Grade 12C Advanced Electrical Wiring Methods

Course Code	9061
Course Credit	1.0

English Program

Discipline Overview

An approved technical vocational education (TVE) program cluster comprises departmentally developed and/or approved courses in one specific trade or trained occupation that facilitates the transition from school to either post-secondary training (such as the training provided through Apprenticeship Manitoba) or entry into the workforce (often at an entry-level position).

When learners pursue their studies in an environment modelled after the workplace, they will acquire not only trade-related skills, but they will also develop

- employability skills required to make an effective transition from school to work
- an understanding of career development and planning
- an understanding of the importance of becoming an autonomous, lifelong learner in order to adapt to the skills and knowledge needed in the future
- an awareness of safety in school, in the workplace, and at home
- an awareness of sustainability as it relates to the specific skilled trade area and society

The TVE curriculum in electrical trades technology has been designed specifically for learners interested in the opportunity of becoming journeyperson or Red Seal electricians by teaching them all of the Level 1 technical training standards that they need to learn, along with providing them with hundreds of hours of practical experience.

Course Overview

This course provides students with advanced electrical wiring training, focusing on complex installations, service calculations, and compliance with the Canadian Electrical Code. Learners develop practical skills in using tools, materials, and wiring devices, while applying trade-related mathematics and blueprint interpretation. Emphasis is placed on safe work practices, communication, and workplace competencies essential for professional success. Learners also explore emerging trends in electrical systems and technologies, preparing for post-secondary training and careers in the electrical trades.

This course focuses on the following units in Apprenticeship Manitoba Level 1 technical training:

- A5 Residential Electrical Code (Canadian Electrical Code)

Global Competencies



Critical Thinking

Critical thinking in electrical trades technology involves the intentional process of synthesizing and analyzing ideas using criteria and evidence, making reasoned judgments, and reflecting on the outcomes and implications of those judgments.

When critical thinking as a competency is applied in electrical trades technology, learners

- find, use, and reflect on diverse sources strategically, efficiently, and effectively when interpreting wiring diagrams, Canadian Electrical Code, and manufacturer specifications to make informed decisions about installations and troubleshooting
- evaluate the sources of their and others' perspectives for bias, reliability, and relevance as they consider the impacts of technology use on the environment and on health and well-being of the tradesperson
- connect ideas, patterns, and relationships between circuit theory and practical applications, using criteria and evidence from test instruments and load calculations
- understand how perspectives are rooted in lived experiences, client needs, past practice, emerging trends, and safety standards
- demonstrate flexibility to reconsider their thinking when troubleshooting faults or adapting plans to meet updated codes or unexpected site conditions



Creativity

Creativity in electrical trades technology involves exploring and playing with ideas and concepts in order to represent thinking, solve problems, explore opportunities, and innovate in unique ways. It is the interaction between intuition and thinking.

When creativity as a competency is applied in electrical trades technology, learners

- try new things and take risks by being open to new ideas in learning
- demonstrate curiosity by exploring new ideas and asking relevant questions about energy efficiency and renewable integration
- use strategies to generate innovative solutions for wiring challenges in complex spaces while meeting code and client needs
- enhance new ideas by building on suggestions from peers and industry standards
- create plans for conduit runs/layouts and adjust them as needed to meet project goals
- test and adapt wiring layouts, persevere through obstacles, and refine designs for efficiency and aesthetics
- reflect on their process and seek and use feedback from instructors and peers to improve



Citizenship

Citizenship in electrical trades technology involves engaging and working towards a more equitable, compassionate, and sustainable world through the development and value of relationships to self, others, and the natural world.

When citizenship as a competency is applied in electrical trades technology, learners

- develop, understand, and reflect on their own perspective in complex issues such as energy or human sustainability and workplace safety
- recognize discrimination, principles of equity, and human rights when working on diverse job sites and with clients from different backgrounds
- explore the interconnectedness of self, others, and the natural world by considering the environmental impact of electrical installations, and the health and well-being of the tradespeople
- seek out diverse viewpoints and lived experiences and collaborate respectfully in team settings
- reflect on and empathize with perspectives that do not align with their own (e.g., client preferences vs. code requirements)

- connect with others in responsible, respectful, and inclusive ways, both in person and in digital contexts
- realize their potential in contributing to the betterment of communities by promoting safe practices and reducing environmental impact (e.g., recommending LED lighting)
- work to find equitable solutions to support diversity, inclusivity, and human rights in the workplace
- make ethical choices to promote healthy and sustainable outcomes for the natural world



Connection to Self

Connection to self in electrical trades technology involves awareness of the related nature of emotional, intellectual, physical, social, cultural, and spiritual aspects of living and learning, and the responsibility for personal growth, well-being, and well-becoming.

When connection to self as a competency is applied in electrical trades technology, learners

- recognize personal interests, strengths, gifts, challenges, and opportunities in precision wiring, troubleshooting, and adapting to new technologies
- come to know factors that shape their identity, including lived experiences, cultural background, and trade experiences
- understand and use strategies to support self-regulation and well-being to support safety during high-stakes tasks like live circuit testing
- reflect on personal decisions, effort, and experiences, and on others' feedback for improvement
- set goals to strengthen their learning and well-being, such as moving into apprenticeship or post-secondary training
- have hope and demonstrate resiliency as they plan for the future in a rapidly evolving trade
- persevere through obstacles such as complex troubleshooting or adapting to new code requirements
- demonstrate an ability to change or adapt to new experiences and technologies
- recognize and embrace their role in lifelong learning and well-being



Collaboration

Collaboration in electrical trades technology involves learning with and from others, and working together with a shared commitment to a common goal.

When collaboration as a competency is applied in electrical trades technology, learners

- actively welcome and seek out diverse perspectives, voices, and ideas, valuing input from others and from different trades (e.g., plumbers, carpenters) to better understand and integrate complex systems
- understand that building on others' ideas deepens thinking and improves project outcomes
- value and put trust in others' contributions during team-based installations
- practise active listening and asking questions of themselves and others to clarify plans
- work through differences and show a willingness to compromise or change perspective when appropriate (e.g., adjusting conduit runs to accommodate HVAC)
- co-construct meaning and plans with others for electrical layouts in construction projects
- contribute equitably to the collective purpose or common goal of safe, efficient installations



Communication

Communication in electrical trades technology involves interacting with others and allowing for a message to be received, expressed, and understood in multiple ways and for a variety of purposes.

When communication as a competency is applied in electrical trades technology, learners

- express ideas and emotions while following context cues (e.g., technical drawings, labelling, tone of voice, digital diagrams) and conventions of the trade
- thoughtfully consider audience, purpose, context, modes, and forms to effectively share ideas (e.g., explaining electrical concepts to clients vs. inspectors)
- understand how their words and actions impact their identities and relationships on job sites
- use context cues to enhance understanding when receiving messages (e.g., interpreting schematics and inspector notes)
- seek to understand others' messages through observation, active listening, and questioning during project planning and troubleshooting

- recognize how diverse contexts (e.g., linguistic, cultural, generational, experiential) can impact and influence understanding in peer and client interactions
- make meaning and deepen understanding using precise, continually evolving technical terminology of the trade and language of clients and others in the field
- make connections and build relationships through conversations and discussions, both in person and in digital contexts
- value how communication strengthens community safety and efficiency on job sites

Enduring Understandings

Explore career opportunities.

Technical-vocational education supports learners in understanding the unique characteristics, scope, working conditions, and career opportunities of various occupations to make informed choices.

Create safe, healthy, and effective workspaces.

Technical-vocational education provides learners with safe, healthy, and effective work practices and protocols that meet industry standards for technical competence and professionalism.

Navigate the world.

Technical-vocational education prepares learners with attitudes, skills, and knowledge to successfully navigate complex, competitive, and collaborative environments to develop an awareness of regulations, cultural competence, and ethical practices.

Experience connected and innovative learning.

Technical-vocational education readies learners to be entrepreneurial and innovative thinkers while making cross-curricular connections and transdisciplinary experiences (STEAM), utilizing industry standard digital tools and technologies, and fostering awareness of industry trends.

Promote inclusive and responsive systems.

Technical-vocational education promotes equity, diversity, and inclusion, is responsive to global challenges, and promotes environmental stewardship to prepare learners for an interconnected world.

Prepare for evolving economies.

Technical-vocational education equips learners with relevant and adaptable skills to become lifelong learners in an ever-changing world.

Learning Outcomes

The learning outcomes in this course may not follow a fixed sequence, as they are organized to align with Apprenticeship Manitoba standards. Only the outcomes relevant to this course are included. A complete list of learning outcomes can be found in the primary learning outcomes resource.

Strand A: Trade Safety (A2)

ETT.12C.A1 Define Manitoba safety and health requirements.

ETT.12C.A1.1 Define Manitoba safety and health requirements under The Workplace Safety and Health Act and Regulations for **workers' rights,** including

- the right to know
- the right to participate
- the right to refuse
- the right to protection from reprisal

ETT.12C.A1.2 Define Manitoba safety and health requirements under The Workplace Safety and Health Act and Regulations for **workers' responsibilities,** including

- taking reasonable care to protect themselves and others
- using safety equipment properly
- following safety rules and procedures
- cooperating with safety representatives and supervisors

ETT.12C.A1.3 Define and describe Manitoba safety and health requirements under The Workplace Safety and Health Act and Regulations for

- the rights and responsibilities of **supervisors**
- the rights and responsibilities of **employers**

ETT.12C.A1.4 Define and describe workplace **safety and health programs** and the roles of workers, including

- safety and health committee
- participation in investigation and inspection processes

ETT.12C.A1.5 Define and describe the Manitoba safety and health requirements for various **public agencies**, including

- SAFE Work Manitoba (prevention)
- Workplace Safety and Health (enforcement)

ETT.12C.A2 Recognize, explain, and demonstrate personal protective equipment (PPE) requirements and standards in the workplace.

ETT.12C.A2.1 Recognize various types of **personal protective equipment** (PPE), including

- eye protection
- face protection
- hearing protection
- foot protection
- head protection
- hand protection
- skin protection
- respiratory protection
- protective clothing
- fall protection (trade-specific)

ETT.12C.A2.2 Explain various types of **personal protective equipment** (PPE), including

- selection of the appropriate PPE
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance

ETT.12C.A2.3 Demonstrate how to use the required **personal protective equipment** (PPE), including ensuring

- a proper fit
- a proper seal
- it is worn properly
- an understanding of the procedures for reporting any damage or malfunctions

ETT.12C.A2.4 Recognize **hierarchy of control measures** and explain the requirements and standards, including

- elimination
- substitution
- engineering controls
- administrative controls
- personal protective equipment (PPE)

ETT.12C.A2.5 Explain each individual's responsibilities when using and managing **personal protective equipment** (PPE) at work or in training for **various roles**, including the

- employer
- supervisor
- worker
- teacher
- learner

ETT.12C.A2.6 Explain requirements for **personal protective equipment** (PPE), including
- the name of the provider
- its proper maintenance
- required training
- the different types of gear
- procedures in place to guarantee regulations are upheld

ETT.12C.A3 Recognize and explain the Workplace Hazardous Material Information System (WHMIS) and procedures.

ETT.12C.A3.1 Explain how various hazardous materials are **identified**, including
- classification
- safety data sheets (SDS)
- labelling
- training
- access to information

ETT.12C.A3.2 Explain what **suppliers and workplaces** must do when labelling hazardous products, including
- using safety symbols
- classifying chemicals

ETT.12C.A3.3 Recognize various **safety data sheets** (SDS).

ETT.12C.A3.4 Recognize various **chemical and biological hazards.**

ETT.12C.A3.5 Explain how to deal with **chemical and biological hazards** safely, including
- how to wash off spills
- moving dangerous materials
- storing dangerous materials properly

ETT.12C.A4 Recognize and explain safe work procedures (SWP).

ETT.12C.A4.1 Recognize a **safe work procedure** (SWP) that outlines specific steps to safely perform a task, including
- hazard identification
- risk assessment
- control measures

ETT.12C.A4.2 Explain a **safe work procedure** (SWP), including
- purpose
- scope
- procedure
- training

ETT.12C.A4.3 Recognize a hazard and explain the procedures to follow for **managing various uncontrolled risks**, including

- unsecured tools or equipment
- improper use of machinery
- electrical hazards
- chemical exposure
- lack of personal protective equipment (PPE)
- poor housekeeping

ETT.12C.A4.4 Develop a **safe work procedure** (SWP), including

- purpose
- scope
- procedure
- training

ETT.12C.A5 Recognize and explain injury prevention.

ETT.12C.A5.1 Recognize, explain, and demonstrate the **SAFE acronym:**

- **S**pot the hazard
- **A**ssess the risk
- **F**ind a safer way
- **E**very day

ETT.12C.A5.2 Recognize various risks affecting **mental health wellness** at work and school, such as

- stress
- bullying
- violence
- impairment risks

ETT.12C.A5.3 Explain various risks affecting **mental health wellness** at work and school, including

- respectful communication
- implementation of clear policies
- access to support systems

ETT.12C.A5.4 Demonstrate how to reduce various risks affecting **mental health wellness** at work and school, such as by

- promoting respect and inclusivity
- offering support
- proactively identifying and managing issues such as stress or bullying

ETT.12C.A5.5 Recognize various methods to prevent injuries among **young workers**, such as through

- completion of the Young Worker Readiness Certificate Course
- mandatory safety orientation and training
- supervision by experienced workers
- implementation of SAFE Work Manitoba's Young Worker Injury Prevention Strategy
- use of personal protective equipment (PPE)
- encouraging reporting of unsafe conditions
- promoting awareness of workers' rights

ETT.12C.A5.6 Explain various methods to prevent injuries among **young workers**, such as through

- selection of the appropriate method
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance

ETT.12C.A5.7 Recognize various **chemical and biological hazards**, including

- dust
- fumes
- gases
- liquids
- moulds

ETT.12C.A5.8 Explain how to prevent various **chemical and biological hazards**, such as by

- using proper ventilation
- using safety gear
- using personal protective equipment (PPE)
- implementing safe handling procedures

ETT.12C.A5.9 Explain how to prevent various injuries related to **electrical safety**, including

- using proper tools
- turning off power before repairs
- following lockout/tagout steps to make sure machines cannot be turned on accidentally

ETT.12C.A5.10 Demonstrate how to safely shut off and lock electrical equipment using a **lockout/tagout** procedure.

ETT.12C.A5.11 Recognize how to prevent various **fire injuries,** including

- recognizing different types of fires
- recognizing different kinds of fire extinguishers
- describing how to use fire extinguishers safely

ETT.12C.A5.12 Demonstrate knowledge of the locations of various fire emergency safety equipment and evacuation safety measures, including

- fire extinguishers
- alarm pull stations
- emergency exits
- muster points

ETT.12C.A5.13 Recognize and explain how to prevent various work-related **diseases and illnesses,** such as

- asbestos-related diseases
- hearing loss
- carpal tunnel syndrome
- tendonitis
- lead poisoning
- silicosis (silica dust)

ETT.12C.A5.14 Recognize various **muscle and joint injuries,** and explain how to prevent them by using ergonomics prevention methods, including

- good posture
- proper workplace setup

ETT.12C.A5.15 Recognize various **confined spaces**.

ETT.12C.A5.16 Explain methods to prevent injuries during **confined space** entry.

ETT.12C.A6 Recognize and explain injury response.

ETT.12C.A6.1 Explain how to **manage a scene** when responding to an injury, such as by

- staying calm
- keeping the area safe
- providing support until trained help arrives

ETT.12C.A6.2 Explain how to **report an injury**, including reporting the injury to

- a teacher or supervisor
- Workers Compensation Board of Manitoba (WCB)

ETT.12C.A6.3 Demonstrate knowledge of the locations of **emergency safety equipment**, including

- first aid kit
- automated external defibrillator (AED)
- eyewash station

ETT.12C.A7 Demonstrate navigation of the SAFE Work Manitoba website.

ETT.12C.A7.1 Demonstrate how to navigate **SAFE Work Manitoba's** website and retrieve and apply resources from key content, including

- legislation
- bulletins
- templates
- shop talk
- other resources

ETT.12C.A8 Discuss emerging trends in trade safety.

ETT.12C.A8.1 Discuss various current and **emerging trends** in trade safety.

Strand B: Career Education (A1)

ETT.12C.B1 Explain the structure and scope of the construction electrician, industrial electrician, and power electrician trades.

ETT.12C.B1.1 Explain opportunities and future **career paths** in a trade, including

- becoming a specialist
- moving into leadership
- working in different locations
- growing with new technology

ETT.12C.B1.2 Explain **The Apprenticeship and Certification Act**, including

- support training
- the board
- trade committees
- rules for each trade
- policies about attendance
- continuing training

ETT.12C.B1.3 Explain the **Red Seal Occupational Standard (RSOS)**, including

- how it helps with training
- tracking work hours
- preparing for tests in a trade

ETT.12C.B2 Explain levels of workplace competency.

ETT.12C.B2.1 Explain **job competencies** workers and learners need to know related to **workplace culture**, including

- understanding tools and materials
- using the right skills to do the job well

ETT.12C.B2.2 Explain the **social competencies** workers and learners need to know related to **workplace culture**, including

- working well with others
- using appropriate and respectful language
- acknowledging and appreciating varied viewpoints
- supporting fairness, diversity, and inclusion

ETT.12C.B2.3 Explain **professional competencies** workers and learners need to know related to **workplace culture**, including

- attending regularly and on time
- taking responsibility for their own actions
- being adaptable
- showing initiative and effort
- demonstrating teamwork
- staying on task and using time effectively
- responsibly using wireless communication devices
- participating in worksite cleanup

ETT.12C.B3 Explain accommodation for apprentices with accessibility requirements.

ETT.12C.B3.1 Explain **The Accessibility for Manitobans Act** and how it supports apprentices with accessibility, including

- customer service
- communication
- buildings
- transportation
- training at work

Strand C: Trade-Related Communications (A3)

ETT.12C.C1 Explain and demonstrate techniques for effective verbal and non-verbal communication in and outside the workplace.

ETT.12C.C1.1 Explain how to communicate clearly and respectfully with various people at school and/or work, using **tone, words, and body language**.

ETT.12C.C1.2 Demonstrate how to communicate clearly and respectfully with various people at school and/or work, using **tone, words, and body language**.

ETT.12C.C2 Recognize workplace behaviours and communication that constitute bullying as defined by the Canadian Human Rights Act and jurisdictional human rights laws.

ETT.12C.C2.1 Recognize what **respectful workplace** values look like and what kinds of behaviour are considered bullying, harassment, or discrimination under Canadian law.

ETT.12C.C3 Demonstrate effective communication skills, and practise active listening and response in face-to-face and group settings.

ETT.12C.C3.1 Demonstrate **effective communication and active listening,** including

- listening carefully
- responding clearly
- using appropriate body language
- asking questions
- being open to feedback

ETT.12C.C4 Recognize various types of communication devices, and explain their purpose and operation.

ETT.12C.C4.1 Recognize various types of **communication devices**, including

- telephones
- two-way radios
- computers
- smartphones
- tablets
- fax machines

ETT.12C.C4.2 Explain various purposes and the operation of **communication devices**, such as their use for

- speaking
- sending messages
- sharing information

ETT.12C.C5 Demonstrate communication techniques using various communication devices.

ETT.12C.C5.1 Demonstrate good **communication skills** when using various communication devices to speak, send messages, or share information, including

- keeping the message concise
- articulating ideas precisely to avoid confusion
- remaining polite and professional

ETT.12C.C6 Recognize types of trade-related documents, explain their applications, and demonstrate their use.

ETT.12C.C6.1 Recognize various **documents** used in the trade, such as
- invoices
- shipping documents
- work orders
- cut lists
- order sheets

ETT.12C.C6.2 Explain various **documents** used in the trade, such as
- selection of the appropriate documents
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance

ETT.12C.C6.3 Demonstrate the procedures used to **prepare and/or complete** various trade-related documents, including
- preparing a business email
- defining technical terms in detail
- writing instructions to inform readers
- project planning

ETT.12C.C7 Explain the importance of communicating job requirements.

ETT.12C.C7.1 Explain the importance of **clearly defining** what a job entails so that each team member understands exactly what is expected of them.

ETT.12C.C8 Explain the importance of the client or customer.

ETT.12C.C8.1 Explain the various costs and benefits of **retaining** a client.

ETT.12C.C8.2 Explain the various costs and benefits of **gaining** new clients.

ETT.12C.C8.3 Explain the various costs and benefits and the value of **repeat** business.

ETT.12C.C8.4 Explain the various costs, benefits, and techniques for **recovering** "lost" clients.

ETT.12C.C9 Explain effective techniques for addressing clients' complaints.

ETT.12C.C9.1 Explain various effective techniques for addressing clients' **written complaints**.

ETT.12C.C9.2 Explain various effective techniques for addressing various **difficult situations** with clients, including
- angry clients
- impatient clients
- indecisive clients

ETT.12C.C10 Explain techniques for maintaining good communication in the workplace.

ETT.12C.C10.1 Explain various techniques for maintaining **good internal communication** in the workplace, including with

- support staff
- fellow staff (colleagues)
- supervisors
- management

ETT.12C.C10.2 Explain various techniques for **maintaining good external communication** in the workplace, including with

- tradespeople
- retail clients
- wholesale clients
- suppliers
- authorities (e.g., inspectors, general contractors)

ETT.12C.C11 Demonstrate trade-related computer skills, as specified by the instructor.

ETT.12C.C11.1 Demonstrate various trade-related computer skills, using **office application** programs such as

- word processor (e.g., Microsoft Word)
- spreadsheet (e.g., Microsoft Excel)
- presentation software (e.g., Microsoft PowerPoint)
- learning management systems (LMS) in a computer environment

ETT.12C.C11.2 Demonstrate various trade-related computer skills, using Internet **searching skills** such as

- search engines via universal resource locator (URL) addresses
- key word searches
- filtering results

ETT.12C.C11.3 Demonstrate various trade-related computer skills, using **email for work-related communications** such as

- public email services
- email addresses
- sending and replying to email
- adding attachments to email (text, documents, graphs)
- email website links

ETT.12C.C12 Discuss emerging trends in trade-related communications.

ETT.12C.C12.1 Discuss various current and **emerging trends** in trade-related communications.

Strand D: Trade-Related Mathematics and Science (A4)

ETT.12C.D1 Use mathematical properties to solve problems involving whole, fractional, decimal, and percentage numbers, with an emphasis on trade-related problems.

ETT.12C.D1.1 Demonstrate how to solve math problems with both **positive and negative numbers**, indicating how the signs (+ or –) affect the answer, when

- adding
- subtracting
- multiplying
- dividing

ETT.12C.D1.2 Recognize various **types of fractions**, including

- proper fractions
- improper fractions
- mixed fractions

ETT.12C.D1.3 Explain various **types of fractions**, including the following:

- a proper fraction has a smaller number on top (like ¾)
- an improper fraction has a bigger number on top (like ⅝)
- a mixed fraction combines a whole number and a fraction (like 1⅔)

ETT.12C.D1.4 Demonstrate how to add and subtract **fractions**.

ETT.12C.D1.5 Demonstrate how to multiply, divide, simplify (reduce), and expand **fractions.**

ETT.12C.D1.6 Demonstrate how to change a fraction into a **decimal** and a decimal into a fraction.

ETT.12C.D1.7 Demonstrate how to calculate **percentages** in trade situations, such as

- when material costs increase by 10%
- when applying a 15% discount

ETT.12C.D1.8 Demonstrate how to apply the **order of operations** (BEDMAS) to solve trade-related math problems like calculating material quantities or cutting dimensions.

ETT.12C.D1.9 Demonstrate how to **solve roots and exponents** calculations in trade situations, such as

- figuring out the area (e.g., $4^2=16$)

ETT.12C.D2 Demonstrate how to communicate measurement.

ETT.12C.D2.1 Demonstrate how to **measure**.

ETT.12C.D2.2 Demonstrate how to **measure** using both **metric and imperial** measurement systems, such as when

- measuring length
- measuring materials

ETT.12C.D2.3 Demonstrate how to provide **measurements,** including how much the measurements can vary (e.g., length of wire).

ETT.12C.D2.4 Demonstrate how to **convert measurements** within and between the metric and imperial systems.

ETT.12C.D2.5 Demonstrate how **scientific and engineering** notation are used to express numbers, and explain how the formats can differ depending on the context or precision required.

ETT.12C.D3 Calculate the perimeter, area, and volume of simple and complex shapes, using both metric and imperial units of measurement.

ETT.12C.D3.1 Demonstrate how to use **proportions** to solve problems, including

- direct proportion (e.g., as one value increases, the other also increases)
  - If 2 litres of paint cover 10 m^2, then 4 litres cover 20 m^2.
- indirect (inverse) proportion (as one value increases, the other decreases)
  - If four workers take six hours to complete a task, then two workers would take 12 hours.

ETT.12C.D3.2 Demonstrate how to calculate various **circumferences and areas** of circles.

ETT.12C.D3.3 Demonstrate how to calculate various **volumes** of prisms and cylinders.

ETT.12C.D4 Solve problems using direct and indirect proportion.

ETT.12C.D4.1 Demonstrate how to calculate and apply **direct proportion** for scaling objects, ratios, and quantities.

ETT.12C.D4.2 Demonstrate how to calculate percentages and multiples to solve **trade-related problems**, such as

- adjusting quantities for scaling
- calculating material wastage
- applying discounts
- determining markups
- computing sales taxes

ETT.12C.D5 Solve algebraic problems involving one variable.

ETT.12C.D5.1 Demonstrate how to solve equations by applying key algebraic principles, including the addition and multiplication properties of **equality**.

ETT.12C.D5.2 Demonstrate how to solve equations by applying key algebraic principles, including additive and multiplicative **inverses**.

ETT.12C.D5.3 Demonstrate how to solve equations by applying key algebraic principles like **order of operations** to rearrange equations and solve for unknown variables step by step.

ETT.12C.D5.4 Demonstrate how to solve and use basic **algebraic equations** to represent trade-related problems, making them easier to organize, simplify, and solve.

ETT.12C.D6 Solve problems related to simple machines, force, and pressure related to electrical trade applications.

ETT.12C.D6.1 Demonstrate how to calculate **mechanical advantage** for simple machines, including

- effort
- load
- effort distance
- load distance

ETT.12C.D6.2 Demonstrate how to calculate how each component affects a machine's **efficiency**, including

- levers
- pulleys
- inclined planes

ETT.12C.D6.3 Demonstrate how to **calculate force, distance, and friction** using the appropriate physics formulas.

ETT.12C.D7 Demonstrate how to use Boyle's law, Charles's law, and ideal gas law equations to calculate the physical properties of ideal gases.

ETT.12C.D7.1 Demonstrate how to apply **Boyle's law** to solve for different physical properties of an ideal gas, including

- temperature
- volume
- pressure
- density

ETT.12C.D7.2 Demonstrate how to apply **Charles's law** to solve for different physical properties of an ideal gas, including
- temperature
- volume
- pressure
- density

ETT.12C.D7.3 Demonstrate how to apply the **ideal gas law** to solve for different physical properties of an ideal gas, including
- temperature
- volume
- pressure
- density

ETT.12C.D8 Discuss emerging trends in trade math.

ETT.12C.D8.1 Discuss various current and **emerging trends** in trade math.

Strand E: Tools and Equipment

ETT.12C.E1 Recognize, explain, and demonstrate an understanding of terminology associated with tools and equipment.

ETT.12C.E1.1 Recognize **key terms** and names of various tools and equipment.

ETT.12C.E1.2 Explain the **names and purposes** of various tools and equipment.

ETT.12C.E1.3 Demonstrate an understanding of the **names** and **purposes** of various tools and equipment.

ETT.12C.E2 Recognize the various hazards associated with tools and equipment, and explain and demonstrate the related safe work practices.

ETT.12C.E2.1 Recognize various **hazards** of tools and equipment, including
- harmful noise levels
- lacerations caused by sharp tools or materials
- crush injury hazards
- moving parts on machines that can catch and trap hands, hair, or garments
- flying debris hazards

ETT.12C.E2.2 Explain **safe work practices** for various tools and equipment, including
- wearing appropriate personal protective equipment (PPE)

- inspecting tools and equipment before use
- using the correct tool for the job
- keeping the work area clean and organized
- following manufacturer instructions and safety guidelines
- disconnecting power tools when not in use or during maintenance
- reporting and removing damaged tools from service
- staying alert and avoiding distractions while working
- using guards and safety devices as intended
- storing tools properly after use

ETT.12C.E2.3 Demonstrate **safe work practices** related to tools and equipment.

ETT.12C.E3 Recognize, explain, and demonstrate tools and equipment, including their selection, characteristics, applications, and limitations.

ETT.12C.E3.1 Recognize various **hand tools and metering equipment**.

ETT.12C.E3.2 Explain various **hand tools and metering equipment**, including
- selection of the appropriate hand tool and metering equipment
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.E3.3 Demonstrate how to safely and properly use various **hand tools and metering equipment**.

ETT.12C.E3.4 Recognize various tools used for **layout, measuring, and marking**.

ETT.12C.E3.5 Explain various tools used for **layout, measuring, and marking**, including
- selection of the appropriate layout, measuring, and marking tool
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.E3.6 Demonstrate how to safely and properly use various tools used for **layout, measuring, and marking**.

ETT.12C.E3.7 Recognize various **portable power tools**.

ETT.12C.E3.8 Explain various **portable power tools**, including
- selection of the appropriate portable power tool
- characteristics and key features

- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.E3.9 Demonstrate how to safely and properly use various **portable power tools**.

ETT.12C.E4 Discuss emerging trends in tools and equipment.

ETT.12C.E4.1 Discuss various current and **emerging trends** in tools and equipment.

Strand F: Materials and Consumables

ETT.12C.F1 Recognize, define, and demonstrate terminology associated with materials and consumables.

ETT.12C.F1.1 Recognize **key terms and names** of various materials and consumables.

ETT.12C.F1.2 Explain the **names and purposes** of various materials and consumables.

ETT.12C.F1.3 Demonstrate an understanding of the **names and purposes** of various materials and consumables.

ETT.12C.F2 Share and discuss Indigenous perspectives and environmental impact.

ETT.12C.F2.1 Share and discuss an **Indigenous perspective** on material selection, emphasizing sustainability, respect for natural resources, and cultural significance, such as

- principles of the honourable harvest
- four sacred elements (earth, wind, water, fire)
- inviting an Elder to teach sustainability

ETT.12C.F2.2 Share and discuss the **environmental impact** of selecting and disposing of various materials.

ETT.12C.F3 Recognize the various hazards associated with consumables and materials, and explain and demonstrate the related safe work practices.

ETT.12C.F3.1 Recognize various **hazards** of consumables and materials, such as

- harmful noise levels

- lacerations caused by sharp tools or materials
- crush injury hazards
- moving parts on machines that can catch and trap hands, hair, or garments
- flying debris hazards

ETT.12C.F3.2 Explain various **safe work practices** for consumables and materials, including
- wearing appropriate personal protective equipment (PPE)
- inspecting consumables and materials before use
- using the correct consumables and materials for the job
- keeping the work area clean and organized
- following manufacturers' instructions and safety guidelines
- reporting and removing damaged consumables and materials from service
- staying alert and avoiding distractions while working
- storing consumables and materials properly after use
- properly disposing of materials and consumables

ETT.12C.F3.3 Demonstrate **safe work practices** related to consumables and materials.

ETT.12C.F4 Recognize and explain organizing materials and their characteristics, applications, and procedures.

ETT.12C.F4.1 Recognize various **materials and consumables**.

ETT.12C.F4.2 Explain various types of **materials and consumables**, including
- selection of the appropriate type of materials or consumables
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage
- properly disposing of materials and consumables

ETT.12C.F4.3 Recognize various ways to **collect materials** required, such as
- list
- job specifications

ETT.12C.F4.4 Explain various ways to **collect materials**, including
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)

ETT.12C.F4.5 Demonstrate how to safely and properly **use** various types of materials and

consumables.

ETT.12C.F5 Discuss emerging trends in materials and consumables.

ETT.12C.F5.1 Discuss various current and **emerging trends** in materials and consumables.

Strand G: Residential Electrical Code (A5) — Canadian Electrical Code (and Commercial)

ETT.12C.G1 Recognize, explain, and demonstrate an understanding of the primary objectives and scope of the Canadian Electrical Code (CEC).

ETT.12C.G1.1 Recognize **key terms and names** of the Canadian Electrical Code (CEC).

ETT.12C.G1.2 Explain the **objectives and scope** of the Canadian Electrical Code (CEC).

ETT.12C.G1.3 Demonstrate an understanding of the **objectives and scope** of the Canadian Electrical Code (CEC).

ETT.12C.G2 Recognize, explain, and demonstrate terminology associated with navigating the Canadian Electrical Code (CEC).

ETT.12C.G2.1 Recognize **key terms, sections, sub-sections, and rule numbers** of various electrical codes.

ETT.12C.G2.2 Explain the **names and purposes** of various electrical codes.

ETT.12C.G2.3 Demonstrate an understanding of the **names and purposes** of various electrical codes.

ETT.12C.G3 Recognize, explain, and demonstrate commercial system voltages and circuitry.

ETT.12C.G3.1 Recognize the differences of **3-phase** compared to single-phase circuits in commercial systems.

ETT.12C.G3.2 Explain the differences of **3-phase** compared to single-phase circuits in commercial systems.

ETT.12C.G3.3 Recognize potential **circuit problems** in commercial systems.

ETT.12C.G3.4 Explain potential **circuit problems** in commercial systems.

ETT.12C.G3.5 Demonstrate knowledge of potential **circuit problems** in commercial systems.

ETT.12C.G3.6 Recognize **temporary wiring** requirements in commercial systems.

ETT.12C.G3.7 Explain **temporary wiring** requirements in commercial systems.

ETT.12C.G3.8 Demonstrate **temporary wiring** requirements in commercial systems.

ETT.12C.G3.9 Identify **extra-low-voltage and low-voltage** systems in commercial systems.

ETT.12C.G3.10 Explain **extra-low-voltage and low-voltage** systems in commercial systems.

ETT.12C.G3.11 Demonstrate **extra-low-voltage and low-voltage** systems in commercial systems.

ETT.12C.G4 Recognize, explain, and demonstrate commercial wiring methods and practices.

ETT.12C.G4.1 Recognize the **Canadian Electrical Code (CEC)** requirements in commercial systems.

ETT.12C.G4.2 Explain the **Canadian Electrical Code (CEC)** requirements in commercial systems.

ETT.12C.G4.3 Demonstrate the **Canadian Electrical Code (CEC)** requirements in commercial systems.

ETT.12C.G4.4 Recognize various **conductors** used in commercial systems, including

- ampacities
- derations
- conditions of use
- metallurgy (compatibility of materials)

ETT.12C.G4.5 Explain various **conductors** used in commercial systems, including

- selection of the appropriate conductor
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.G4.6 Demonstrate how to safely and properly use various **conductors** in commercial systems.

ETT.12C.G4.7 Recognize various **cables** used in commercial systems, including

- ampacities
- derations
- conditions of use

- metallurgy (compatibility of materials)

ETT.12C.G4.8 Explain various **cables** used in commercial systems, including
- selection of the appropriate cable
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.G4.9 Demonstrate how to safely and properly use various **cables** in commercial systems.

ETT.12C.G4.10 Recognize various **raceways** used in commercial systems, including
- conditions of use
- installation techniques
- derations
- metallurgy (compatibility of materials)

ETT.12C.G4.11 Explain various **raceways** used in commercial systems, including
- selection of the appropriate raceway
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.G4.12 Demonstrate how to safely and properly use various **raceways** in commercial systems.

ETT.12C.G4.13 Recognize various **bonds or bonding** used in commercial systems.

ETT.12C.G4.14 Explain various **bonds or bonding** used in commercial systems, including
- selection of the appropriate bond
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance

ETT.12C.G4.15 Demonstrate how to safely and properly use various **bonds or bonding** in commercial systems.

ETT.12C.G4.16 Recognize various **grounds or grounding** used in commercial systems.

ETT.12C.G4.17 Explain various **grounds or grounding** used in commercial systems, including

- selection of the appropriate ground
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance

ETT.12C.G4.18 Demonstrate how to safely and properly use various **grounds or grounding** in commercial systems.

ETT.12C.G4.19 Recognize various **voltage drop calculations** used in commercial systems.

ETT.12C.G4.20 Explain various **voltage drop calculations** used in commercial systems, including

- selection of the appropriate **voltage drop calculation**
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance

ETT.12C.G4.21 Demonstrate various **voltage drop calculations** used in commercial systems.

ETT.12C.G4.22 Recognize various **raceway fill calculations** used in commercial systems.

ETT.12C.G4.23 Explain **raceway fill calculations** used in commercial systems, including

- selection of the appropriate **raceway fill calculation**
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance

ETT.12C.G4.24 Demonstrate various **raceway fill calculations** used in commercial systems.

ETT.12C.G5 Recognize and explain commercial wiring devices and applications.

ETT.12C.G5.1 Recognize the Canadian Electrical Code (CEC) requirements for **wiring devices and applications** used in commercial systems.

ETT.12C.G5.2 Explain the Canadian Electrical Code (CEC) requirements for **wiring devices and applications** used in commercial systems.

ETT.12C.G5.3 Demonstrate the Canadian Electrical Code (CEC) requirements for **wiring**

devices and applications used in commercial systems.

ETT.12C.G5.4 Recognize various **outlet boxes** used in commercial wiring systems.

ETT.12C.G5.5 Explain various **outlet boxes** used in commercial wiring systems, including
- selection of the appropriate outlet box
- calculate box fill
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.G5.6 Demonstrate how to safely and properly use various **outlet boxes** in commercial wiring systems.

ETT.12C.G5.7 Recognize various **receptacles** used in commercial wiring systems.

ETT.12C.G5.8 Explain various **receptacles** used in commercial wiring systems, including
- selection of the appropriate receptacle
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.G5.9 Demonstrate how to safely and properly use various **receptacles** in commercial wiring systems.

ETT.12C.G5.10 Recognize various **switches** used in commercial wiring systems.

ETT.12C.G5.11 Explain various **switches** used in commercial wiring systems, including
- selection of the appropriate switches
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.G5.12 Demonstrate how to safely and properly use various **switches** in commercial wiring systems.

ETT.12C.G5.13 Recognize various **luminaires** used in commercial wiring systems.

ETT.12C.G5.14 Explain various **luminaires** used in commercial wiring systems, including
- selection of the appropriate luminaires

- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.G5.15 Demonstrate how to safely and properly use various **luminaires** in commercial wiring systems.

ETT.12C.G5.16 Recognize various **specialty outlets** used in commercial wiring systems.

ETT.12C.G5.17 Explain various **specialty outlets** used in commercial wiring systems, including

- selection of the appropriate specialty outlets
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.G5.18 Demonstrate how to safely and properly use various **specialty outlets** in commercial wiring systems.

ETT.12C.G5.19 Recognize various **smoke alarms** used in commercial wiring systems.

ETT.12C.G6 Explain Canadian Electrical Code (CEC) requirements for device layout and placement in commercial wiring systems.

ETT.12C.G6.1 Explain Canadian Electrical Code (CEC) requirements for **device layout and placement** in commercial wiring systems.

ETT.12C.G6.2 Demonstrate an understanding of Canadian Electrical Code (CEC) requirements for **device layout and placement** in commercial wiring systems.

ETT.12C.G7 Recognize and explain Canadian Electrical Code (CEC) requirements for overcurrent protection in commercial wiring systems.

ETT.12C.G7.1 Recognize Canadian Electrical Code (CEC) requirements for **overcurrent protection** in commercial wiring systems.

ETT.12C.G7.2 Explain Canadian Electrical Code (CEC) requirements for **overcurrent protection** in commercial wiring systems.

ETT.12C.G7.3 Demonstrate an understanding of Canadian Electrical Code (CEC) requirements for **overcurrent protection** in commercial wiring systems.

ETT.12C.G7.4 Recognize the various types of **overcurrent protection** in commercial wiring systems.

ETT.12C.G7.5 Explain various types of **overcurrent protection** used in commercial wiring systems, including

- selection of the appropriate overcurrent protection
- characteristics and key features
- application (i.e., their role or utility in specific scenarios)
- limitations in scope or performance
- procedures for conducting a thorough inspection
- procedures for regular maintenance
- guidelines for proper storage

ETT.12C.G7.6 Demonstrate how to safely and properly use various **overcurrent protection** in commercial wiring systems.

ETT.12C.G8 Describe commercial loads and related Canadian Electrical Code (CEC) branch circuit calculations.

ETT.12C.G8.1 Identify Canadian Electrical Code (CEC) requirements to calculate a branch circuit of a **special purpose outlet** in commercial wiring systems.

ETT.12C.G8.2 Explain Canadian Electrical Code (CEC) requirements to calculate a branch circuit of a **special purpose outlet** in commercial wiring systems.

ETT.12C.G8.3 Demonstrate Canadian Electrical Code (CEC) requirements to calculate a branch circuit of a **special purpose outlet** in commercial wiring systems.

ETT.12C.G9 Discuss emerging trends in electrical codes.

ETT.12C.G9.1 Discuss various current and **emerging trends** in electrical codes.

Curriculum Implementation Resources

Curriculum implementation resources are frequently added. You are encouraged to visit the website regularly.