

**Construction Electrician/Industrial Electrician/Power Electrician
Common Core – Level 1**

Construction Electrician/Industrial Electrician/Power Electrician

Unit: A1 Learning About Work

Level: One

Duration: 10 hours

Theory: 10 hours

Practical: 0 hours

Overview:

One sign that an apprentice has become competent in a task or technique is to be asked to share this knowledge. Jobsite skills-exchange has long been fundamental to trade-learning. Even trade veterans rely on peers to refine their knowledge and skill. The opportunity to benefit from this process, however, is shaped by complex factors that include jobsite 'politics' and industrial/construction deadlines. As adult trade-learners, apprentices at all levels of training must use their observational, listening and interpersonal skills to benefit from the JP's knowledge and experience. This requires understanding the trade's dynamics, as well as the roles and responsibilities which order workplace/jobsite work-life.

This unit profiles the trade's structure and scope as determined by the Apprenticeship and Certification Act, regulations, Provincial Advisory Committees and the Red Seal Occupational Standard or Provincial Occupational Standard from which the training standards are derived (core tasks and skill requirements), as well as its job-ladders and long-term career options and social competencies. This includes information about major areas of working knowledge, activities and interactions at work, and expansive and restrictive workplaces, stressing their application to apprenticeship on-the-job training.

A sound grasp of the roles, workplace relationships, and possibilities introduced in this unit are part of 'learning to learn' in Manitoba's apprenticeship system. Senior apprentices are later offered information about learning to *teach* in this system – a central and time-honored foundation of Trades journeywork.

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>
1. Describe structure and scope of the Construction Electrician, Industrial Electrician and Power Electrician trades.	n/a
a. The Apprenticeship and Certification Act	
• Apprenticeship and Certification Board and Provincial Advisory Committees	
• General and specific trade regulation	
• Policies regarding attendance, evaluation procedures, conduct and progression requirements (Apprenticeship Manitoba, Training provider)	
b. Uses of the Red Seal Occupational Standard (RSOS) for Construction Electrician and Industrial Electrician or the Provincial Occupational Standard (POS) for Power Electrician	
• Technical training in-school curriculum	
• On-the-job record book of hours (Manitoba blue book)	
• Logbook of on-the-job task competencies	

- Examinations (level placement tests, final certification examinations)
- c. Opportunities and future career options
 - Generalists and specialists. The move toward specialization is well known to modern tradespeople. Some prefer to specialize and others want to do it all. Supervisory positions require a broad scope.
 - Lead hands and other immediate supervisors. Apprentices need to know how to become a lead-hand as much as they need to know the benefits and pit-falls of leadership between management and shop floor workers.
 - Geographic mobility. What does it mean to a construction/industrial worker to have to travel to find work? Are there more opportunities if they do? What are they? What are the draw-backs to being away from home for several weeks at a time?
 - Job hierarchies and innovations. What trade specific special training opportunities are available in your trade? Is there travel involved? Is there an opportunity to move up the ladder on a work crew as opposed to staying in the shop?

2. Describe two levels of workplace competency. n/a

- a. Job competencies related to workplace culture
 - Knowledge of workplace equipment and materials
 - Skills and techniques
- b. Social competencies related to workplace culture
 - Frame of reference for evaluation workplace events
 - Language of work
 - Workplace belief systems
 - Rules and meanings
 - Multiculturalism and equity in the workplace

3. Describe accommodation for apprentices with disabilities. n/a

- a. Technical training
 - Requirements
 - 1 Roles and responsibilities
 - 2 Services and information required by persons with disabilities
- b. On-the-job
 - Requirements
 - 3 Roles and responsibilities
 - 4 Services and information required by persons with disabilities

Construction Electrician/Industrial Electrician/Power Electrician

Unit: A2 Trade Safety Awareness

Level: One

Duration: 10 hours

Theory: 10 hours

Practical: 0 hours

Overview:

Safe working procedures and conditions, injury prevention, and the preservation of health are of primary importance to industry in Canada. These responsibilities are shared and require the joint efforts of government, employers, and employees. It is imperative that all parties become aware of circumstances that may lead to injury or harm. Safe learning experiences and environments can be created by controlling the variables and behaviours that may contribute to incidents or injury. It is generally recognized that safety-conscious attitudes and work practices contribute to a healthy, safe, and accident-free working environment. It is imperative to apply and be familiar with the Workplace Safety and Health Act and Regulations. As well, it's essential to determine workplace hazards and take measures to protect oneself, co-workers, the public, and the environment. Safety education is an integral part of trade apprenticeship training both in school and on-the-job. Unit content is supplemented throughout Technical Training by trade-specific information about trade safety hazards and precautions presented in the appropriate contexts of discussion and study.

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:

**Percent of
Unit Mark (%)**

1. Identify safety and health requirements.

n/a

- a. Overview of The Workplace Safety and Health Act ("the Act")
 - Rights and responsibilities of employees under the Act
 - Rights and responsibilities of employers under the Act
 - Rights and responsibilities of supervisors under the Act
- b. Fourteen (14) regulations
- c. Codes of practice
- d. Guidelines
- e. Right to refuse
 - Explanation of right to refuse process
 - Rights and responsibilities of employees
 - Rights and responsibilities of employers
 - Rights and responsibilities of supervisors under the Act

2. Identify personal protective equipment (PPE) and procedures.

n/a

- a. Employer and employee responsibilities as related to personal protective equipment.
- b. Standards: Canadian Standards Association (CSA), American National Standards Institute (ANSI) and guidelines

- c. Work protective clothing and danger if it fits poorly.
 - d. Gloves – Importance of proper glove selection (when handling chemicals, cold items, slivers, etc.)
 - e. Headwear – appropriate protective headwear when required and the approved type of headwear.
 - f. Eye protection – comparison and distinction of everyday eyeglasses, industrial safety glasses and safety goggles
 - g. Foot protection – when required according to safety standards
 - h. Hearing protection
 - Hazards of various noise levels (hearing protection must be worn)
 - Laws
 - Types of hearing protection
 - i. Respiratory protection – types, overview of proper selection
 - j. Fall protection – Manitoba requirements standards guidelines
 - ANSI (U.S.A. standards), etc.
 - k. Ladders and scaffolding
 - l. Safety principles for working with or around industrial trucks site-specific (forklifts, pallet trucks, etc.)
- 3. Identify electrical safety.** **n/a**
- a. Effects of electric current on the human body
 - b. Three factors that affect the severity of an electric shock
 - c. The effects of arc and blast on the human body and equipment
 - d. Work with energized equipment
- 4. Identify fire safety.** **n/a**
- a. Types of fires
 - b. Types of firefighting equipment
 - c. Classifications of fire extinguishers (A, B and C)
 - d. Location of fire extinguishers and fire exits
 - e. Fire alarms and drills
- 5. Identify ergonomics.** **n/a**
- a. Definition of ergonomics and conditions that may affect the body
 - Working postures
 - Repetition
 - Force
 - Lifting (simple safety procedures and precautions related to material handling procedures on how to lift carry and put down a load)
 - Tools
 - Identify tool and safety equipment
 - Causes of hand tool accidents
 - Equipment
- 6. Hazard recognition and control.** **n/a**
- a. Safe work practices
 - b. Basic risk assessment
 - c. Injury prevention and control measures
 - d. Identification of hazards involved in pneumatic tool use and explanation of how to guard against them
- 7. Hazard of confined space entry:** **n/a**
- a. Identification of a confined space
 - b. Hazards of a confined space
 - Physical

- Biological
- c. Working in a confined space
- d. Emergency response plan
- e. Self contained breathing apparatus (SCBA)

8. Identify First Aid/CPR: n/a

- a. Overview of First Aid Regulation
- b. Obligations of employers regarding First Aid
 - Who is certified to provide First Aid?
 - What to do while waiting for help?
 - Where is First Aid kit?
- c. Describe basic First Aid requirements and techniques
 - Scope and limits of First Aid intervention
 - Specific interventions (cuts, burns, abrasions, fractures, suffocation, shock, electrical shock, etc.)
 - What is it?
 - Interface with other services and agencies (e.g. Workers Compensation claims)
- d. Describe basic Cardiopulmonary Resuscitation (CPR) requirements and techniques
 - How do you get certified?
 - Scope and limits of CPR intervention (include varieties of CPR certification)

9. Identify the safety requirements as they apply to WHMIS with emphasis on: n/a

- a. WHMIS is a system
- b. Provincial Regulation under The Workplace Safety and Health Act
 - Each province has a WHMIS regulation
- c. Federal Hazardous Products Act
- d. WHMIS generic training:
 - WHMIS defined and the format used to convey information about hazardous materials in the workplace
 - Information found on supplier and workplace labeling using WHMIS
 - Hazardous materials in accordance with WHMIS
 - Compliance with government safety standards and regulations
- e. Description of WHMIS (include varieties of WHMIS Certification)
 - Typology of WHMIS labels, symbols, and classifications
 - Scope and use of Materials Safety Data Sheets (MSDS)

10. Identifying and controlling hazards: n/a

- a. Basic control measures (injury prevention)
- b. Safe work procedures
- c. Explanation on the importance of industrial housekeeping
- d. Employer responsibilities
- e. How and where to store materials
- f. Safety measures related to walkways, stairs and floor openings
- g. Explanation of how to protect the worker and others when working in traffic paths

Construction Electrician/Industrial Electrician/Power Electrician

Unit: A3 Computer and Communication Skills

Level: One

Duration: 30 hours

Theory: 20 hours

Practical: 10 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about computers and communication skills. The unit includes coverage of the importance of the customer and effective techniques for addressing customer complaints. Part of the unit covers trade related documents and general organization skills. Finally, the unit covers trade related computer skills.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
<p>1. Describe the communication skills/modes used in the workplace.</p> <p>a. Verbal communications</p> <ul style="list-style-type: none"> • Face to face contact • Telephone • Group environment <p>b. Written communications</p> <ul style="list-style-type: none"> • Letters and memos • Fax • Email 	10%
<p>2. Describe the importance of the customer.</p> <p>a. Costs and benefits of retaining a customer</p> <p>b. Costs and benefits of gaining new customers</p> <p>c. Value of repeat business</p> <p>d. Techniques for recovering 'lost' customers</p>	10%
<p>3. Describe effective techniques for addressing customer complaints.</p> <p>a. Written complaints</p> <p>b. Difficult situations with customers</p> <ul style="list-style-type: none"> • Angry customers • Impatient customers • Indecisive customers • Other situations 	10%
<p>4. Describe techniques for maintaining good communications in the workplace.</p> <p>a. Internal communications</p> <ul style="list-style-type: none"> • Support staff 	10%

- Fellow staff (colleagues)
 - Supervisors
 - Management
- b. External communications
- Tradespersons
 - Retail customers
 - Wholesale customers
 - Suppliers
 - Authorities (inspectors, general contractors)
- 5. Describe general organization and basic reading strategies for trade-related documents. 10%**
- a. Service bulletins
 - b. Tech bulletins
 - c. Service manuals
 - d. Other publications
 - e. Computer-based resources
 - f. Online resources
- 6. Create trade-related documents using proper writing techniques. 20%**
- a. Prepare a business email
 - b. Define technical terms using expansion techniques
 - c. Write instructions to inform readers
 - d. Project planning
- 7. Demonstrate trade-related computer skills as specified by instructor. 30%**
- a. Office application programs
 - Word processor (e.g. Microsoft Word)
 - Spreadsheet (e.g. Microsoft Excel)
 - Presentation software (e.g. Microsoft PowerPoint)
 - Learning Management Systems (LMSs) in a computer environment
 - b. Internet searching skills for trade-related research
 - Search engines via Universal Resource Locator (URL) addresses
 - Key word search
 - Filtering results
 - c. Using email for work related communications
 - Public email service
 - Email addresses
 - Sending and replying to email
 - Adding attachments to email (text, documents, graphs)
 - Email website links

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Unit: A4 Trade Related Math and Science

Level: One

Duration: 50 hours

Theory: 50 hours

Practical: 0 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about trade related math and science. The unit begins with coverage of the rules of significant figures, Ohm's Law calculations, and graphing. Part of the unit covers electrical terminology. Finally, the unit covers Charles' Law and Boyle's Law.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
1. Describe and solve problems using algebraic equations and formulas.	25%
a. Algebraic equations (addition, subtraction, multiplication and division)	
b. Transposing of algebraic equations	
c. Fractions (addition, subtraction, multiplication and division), decimals and percent	
d. Positive and negative numbers	
e. Ratios and proportions	
f. Areas and volumes	
2. Describe and solve the rules of significant figures.	10%
a. Scientific notation	
b. Engineering notation (kilo, mega, micro, milli, etc.)	
c. Usage of significant figures.	
3. Describe and solve basic Ohm's Law circuits (series, parallel and combination).	20%
a. Resistance calculations (total and component)	
b. Current calculations (total and component)	
c. Power calculations (total and component)	
4. Describe and demonstrate how to plot data on graphs.	5%
a. Display abscissa and ordinate (horizontal and vertical line)	
b. Display proper scaling, and base line or reference line	
5. Describe and solve right angle triangles with use of electrical terminology.	25%
a. Pythagorean Theorem	
b. Trigonometry	
• Sine function	
• Cosine function	
• Tangent function	

6. **Describe simple machines, force, and pressure related to electrical trade applications.** **10%**
- a. Simple machines, including:
 - Lever
 - Inclined plane
 - Pulley
 - b. Perform related calculations
 - Force-distance
 - Friction
7. **Describe Charles' Law and Boyle's Law.** **5%**
- a. Pressure
 - b. Temperature
 - c. Volumes and vacuum

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Unit: A5 Residential Electrical Code

Level: One

Duration: 90 hours

Theory: 90 hours

Practical: 0 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about residential electrical code. The unit begins with coverage of residential system voltages and circuitry, wiring methods and practices, wiring devices and applications. Part of the unit covers residential device layout and placement, overcurrent protection, and loads and branch circuit calculations. Finally, the unit covers power distribution and related calculations.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
<p>1. Describe the objectives and scope of the Canadian Electrical Code (CEC).</p> <p>a. Orientation to CEC</p> <ul style="list-style-type: none"> • Sections, sub-sections, conventions 	10%
<p>2. Describe residential system voltages and circuitry.</p> <p>a. advantages of 3 wire over 2-2 wire circuits,</p> <p>b. potential circuit problems,</p> <p>c. temporary wiring requirements</p> <p>d. Extra low voltage and low voltage systems</p>	10%
<p>3. Describe residential wiring methods and practices.</p> <p>a. CEC requirements</p> <p>b. Conductors, cables and raceways</p> <ul style="list-style-type: none"> • Ampacities • Derations • Conditions of use • Metallurgy (compatibility of materials) <p>c. Bonding and grounding</p> <p>d. Perform related calculations.</p> <ul style="list-style-type: none"> • Voltage drop calculations • Raceway fill calculations 	20%
<p>4. Describe residential wiring devices and applications.</p> <p>a. CEC requirements</p> <p>b. Outlet boxes</p> <ul style="list-style-type: none"> • Sizes • Types 	15%

- Applications
 - Box fill calculations
- c. Receptacles
 - d. Switches
 - e. Luminaires
 - f. Specialty outlets
 - g. Smoke detectors
- 5. Describe residential device layout and placement. 5%**
- a. CEC requirements
- 6. Describe residential overcurrent protection. 5%**
- a. CEC requirements
 - b. Types and their operation
- 7. Describe residential loads and related CEC branch circuit calculations. 20%**
- a. Electric range
 - b. Electric dryer
 - c. Electric hot water tank
 - d. Electric space heat and heating control requirements
 - e. Special purpose outlets
 - f. Convenience outlets (lights, receptacles)
- 8. Describe the installation and maintenance of power distribution and perform service calculations for single phase 3 wire (120/240V). 15%**
- a. CEC requirements
 - b. Overcurrent protection
 - c. Wire size and type
 - d. Raceway size and type
 - e. Bonding jumper size
 - f. Grounding
 - g. Metering

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Unit: A6 Residential Wiring Practices

Level: One

Duration: 40 hours

Theory: 10 hours

Practical: 30 hours

Overview:

This unit is designed to provide the apprentice with the skills for applying residential wiring practices. The unit begins with coverage of installation of residential wiring devices. Part of the unit covers installation of voice data video and community antenna television systems. Finally, the unit covers blueprint use and mounting methods for residential applications.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
<p>1. Perform installation of residential wiring devices.</p> <ul style="list-style-type: none"> a. CEC requirements b. Create connection diagrams c. Wire and terminate <ul style="list-style-type: none"> • Branch circuits • Overhead service d. Proper use and selection of tools 	50%
<p>2. Describe and perform installation of voice data video (VDV) structured fiber-optic cabling systems and community antenna television (CATV) systems.</p> <ul style="list-style-type: none"> a. CEC requirements b. Installation requirements and procedures c. Testing and troubleshooting procedures 	20%
<p>3. Interpret and demonstrate use of blueprints for residential applications.</p> <ul style="list-style-type: none"> a. Symbols and terminology b. Specifications 	20%
<p>4. Describe and demonstrate various mounting methods for residential applications.</p> <ul style="list-style-type: none"> a. Fasteners and brackets <ul style="list-style-type: none"> • Types • Conditions of use b. Bolts <ul style="list-style-type: none"> • Grades • Torque specifications 	10%

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Unit: A7 DC Fundamentals

Level: One

Duration: 60 hours

Theory: 60 hours

Practical: 0 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about DC fundamentals. The unit begins with terminology and basic concepts associated with electrical theory and circuitry. Part of the unit covers battery concepts and the laws of magnetism. Finally, the unit covers AC wave forms.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
<p>1. Define terminology and describe basic concepts associated with electrical theory and circuitry.</p> <ul style="list-style-type: none"> a. Electrical terminology b. Atomic structure and its effects on electrical flow c. Static electricity effect d. Distinguish between these theories and apply to electrical flow/current: <ul style="list-style-type: none"> • Electron theory • Conventional theory e. Resistance <ul style="list-style-type: none"> • Explaining the nature of resistance and the factors that contribute to it. • computing the resistance of wires and bus bars using metric units and AWG tables (wires) only • computing the temperature effect on resistance • explaining various types of standard resistors, including power ratings and colour coding f. Ohm's Law g. Work, power and energy 	50%
<p>2. Describe battery theory, installation and maintenance.</p> <ul style="list-style-type: none"> a. Characteristics, types and ratings b. Safety considerations 	10%
<p>3. Describe laws of magnetism.</p> <ul style="list-style-type: none"> a. Basic principles b. Left hand rules <ul style="list-style-type: none"> • Conductor • Coil • Generator c. Electro-magnetism 	30%

4. Describe AC wave forms.

10%

- a. Generation and characteristics of a sinusoidal wave form
- Comparison to DC
 - Other non sinusoidal wave forms

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Unit: A8 DC Circuit Analysis

Level: One

Duration: 60 hours

Theory: 50 hours

Practical: 10 hours

Overview:

This unit is designed to provide the apprentice with the knowledge about DC circuit analysis. The unit begins with coverage of the principles and laws that govern electrical circuits. Part of the unit covers electromagnetic induction. Finally, the unit covers DC instruments and measuring instruments.

Objectives and Content:	<u>Percent of Unit Mark (%)</u>
<p>1. Describe and apply principles and laws that govern electrical circuits.</p> <ul style="list-style-type: none"> a. Diagram simple electrical circuits and construct, calculate and compare the three types of simple circuits based on principles of electricity <ul style="list-style-type: none"> • Series • Parallel • Series-parallel b. Perform electrical measurements and calculations within specific circuits c. Analyze and interpret results d. Kirchhoff's Law of Voltage and Law of Amperage as it applies to a specific type of electrical circuit e. Battery connections and circuit applications 	40%
<p>2. Describe and demonstrate electromagnetic induction principles and applications.</p> <ul style="list-style-type: none"> a. Electromagnetism <ul style="list-style-type: none"> • Faraday's Law • Lenz's Law b. Self-induction c. Solenoids 	30%
<p>3. Describe DC instruments (including the operation of direct current measuring instruments, their construction and use).</p> <ul style="list-style-type: none"> a. Analog meter movement b. Voltmeter circuit c. Ammeter circuit d. Wattmeter 	10%
<p>4. Demonstrate the use of measuring instruments to analyze electrical flow through or within specific electrical circuits.</p> <ul style="list-style-type: none"> a. Application of Ohm's Law, Joule's Law and Kirchhoff's Law of Voltage and Law of 	20%

Amperage when measuring the following electrical circuits

- Series
 - Parallel
 - Series-parallel
- b. Test equipment (e.g., Voltage Ohmmeter (VOM)) to measure and determine the main aspects of electrical flow within a specific circuit
- c. Relationships between:
- Voltage and amperage
 - Resistance and amperage
 - Simple electrical circuits
- d. Common electrical faults
- “Open circuit”
 - “Short circuit”
 - “Ground fault”
