



**Skilled  
Trades**  
Ontario

**Métiers  
spécialisés**  
Ontario

Apprenticeship  
Curriculum Standard

Industrial Mechanic Millwright  
433A

Construction Millwright  
426A

Level 1 Common Core

2005



# Apprenticeship Pathway to a Certificate of Qualification

Phase 1: Registration

**Submit Application for Apprenticeship Training through the on-line portal or to local Service Delivery Office**

For on-line portal, please follow instructions for registration. You will need to create a *My Ontario* account to access online services.

**Training agreement signed and registered by both apprentice and sponsor**

**Access your Apprenticeship Training Standard Logbook\*\***  
skilledtradesontario.ca/about-trades/trades-information

\*\* This is the official record of your training progress. You are responsible for keeping it up-to-date.

**Complete on-the-job training**

*Demonstrate and receive sign-off on the competencies/skills in your Apprenticeship Training Standard Logbook*

**Complete in-school training**

*Attend and complete the in-class training set out in the Curriculum Training Standard*

Apprentices eligible to apply for apprenticeship incentive grants (Red Seal trades) and loans.

**Review and finalize your logbook with your sponsor**

**Submit proof of apprenticeship completion**  
via email, in-person or digital portal

Your Apprenticeship Training Standard Logbook details completion requirements. Submit the following:

- completed Apprenticeship Training Standard Logbook with signatures
- proof of hours

**Certificate of Apprenticeship is issued**

Trades without examination

**CofA is the final step of the program**

Trades with examination (compulsory and non-compulsory trades)\*

**Provisional Certificate of Qualification issued for a 12 month term**

To prepare for the CofQ examination download the Provincial and/or Red Seal Exam preparation guides.

**Make payment for your Certificate of Qualification examination**

Call to make a payment (647-847-3000 or 1-855-299-0028)

**Schedule a date to write your Examination**

To schedule your examination, contact your local Service Delivery Office.

**Pass Certificate of Qualification examination**

Apprentices eligible to apply for Apprenticeship Completion Grant (Red Seal trades) or Apprentice Completion Bonus (non-Red Seal)

**Certificate of Qualification is issued**

Upon completion, Sponsors may be eligible for Apprenticeship grants, incentives, bonuses or tax credits

Phase 2: Apprenticeship

Phase 3: Certification

\* For a list of trades subject to a certification examination, visit: skilledtradesontario.ca

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**Please Note:** This Standard has been revised to reflect the visual identity of Skilled Trades Ontario (STO) which replaced the Ontario College of Trades on January 1, 2022. The content of this Standard may refer to the former organization; however, all trade specific information or content remains relevant and accurate based on the original date of publishing.

Please refer to STO's website: [skilledtradesontario.ca](https://skilledtradesontario.ca) for the most accurate and up to date information. For information about BOSTA and its regulations, please visit [\*\*Building Opportunities in the Skilled Trades Act, 2021 \(BOSTA\)\*\*](#).

Any updates to this publication are available on-line; to download this document in PDF format, please follow the link: [Skilled Trades Ontario.ca](https://skilledtradesontario.ca).

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*Maintained with transfer to Skilled Trades Ontario 2005 (V100)*

## **Preface**

This curriculum standard for the Industrial Mechanic (Millwright)/Construction Millwright trade program is based upon the on-the-job performance objectives, located in the industry-approved training standard.

This is the first level of 3 levels of training. The Reportable Subjects Summary chart (located on page 5) summarizes the training hours for each reportable subject.

The curriculum identifies the learning that takes place in-school. The in-school program focuses primarily on the theoretical knowledge and the essential skills required to support the performance objectives of the Apprenticeship Training Standards.

Employers/Sponsors are expected to extend the apprentice's knowledge and skills through practical training on a work site. Regular evaluations of the apprentice's knowledge and skills are conducted throughout training to verify that all apprentices have achieved the learning outcomes identified in the curriculum standard.

It is not the intent of the in-school curriculum to perfect on-the-job skills. The practical portion of the in-school program is used to reinforce theoretical knowledge. Skill training is provided on the job.

Please refer to Skilled Trades Ontario website ([www.skilledtradesontario.ca](http://www.skilledtradesontario.ca)) for the most accurate and up-to-date information about Skilled Trades Ontario. For information on *Building Opportunities in the Skilled Trades Act, 2021 (BOSTA)* and its regulations, please visit [Building Opportunities in the Skilled Trades Act, 2021, S.O. 2021, c. 28 - Bill 288 \(ontario.ca\)](http://www.skilledtradesontario.ca/building-opportunities-in-the-skilled-trades-act-2021-s.o.-2021-c.-28-bill-288)

## **Pre-requisites**

In order to advance to Level 2 of the apprenticeship program, an individual must have completed all of the units outlined in Level 1. Similarly, in order to advance to Level 3 of the program, an individual must have completed all of the units outlined in Level 1 and 2.

## **Hours Disclaimer** (if applicable)

It is agreed that Training Delivery Agents (TDAs) may need to make slight adjustments (with cause) according to particular apprentice needs and may deviate from the unit sequencing and the prescribed practical and theoretical hours shown within the standard. However, all TDAs will comply with the hours at the reportable subject level.

## **Suggested Equipment for Training Delivery Agencies**

The listing of tools on page 30 does not list minimum quantities based on the understanding that the delivering TDA is in the best position to determine the need based on its delivery methodology.

Personal and Safety Equipment: Personal protective equipment is at the discretion of the TDA who must conform to Ontario Provincial Health and Safety Regulations.

## Introduction

The curriculum has been developed in keeping with the prescribed training standards of Workplace Training Branch, Ministry of Labour, Immigration, Training and Skills Development. The curriculum will allow for easy adaptation to the current reporting structures for the respective program phases and to alternate delivery formats.

For easy reference, a time allocation has been included for each respective unit, along with the Theory/Practical breakdown for the delivery of the performance outcomes.

The continual introduction of innovative techniques and more complex equipment is resulting in increasing demands for tradespeople who are not only skilled in the practical aspects of the trade, but who also have a sound theoretical knowledge of the requirements to inspect, diagnose, repair and service. The curriculum has been developed to provide this theoretical knowledge and to offer some practical applications to complement the on-the-job work experiences of the Industrial Mechanic Millwright and Construction Millwright apprentice.

The outcomes of the curriculum, therefore, are to provide a basis for:

- a. sound theoretical training to meet the challenges presented by the increasingly more complex designs and testing techniques.
- b. the acquisition of fundamental skills of the trade through exposure to practical applications.
- c. developing in the apprentices high standards of craftsmanship, problem- solving skills and personal pride in their respective trades.
- d. developing desirable work attitudes and a keen sense of responsibility, particularly in regard to public and personal safety.

The curriculum has also been designed to give the instructor every reasonable opportunity for flexibility and innovation without unnecessary deviation from the course requirements (as determined by the Industry Committee and Provincial Advisory Committee, and as prescribed in the regulation for the trades). Since the scope of the prescribed curriculum is quite extensive, the apprentices will be expected to reinforce the acquired knowledge through regular, independent out- of-classroom assignments. In keeping with sound teaching methodologies, the curriculum has been presented in a chronological sequence. However, the actual application of the sequence may differ somewhat between colleges because of scheduling, staffing and utilisation of facilities.

The curriculum includes specific references to the training standards of Workplace Training Branch, Ministry of Labour, Immigration, Training and Skills Development. While the references to various terminal performance outcomes in the Training Standards have been linked to the respective in-school outcomes, employers should not assume complete coverage in all aspects of the outcome. The in-school delivery focuses primarily on the knowledge required to master the respective performance outcomes outlined in the Training Standards. Employers, therefore, are expected to complete the delivery of these respective outcomes by applying the prescribed in-school knowledge to the required practical learning experienced in the work setting.

To ensure that successful students will be able to satisfy the individual outcomes according to the performance criteria, specific times have been allocated in the respective areas to allow for some application enhancement. It is of utmost importance that all application assignments relate to prescribed experiences only. Time constraints will not permit engaging students in irrelevant tasks of limited learning benefits that are unrelated to the curriculum outcomes.

Regular evaluations of the apprentices' learning achievements must be performed in both theory and application throughout the program to assure consistency in learning outcome expectations.

Implementation Date:  
September 2004



# **Industrial Mechanic Millwright / Construction Millwright**

## **Level 1**

### Reportable Subject Summary – Level 1

Number	Reportable Subjects	Hours Total	Hours Theory	Hours Practical
1	Workshop Practice I	48	32	16
2	Workshop Technology I	56	16	40
3	Machine Technology I	32	24	8
4	Rigging & Hoisting	24	20	4
5	Welding & Fabrication I	32	8	24
6	Electrical & Electronic Controls I	16	12	4
7	Drawings & Schematics I	32	32	0
	<b>Total</b>	<b>240</b>	<b>144</b>	<b>96</b>

This level is common core between the following trades/  
occupations: Industrial Mechanic Millwright 433A  
Construction Millwright 426A

Number:	1		
<b>Title:</b>	<b>Workshop Practice I</b>		
Duration:	Total Hours: 48	Theory: 32	Practical: 16
Prerequisites:	None		
Co-requisites:	None		

1.1 Safety

8 Total Hours      Theory: 8 Hours      Practical: 0 Hours

1.2 – Hand & Power Tools

16 Total Hours      Theory: 4 Hours      Practical: 12 Hours

1.3 - Precision Measuring Equipment 1

24 Total Hours      Theory: 20 Hours      Practical: 4 Hours

Number:	1.1		
Title:	Safety		
Duration:	Total Hours: 8	Theory: 8	Practical: 0
Cross Reference to Training Standards:			
CM 1301			
IMM 4600, 4601			

## General Learning Outcomes

To develop the apprentice's knowledge of safety legislation, lock-out and isolation procedures, protective clothing and equipment, confined space procedures, housekeeping rules, fire, electrical and chemical hazards.

## Learning Outcomes and Content

Upon successful completion, the apprentice is able to:

- 1.1.1 Apply all machinery and equipment lock-out and de-energizing procedures (mechanical, electrical, hydraulic and pneumatic) before commencing maintenance and overhaul procedures.
- 1.1.2 Demonstrate proper use and care of required safety clothing and equipment.
- 1.1.3 Comply with confined space safety procedures, including the use of the breathing apparatus prior to and while working.
- 1.1.4 Prevent fires by determining the potential for fire posed by the work performed. Obtain the required fire prevention and fire fighting equipment.
- 1.1.5 Report all hazards and accidents to co-workers and supervisory personnel, and complete all paper work in compliance with company procedures and government regulations.
- 1.1.6 Apply correct body mechanics when bending, lifting or moving heavy objects/equipment.

Number:	1.2		
<b>Title:</b>	<b>Hand &amp; Power Tools</b>		
Duration:	Total Hours: 16	Theory: 4	Practical: 12
Cross Reference to Training Standards:			
<b>CM</b> 1305			
<b>IMM</b> 4603			

## General Learning Outcomes

To develop the apprentice's knowledge and skill in the selection, safe use and care of the cutting and non-cutting tools used in the trade.

## Learning Outcomes and Content

Upon successful completion, the apprentice is able to:

- 1.2.1 Correctly select, use and maintain non-cutting hand tools when installing and maintaining machinery to specifications, such as:
- sockets
  - drifts
  - wrenches
  - screwdrivers
  - hammers
  - power jacks
  - plumb bob
  - tube and pipe benders
  - squares
  - torque wrenches
  - punches
  - pliers
  - pry bars
  - tapes
  - rules

- 1.2.2      Correctly select, use and maintain hand cutting tools when installing and maintaining machinery, or when manufacturing and shaping components to specifications, such as:
- files
  - hacksaws
  - chisels
  - pliers (cutting)
  - twist drills
  - reamers
  - tapping chucks
  - taps and dies
  - tin snips
  - shears
  - powder actuated tools
  - nibblers
  - broaches
  - pipe cutters
  - power sanders
  - impact tools
  - power chippers
  - threading machines
  - grinders
  - magnetic base drills
  - power saws

Number:	1.3		
<b>Title:</b>	<b>Precision Measuring Equipment 1</b>		
Duration:	Total Hours: 24	Theory: 20	Practical: 4
Cross Reference to Training Standards:			
<b>CM 1307</b>			
<b>IMM 4605</b>			

## General Learning Outcomes

To develop the apprentice's knowledge of units of measurement used in the trade, and skill in the use of measuring devices:

## Learning Outcomes and Content

Upon successful completion, the apprentice is able to:

- 1.3.1 Interpret imperial and metric linear scales.
- 1.3.2 Demonstrate the use of and interpret readings from the following devices:
  - rules
  - calipers
  - hole gauges
  - levels
  - combination sets
  - steel squares
  - micrometers
  - straight edge and feeler gauges
  - verniers
  - dial indicators
  - gauge blocks
  - sine bars
  - mechanical tachometers
- 1.3.3 Check accuracy, adjust to standard, maintain and store precision measuring devices.
- 1.3.4 Identify and select appropriate measuring device, and measure acute, obtuse and compound angles.

**Instructional/Delivery Strategies:**

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
67%	33%	100%



Number:	2		
<b>Title:</b>	<b>Workshop Technology 1</b>		
Duration:	Total Hours: 56	Theory: 16	Practical: 40
Prerequisites:	None		
Co-requisites:	None		

## 2.1 Machine Tools 1

56 Total Hours      Theory: 16 Hours      Practical: 40 Hours

Number:	2.1		
<b>Title:</b>	<b>Machine Tools 1</b>		
Duration:	Total Hours: 56	Theory: 16	Practical: 40
Cross Reference to Training Standards:			
<b>CM 1306</b>			
<b>IMM 4604</b>			

## General Learning Outcomes

To develop the apprentice's knowledge of the principles of cutting and the relationship between speeds and feeds during the various machining operations.

## Learning Outcomes and Content

Upon successful completion, the apprentice is able to:

- 2.1.1 Read and apply chart information to establish feed, speed, thread cutting, drill and tap specifications for a variety of machining operations.
- 2.1.2 Use different methods to calculate imperial/metric conversion as required.
- 2.1.3 Apply specific trade calculations and formulae to ensure compliance with engineering drawings and manufacturing specifications when:
  - setting up
  - laying out
  - aligning
  - establishing gear ratios
  - machining
  - fitting
- 2.1.4 List and describe safety rules and procedures pertaining to lathe operations.
- 2.1.5 Describe the machining functions normally performed on a lathe.
- 2.1.6 Identify the component parts, holding devices, and accessories of the lathe and describe the function of each.
- 2.1.7 Identify the appropriate cutting tool and define the proper rake and clearance angles for specific cutting requirements.

- 2.1.8 Set up and safely operate a lathe using High Speed Steel (H.S.S.) and carbide cutting tools to perform machining operations within a unit tolerance such as:
- turn
  - thread
  - form cutting
  - bore
  - taper
  - face
  - knurl
- 2.1.9 List and describe safety rules and procedures pertaining to drilling operations.
- 2.1.10 Describe the machining functions normally performed on a drilling machine.
- 2.1.11 Identify the component parts, holding devices, and accessories of the drilling machine and describe the function of each.
- 2.1.12 Identify the appropriate cutting tool for specific cutting requirements.
- 2.1.13 Set up and safely operate a drilling machine using tooling such as High Speed Steel (H.S.S.), Carbide and Titanium cutting tools to perform the following machining operations:
- drill
  - tap
  - ream
  - countersink
  - bore and counter-bore
  - spot face
- 2.1.14 List and describe safety rules and procedures pertaining to grinding operations.
- 2.1.15 Describe the machining functions normally performed on a grinder.
- 2.1.16 Identify the component parts, holding devices, and accessories of the grinding machines and describe the function of each.
- 2.1.17 Identify the appropriate grinding wheels in terms of abrasive, grade, bonding, material, structure and grinding operation.
- 2.1.18 Set up and safely operate a surface grinder with correct wheel selection to grind flats, shims, and valves within a unit tolerance.

- 2.1.19 Safely operate a pedestal grinder to sharpen and grind cutting tools.
- 2.1.20 Set up and safely operate cut-off and band saws to perform required cutting operations within specifications.
- 2.1.21 Safely set up and operate an arbor press to perform specific operations.

**Instructional/Delivery Strategies:**

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
29%	71%	100%

Number:	3			
<b>Title:</b>	<b>Machine Technology 1</b>			
Duration:	Total Hours: 32	Theory: 24	Practical: 8	
Prerequisites:	None			
Co-requisites:	None			

3.1 Materials & Fasteners

24 Total Hours      Theory: 16 Hours      Practical: 8 Hours

3.2 – Lubrication

8 Total Hours      Theory: 8 Hours      Practical: 0 Hours

Number:	3.1		
<b>Title:</b>	<b>Materials &amp; Fasteners</b>		
Duration:	Total Hours: 24	Theory: 16	Practical: 8
Cross Reference to Training Standards:			
<b>CM</b> 1309			
<b>IMM</b> 4606			

## General Learning Outcomes

To develop the apprentice's knowledge of ferrous and non-ferrous metals, basic heat treatment procedures, and applications of fasteners.

## Learning Outcomes and Content

Upon successful completion, the apprentice is able to:

- 3.1.1 Identify and describe the various properties of metals and alloys.
- 3.1.2 Identify and describe the effects of temperature on metals and alloys.
- 3.1.3 Define the following properties of metals and alloys:
  - tensile strength
  - yield point
  - malleability
  - hardness
  - ductility
  - elasticity
  - strength
- 3.1.4 Describe the purpose for adding the following to steel:
  - carbon
  - sulphur
  - phosphorus
  - silicon
  - manganese
  - copper
- 3.1.5 Identify and describe the uses of non-metallic materials such as:
  - rubber
  - plastic
  - nylon

- 3.1.6 Identify, describe and perform the methods and procedures of heat treating metals and alloys, including:
- annealing
  - tempering
  - hardening
  - normalizing
  - stress relieving
  - case hardening
  - induction hardening
- 3.1.7 Identify types, applications, and qualities of fasteners including:
- Unified National, Acme, Metric
  - pipe thread system
- 3.1.8 Identify and select bolts, nuts, dowels, snap rings, chemical fasteners, adhesives and powder actuated fasteners for specific applications.
- 3.1.9 Describe methods of securing machinery and components using bolts, anchors, fasteners, grouting and epoxy resins.

Number:	3.2		
<b>Title:</b>	<b>Lubrication</b>		
Duration:	Total Hours: 8	Theory: 8	Practical: 0
Cross Reference to Training Standards:			
<b>CM 1310</b>			
<b>IMM 4607</b>			

### General Learning Outcomes

To develop the apprentice's knowledge concerning different types of lubricants, and their properties and applications.

### Learning Outcomes and Content

Upon successful completion, the apprentice is able to:

- 3.2.1 Describe the characteristics of friction.
- 3.2.2 Explain the theory of friction as it applies to moving parts.
- 3.2.3 Explain lubrication terms, such as:
  - viscosity
  - flash point
  - specific gravity
  - viscosity index
- 3.2.4 List types, applications, and describe the advantages and disadvantages of:
  - lubricating oils
  - solid lubricants
  - greases
  - synthetic oils
- 3.2.5 Read and interpret lubrication charts.
- 3.2.6 List and describe lubrication devices:
  - manual
  - automatic
  - centralized



- 3.2.7 List and describe filtration methods:
- full flow
  - partial flow
  - surface
  - depth
- 3.2.8 Comply with all safety rules, manufacturers' specifications, and environmental legislation when handling and storing lubricants.

**Instructional/Delivery Strategies:**

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	4		
<b>Title:</b>	<b>Rigging &amp; Hoisting</b>		
Duration:	Total Hours: 24	Theory: 20	Practical: 4
Prerequisites:	None		
Co-requisites:	None		

#### 4.1 Rigging & Hoisting

24 Total Hours      Theory: 20 Hours      Practical: 4 Hours

Number:	4.1		
<b>Title:</b>	<b>Rigging &amp; Hoisting</b>		
Duration:	Total Hours: 24	Theory: 20	Practical: 4
Cross Reference to Training Standards:			
<b>CM 1312</b>			
<b>IMM 4609</b>			

## General Learning Outcomes

To develop the apprentice's knowledge of correct lifting and hoisting procedures and the safe use of all equipment.

## Learning Outcomes and Content

Upon successful completion, the apprentice is able to:

- 4.1.1 List, describe, and comply with all safety rules and procedures pertaining to lifting, hoisting and machine moving.
- 4.1.2 Plan lifts using the following:
  - correct sling angles
  - load charts
  - workload limits (SWL)
  - assessment of load characteristics
- 4.1.3 Select, inspect and maintain hoisting and rigging equipment for specific applications, including:
  - ropes (fiber & wire)
  - slings
  - skates and rollers
  - spreader bars
  - equalizer beams
  - hooks
  - EYE-bolts
  - jacks
  - winches
  - chains
  - thimbles
  - shackles
  - blocks

- ladders
- tie knots
- chain falls
- come-alongs
- scaffolding
- turn buckles

4.1.4 Describe the principles and operation of hoists, overhead and mobile cranes.

4.1.5 Demonstrate signals to ensure that correct and safe hoisting operations are performed, using international hand signals, overhead crane signals and radio communications.

4.1.6 Demonstrate methods of moving, rigging and hoisting machinery and equipment safely into position.

4.1.7 Describe methods of installing and aligning machinery to specifications.

**Instructional/Delivery Strategies:**

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
83%	17%	100%

Number:	5		
<b>Title:</b>	<b>Welding &amp; Fabrication 1</b>		
Duration:	Total Hours: 32	Theory: 8	Practical: 24
Prerequisites:	None		
Co-requisites:	None		

#### 5.1 Welding & Fabrication 1

32 Total Hours      Theory: 8 Hours      Practical: 24 Hours

Number:	5.1		
<b>Title:</b>	<b>Welding &amp; Fabrication 1</b>		
Duration:	Total Hours: 32	Theory: 8	Practical: 24
Cross Reference to Training Standards:			
<b>CM 1311</b>			
<b>IMM 4614</b>			

## General Learning Outcomes

To develop the apprentice's knowledge and ability to set-up and operate oxyacetylene and arc welding equipment to weld, braze, solder and cut safely, and to specifications.

## Learning Outcomes and Content

Upon successful completion, the apprentice is able to:

- 5.1.1 List and describe personal protective equipment for oxy-gas welding, arc welding and cutting.
- 5.1.2 Describe the construction of oxygen, acetylene and other fuel gas cylinders. Demonstrate withdrawal rates and safe handling procedures.
- 5.1.3 Safely set-up and disassemble oxyacetylene and other oxy-gas equipment including valves and hoses.
- 5.1.4 Describe the principles and applications of:
  - brazing and soldering
  - gas fueled torches
- 5.1.5 Select the proper equipment and demonstrate:
  - fusion welding of steel
  - cutting plate and pipe
  - heating operations such as bending and stress relieving
- 5.1.6 Define arc welding terms.
- 5.1.7 Describe the basic principles of the following:
  - shielded metal arc welding process
  - alternating current welding machines
  - direct current welding machines
  - polarity and arc blow

- 5.1.8 Identify, describe, and apply arc welding electrodes for specific applications.
- 5.1.9 Demonstrate flame cutting of structural shapes/plates.
- 5.1.10 Demonstrate safe work practices with fabrication equipment.
- 5.1.11 Demonstrate SMAW welding in the flat position.

**Instructional/Delivery Strategies:**

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
25%	75%	100%

Number:	6		
Title:	Electrical & Electronic Controls 1		
Duration:	Total Hours: 16	Theory: 12	Practical: 4
Prerequisites:	None		
Co-requisites:	None		

#### 6.1 Electrical & Electronic Controls 1

16 Total Hours      Theory: 12 Hours      Practical: 4 Hours



Number:	6.1		
Title:	<b>Electrical &amp; Electronic Controls 1</b>		
Duration:	Total Hours: 16	Theory: 12	Practical: 4
Cross Reference to Training Standards:			
<b>CM</b> 1301, 1316, 1320, 1321, 1322			
<b>IMM</b> 4600.01, 4613.03, 4617.08, 4618.10			

## General Learning Outcomes

To develop the apprentice's basic knowledge of electrical and electronic theory.

## Learning Outcomes

Upon successful completion, the apprentice is able to:

- 6.1.1 Describe the purpose and scope of electrical codes and safety precautions and understand electric shock.
- 6.1.2 Describe the purpose and function of electrical components as they pertain to safety, such as:
  - fuses
  - circuit breakers
  - lock-outs and tagouts
  - shut-off procedures
- 6.1.3 Describe electric and electron principles, and differentiate between AC and DC.
- 6.1.4 Describe and apply OHM'S law including:
  - Units
    - a. Voltage in volts (V)
    - b. Current in amperes (I)
    - c. Resistance in Ohms (R)
  - Relationship
    - a.  $V = I \times R$
    - b.  $I = V/R$
    - c.  $R = V/I$
- 6.1.5 Describe on a basic level, series/parallel circuits in relation to:
  - design
  - characteristics of circuits
  - calculations for circuits

- 6.1.6 Describe electrical power in terms of:
- Watts
  - joules
- 6.1.7 Identify, select, and use electrical instruments safely:
- ohmmeters, continuity testers, ammeters, voltmeters, and multimetres
  - meggers
  - soldering irons
- 6.1.8 Describe the principles of grounding and Ground-Fault Interrupter GFI's.

**Instructional/Delivery Strategies:**

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
75%	25%	100%

Number:	7		
Title:	Drawings & Schematics 1		
Duration:	Total Hours: 32	Theory: 32	Practical: 0
Prerequisites:	None		
Co-requisites:	None		

#### 7.1 Drawings & Schematics 1

32 Total Hours      Theory: 32 Hours      Practical: 0 Hours

Number:	7.1		
<b>Title:</b>	<b>Drawings &amp; Schematics 1</b>		
Duration:	Total Hours: 32	Theory: 32	Practical: 0
Cross Reference to Training Standards:			
<b>CM 1302</b>			
<b>IMM 4602</b>			

## General Learning Outcomes

To develop the apprentice's ability to draw, sketch, read and interpret engineering drawings and schematics.

## Learning Outcomes and Content

Upon successful completion, the apprentice is able to:

- 7.1.1 Read and interpret orthographic projections, multi-view projections and auxiliary views of machine components.
- 7.1.2 Read and interpret assembly and detail drawings of machine components including bill of material, title block and change orders.
- 7.1.3 Draw and sketch assembly and component parts using orthographic, isometric and sectional views and with the relevant dimensions and notes.
- 7.1.4 Read and interpret basic principles of geometric tolerance and symbols.

## Instructional/Delivery Strategies:

- Assignments related to theory and appropriate application skills.
- Minimum of one mid-term test during the eight-week term.
- Final exam at end of term.
- Periodic quizzes.

Evaluation Structure		
Theory Testing	Practical Application Testing	Final Assessment
100%	0%	100%

## **APPENDIX C: Tools and Equipment List**

The Master Tool List has been developed in conjunction with the Industrial Mechanic Millwright and Construction Millwright Curriculum Advisory Committee and the Industrial Mechanic Millwright Industry Committee and Construction Millwright Provincial Advisory Committee as a requirement for Training Delivery Agents delivering of the program. Actual numbers of tools or equipment required would depend upon method of delivery and number of students in a program.

<b>Level</b>	<b>Description</b>
I	Socket Sets
I	Torque Wrenches
I	Punch Sets
I	Pairs of Pliers
I	Ball Peen Hammers
I	Screwdriver Sets
I	Chisel Sets
I	Pry Bar Sets
I	Scrapers
I	Assorted Files
I	Hacksaws
I	Drill Indexes with Twist Drills
I	Metric Tap & Die Sets
I	Standard Tap & Die Sets
I	Tap Handles
I	Reamer Sets
I	Tin Snips
I	Rivet Guns
I	Grease Guns
I	Funnel
I	Steel Rules
I	Tape Measures
I	Squares
I	Plumb Bobs
I	0 – 1" Micrometers
I	0 – 25mm Micrometers
I	0 – 150mm Metric Depth Micrometers

<b>Level</b>	<b>Description</b>
I	Sets of Standard Depth Micrometers
I	0 – 6" Inside Micrometers
I	0 – 150mm Inside Micrometers
I	1 – 2" Micrometers
I	25 – 50mm Micrometers
I	3" Micrometers
I	12" Vernier Height Gauges
I	Sine Bars
I	Precision Measurement Rigs
I	Standard 6" Vernier Calipers
I	Metric Vernier Micrometer
I	Master Level
I	Telescoping Gauge Sets
I	Hole Gauge Sets
I	Radius Gauge Sets
I	Standard Gauge Block Set
I	Metric Gauge Block Set
I	.001" Dial Indicators
I	.0001" Dial Indicators
I	Standard Thread Gauge Sets
I	Metric Thread Gauge Sets
I	3/8" Power Hand Drills
I	3/8" Angle Drills
I	Magnetic Drills
I	4" Angle Grinders
I	Die Grinders
I	Impact Wrenches
I	Powder Actuated Gun
I	Lock Out & Isolation Simulators
I	Safety Harnesses & Fall Arrest Equipment
I	Scott Air Packs*
I	Different Examples of Fire Extinguishers
I	Face Shields
I	Arc Welding Shields
I	Safety Locks

<b>Level</b>	<b>Description</b>
I	Safety Glasses (Student Supplied)
I	Hearing Protectors (Student Supplied)
I	First Aid Kits
I	Welders Gloves (Student Supplied)
I	Welding Glasses
I	Air Tool Compressor (May be a Plant Compressor)
I	Metal Cutting Lathes with Threading Capability
I	Vertical Milling Machines
I	Radial Drill Presses
I	Drill Presses
I	Power Hacksaw
I	Bandsaw
I	Cut Off Saws
I	Hydraulic Press
I	Pedestal Grinders
I	Granite Surface Tables
I	V Blocks
I	Angle Plates
I	Heat Treat Oven*
I	Oil Quench Tank
I	Forge
I	Rockwell or Brinell Hardness Tester*
I	Automatic Lubrication System Trainers*
I	Overhead Crane / Hoist*
I	Pneumatic Hoist
I	Lifting Slings
I	Lifting Chains
I	Assortment of Lifting Hardware
I	Load Skates
I	Hydraulic Jacks
I	Assortment of Blocks
I	Chainfalls
I	Portable Hydraulic Lift
I	Fork Lift*
I	Arc Welding Units

<b>Level</b>	<b>Description</b>
I	Oxy-acetylene Units
I	Brooms
I	Shovels
I	Lathe Brushes
I	Various Lathe High Speed Cutting & Parting Tools
I	Various Lathe Carbide Cutting Tools
I	Pedestal Grinder Wheels
I	Standard Bolt, Nut & Washer Assortment
I	Metric Bolt, Nut & Washer Assortment
I	Dowel Pin Assortment
I	Circlip Assortment
I	Cotter Pin Assortment
I	Loctite Assortment
I	Rivet Assortment
I	Grease Assortment
I	Oil Assortment
I	Drafting & Sketching Kits
I	Tap Drill Charts
I	Cutting Speed Charts
I	Load Charts
I	Tubing Benders
I	Tubing Cutters
I	Pipe Cutters
I	Bearing Pullers
I	Straightedge
I	Induction Bearing Heater
II	Pipe Bender
II	Power Jacks
II	Pipe Threading Machine
II	Power Shear
II	Horizontal Milling Machine
II	Boring Heads
II	Surface Grinders
II	Surface Grinder Magnetic Chunks
II	Dividing Head



<b>Level</b>	<b>Description</b>
II	Laser Alignment Units
II	Arbor Press
II	Power Hone
II	Various End Mills
II	Carbide Insert Milling Cutters
II	Surface Grinder Wheels
II	O Ring Assortment
II	Assortment of Pipe Fittings
II	Different Examples of Various Plain, Journal & Sleeve Bearings
II	Different Examples of Bearing Housings & Gearboxes
II	Examples of Various Anti-friction Bearings and Assorted Failures
II	Different Examples of Seals
II	Different Examples of Packing
II	Example of V Belt Drive
II	Example of Chain Drive
II	Example of Magnetic, Fluid or Centrifugal Coupling
II	Example of Piston Compressor
II	Example of Screw Compressor
II	Example of Wet and Dry Compressor
II	Example of Roots Blower or Lobe Compressor
II	Assortment of Filter Examples
II	Example of Dryer
II	Example of Cooler
II	Bearing Installation Set ups
II	Gearbox Training Units with Motors, Couplings, etc.
II	Coupling Alignment Units
II	Compressor Training Units
II	Pneumatic Training Units
II	Dumpy Levels
II	Tilting Levels
II	Transit
II	Auto Level
II	12" Precision Levels
II	Block Level
III	Theodolite Rings

<b>Level</b>	<b>Description</b>
III	Vibration Analyzers
III	Dust Collector*
III	Programmable Logic Controllers
III	Computers with PPM Programs
III	Computer Printer
III	Assortment of Anchors
III	Electrical Multi-testers
III	Tachometer*
III	Ultrasonic Gun*
III	Thermographic Unit*
III	Roller Conveyor System Trainer
III	Belt Conveyor System Trainer
III	Example of Vibrator*
III	Example of Screw, Chain, Monorail or Bucket Conveyor
III	Fly Ball Governor
III	Example of AC Motor
III	Example of DC Stepping Motor
III	Example of Internal Combustion Motor*
III	Example of Turbine*
III	Example of Multi-stage Fan*
III	Example of Shaker Bagger*
III	Assortment of Pneumatic Valves
III	Assortment of Pneumatic Actuators
III	Different Examples of Hydraulic Piston Pumps
III	Different Examples of Hydraulic Vane Pumps
III	Different Examples of Hydraulic Pumps Other Than Piston or Vane
III	Assortment of Filters and Contamination Control Devices
III	Different Examples of Directional Valves
III	Different Examples of Proportional Valves
III	Example of Mechanical Hydraulic Servo Proportioning
III	Different Examples of Linear Hydraulic Actuators
III	Example of Rotary Hydraulic Actuator
III	Example of Electrical Servo Proportioning Valves
III	Example of Fiber Optics*
III	Hydraulic Training Units

<b>Level</b>	<b>Description</b>
III	Hydraulic Pump Test Units
III	Hydraulic Troubleshooting Unit
III	Ironworker
III	Brake
III	Shears
III	Rollers
III	Various Electrical Sensors
III	Electrical Breakers
III	Electrical Fuses

\* These items are considered desirable, but not absolutely necessary.



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