolve conflict/customer criticism
- iv. examine and discuss ways to prevent unnecessary conflict with customers

## Plan of Training – Industrial Mechanic (Millwright)

### **Practical:**

1. Participate in activities to demonstrate knowledge of the course objectives.

## **SP2330      Quality Assurance/Quality Control**

### **Description:**

This course is designed to give students an understanding of the concepts and requirements of QA/QC such as, interpreting standards, controlling the acceptance of raw materials, controlling quality variables and documenting the process. It includes information on quality concepts, codes and standards, documentation, communications, human resources, company structure and policy, teamwork and responsibilities.

### **Course Outcomes:**

Upon completion of this course, students will be able to:

- develop the skills and knowledge required to apply quality assurance/quality control procedures as related to the trade
- develop an awareness of quality principles and processes
- apply quality assurance/quality control procedures in a shop project

**Pre-Requisites:** None

### **Objectives & Content:**

1. Describe the reasons for quality assurance and quality plans.
2. Explain the relationship between quality assurance and quality control.
3. Describe quality control procedures as applied to the production and checking of specifications and processes in applicable occupations.
4. Describe quality control procedures as applied to the acceptance and checking of raw materials.
5. Explain the role of communications in a quality environment.

## Plan of Training – Industrial Mechanic (Millwright)

---

6. Explain why it is important for all employees to understand the structure of the company and its production processes.
7. Explain how human resource effectiveness is maximized in a quality managed organization.
8. Explain the role of company policy in quality management.
9. Explain the purpose of codes and standards in various occupations.
10. Explain the concepts of quality.
  - i. cost of quality
  - ii. measurement of quality
  - iii. elements of quality
  - iv. elements of the quality audit
  - v. quality standards
  - vi. role expectations and responsibilities
11. Explain the structure of quality assurance and quality control.
  - i. describe organizational charts
  - ii. identify the elements of quality assurance system such as ISO, CSA, WHMIS, Sanitation Safety Code (SSC)
  - iii. explain the purpose of the quality assurance manual
  - iv. describe quality assurance procedures
12. Examine quality assurance/quality control documentation.
  - i. describe methods of recording reports in industry
  - ii. describe procedures of traceability (manual and computer-based recording)
  - iii. identify needs for quality control procedures

## Plan of Training – Industrial Mechanic (Millwright)

---

### **Practical:**

1. Apply quality control to a project
  - i. follow QA/QC procedures for drawings, plans and specifications in applicable occupations
  - ii. calibrate measuring instruments and devices in applicable occupations.
  - iii. interpret required standards
  - iv. follow QA/QC procedures for accepting raw materials
  - v. carry out the project
  - vi. control the quality elements (variables)
  - vii. complete QA/QC reports

## **MC1050    Introduction to Computers**

### **Description:**

This course is designed to give the student an introduction to computer systems. Particular emphasis is given to word processing, spreadsheet, e-mail and the Internet and security issues.

### **Course Outcomes:**

Upon completion of this course, students will have a basic understanding of:

- computer systems and their operation
- popular software packages, their applications
- security issues of computers

**Pre-Requisites:**   None

### **Objectives & Content:**

1. Identify the major components of microcomputer system hardware and software system.
2. Describe the functions of the microprocessor.
  - i. describe and give examples of I/O DEVICES
  - ii. describe primary storage (RAM, ROM, Cache)
  - iii. define bit, byte, code and the prefixes k.m. and g.
  - iv. describe secondary storage (diskettes and hard disks, CD ROMS, Zip drives, etc.)
  - v. describe how to care for a computer and its accessories
3. Describe microcomputer software.
  - i. define software
  - ii. describe types of operational and application software
  - iii. define file and give the rules for filenames and file extensions
4. Describe windows software.

## Plan of Training – Industrial Mechanic (Millwright)

---

- i. start and quit a program
- ii. demonstrate how to use the help function
- iii. locate a specific file using the find function
- iv. identify system settings: wall paper, screen saver, screen resolution, background
- v. start a program by using the run command
- vi. shutting down your computer

5. Identify file management commands.

- i. create folders
- ii. maximize and minimize a window
- iii. describe windows task bar

6. Describe keyboards.

- i. identify and locate alphabetic and numeric keys
- ii. identify and locate function key & special keys

7. Describe word processing.

- i. describe windows components
- ii. menu bar
- iii. menu indicators
- iv. document window
- v. the status bar
- vi. the help feature
- vii. insertion point movements

8. Describe the procedure used to develop a document.

- i. enter text
- ii. change the display

9. Describe the procedure for opening, saving and exiting documents.

- i. saving a document
- ii. closing a document.
- iii. starting a new document Window
- iv. opening a document
- v. exiting word processor

10. Describe the procedure for editing a document.

## Plan of Training – Industrial Mechanic (Millwright)

---

- i. adding new text
- ii. deleting text
- iii. using basic format enhancement (split and join paragraphs, insert text)

11. Describe the main select features.

- i. identify a selection
- ii. moving a selection
- iii. copying a selection
- iv. deleting a selection
- v. saving a selection

12. Explain how to change layout format.

- i. changing layout format: (margins, spacing, alignment, paragraph indent, tabs, line spacing, page numbering)

13. Explain how to change text attributes.

- i. changing text attributes: (bold, underline, font, etc.)

14. Describe the auxiliary tools.

- i. using spell check and thesaurus

15. Describe print features.

- i. selecting the print feature: (i.e. number of copies and current document)
- ii. identifying various options in print screen dialogue box

16. Examine and discuss electronic spreadsheet.

- i. spreadsheet basics
- ii. the worksheet window

17. Describe menus.

- i. menu bar
- ii. control menu
- iii. shortcut menu
- iv. save, retrieve from menus

18. Describe the components of a worksheet.

## Plan of Training – Industrial Mechanic (Millwright)

---

- i. entering constant values and formulas
- ii. using the recalculation feature

19. Describe use ranges.

- i. typing a range for a function
- ii. pointing to a range for a function
- iii. selecting a range for toolbar and menu commands

20. Describe how to print a worksheet.

- i. printing to the screen
- ii. printing to the printer
- iii. printing a selected range

21. Describe how to edit a worksheet.

- i. replacing cell contents
- ii. inserting & deleting rows and columns
- iii. changing cell formats
- iv. changing cell alignments
- v. changing column width
- vi. copying and moving cells

22. State major security issues in using computers.

- i. pass words
- ii. accessing accounts
- iii. viruses and how they can be avoided
- iv. identity theft and ways to protect personal information
- v. demonstrate how to view directory structure and folder content
- vi. organize files and folders
- vii. copy, delete, and move files and folders

23. Describe how to use electronic mail.

- i. e-mail etiquette
- ii. e-mail accounts
- iii. e-mail messages
- iv. e-mail message with attachments
- v. e-mail attachments
- vi. print e-mail messages
- vii. deleting e-mail messages

## Plan of Training – Industrial Mechanic (Millwright)

---

24. Explain the internet and its uses.
  - i. the world wide web(www)
  - ii. accessing web sites
  - iii. internet web browsers
  - iv. internet search engines
  - v. searching techniques
  - vi. posting documents on-line

### **Practical:**

1. Create a document using word processing.
2. Complete word processing exercises to demonstrate proficiency in word processing.
3. Prepare and send e-mails with attachments.
4. Retrieve documents and e-mail attachments and print copies.
5. Develop and print a spread sheet.
6. Post a document on-line.

## **SD1700     Workplace Skills**

### **Description:**

This course involves participating in meetings, information on formal meetings, unions, workers' compensation, employment insurance regulations, workers' rights and human rights.

### **Course Outcomes:**

Upon completion of this course, students will be able to:

- participate in meetings
- define and discuss basic concepts of:
  - unions
  - workers' compensation
  - employment insurance
  - workers' rights
  - human rights
  - workplace diversity
  - gender sensitivity

**Pre-Requisites:** None

### **Objectives & Content:**

1. Meetings.
  - i. identify and discuss meeting format and preparation required for a meeting
  - ii. explain the purpose of an agenda
  - iii. explain the roles and responsibilities of meeting participants
  - iv. explain the purpose of motions and amendments and withdrawals
  - v. explain the procedure to delay discussion of motions
  - vi. explain the voting process
2. Unions.
  - i. state why unions exist

## Plan of Training – Industrial Mechanic (Millwright)

---

- ii. give a concise description of the history of Canadian labour
- iii. explain how unions function
- iv. explain labour's structure
- v. describe labour's social objectives
- vi. describe the relationship between Canadian labour and the workers
- vii. describe the involvement of women in unions

3. Worker's Compensation.

- i. describe the aims, objectives, benefits and regulations of the Workplace Health, Safety and Compensation Commission
- ii. explain the internal review process

4. Employment Insurance.

- i. explain employment insurance regulations
- ii. describe how to apply for employment insurance
- iii. explain the appeal process
- iv. identify the components of a letter of appeal

5. Worker's rights.

- i. define labour standards
- ii. explain the purpose of the Labour Standards Act
- iii. identify regulations pertaining to:
  - hours of work
  - minimum wages
  - employment of children
  - vacation pay
- iv. explain the purpose of the Occupational Health & Safety Act as it refers to workers' rights

6. Human Rights.

- i. describe what information cannot be included on an employment application
- ii. describe what information cannot be included in an interview
- iii. examine the Human Rights Code and explain the role of the Human Rights Commission
- iv. define harassment in various forms and identify strategies for prevention

## Plan of Training – Industrial Mechanic (Millwright)

---

7. Workplace diversity.
  - i. define and explore basic concepts and terms related to workplace inclusively including age, race, culture, religion, socio-economic, sexual orientation with an emphasis on gender issues and gender stereotyping.
8. Gender sensitivity.
  - i. explore gender and stereotyping issues in the workplace by identifying strategies for eliminating gender bias

### **Practical:**

1. Prepare an agenda.
2. Participate in a meeting.
3. Analyze a documented case of a human rights complaint with special emphasis on the application, time frame, documentation needed, and legal advice available.

## **SD1710 Job Search Techniques**

### **Description:**

This course is designed to give students an introduction to the critical elements of effective job search techniques.

### **Course Outcomes:**

Upon completion of this course, students will be able to:

- demonstrate effective use of job search techniques

**Pre-Requisites:** None

### **Objectives and Content:**

1. Identify and examine employment trends and opportunities.
2. Identify sources that can lead to employment.
3. Access and review information on the Newfoundland and Labrador Apprenticeship and Certification Web site and the Apprenticeship Employment Gateway.
4. Analyze job ads and discuss the importance of fitting qualifications to job requirements.
5. Identify and discuss employability skills as outlined by the Conference Board of Canada.
6. Discuss the necessity of fully completing application forms.
7. Establish the aim/purpose of a resume.
8. Explore characteristics of effective resumes, types of resumes, and principles of resume format.
9. Explore characteristics of an effective cover letter.

## Plan of Training – Industrial Mechanic (Millwright)

---

10. Identify commonly asked questions in an interview.
11. Explore other employment related correspondence.
12. Explore the job market to identify employability skills expected by an employer.
13. Conduct a self-analysis and compare with general employer expectations.
14. Discuss the value of establishing and maintaining a portfolio.

### **Practical:**

1. Complete sample application forms.
2. Write a resume.
3. Write an effective cover letter.
4. Establish a portfolio.
5. Write out answers to commonly asked questions asked during interviews.
6. Identify three potential employers from the Apprenticeship Employment Gateway, Apprenticeship and Certification website.

## **SD1720      Entrepreneurial Awareness**

### **Description:**

This course is designed to introduce the student to the field of entrepreneurship, including the characteristics of the entrepreneur, the pros and cons of self-employment, and some of the steps involved in starting your own business.

### **Course Outcomes:**

Upon completion of this course, the student will be able to:

- identify the various types of business ownership, the advantages and disadvantages of self-employment and identify the characteristics of an entrepreneur
- state the purpose and identify the main elements of a business plan

### **Pre-Requisites:**   None

### **Objectives and Content:**

1. Explore self-employment: An alternative to employment.
  - i. identify the advantages and disadvantages of self-employment vs. regular employment
  - ii. differentiate between an entrepreneur and a small business owner
  - iii. evaluate present ideas about business people
2. Identify and discuss various types of business ownership.
  - i. explore the characteristics of entrepreneurs
  - ii. identify characteristics common to entrepreneurs
  - iii. compare one's own personal characteristics with those of entrepreneurs
  - iv. examine one's present ideas about business people
3. Identify business opportunities.
  - i. distinguish between an opportunity and an idea
  - ii. examine existing traditional and innovative business ventures

## Plan of Training – Industrial Mechanic (Millwright)

---

- iii. identify and summarize the role of various agencies that support business development

4. Review the entrepreneurial process.

- i. explain the entrepreneurial process
- ii. describe the purpose of a business plan

## **Block 2**

### **MW1660 Material Handling Systems**

#### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- assemble conveyors
- install conveyors
- operate conveyors
- repair conveyors
- maintain conveyors

**Prerequisites:** MW1590 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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

## Plan of Training – Industrial Mechanic (Millwright)

---

### Practical:

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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**

### **Course Outcomes:**

Upon successful completion of course, the apprentice will be able to:

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

**Prerequisites:** WD1380 Electric Arc Welding

### **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.

## Plan of Training – Industrial Mechanic (Millwright)

---

- 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- install pneumatic systems
- troubleshoot pneumatic systems
- maintain and repair pneumatic systems
- identify components, parts and accessories
- identify the main components, parts and accessories in vacuum systems
- maintain and repair vacuum systems

**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. Charlie'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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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.

## **MW2180 Compressors**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- understand the principle of operation of compressor
- maintain compressors and their assembly

**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. Boyles Law
  - ii. Charles 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 procedures

## Plan of Training – Industrial Mechanic (Millwright)

---

### Practical:

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Perform a preventative check on compressors.
2. Disassemble, inspect and assemble a reciprocating compressor.

## **WD1380 Electric Arc Welding**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- set up arc welding equipment
- describe the different types of electrodes and identify the purpose
- describe the different types of joints
- perform basic arc welding procedures

**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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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.

## **Block 3**

### **MW1560 Coupling Alignment**

#### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- align couplings using standard alignment methods
- align couplings using the reverse dial alignment method
- align couplings using the laser alignment method

**Prerequisites:** MW1590 Couplings and Clutches

#### **Objectives and Content:**

#### **Standard Alignment Procedures**

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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Perform alignment per instructor's requirements.
  - i. standard
  - ii. rim and face
  - iii. reverse dial
  - iv. laser
2. Calculate requirements for thermal expansion.

## **MW1620 Metal Lathe**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- identify parts and accessories
- calculate correct speeds and feeds
- calculate thread depth
- perform turning, facing, boring and threading operations

**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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Sharpen a tool bit.
2. Perform the following operations using a lathe:
  - i. straight turning
  - ii. facing
  - iii. boring
  - iv. threading

## **MW1630 Milling Machines**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- calculate correct speeds and feeds
- perform set up and safely 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Cut a keyseat into a shaft using a milling machine.

## **MW2190 Machinery Installation and Alignment**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will have the knowledge and skills to understand how to:

- perform machinery set-up procedures
- locate and lay out machinery

**Prerequisites:** MW1560 Coupling Alignment

### **Objectives and Content:**

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

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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

## **Block 4**

### **MW1680 Dynamic Balancing**

#### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- collect data.
- use a computer to execute balancing calculations.
- use balancing techniques to correct vibration problems.

**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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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

## **MW1740 Preventative and Predictive Maintenance**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- perform preventative maintenance and maintain proper records

**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

**Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Design a preventative maintenance sheet on a piece of equipment.
2. Perform a dye penetrants inspection.
3. Collect and interpret data on equipment.

## **MW2200   Boilers**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- maintain boilers and their components and accessories

**Prerequisites:**     MW1690     Positive Displacement Pumps

### **Objectives and Content:**

1. Describe the principles of boiler operation.
  - i. classification of boilers
  - ii. water tube boilers
  - iii. fire tube boilers
  - iv. boiler tubes
  - v. fire box
  - vi. mud drum
  - vii. steam drum
  - viii. superheaters
  - ix. economizers
  - x. condensers
  - xi. boiler ratings
  - xii. fuels and fuel systems for firing boilers
  - xiii. main steam system
  - xiv. condensate and feed water system
  - xv. circulating water system
2. Describe the various boiler designs and their application.
  - i. fire tube boilers
  - ii. water tube boilers
  - iii. vertical boilers
  - iv. horizontal return tube boilers
  - v. dampers
  - vi. instruments to measure draft pressure
3. Describe the different boiler controls and their specific uses.
  - i. fuel nozzles

- ii. safety valves
- iii. sight glasses
- iv. feed water treatment
- v. soot blowers
- vi. dampers
- vii. draft control
- viii. low water level indicator

4. Describe the principles of operation of fans.

- i. natural draft
- ii. mechanical draft
- iii. induced draft
- iv. balanced draft
- v. pressurized furnace
- vi. output control
- vii. shaft coolers

5. Identify the classification of fans and blade design, 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

**Practical:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Identify various types of fans.

## **MW2210 Prime Movers 1 (Internal Combustion Engines)**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- install internal combustion engines
- maintain internal combustion engines

**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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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

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

## **MW2220 Prime Movers II (Turbines)**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will be able to:

- maintain steam and gas turbines

**Prerequisites:** MW2210 Prime Movers I (Internal Combustion Engines)

### **Objectives and Content:**

1. 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
2. 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

3. 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

4. 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are **mandatory** in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

1. Participate in the disassemble, inspecting andreassembling of a steam and/or gas turbine.

## **MW2230 Vibration Analysis**

### **Course Outcomes:**

Upon successful completion of this course, the apprentice will have the knowledge and skills to understand how to:

- collect data used in vibration analysis
- analyse causes of unbalances
- detect and diagnose vibration levels

**Prerequisites:** MW1740 Preventative and Predictive Maintenance

### **Objectives and Content:**

1. List 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:**

Practical skills enhance the apprentice's ability to meet the objectives of this course. The learning objectives outlined below are mandatory in Newfoundland and Labrador, but are provided as suggestions for Nova Scotia, Prince Edward Island and New Brunswick. Practical activities include:

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.