

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:

**Percent of
Unit Mark (%)**

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 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, supervisors, and workers. It is imperative to be familiar and apply the Manitoba Workplace Safety and Health Act and Regulations. Safety education is an integral part of apprenticeship training both in school and on-the-job. This unit is an overview of occupational safety and health best practices in Manitoba and covers Personal Protective Equipment, the Workplace Hazardous Materials Information System, and Safe Work Procedures. The unit also describes injury prevention and response. Finally, the unit reinforces these best practices by navigating the SAFE Work Manitoba website through each objective to apply Manitoba's most current safety and health standards. Additional trade safety awareness related resources are located on the Apprenticeship Manitoba website link below. Trade specific hazards and safe work practices are supplemented and delivered in-context within technical training units.

- **SAFE Work Manitoba website:** <https://www.safemanitoba.com/>
- **Safety resources:** <https://www.gov.mb.ca/aesi/apprenticeship/generalinfo/instructoreducators.html>

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. Define and describe Manitoba safety and health requirements. a. Overview of the <i>Workplace Safety and Health Act and Regulations</i> • Rights and responsibilities of workers under the <i>Act</i> • Rights and responsibilities of supervisors under the <i>Act</i> • Rights and responsibilities of employers under the <i>Act</i> b. Public agencies • Workplace Safety and Health (Enforcement) • SAFE Work Manitoba (Prevention) • Other c. Codes of practice, guidelines, policies and standards (differences) d. Worker rights • Right to know, participate, refuse • Protection from reprisal e. Workplace safety and health program (worker's involvement) • Workplace safety and health committee • Participation in investigation and inspection process	n/a

2. **Identify and describe personal protective equipment (PPE) requirements and standards in the workplace.** n/a
 - a. Employer, supervisor and worker responsibilities
 - b. Hierarchy of control measures
 - c. Personal protective equipment (PPE)
 - Eye and face protection
 - Hearing protection
 - Foot, head, hand, and skin protection
 - Respiratory protection
 - Protective clothing (including Hi-Visibility/Hi-Vis)
 - Fall protection (trade specific)

3. **Identify and describe the Workplace Hazardous Material Information System (WHMIS) and procedures.** n/a
 - a. Hazard identification
 - b. Product labels, symbols and classification
 - Supplier
 - Workplace
 - c. Safety Data Sheets (SDS)
 - d. Chemical and biological hazards
 - Emergency washing
 - Transportation of dangerous goods
 - Storage and handling

4. **Identify and describe Safe Work Procedures (SWP).** n/a
 - a. Hazard identification
 - b. Uncontrolled risk
 - c. SWP development

5. **Identify and describe injury prevention.**
 - a. Hazard recognition, evaluation, and control (SAFE acronym)
 - b. Occupational disease and illness
 - c. Musculoskeletal
 - Ergonomics
 - d. Psychological health and safety
 - Harassment and violence
 - Working alone
 - e. Young workers
 - f. Physical hazards
 - g. Chemical and biological hazards, and exposures
 - Dust and fibres
 - Fumes, aerosols, gases and vapours
 - h. Confined space entry
 - i. Electrical safety
 - Lockout/tagout procedures
 - j. Fire types, fire extinguisher classifications and applications

6. **Identify and describe injury response.** n/a
 - a. Control the scene
 - b. Incident investigation
 - Near miss
 - Incident
 - Serious incident

- c. Corrective actions
 - d. Follow-up
 - e. Reporting an injury (Workers Compensation Board (WCB) of Manitoba)
7. **Demonstrate navigation and retrieval of key content areas from SAFE Work Manitoba's website and apply resources directly to unit objectives.** n/a
- a. Legislation
 - b. Bulletins
 - c. Templates
 - d. Shop Talk
 - e. Other resources

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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 and skills 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>
1. Describe the communication skills/modes used in the workplace.	10%
a. Verbal communications	
• Face to face contact	
• Telephone	
• Group environment	
b. Written communications	
• Letters and memos	
• Fax	
• Email	
2. Describe the importance of the customer.	10%
a. Costs and benefits of retaining a customer	
b. Costs and benefits of gaining new customers	
c. Value of repeat business	
d. Techniques for recovering 'lost' customers	
3. Describe effective techniques for addressing customer complaints.	10%
a. Written complaints	
b. Difficult situations with customers	
• Angry customers	
• Impatient customers	
• Indecisive customers	
• Other situations	
4. Describe techniques for maintaining good communications in the workplace.	10%
a. Internal communications	
• Support staff	

- 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

Construction Electrician/Industrial Electrician/Power Electrician

Unit: A4 Trade Related Mathematics 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 mathematics and science topics. The unit covers mathematical concepts such as mathematical properties, metric and customary measurements, solving problems involving perimeter, area, volume, direct and indirect proportion, trigonometric ratios and Pythagorean theorem. In addition, the unit covers science topics such as solving problems involving simple machines, force, pressure and physical properties of ideal gases.

Objectives and Content:	Percent of Unit Mark (%)
1. Use mathematical properties to solve problems involving whole, fractional, decimal and numbers, with an emphasis on trade-related problems. The skills studied will include techniques to: a. Add and subtract fractions when presented as proper, improper, or mixed fractions. b. Multiply, divide, reduce, and expand common fractions. c. Perform standard operations with whole numbers, integers and/or real numbers with and without a calculator, using both decimal and common fractions. d. Convert between common and decimal fractions. e. Perform calculations involving exponents and roots. f. Apply the order of operations correctly. g. Use principles of precision and accuracy to communicate values in scientific and engineering notation.	20%
2. Use metric and customary measurement systems to perform trade-related operations and problems. The skills studied will include how to: a. Explain the metric and customary systems of measurement, including common units used in those systems and the metric system's use of base units and prefixes. b. Perform calculations using metric and customary units of measurement. c. Convert within and between measurement systems.	15%
3. Calculate the perimeter, area, and volume of simple and complex shapes, using both metric and customary units of measurement. The skills studied may include how to: a. Calculate perimeters and areas of triangles, quadrilaterals (squares, rectangles, etc.) and polygons. b. Calculate circumferences and areas of circles. c. Calculate volumes of prisms and cylinders.	15%

4. **Solve problems using direct and indirect proportion. The skills studied may include how to:** 10%
 - a. Apply direct proportions for scaling objects, ratios and quantities.
 - b. Apply the properties of percentages and multiples to problems involving scaling, wastage, material discounts, mark-ups, ad sales taxes.
5. **Solve for missing values using trigonometric ratios and the Pythagorean theorem.** 10%
 - a. Use the Pythagorean theorem to solve for unknown sides of a right triangle.
 - b. Calculate the angles and sides of right triangles using basic trigonometric ratios.
 - c. Solve right angle triangles in all four quadrants of the Cartesian plane and determine their angular relation between the hypotenuse and positive X-axis.
6. **Solve algebraic problems involving one variable. The skills studied will include how to:** 10%
 - a. Use the Addition and Multiplication Properties of Equality, additive and multiplicative inverses, and order of operations to manipulative equations and isolate variables.
 - b. Write simple algebraic equations that help organize, simplify, and solve other problems.
7. **Define math anxiety, recognize the effects and identify techniques to overcome math anxiety.** 5%
8. **Solve problems relating to simple machines, force, and pressure related to electrical trade applications.** 10%
 - a. Calculate mechanical advantage, effort, load, effort distance, and load distance for simple machines including levers, pulleys, and inclined planes.
 - b. Perform related calculations to solve for force, distance, and friction.
9. **Use Boyle's Law, Charles' Law and Ideal Gas Law equations to calculate the following physical properties of ideal gases.** 5%
 - a. Temperature
 - b. Volume
 - c. Pressure
 - d. Density

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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:	Percent of Unit Mark (%)
1. Describe the objectives and scope of the Canadian Electrical Code (CEC). a. Orientation to CEC Sections, sub-sections, conventions	10%
2. Describe residential system voltages and circuitry. a. Advantages of 3 wire over 2-2 wire circuits b. Potential circuit problems c. Temporary wiring requirements d. Extra low voltage and low voltage systems	10%
3. Describe residential wiring methods and practices. a. CEC requirements b. Conductors, cables and raceways - Ampacities - Derations - Conditions of use - Metallurgy (compatibility of materials) c. Bonding and grounding d. Perform related calculations - Voltage drop calculations - Raceway fill calculations	20%
4. Describe residential wiring devices and applications. a. CEC requirements b. Outlet boxes - 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

Construction Electrician/Industrial Electrician/Power Electrician

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 knowledge and skills about 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:	Percent of Unit Mark (%)
1. Identify hazards and describe safe work practices pertaining to residential wiring.	5%
2. Perform installation of residential wiring devices.	45%
a. CEC requirements b. Create connection diagrams c. Wire and terminate • Branch circuits • Overhead service d. Proper use and selection of tools	
3. Describe and perform installation of voice data video (VDV), such as structured cabling systems, fiber-optic, and community antenna television (CATV) systems.	20%
a. CEC requirements b. Installation requirements and procedures c. Testing and troubleshooting procedures	
4. Interpret and demonstrate use of blueprints for residential applications.	20%
a. Symbols, terminology and specifications	
5. Describe and demonstrate various mounting methods for residential applications.	10%
a. Fasteners and brackets • Types • Conditions of use b. Bolts • Grades • Torque specifications	

Construction Electrician/Industrial Electrician/Power Electrician

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:	Percent of Unit Mark (%)
1. Identify hazards and describe safe work practices pertaining to DC fundamentals.	5%
2. Define terminology and describe basic concepts associated with electrical theory and circuitry.	50%
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: • Electron theory • Conventional theory e. Resistance • 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	
3. Describe battery theory, installation and maintenance.	5%
a. Characteristics, types and ratings b. Safety considerations	
4. Describe laws of magnetism.	30%
a. Basic principles b. Left hand rules • Conductor • Coil	

- Generator
- c. Electro-magnetism

5. Describe AC wave forms.

10%

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

Construction Electrician/Industrial Electrician/Power Electrician

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>
1. Identify hazards and describe safe work practices pertaining to DC circuits.	5%
2. Describe and apply principles and laws that govern electrical circuits.	40%
a. Diagram simple electrical circuits and construct, calculate and compare the three types of simple circuits based on principles of electricity • Series • Parallel • Series-parallel	
b. Perform electrical measurements and calculations within specific circuits	
c. Analyze and interpret results	
d. Perform related calculations using • Kirchhoff's Voltage Law (KVL) • Kirchhoff's Current Law (KCL) • Voltage Divider Rule • Current Divider Rule	
e. Battery connections and circuit applications	
3. Describe and demonstrate electromagnetic induction principles and applications.	30%
a. Electromagnetism • Faraday's Law • Lenz's Law	
b. Self-induction	
c. Solenoids	
4. Describe DC instruments (including the operation of direct current measuring instruments, their construction and use).	10%
a. Analog meter movement	
b. Voltmeter circuit	

- c. Ammeter circuit
- d. Wattmeter

5. Demonstrate the use of measuring instruments to analyze electrical flow through or within specific electrical circuits. 15%

- a. Application of Ohm's Law, Joule's Law and Kirchhoff's Law of Voltage and Law of 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"
