

Industrial Mechanic (Millwright) Level 4

Industrial Mechanic (Millwright)

Unit: D1 Mechanical Installation Drawings and Equipment Installation and Alignment

Level: Four

Duration: 21 hours

Theory: 10 hours

Practical: 11 hours

Overview:

This unit is designed to introduce knowledge of mechanical installation drawings, their use and interpretation.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with mechanical installation drawings.	5%
2. Identify the purposes for mechanical installation drawings. a. Determine location of components b. Determine the positioning of components c. Determine elevation of components	15%
3. Identify the views found on mechanical installation drawings and describe their characteristics.	15%
4. Interpret mechanical installation drawings. a. Location of equipment • Placement and elevation b. Placing of components in system c. Alignment, clearances and tolerances d. Process and Instrumentation Drawing (PNID)	15%

D1.a Mechanical Installation Drawings and Equipment Installation and Alignment

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with equipment installation, leveling and alignment.	5%
2. Identify hazards and describe safe work practices pertaining to equipment installation, leveling and alignment.	3%

- 3. Identify tools and equipment used for equipment installation, leveling and alignment and describe their applications and procedures for use. 12%**
- a. Theodolites
 - b. Optical levels
 - c. Piano wire
 - d. Water level
 - e. Laser
- 4. Identify types of bases and describe their applications. 12%**
- a. Base plate
 - b. Sole plate
 - c. Fabricated
 - d. Skid mounted
- 5. Describe the procedures used to install, level and align equipment. 13%**
- a. Planning
 - b. Interpret drawings
 - c. Fabricate component supports
 - d. Install base
 - e. Position equipment
 - f. Relieve stresses/strains
 - g. Anchor and grout
 - h. Complete documentation
- 6. Describe the procedures used to commission equipment. 5%**

Industrial Mechanic (Millwright)

Unit: D2 Journeyperson Trainer

Level: Four

Duration: 10 hours

Theory: 10 hours

Practical: 0 hours

Overview:

Level 1 in-school technical training offers an entry-level orientation to the challenges of apprenticeship training as it relates to the development of core tasks and skill requirements, as well as social competencies. This unit introduces senior apprentices to the responsibilities of workplace training that they will assume as supervising journeypersons. Most trades have a rich tradition of refreshing and sharing their trade skills from one generation of trade practitioner to the next. This unit orients senior apprentices to some of the practical and conceptual tools that can enable them to contribute to this trade heritage when they become certified journeypersons and, ultimately, journeyperson trainers.

The journeyperson's obligation to assist entry-level apprentices to develop skills and knowledge is complex and challenging. It involves safety considerations, employer expectations, provincial regulations, as well as the tradition of skills stewardship that links modern practice with the long history of workplace teaching and learning that defines the apprenticeable trades. The ability to offer timely and appropriate support to apprentices is itself an important area of trade learning. This unit presents material intended to help refine this ability through reflection and discussion by senior apprentices, and discussion with their in-school instructor and journeyperson trainer.

This content reflects Manitoba and Canadian standards prescribed for journeyperson-level supervisory capabilities, as well as key topics in current research on the importance of workplace training in apprenticeship systems. These detailed descriptors represent suggested focal points or guidelines for potentially worthwhile exploration, and are neither mandatory nor exhaustive.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Compare/contrast role-options and responsibilities of the supervising journeyperson.	40%
a. Implicit vs. explicit standards and content: training goals are/are not codified; assessment measures are/are not used	
b. Accountability for results: e.g. journeyperson is/is not required to prepare performance evaluation that could affect apprentice's employability or wage-rate, etc.	
c. Long-term vs. short-term supervision assignments – e.g., considerable latitude/little latitude for apprentice to learn from mistakes	
d. Formally vs. informally structured – e.g. supervision assignment is part of a prescribed cycle of assignments involving coordination among multiple journeypersons; apprentice is trained according to an individual training plan negotiated with employer	
e. Types of supervisory role options and what is implied by each:	
• Journeyperson Trainer (JT) role: often initiated by someone other than apprentice, and limited to a particular skill set, task, or production requirement	

- Mentor role: often initiated by apprentice, and relatively open-ended regarding content, duration, etc.
- Peer role: typically involves individual upgrading or cross-training of one journeyperson by another; can include senior apprentice assisting less-experienced trade learner
- Coordinator role: often a senior-level journeyperson appointed by an organization to assume responsibilities for monitoring progression of groups of apprentices
- Other roles: may be improvised by journeyperson, such as combination or multiple roles of the above

2. Describe and demonstrate common requirements about providing journeyperson level supervision. 60%

- Apprenticeship learning adapted to journeyperson supervision assignments and a journeyperson perspective
 - Application of adult education concepts to trades teaching and learning (e.g. responsibilities and expectations of senior-level apprentices)
 - Practical significance of 'styles' of adult learning and teaching
 - Helping senior-level apprentices integrate in-school technical training and on-the-job practical training experiences
 - Providing help and guidance about new tasks and skills
 - Providing help and guidance about fixing mistakes
 - Learning and teaching "the ropes" – socialization of apprentice within a community of trade practice (e.g. how to borrow a tool, interrupt a journeyperson, and seek advice of experienced co-workers)
 - Coverage and documentation of prescribed tasks and subtasks where applicable.
 - Discuss the limits of the journeyperson trainers' own responsibilities and competence (e.g. scope, willingness to train, etc.)
 - Benefits of maintaining a personal record of achievements, ideas, and needs as a journeyperson trainer (e.g. resume, portfolio, training credentials, logbook, etc.)
- Individual reflection and guided group discussion about personal experiences of workplace learning as an apprentice
 - Identification of best and worst practices of journeyperson trainer
 - Identification of workplace and other factors that can contribute to good and bad trades teaching/learning experiences
 - Development of professional standards and work ethics about responsibility to share one's knowledge and skill with others in the workplace (e.g., use/misuse of humour, rigour, discretion, craft-pride, etc.)
 - Qualities of a good journeyperson trainer
 - Components of workplace journeyperson training
 - Processes and recommended practices re: journeyperson training
 - Troubleshooting problems re: supervision assignments
- Role of assessment in supervising, coaching, or guiding other people to learn or improve their skills (e.g. formative and summative evaluation), and how this might contribute to how the journeyperson-level supervision task is approached in future
- Compare and contrast discussion results with current knowledge and resources about workplace training methods as they apply to journeyperson-level supervision assignments
- Other (as may be specified by instructor)

Industrial Mechanic (Millwright)

Unit: D3 Pre-IP Examination Review

Level: Four

Duration: 50 hours

Theory: 39 hours

Practical: 11 hours

Overview:

This unit offers senior Industrial Mechanic (Millwright) apprentices a systematic review of skills and knowledge required to pass the Inter-Provincial Examination. It promotes a purposeful personal synthesis between on-the-job learning and the content of in-school technical training. The unit includes information about the significance of Inter-Provincial certification and the features of the Inter-Provincial Examination. **Note: No percentage-weightings for test purposes are prescribed for this unit's objectives. Instead, a 'Pass/Fail' grade will be recorded for the unit in its entirety.**

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
<p>1. Describe the significance, format and general content of Inter-Provincial Examinations for the trade of Industrial Mechanic (Millwright).</p> <p>a. Scope and aims of certification; value of certifications</p> <p>b. Obligations of candidates for Inter-Provincial certification</p> <ul style="list-style-type: none"> • Relevance of Inter-Provincial Examinations to current, accepted trade practices; industry-based provincial validation of test items • Supplemental Policy (retesting) • Confidentiality of examination content <p>c. Multiple-choice format (four-option) item format, Apprenticeship Manitoba standards for acceptable test items</p> <p>d. Government materials relevant to the Certification Examinations for apprentice Industrial Mechanic (Millwright)</p> <ul style="list-style-type: none"> • Inter-Provincial Occupational Analysis (NOA); prescribed scope of the skills and knowledge which comprise the trade • NOA "Pie-chart" and its relationship to content distribution of Inter-Provincial Examination items • Apprenticeship Manitoba technical training package. 	n/a
<p>2. Identify resources, strategies and other considerations for maximizing successful completion of written examinations.</p> <p>a. Personal preparedness</p> <ul style="list-style-type: none"> • Rest • Nutrition • Personal study regimen • Prior experience in test situations (e.g., Unit Tests) 	n/a

- c. Self-assessment, consultation and personal study plan
 - Self-assessment of individual strengths/weaknesses in trade related skills and knowledge
 - Approved textbooks
 - Study groups

- 3. **Review program content regarding common occupational skills.** n/a

- 4. **Review program content regarding rigging, hoisting/lifting and moving.** n/a

- 5. **Review program content regarding mechanical components and systems.** n/a

- 6. **Review program content regarding material handling/process systems.** n/a

- 7. **Review program content regarding hydraulic, pneumatic and vacuum systems.** n/a

- 8. **Review program content regarding preventative and predictive maintenance, testing and commissioning.** n/a

Industrial Mechanic (Millwright)

Unit: D4 Electrical Principles

Level: Four

Duration: 14 hours

Theory: 9 hours

Practical: 5 hours

Overview:

This unit is designed to introduce knowledge of the basic concepts of electricity. It is also designed to introduce knowledge of electrical components and equipment.

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

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with electricity.	5%
2. Explain the basic principles of electricity.	10%
3. Explain the principles of magnetism and electromagnetism.	10%
4. Describe the types of electric current, phases and cycles.	10%
5. Explain the mathematical relationship between amps, volts, ohms and watts.	10%
6. Identify hazards and describe safe work practices pertaining to working on or around electrical equipment and sources.	10%
7. Identify electrical devices and describe their purpose.	15%
a. Circuit breakers	
b. Disconnects	
c. Overload heaters	
d. Ground fault interrupters	
e. Fuses	
f. Contactors	
g. Transformers	
h. Interlocks	
i. Programmable logic controllers (PLC's)	
j. Motors	

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| 8. Describe series and parallel circuits. | 5% |
| 9. Perform the types of electrical test meters and describe their applications and procedures for use. | 10% |
| 10. Explain the purpose of the electrical code. | 5% |
| 11. Perform procedures for use of multi-meters in all facets. | 10% |

Industrial Mechanic (Millwright)

Unit: D5 Prime Movers

Level: Four

Duration: 50 hours

Theory: 30 hours

Practical: 20 hours

Overview:

This unit is designed to introduce knowledge of electric motors, their components and operation. It is also designed to introduce knowledge of the procedures used to install and maintain electric motors.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with electric motors.	2%
2. Identify hazards and describe safe work practices pertaining to electric motors.	5%
3. Identify types of electric motors and describe their applications.	2%
4. Describe the procedures used to remove and install electric motors.	6%
5. Describe the procedures used to inspect and maintain bearings in electric motors.	6%
6. Perform the procedures used to:	6%
a. Identify frame sizes	
b. Installations	
c. Lubrication	
d. Start up	

D5.a Prime Movers

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with internal combustion engines.	1%
2. Identify hazards and describe safe work practices pertaining to internal combustion engines.	1%
3. Identify types of internal combustion engines and describe their operation.	1%

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| 4. | Identify internal combustion engines components and describe their purpose and operation. | 1% |
| 5. | Identify tools and equipment used to install, maintain, troubleshoot and repair combustion engines components and describe their applications and procedures for use. | 3% |
| 6. | Describe the factors to consider when installing internal combustion engines. | 2% |
| | a. Manufacturer's specifications | |
| | b. Job site specifications | |
| | c. Location drawing | |
| | d. Auxiliary systems | |
| | e. Sequence of installation | |
| 7. | Perform the procedures used to remove and install internal combustion engines and their components. | 3% |
| 8. | Describe the procedures used to inspect and maintain internal combustion engines and their components. | 2% |
| 9. | Describe the procedures used to troubleshoot internal combustion engines and their components. | 2% |
| 10. | Identify the considerations for determining if internal combustion engine component repair or replacement is required. | 2% |
| 11. | Describe the procedures used to repair internal combustion engines and their components. | 2% |
| 12. | Describe the procedures used to commission internal combustion engines and their components. | 1% |

D5.b Prime Movers

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with turbines.	2%
2. Identify hazards and describe safe work practices pertaining to turbines.	2%
3. Identify the types of turbines and describe their operation.	2%
a. Steam	
b. Gas	
c. Hydro	
d. Wind	
4. Explain the principles and operation of boilers.	1%
5. Identify turbine components and describe their purpose and operation.	2%
6. Identify tools and equipment used to install, maintain, troubleshoot and repair turbines and describe their applications and procedures for use.	1%

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| 7. | Describe the procedures used to remove and install process tanks and containers and their components. | 1% |
| 8. | Describe the factors to consider when installing turbines.
a. Manufacturers' specifications
b. Job site specifications
c. Location drawings
d. Auxiliary systems
e. Sequence of installation | 2% |
| 9. | Describe the procedures used to inspect and maintain turbines and their components.
a. Manufacturers' specifications
b. Manufacturers' representative
c. Technical manuals | 3% |
| 10. | Perform the procedures used to troubleshoot turbines and their components. | 3% |
| 11. | Identify considerations for determining if turbine component repair or replacement is required. | 1% |
| 12. | Perform the procedures used to repair turbines and their components.
a. Manufacturers' specifications
b. Manufacturers' representative
c. Technical manuals | 3% |
| 13. | Perform the procedures used to commission turbines. | 2% |

D5.c Prime Movers

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with fans and blowers.	1%
2. Identify hazards and describe safe work practices pertaining to fans and blowers.	1%
3. Identify the types of fans and blower systems and describe their components and operation.	1%
4. Identify types of fan blades and describe their applications.	1%
5. Identify tools and equipment used to remove, install, maintain, troubleshoot and repair fans and blowers and describe their applications and procedures for use.	2%
6. Describe the procedures used to remove and install fans and blowers.	3%
7. Describe the procedures used to inspect and maintain fans and blowers.	3%
8. Perform the procedures used to troubleshoot fans and blowers.	3%

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| 9. Identify considerations for determining if fan and blower repair or replacement is required. | 3% |
| 10. Perform the procedures used to repair fans and blowers. | 3% |
| 11. Describe the procedures used to regulate output for fans and blowers. | 3% |
| 12. Describe the procedures used to commission fans and blowers. | 3% |

Industrial Mechanic (Millwright)

Unit: D6 Hydraulic Systems II

Level: Four

Duration: 35 hours

Theory: 21 hours

Practical: 14 hours

Overview:

This unit is designed to introduce knowledge of the procedures and calculations used to install, maintain, troubleshoot and repair hydraulic systems and components. It is also designed to introduce knowledge of the procedures used to commission hydraulic systems.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Identify tools and equipment used to install, maintain, troubleshoot and repair hydraulic systems and describe their applications and procedures for use.	10%
2. Identify the types of fluids used in hydraulics systems and describe their characteristics and applications.	10%
3. Describe the calculations and procedures used to select and install hydraulic systems and components.	15%
4. Perform the procedures used to inspect and maintain hydraulic systems and components. a. Check hoses, piping and tubing b. Check fluids (condition and level) c. Check/change filters d. Determine operating parameters e. Adjust system pressure, temperature and flow	20%
5. Perform the procedures used to troubleshoot hydraulic systems and components.	15%
6. Identify considerations for determining if hydraulic system component repair or replacement is required.	10%
7. Describe the procedures used to repair hydraulic systems and components.	10%
8. Perform the procedures used to commission hydraulic systems.	10%

Industrial Mechanic (Millwright)

Unit: D7 Pneumatic Systems II

Level: Four

Duration: 12 hours

Theory: 6 hours

Practical: 6 hours

Overview:

This unit is designed to introduce knowledge of the calculations and procedures used to install, maintain, troubleshoot and repair pneumatic systems and components. It is also designed to introduce knowledge of the procedures used to commission pneumatic systems.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Identify tools and equipment used to install, maintain, troubleshoot and repair pneumatic systems and describe their applications and procedures for use.	10%
2. Describe the calculations and procedures used to select and install pneumatic systems and components.	10%
3. Perform the procedures used to inspect and maintain pneumatic systems and components.	25%
a. Check hoses, piping and tubing	
b. Check lubricating fluids (condition and level)	
c. Check/change filters	
d. Determine operating parameters	
e. Adjust system pressure, temperature and flow	
f. Air drying and filtering systems	
4. Perform the procedures used to troubleshoot pneumatic systems and components.	20%
5. Identify considerations for determining if pneumatic system component repair or replacement is required.	15%
6. Describe the procedures used to repair pneumatic systems and components.	10%
7. Describe the procedures used to commission pneumatic systems.	10%

Industrial Mechanic (Millwright)

Unit: D8 Non-destructive Testing

Level: Four

Duration: 7 hours

Theory: 3 hours

Practical: 4 hours

Overview:

This unit is designed to introduce knowledge of the procedures used to perform non-destructive testing.

Objectives and Content:	Percent of Unit Mark (%)
1. Define terminology associated with non-destructive testing.	10%
2. Identify hazards and describe safe work practices pertaining to non-destructive testing.	10%
3. Identify and interpret codes and regulations pertaining to non-destructive testing.	10%
4. Identify tools and equipment used for non-destructive testing and describe their applications and procedures for use.	15%
5. Perform various types of non-destructive testing and describe their applications. a. Dye penetrant b. Magnetic particle c. Radiography d. Ultrasonic e. Visual	30%
6. Perform the procedures used to perform dye penetrant and magnetic particle testing.	15%
7. Record and interpret data collected using non-destructive testing.	10%

Industrial Mechanic (Millwright)

Unit: D9 Introduction to Commissioning

Level: Four

Duration: 7 hours

Theory: 7 hours

Practical: 0 hours

Overview:

This unit is designed to introduce knowledge of commissioning and its purpose.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with commissioning.	10%
2. Identify hazards and describe safe work practices pertaining to commissioning systems or components.	30%
a. Verify equipment/system safety components	
• Guards	
• Emergency stops	
• Overrun switches	
3. Identify the purpose of commission and the types of systems and components requiring it.	30%
4. Identify and interpret information sources and documentation pertaining to the commissioning.	30%
a. Manufacturers' specifications	
b. Operating parameters	

Industrial Mechanic (Millwright)

Unit: D10 Preventative and Predictive Maintenance

Level: Four

Duration: 58 hours

Theory: 33 hours

Practical: 25 hours

Overview:

This unit is designed to introduce knowledge of preventive and predictive maintenance practices.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with preventive and predictive maintenance.	2%
2. Identify tools and equipment used for preventive and predictive maintenance and describe their applications and procedures for use.	4%
3. Identify types of maintenance and describe their purpose and applications.	6%
a. Breakdown	
b. Preventative	
c. Predictive	
d. Proactive	
e. Corrective	
4. Identify sources of information used to develop maintenance history.	5%
a. Reports and checklists	
b. Manufacturers' specifications	
c. Root cause analysis	
5. Identify preventative and predictive maintenance practices and describe their applications.	5%
a. Vibration analysis	
b. Non-destructive testing	
c. Fluid analysis	
d. Balancing	
e. Thermography	
6. Describe the procedures used to record preventative and predictive maintenance data.	3%

D10.a Preventative and Predictive Maintenance

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with vibration analysis.	2%
2. Identify hazards and describe safe work practices pertaining to vibration analysis.	2%
3. Identify tools and equipment used for vibration analysis and describe their applications and procedures for use.	3%
4. Identify and interpret sources of information pertaining to vibration analysis. a. Manufacturers' specifications b. Vibration standards and charts c. Canadian Machinery Vibration Association (CMVA) interpretations and guidelines	3%
5. Perform causes of vibration.	4%
6. Identify vibration analysis methods and describe their applications.	4%
7. Describe the procedures used to perform vibration analysis.	4%
8. Perform procedures to weigh and centre balance.	3%

D10.b Preventative and Predictive Maintenance

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with balancing.	2%
2. Identify hazards and describe safe work practices pertaining to balancing.	2%
3. Identify tools and equipment used for balancing and describe their applications and procedures for use.	4%
4. Identify and interpret sources of information pertaining to balancing. a. Manufacturers' specifications b. Vibration standards and charts c. Canadian Machinery Vibration Association (CMVA) interpretations and guidelines	3%
5. Identify the conditions of unbalance and describe their characteristics. a. Static b. Couple c. Quasi-static d. Dynamic	6%
6. Identify the types of balancing methods and describe their applications. a. Single-plane b. Multi-plane	3%
7. Describe calculations required for balancing.	3%

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| 8. Perform balancing procedures. | 3% |
| a. Static | |
| b. Dynamic | |

D10.c Preventative and Predictive Maintenance

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Define terminology associated with fluid analysis.	2%
2. Identify hazards and describe safe work practices pertaining to fluid sampling.	2%
3. Identify and interpret codes and regulations pertaining to fluid sampling.	3%
4. Identify tools and equipment used for fluid sampling and describe their applications and procedures for use.	4%
5. Identify contaminant and describe their causes and remedies.	5%
6. Perform the procedures used to collect and test fluid samples from systems.	3%
7. Record and interpret data from fluid analysis.	5%

Industrial Mechanic (Millwright)

Unit: D11 Robotics and Automated Equipment

Level: Four

Duration: 16 hours

Theory: 11 hours

Practical: 5 hours

Overview:

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

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Installs robotics and automated equipment.	25%
a. Demonstrate knowledge of robotics and automated equipment, their components and operation.	
b. Demonstrate knowledge of safety practices related to robotics and automated equipment.	
c. Demonstrate knowledge of the procedures used to install robotics and automated equipment.	
2. Diagnoses robotics and automated equipment.	25%
a. Demonstrate knowledge of the procedures used to diagnose robotics and automated equipment, their components and operation.	
3. Maintains robotics and automated equipment.	25%
a. Demonstrate knowledge of the procedures used to maintain robotics and automated equipment, their components and operation.	
4. Repairs robotics and automated equipment.	25%
a. Demonstrate knowledge of the procedures used repair robotics and automated equipment, their components and operation.	
