# Construction Electrician

# Guide to Course Content

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*Recognition:*
*To promote transparency and consistency, portions of this document have been adapted from the 2021 Construction Electrician Red Seal Occupational Standard (Employment and Social Development Canada).*

*A complete version of the Occupational Standard can be found* at www.red-seal.ca

# STRUCTURE OF THE GUIDE TO COURSE CONTENT

To facilitate understanding of the occupation, this guide to course content contains the following sections:

**Task Matrix**: a chart which outlines graphically the major work activities, tasks and sub-tasks of this standard detailing the essential skills and the level of training where the content is covered. The Task Matrix is broken down into the following:

**Major Work Activity (MWA):** the largest division within the standard that is comprised of a distinct set of trade activities.

**Task**: distinct actions that describe the activities within a major work activity.

**Sub-task**: distinct actions that describe the activities within a task.

**Training Profile Chart**: a chart which outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training.

**Technical Training Course Content for the Construction Electrician trade**: a chart which outlines the model for SATCC technical training sequencing.

# TRAINING REQUIREMENTS FOR THE CONSTRUCTION ELECTRICIAN TRADE

To graduate from each level of the apprenticeship program, an apprentice must successfully complete the required technical training and compile enough on-the-job experience to total at least 1800 hours each year. Total trade time required is 7200 hours and at least 4 years in the trade.

There are four levels of technical training delivered by Saskatchewan Polytechnic in Moose Jaw, Regina, and Saskatoon.

| | |
|---|---|
| Level One: | 8 weeks |
| Level Two: | 8 weeks |
| Level Three: | 8 weeks |
| Level Four: | 8 weeks |

***Any person who is not a journeyperson construction electrician must become registered as an apprentice to work in this trade.**

The information contained in this document details the technical training delivered for each level of apprenticeship. An apprentice spends approximately 15% of their apprenticeship term in a technical training institute learning the technical and theoretical aspects of the trade. The hours and percentages of technical and practical training may vary according to class needs and progress.

The content of the technical training components is subject to change without notice.

**Entrance Requirements for Apprenticeship Training**

Your grade twelve transcripts (with no modified classes) or GED 12 is your guarantee that you meet the educational entrance requirements for apprenticeship in Saskatchewan. In fact, employers prefer and recommend apprentices who have completed high school. This ensures the individual has all of the necessary skills required to successfully complete the apprenticeship program and receive journeyperson certification.

Individuals with “modified” or “general” classes in math or science do not meet our entry requirements. These individuals are required to take an entrance assessment prescribed by the SATCC.

English is the language of instruction in all apprenticeship programs and is the common language for business in Saskatchewan. Before admission, all apprentices and/or “upgraders” must be able to understand and communicate in the English language. Applicants whose first language is not English must have a minimum Canadian Language Benchmark Assessment of six (CLB6).

Note: A CLB assessment is valid for a one-year period from date of issue.

| Designated Trade Name | **Math Credit** at the Indicated Grade Level❶ | **Science Credit** at Grade Level |
|---|---|---|
| Construction Electrician | Grade 11 | Grade 10 |

❶ - (One of the following) WA – Workplace and Apprenticeship; or F – Foundations; or P – Pre-calculus, or a Math at the indicated grade level (Modified and General Math credits are not acceptable.).

*Applicants who have graduated in advance of 2015-2016, or who do not have access to the revised Science curricula will require a Science at the minimum grade level indicated by trade.

For information about high school curriculum, including Math and Science course names, please see: http://www.curriculum.gov.sk.ca/

**Individuals not meeting the entrance requirements will be subject to an assessment and any required training**

# CONSTRUCTION ELECTRICIAN TASK MATRIX CHART

This chart outlines the major work activities, tasks and sub-tasks from the 2021 Construction Electrician Red Seal Occupational Standard. Each sub-task details the corresponding essential skill and level of training where the content is covered.*

*Sub-tasks with numbers in the boxes is where the content will be delivered in training. Harmonization for the Construction Electrician trade has been fully implemented for each technical training level.

## A - Performs Common Occupational Skills — 11%

| | | | | | |
|---|---|---|---|---|---|
| **A-1 Performs safety-related functions** | **1.01 Uses personal protective equipment (PPE) and safety equipment**<br>1 | **1.02 Maintains safe work environment**<br>1 | **1.03 Performs lock-out and tag-out procedures**<br>1 | | |
| **A-2 Uses tools and equipment** | **2.01 Uses common and specialty tools and equipment**<br>1 | **2.02 Uses access equipment**<br>1 | **2.03 Uses rigging, hoisting and lifting equipment**<br>1 | | |
| **A-3 Organizes work** | **3.01 Interprets plans, drawings and specifications**<br>(In Context 1, 2, 3, 4) | **3.02 Organizes materials and supplies**<br>(In Context 1, 2, 3, 4) | **3.03 Plans project tasks and procedures**<br>(In Context 1, 2, 3, 4) | **3.04 Prepares worksite**<br>(In Context 1, 2, 3, 4) | **3.05 Finalizes required documentation**<br>(In Context 1, 2, 3, 4) |
| **A-4 Fabricates and installs support components** | **4.01 Fabricates support structures**<br>1 (In Context 2, 3, 4) | **4.02 Installs brackets, hangers and fasteners**<br>1 (In Context 2, 3, 4) | **4.03 Installs seismic restraint systems**<br>1 (In Context 2, 3, 4) | | |

| | | |
|---|---|---|
| A-5 Commissions and decommissions electrical systems | 5.01. Performs startup and shutdown procedures<br>(In Context 1, 2, 3, 4) | 5.02 Performs commissioning and decommissioning of systems<br>(In Context 1, 2, 3, 4) |
| A-6 Uses communication and mentoring techniques | 6.01 Uses communication techniques<br>1 | 6.02 Uses mentoring techniques<br>4 |

## B – Installs, Services and Maintains Generating, Distribution and Service Systems

**28%**

| | | | | |
|---|---|---|---|---|
| B-7 Installs, services and maintains consumer/supply services and metering equipment | 7.01 Installs single-phase consumer/supply services and metering equipment<br>1 | 7.02 Installs three-phase consumer/supply services and metering equipment<br>4 | 7.03 Performs servicing and maintenance of single-phase services and metering equipment<br>1 | 7.04 Performs servicing and maintenance of three-phase services and metering equipment<br>4 |
| B-8 Installs, services and maintains protection devices | 8.01 Installs overcurrent protection devices<br>(In Context 1, 2, 3, 4) | 8.02 Installs ground fault, arc fault and surge protection devices<br>(In Context 1, 2, 3, 4) | 8.03 Performs servicing and maintenance of protection devices<br>(In Context 1, 2, 3, 4) | |
| B-9 Installs, services and maintains power distribution equipment | 9.01 Installs power distribution equipment<br>1, 4 | 9.02 Performs servicing and maintenance of power distribution equipment<br>1, 4 | | |

| | | | | | |
|---|---|---|---|---|---|
| **B-10 Installs, services and maintains power conditioning, uninterruptible power supply (UPS) and surge suppression systems** | **10.01 Installs power conditioning, UPS and surge suppression systems**<br>**4** | **10.02 Performs servicing and maintenance of power conditioning, UPS and surge suppression systems**<br>**4** | | | |
| **B-11 Installs, services and maintains bonding and grounding and ground fault protection and detection systems** | **11.01 Installs grounding and bonding systems**<br>**1, 2, 3, 4** | **11.02 Installs ground fault and protection and detection systems**<br>**1, 2, 3, 4** | **11.03 Installs lightning protection systems**<br>**1, 2, 3, 4** | **11.04 Performs servicing and maintenance of bonding and grounding systems**<br>**1, 4** | |
| **B-12 Installs, services and maintains power generation and conversion systems** | **12.01 Installs AC (alternating current) generating systems**<br>**3** | **12.02 Performs servicing and maintenance of AC generating systems**<br>**3** | **B-12.03 Installs DC (direct current) generating and conversion systems**<br>**2** | **12.04 Performs servicing and maintenance of DC generating and conversion systems**<br>**2** | |
| **B-13 Installs, services and maintains renewable energy generating and storage systems** | **13.01 Installs renewable energy generating and storage systems**<br>**4** | **13.02 Performs servicing and maintenance of renewable energy generating and storage systems**<br>**4** | | | |
| **B-14 Installs, services and maintains high voltage systems** | **14.01 Installs high voltage equipment**<br>**4** | **14.02 Installs high voltage cables**<br>**4** | **14.03 Performs servicing and maintenance of high voltage systems**<br>**4** | | |
| **B-15 Installs, services and maintains transformers** | **15.01 Installs extra-low voltage transformers**<br>**2** | **15.02 Installs low-voltage single-phase transformers**<br>**2** | **15.03 Installs low-voltage three-phase transformers**<br>**3** | **15.04 Installs high voltage transformers**<br>**3** | **15.05 Performs servicing and maintenance of transformers**<br>**3** |

## C – Installs, Services and Maintains Wiring Systems — 31%

| | | | | | |
|---|---|---|---|---|---|
| C-16 Installs, services and maintains raceways, conductors, cables and enclosures | 16.01 Installs conductors and cables<br>1, 2 (In Context 3, 4) | 16.02 Installs conduit and fittings<br>1, 2 (In Context 3, 4) | 16.03 Installs raceways<br>1, 2 (In Context 3, 4) | 16.04 Installs boxes and enclosures<br>1, 2 (In Context 3, 4) | 16.05 Performs servicing and maintenance of raceways, conductors, cables and enclosures<br>1, 2 (In Context 3, 4) |
| C-17 Installs, services and maintains branch circuitry and devices | C-17.01 Installs luminaires<br>1, 2, 3 | 17.02 Installs wiring devices<br>1, 2, 3 | 17.03 Installs lighting controls<br>1, 2, 3 | 17.04 Installs lighting standards<br>1, 2, 3 | 17.05 Performs servicing of branch circuitry<br>1, 2, 3 |
| | 17.06 Installs, services and maintains airport visual aid systems<br>4 | 17.07 Installs, services and maintains traffic signal lights and controls<br>4 | | | |
| C-18 Installs, services and maintains heating, ventilating and air-conditioning (HVAC) systems | 18.01 Connects HVAC systems and associated equipment<br>2 | 18.02 Installs HVAC controls<br>2 | 18.03 Performs servicing and maintenance of HVAC systems and controls<br>2 | | |
| C-19 Installs, services and maintains electric heating systems | 19.01 Installs electric heating systems<br>2 | 19.02 Installs electric heating system controls<br>2 | 19.03 Performs servicing and maintenance of electric heating systems and controls<br>2 | | |

| | | |
|---|---|---|
| C-20 Installs, services and maintains exit and emergency lighting systems | 20.01 Installs exit and emergency lighting<br>2 | 20.02 Performs servicing and maintenance of exit and emergency lighting systems<br>2 |
| C-21 Installs, services and maintains cathodic protection systems | 21.01 Installs cathodic protection systems<br>2 | 21.02 Performs servicing and maintenance of cathodic protection systems<br>2 |

## D – Installs, Services and Maintains Motors and Control Systems 20%

| | | | | | |
|---|---|---|---|---|---|
| D-22 Installs, services and maintains motor starters and controls | 22.01 Installs motor starters<br>2, 3 | 22.02 Performs servicing and maintenance of motor starters<br>2, 3 | D-22.03 Installs motor control devices<br>2, 3 | 22.04 Performs servicing and maintenance of motor controls<br>2, 3 | |
| D-23 Installs, services and maintains drives | 23.01 Installs AC drives<br>3 | 23.02 Performs servicing and maintenance of AC drives<br>3 | 23.03 Installs DC drives<br>3 | 23.04 Performs servicing and maintenance of DC drives<br>3 | |
| D-24 Installs, services and maintains motors | 24.01 Installs single-phase motors<br>3, 4 | 24.02 Performs servicing and maintenance of single-phase motors<br>3, 4 | 24.03 Installs three-phase motors<br>3, 4 | 24.04 Performs servicing and maintenance of three-phase motors<br>3, 4 | 24.05 Installs DC motors<br>2, 3, 4 |

| | | | | |
|---|---|---|---|---|
| | 24.06 Performs servicing and maintenance of DC motors<br>2, 3, 4 | | | |
| D-25 Installs, programs, services and maintains automated control systems | 25.01 Installs automated control systems<br>4 | 25.02 Performs servicing and maintenance of automated control systems<br>4 | 25.03 Programs and configures automated control systems<br>4 | |

## E – Installs, Services and Maintains Signalling and Communication Systems

**10%**

| | | | | |
|---|---|---|---|---|
| E-26 Installs, services and maintains signaling systems | 26.01 Installs fire alarm systems<br>4 | 26.02 Performs servicing and maintenance of fire alarm systems<br>4 | 26.03 Installs security and surveillance systems<br>1, 4 | 26.04 Performs servicing and maintenance of security and surveillance systems<br>1, 4 |
| E-27 Installs, services and maintains communication systems | 27.01 Installs voice/data/video (VDV) and community antenna television (CATV) systems<br>1, 4 | 27.02 Installs public address (PA) and intercom systems<br>1, 4 | 27.03 Installs nurse call systems<br>1, 4 | 27.04 Performs servicing and maintenance of communication systems<br>1, 4 |
| E-28 Installs, services and maintains integrated control systems | 28.01 Installs building automation systems<br>4 | 28.02 Installs building control systems<br>4 | 28.03 Performs servicing and maintenance of integrated control systems<br>4 | |

# TRAINING PROFILE CHART

This Training Profile Chart represents Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training at the topic level.

| Level One | Transcript Code | Hours |
|---|---|---|
| Safety and Personal Protective Equipment | SFTY 131 | 20 |
| Introductory Electrical Theory and Practices | BT 131 | 48 |
| Extra-Low Voltage, Magnetism and Meters | BWC 131 | 36 |
| Wiring Methods | WM 130 | 34 |
| Single Dwelling Plans, Lighting and Services | PLS 130 | 36 |
| Solving DC Circuits | BT 130 | 36 |
| Conductors and Branch Circuits | BWC 130 | 30 |
| | | 240 |

| Level Two | Transcript Code | Hours |
|---|---|---|
| DC Machines | EMC 225 | 30 |
| Motor Starters and Controls | EMC 227 | 18 |
| Electronic Instruments, Rectification, and Filtering | IE 222 | 36 |
| Services Under 900 Square Meters | PLS 222 | 42 |
| Transformers | TRNS 220 | 36 |
| Residential Electric Heat | HC 220 | 6 |
| Heating and Cooling Systems | HC 221 | 30 |
| AC Theory and Meters | BT 220 | 24 |
| Resistive, Inductive, and Capacitive Circuits | BT 224 | 18 |
| | | 240 |

| Level Three | Transcript Code | Hours |
|---|---|---|
| Motor Starters and Controls | EMC 325 | 42 |
| Three-Phase Rectification and DC Power Supplies | IE 322 | 36 |
| Sensors and Phase Control and Data Cabling | IE 323 | 36 |
| Services for Occupancies Over 900 Square Metres | PLS 323 | 36 |
| AC Motors | EMC 326 | 24 |
| Three-Phase Theory/Alternators | BT 300 | 33 |
| Three-Phase Transformers | TRNS 322 | 33 |
| | | 240 |

| Level Four | Transcript Code | Hours |
|---|---|---|
| Hazardous Locations | WM 420 | 18 |
| Power Factor Correction | BT 426 | 24 |
| Three-Phase Four-Wire Services and Code | PLS 424 | 42 |
| Thyristors | IE 425 | 24 |
| Programmable Logic Controllers | IE 427 | 36 |
| Primary Metering and High Voltage | HVM 424 | 30 |
| Building Systems | BLDG 400 | 36 |
| Fire Alarm Systems | FA 420 | 30 |
| | | 240 |

# TECHNICAL TRAINING COURSE CONTENT

This chart outlines the model for Saskatchewan Apprenticeship and Trade Certification Commission (SATCC) technical training sequencing. For the harmonized levels of training, a cross reference to the Red Seal Occupational Standard (RSOS) apprenticeship technical training sequencing, at the learning outcome level, is provided.

Sub-tasks listed are the minimum to be covered in a topic. Related sub-tasks not listed may be used as a reference and taught “in context” in other topics.

## Level One — 8 weeks — 240 hours

### Safety and Personal Protective Equipment — 20 hours

- describe *The Saskatchewan Employment Act* and *The Occupational Health and Safety Regulations* requirements in the electrical trade
- describe personal protective equipment
- describe arc flash
- describe rigging equipment
- describe applicable health and safety regulation and legislation in rigging applications
- describe safe hoisting operations
- describe safe hoisting or pulling operations without a crane

**RSOS topics covered in this section of training:**

**A-1 Performs safety-related functions**
A-1.01 Uses personal protective equipment (PPE) and safety equipment
A-1.02 Maintains safe work environment
A-1.03 Performs lock-out and tag-out procedures

**A-2 Tools and Equipment**
A-2.01 Uses common and specialty tools and equipment
A-2.02 Uses access equipment

### Introductory Electrical Theory and Practices — 48 hours

- describe the electrician trade in Saskatchewan
- describe the application of the Canadian Electrical Code
- describe basic principles of electricity
- describe basic electrical circuit concepts
- describe common electrical devices
- select common fasteners
- terminate conductors
- connect basic electrical circuits

**RSOS topics covered in this section of training:**

**A-4 Fabricates and installs support components**
A-4.02 Installs brackets, hangers and fasteners
A-4.03 Installs seismic restraint systems

**A-6 Uses communication and mentoring techniques**
A-6.01 Uses communication techniques

## Extra-Low Voltage, Magnetism, and Meters — 36 hours

- describe the principles of electromagnetism
- describe the operating principles of meters
- use meters for voltage measurement
- use meters for current measurement
- use meters for resistance measurement
- use meters for power and energy measurement
- install basic signal systems
- install remote control relay systems

**RSOS topics covered in this section of training:**

**E-26 Installs, services, and maintains signaling systems**
E-26.01 Installs fire alarm systems
E-26.02 Performs servicing and maintenance of fire alarm systems
E-26.03 Installs security and surveillance systems
E-26.04 Performs servicing and maintenance of security and surveillance systems

**E-27 Installs, services and maintains communication systems**
E-27.01 Installs voice/data/video (VDV) and community antenna television (CATV) systems
E-27.02 Installs public address (PA) and intercom systems
E-27.03 Installs nurse call systems
E-27.04 Performs servicing and maintenance of communication systems

## Wiring Methods — 34 hours

- install non-metallic sheathed cable
- install armoured cable
- describe aluminum sheathed cable
- describe mineral insulated cable
- describe raceways
- describe rigid and flexible conduit
- describe electrical metallic tubing
- describe rigid PVC conduit
- describe surface raceways
- describe installation requirements for data cabling
- terminate data cabling

**RSOS topics covered in this section of training:**

**C-16 Installs, services and maintains raceways, cables and enclosures**
C-16.01 Installs conductors and cables
C-16.02 Installs conduit and fittings
C-16.03 Installs raceways
C-16.04 Installs boxes and enclosures
C-16.05 Performs servicing and maintenance of raceways, conductors, cables and enclosures

## Single Dwelling Plans, Lighting, and Services — 36 hours

- describe common construction drawings
- describe electrical drawings, symbols and schedules
- determine lighting requirements
- determine single dwelling service requirements
- install single dwelling services

**RSOS topics covered in this section of training:**

**A-3 Organizes Work**
A-3.01 Interprets plans, drawings and specifications

**B-7 Installs, services and maintains consumer/supply services and metering equipment**
B-7.01 Installs single-phase consumer/supply services and metering equipment
B-7.03 Performs servicing and maintenance of single-phase services and metering equipment

**B-9 Installs, services and maintains distribution equipment**
B-9.01 Installs power distribution equipment
B-9.02 Performs servicing and maintenance of power distribution equipment

## Conductors and Branch Circuits — 30 hours

- describe common conductors
- calculate conductor resistance and ampacity
- select overcurrent devices
- select bonding conductors
- determine branch circuit requirements

**This section of training exceeds the minimum sequencing as set out by the Construction Electrician RSOS.**

## Solving DC Circuits — 36 hours

- analyze series circuits
- analyze parallel circuits
- analyze combination circuits
- analyze three-wire circuits
- connect cells and batteries

**RSOS topics covered in this section of training:**

**B-11 Installs, services, and maintains bonding and grounding protection systems**
B-11.01 Installs grounding and bonding systems
B-11.02 Installs ground fault protection and detection systems
B-11.03 Installs lightning protection systems

**C-17 Installs, services and maintains branch circuitry and devices**
C-17.01 Installs luminaires
C-17.02 Installs wiring devices
C-17.03 Installs lighting controls
C-17.04 Installs lighting standards
C-17.05 Performs servicing of branch circuitry

**Level One topics from the RSOS that are taught in context:**

***A-3 Organizes Work***
***A-5 Commissions and Decommissions Systems***
***B-8 Installs, services and maintains protection devices***

***Canadian Electrical Code***

***For details regarding the In Context Topic, see page 27***

## Level Two — 8 weeks — 240 hours

### DC Machines — 30 hours

- describe typical DC machine construction
- describe common DC generator connections
- connect DC generators
- describe DC motor connections
- connect DC motors
- connect DC generators in parallel

**RSOS topics covered in this section of training:**

**B-12 Installs, services, and maintains power generation and conversion systems**
B-12.03 Installs direct current (DC) generating systems
B-12.04 Performs servicing and maintenance of DC generating and conversion systems

**D-24 Installs, services and maintains motors**
D-24.05 Installs DC motors
D-24.06 Performs servicing and maintenance of DC motors

### Motor Starters and Controls — 18 hours

- connect manual motor control circuits
- connect overload protection
- connect electromagnetic motor control circuits
- determine motor control (installation standards)

**RSOS topics covered in this section of training:**

**D-22 Installs, services, and maintains motor starters and controls**
D-22.01 Installs motor starters
D-22.02 Performs servicing and maintenance of motor starters
D-22.03 Installs motor control devices

### Electronic Instruments, Rectification and Filtering — 36 hours

- select resistors for electronic circuits
- use voltmeters in electronic circuits
- use AC wave forms and DC
- describe semi-conductor junction diodes
- connect single-phase 1/2 wave rectifier circuit
- connect single-phase bi-phase rectifier circuit
- connect single-phase bridge rectifier circuit
- describe resistive/capacitive (RC) time constants
- connect basic rectifier filter circuits

**This section of training exceeds the minimum sequencing as set out by the Construction Electrician RSOS.**

## Services Under 900 Square Meters — 42 hours

- determine single phase motors (branch circuit and feeder requirements)
- determine feeder requirements (motors and other loads combined)
- determine service entrance requirements (for institutional buildings up to and including 900 sq. meters, for common institutional and commercial buildings, and for row housing and apartment building complexes)
- renewable energy generating and storage systems
- cathodic protection
- exit and emergency lighting systems

**RSOS topics covered in this section of training:**

**B-11 Installs, services and maintains bonding and grounding protection systems**
B-11.01 Installs grounding and bonding systems
B-11.02 Installs ground fault protection and detection systems
B-11.03 Installs lightning protection systems

**B-13 Installs, services and maintains renewable energy systems**
B-13.01 Installs renewable energy generating and storage systems
B-13.01 Performs servicing and maintenance of renewable energy generating and storage systems

**C-16 Installs, services and maintains raceways, cables and enclosures**
C-16.01 Installs conductors and cables
C-16.02 Installs conduit and fittings
C-16.03 Installs raceways
C-16.04 Installs boxes and enclosures
C-16.05 Performs servicing and maintenance of raceways, conductors, cables, and enclosures

**C-17 Installs, services and maintains branch circuitry and devices**
C-17.01 Installs luminaires
C-17.02 Installs wiring devices
C-17.03 Installs lighting controls
C-17.04 Installs lighting standards
C-17.05 Performs servicing of branch circuitry

**C-20 Installs, services and maintains exit and emergency lighting systems**
C-20.01 Installs exit and emergency lighting
C-20.02 Performs servicing and maintenance of exit and emergency lighting systems

**C-21 Installs, services and maintains cathodic protection systems**
C-21.01 Installs cathodic protection systems
C-21.02 Performs servicing and maintenance of cathodic protection systems

## Transformers — 36 hours

- describe basic transformers
- describe single-phase transformer construction
- connect typical dual-secondary single-phase transformers
- calculate winding turns, voltages and currents using transformer ratio formulas
- describe basic instrument transformer circuits
- calculate transformer values
- identify unmarked transformer leads
- conduct transformer impedance tests
- connect transformers in parallel
- connect autotransformers

**RSOS topics covered in this section of training:**

**B-15 Installs, services and maintains transformers**
B-15.01 Installs extra-low voltage transformers
B-15.02 Installs low-voltage single-phase transformers

## Residential Electric Heat — 6 hours

- determine residential electric heating requirements
- describe installation requirements for residential electric heating

**RSOS topics covered in this section of training:**

**C-19 Installs, services and maintains electric heating systems**
C-19.01 Installs electric heating systems
C-19.02 Installs electric heating system controls
C-19.03 Performs servicing and maintenance of HVAC systems and controls

## Heating and Cooling Systems — 30 hours

- install residential heating and cooling systems
- service residential heating and cooling systems
- install commercial and industrial burner controls
- service commercial and industrial burner controls

**RSOS topics covered in this section of training:**

**C-18 Installs, services, and maintains heating, ventilating and air- conditioning (HVAC) systems**
C-18.01 Connects HVAC systems and associated equipment
C-18.02 Installs HVAC controls
C-18.03 Performs servicing and maintenance of the HVAC systems and controls

## AC Theory and Meters — 24 hours

- use analog and digital meters to measure resistance, voltage, and current
- describe power meters
- describe the principles of electromagnetic induction
- describe the operation of an elementary AC generator
- calculate instantaneous, average, and RMS values for sine waves
- compare the effects of resistance, inductive reactance and capacitive reactance in an AC circuit
- draw sine wave and phasor diagrams for AC resistive, inductive, and capacitive circuits

**This section of training exceeds the minimum sequencing as set out by the Construction Electrician RSOS.**

## Resistive, Inductive and Capacitive Circuits — 18 hours

- sketch sine wave and phasors for parallel circuits
- solve AC parallel circuits
- calculate AC power units and power formulas
- solve AC series circuit problems

**This section of training exceeds the minimum sequencing as set out by the Construction Electrician RSOS.**

**Level Two topics from the RSOS that are taught in context:**

***A-3 Organizes work***
***A-4 Fabricates and installs support components***
***A-5 Commissions and decommissions systems***
***B-8 Installs, services and maintains protection devices***

***Canadian Electrical Code***

***For details regarding the In Context Topic, see page 27***

## Level Three — 8 weeks — 240 hours

### Motor Starters and Controls — 42 hours

- interpret schematic and wiring diagrams (for various motor control applications)
- install motor control devices (for three phase motors in manual and automatic applications)
- install advanced motor control devices (for three phase motors in manual and automatic applications)
- determine regulatory standards (motor control)

**RSOS topics covered in this section of training:**

**D-22 Installs, services and maintains motor starters and controls**
D-22.01 Installs motor starters
D-22.02 Performs servicing and maintenance of motor starters
D-22.03 Installs motor control devices
D-22.04 Performs servicing and maintenance of motor controls

### Three Phase Rectification and DC Power Supplies — 36 hours

- connect three-phase wye rectifier circuits
- connect three-phase full-wave bridge rectifier circuits
- describe zener diodes
- describe bi-polar transistors
- connect voltage regulator circuits

**RSOS topics covered in this section of training:**

**No Specific Task in RSOS**

### Sensors, Phase Control and Data Cabling — 36 hours

- describe temperature sensing devices
- describe optical devices
- describe proximity sensing switches
- connect SCR phase control circuits
- describe J-Fets and Mos-Fets
- terminate data cabling

**RSOS topics covered in this section of training:**

**No Specific Task in RSOS**

### Services for Occupancies Over 900 Square Metres — 36 hours

- determine lighting requirements
- determine three-phase squirrel cage and synchronous motor branch circuits and feeders
- calculate wound rotor and continuous duty motor branch circuits and feeders
- calculate welder branch circuits and feeders
- determine services and feeders for buildings with an area exceeding 900 square metres
- isometric drawings

**RSOS topics covered in this section of training:**

**B-7 Installs, services and maintains consumer/supply services and metering equipment**
B-7.01 Installs single-phase consumer/supply services and metering equipment
B-7.03 Performs servicing and maintenance of single-phase services and metering equipment

**B-11 Installs, services and maintains bonding and grounding protection systems**
B-11.01 Installs grounding and bonding systems
B-11.02 Installs ground fault protection and detection systems
B-11.03 Installs lightning protection systems

**C-17 Installs services and maintains branch circuitry and devices**
C-17.01 Installs luminaires
C-17.02 Installs wiring devices
C-17.03 Installs lighting controls
C-17.04 Installs lighting standards
C-17.05 Performs servicing of branch circuitry

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## AC Motors — 24 hours

- describe the construction and operation of three-phase AC motors
- connect three-phase squirrel cage motors
- connect three-phase wound rotor motors
- connect three-phase synchronous motors
- describe the maintenance requirements of three-phase motors
- describe the construction and operation of single-phase AC motors
- connect single-phase squirrel cage, split phase, induction motors
- describe single-phase repulsion motors
- describe the maintenance requirements of single-phase motors

**RSOS topics covered in this section of training:**

**D-23 Installs, services and maintains drives**
D-23.01 Installs AC drives
D-23.02 Performs servicing and maintenance of AC drives
D-23.03 Installs DC drives
D-23.04 Performs servicing and maintenance of DC drives

**D-24 Installs, services and maintains motors**
D-24.01 Installs single-phase motors
D-24.02 Performs servicing and maintenance of single-phase motors
D-24.03 Installs three-phase motors
D-24.04 Performs servicing and maintenance of three-phase motors
D-24.05 Installs DC motors
D-24.06 Performs servicing and maintenance of DC motors

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## Three-Phase Theory/Alternators — 33 hours

- describe AC generator principles and configurations
- describe AC generators set components
- describe AC generator terminal markings and connections
- connect three-phase loads and solve three-phase load problems
- describe AC generator operation with mixed PF loads
- describe instruments used to find frequency, phase sequence, motor rotation, shaft speed (tachometers), and insulation resistance
- connect AC generator in parallel

**RSOS topics covered in this section of training:**

**B-12 Installs, services and maintains power generation and conversion systems**
B-12.01 Installs alternating current (AC) generating systems
B-12.02 Performs servicing and maintenance of AC generating systems

## Three-Phase Transformers — 33 hours

- describe transformers
- describe the characteristics of various three-phase transformer connections
- determine Canadian Electrical Code requirements for transformer installations
- connect three phase transformers

**RSOS topics covered in this section of training:**

**B-15 Installs, services and maintains transformers**
B-15.03 Installs low-voltage three-phase transformers
B-15.04 Installs high-voltage transformers
B-15.05 Performs servicing and maintenance of transformers

**Level Three topics from the RSOS that are taught in context:**

***A-3 Organizes work***
***A-4 Fabricates and installs support components***
***A-5 Commissions and decommissions systems***
***B-8 Installs, services and maintains protection devices***
***C-16 Installs, services and maintains raceways cables and enclosures***

***Canadian Electrical Code***

***For details regarding the In Context Topic, see page 27***

## Level Four — 8 weeks — 240 hours

### Power Factor Correction — 24 hours

- describe power factor correction
- apply power factor correction to AC induction motors
- describe power factor correction principles using synchronous motors

**RSOS topics covered in this section of training:**

**No Specific Task in RSOS**

### Thyristors — 24 hours

- connect a semi-converter phase control circuit and components
- connect the inverse-parallel SCR phase control circuit and components
- connect protective devices for transient voltages and rate-turn on
- connect a ramp and pedestal firing circuit
- connect a TRIAC phase control circuit and components
- connect solid-state contactors

**RSOS topics covered in this section of training:**

**No Specific Task in RSOS**

### Programmable Logic Controllers — 36 hours

- connect standard logic gate control circuits
- connect inverted logic gate control circuits
- describe numbering systems used in programmable controllers
- connect programmable logic controller hardware
- describe programmable logic controller memory structure, addressing, and control sequence
- program a programmable logic controller for digital control
- program a programmable logic controller for analog control

**RSOS topics covered in this section of training:**

**No Specific Task in RSOS**

### Primary Metering and High Voltage — 30 hours

- determine high voltage metering requirements
- describe high voltage installation requirements

**RSOS topics covered in this section of training:**

**B-14 Installs high voltage equipment**
B-14.01 Installs high voltage equipment
B-14.02 Installs high voltage cables
B-14.03 Performs servicing and maintenance of high voltage systems

## Hazardous Locations — 18 hours

- describe installation requirements for hazardous locations
- describe installation requirements for flammable liquid and dispensing areas
- describe installation requirements for areas of harmful and corrosive liquids
- describe installation requirements for patient care specification areas

**RSOS topics covered in this section of training:**

**No Specific Task in RSOS**

## Fire Alarm Systems — 30 hours

- describe fire alarm systems and components
- determine fire alarm system requirements
- determine wiring requirements for fire alarm systems
- connect typical fire alarm panels
- troubleshoot typical fire alarm systems

**RSOS topics covered in this section of training:**

**E-26 Installs, services and maintains signalling systems**
E-26.01 Installs fire alarm systems
E-26.02 Performs servicing and maintenance of fire alarm systems
E-26.03 Installs security and surveillance systems
E-26.04 Performs servicing and maintenance of security and surveillance systems

## Building Systems — 36 hours

- describe Building automation systems
- describe UPS and surge suppression systems
- describe renewable energy generating and storage systems
- describe automated control systems
- describe communication systems

**RSOS topics covered in this section of training:**

**B-10 Installs, services and maintains power conditioning uninterruptible power supply (UPS) and surge suppression systems**
B-10.01 Installs power conditioning, UPS and surge suppression systems
B-10.02 Performs servicing and maintenance of power conditioning, UPS and surge suppression systems

**B-13 Installs, services and maintains renewable energy generating and storage systems**
B-13.01 Installs renewable energy generating and storage systems
B-13.02 Performs servicing and maintenance of renewable energy generating and storage systems

**D-25 Installs, programs, services and maintains automated control systems**
D-25.01 Installs automated control systems
D-25.02 Performs servicing and maintenance of automated control systems
D-25.03 Programs and configures automated control systems

**E-27 Installs, services and maintains communication systems**
E-27.01 Installs voice/data/video (VDV) and community antenna television (CATV) systems
E-27.02 Installs public address (PA) and intercom systems
E-27.03 Installs nurse call systems
E-27.04 Performs servicing and maintenance of communication systems

**E-28 Installs, services and maintains integrated control systems**
E-28.01 Installs building automation systems

E-28.02 Installs building control systems
E-28.03 Performs servicing and maintenance of integrated control systems

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**Three-Phase Four-Wire Services** **42 hours**

- describe three-phase circuit loading characteristics of three-phase three-wire and three-phase four-wire circuits
- calculate the requirements for services and feeders for buildings to be supplied with three-phase energy
- determine electrical requirements considering conductor voltage drop
- determine the installation requirements for specialized wiring methods describe thermit weld conductor terminations
- describe effective trade qualification exam preparation techniques
- identify Canadian Electrical Code rules

**RSOS topics covered in this section of training:**

**B-7 Installs, services and maintains consumer/supply services and metering equipment (three-Phase)**
B-7.02 Installs three-phase consumer/supply services and metering equipment
B-7.04 Performs servicing and maintenance of three-phase services and metering equipment

**C-17 Installs, services and maintains branch circuitry and devices (Three-Phase)**
C-17.01 Install luminaires
C-17.02 Installs wiring devices
C-17.03 Installs lighting controls
C-17.04 Install lighting standards
C-17.05 Performs servicing on branch circuitry
C-17.06 Installs, services and maintains airport visual aid systems
C-17.07 Installs, services and maintains traffic signal lights and controls

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**Level Four topics from the RSOS that are taught in context:**

***A-3 Organizes work***
***A-4 Fabricates and installs support components***
***A-5 Commissions and decommissions systems***
***B-8 Installs, services and maintains protection devices***
***C-16 Installs, services and maintains raceways cables and enclosures***

***Canadian Electrical Code***

***For details regarding the In Context Topic, see page 27***

# In Context Topics

In context means learning that has already taken place and is being applied to the applicable task. Learning outcomes for in context topics are accomplished in other topics in that level.

**A-3 Organizes Work**
A-3.01 Organizes project tasks and procedures
A-3.02 Organizes materials and supplies

**A-4 Fabricates and installs support components**
A-4.02 Installs brackets, hangers and fasteners
A-4.03 Installs seismic restraint systems

**A-5 Commissions and decommissions electrical systems**
A-5.01 Performs start-up and shutdown procedures
A-5.02 Performs commissioning and decommissioning of systems

**B-8 Installs, services and maintains protection devices**
B-8.01 Installs overcurrent protection devices
B-8.02 Installs ground fault, arc fault and surge protection devices
B-8.03 Performs servicing and maintenance of ground fault, arc fault and surge protection devices

**C-16 Installs, services and maintains raceways cables and enclosures**
C-16.01 Installs conductors and cables
C-16.02 Installs conduit and fittings
C-16.03 Installs raceways
C-16.04 Installs boxes and enclosures
C-16.05 Performs servicing and maintenance of raceways, conductors, cables and enclosures