



# Board/Authority Authorised Course Construction Trades Sampler - Electrical

School District/Independent School Authority Name	Kamloops/Thompson
School District/Independent School Authority Number	#73
Developed by	Wendy Blaskovic
Date Developed	December 2013
School Name	NorKam Secondary
Principal's Name (District)	Sheryl Lindquist
Superintendent Approval Date (for School Districts only)	
Superintendent Signature (for School Districts only)	
Board/Authority Approval Date	
Board/Authority Chair Signature	
Course Name	Construction Trades Sampler – Electrical
Grade Level of Course	11 and 12
Number of Course Credits	4
Number of Hours of Instruction	120
Prerequisite(s)	Completion of Grade 10 as well as successful application process.

## Synopsis

This course has been developed to provide students with an opportunity to explore four common trades within the Construction sector, in the following order – Carpentry, Plumbing, Electrical (Construction), and Industrial Instrumentation Mechanic (IIM). The third trade taught within the Construction Sampler, Electrical, will expose students to the Foundation program offered at Thompson Rivers University (TRU) which follows sections of the ITA Level 1 curriculum. The ITA Level 1 curriculum has been utilized as a guide and framework for the content covered in the Sampler. In Electrical (as with the three



accompanying trades taught within the Construction Sampler), students will cover: safe work practices (personal and shop), mathematical applications, tools and equipment, materials, cutting processes, and forming and joining processes. The approach supports safe workplace practices, student skill development and encourages meaningful methods of ideation, design, planning, production and evaluation of various construction sampler techniques and projects. To provide students with tangible skills and assist their understanding of the trade, all trades covered within the Construction Sampler will build skill sets towards a common project. For example, a bathroom or kitchen unit framed to scale by the carpentry trade with plumbing and electrical components installed over the course of the semester. Students will gain an understanding and appreciation for trades that are in their everyday lives.

## Rationale

This course will:

1. Provide students with an overview of the Electrical Foundation Program.
2. Provide students with an introduction to safe work practices employed in a construction facility.
3. Provide students with an overview of the practices, skill sets needed for the electrical trade.
4. Provide students with theory and practical applications within a major project which is inclusive with the accompanying trades in the Construction Sampler.
5. Provide direct exposure to foundation training content, post-secondary and job ready expectations; therefore, providing students with the ability to make informed choices regarding which direction they choose to embark on during Senior Secondary School and/or after.
6. Provide students with 20% theory and 80% practical content. The 20-80 approach supports the purpose of the sampler – a hands-on experiential program to excite students, yet be realistic in the expectations of the trade and program.

Unit/Topic	Title	Time
Unit 1	SAFE WORK PRACTICES 1.1 Perform Lockout Procedures	5 hours
Unit 2	APPLY CIRCUIT CONCEPTS 2.1 Use Electrical Circuit Concepts 2.2 Analyze DC Circuits	25 hours
Unit 3	INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS 3.1 Apply Codes, Regulations, and Standards	10 hours
Unit 4	INSTALL ELECTRICAL EQUIPMENT INSTALL CONTROL CIRCUITS AND DEVICES 4.1 Major Project  *Final project will be in collaboration with Carpentry and Plumbing Samplers (For example, Life-size framed bathroom/kitchen with plumbing and electrical installations. Details in development stages).	80 hours
	Total Hours	120 hours



## Grading

Although 50% is a passing grade for high school credit, recommendation for TRU's ACE IT Program will require a minimum grade of 70% per course. Students in the Construction Sampler will be encouraged and supported to meet TRU's 70% standard, but not halted by it.

## Unit 1 – Safe Work Practices - 1.1 Perform Lockout Procedures

**Objective:** To be competent in this area, students will be able to:

- Explain lockout requirements and use lockout procedures for various situations.
- De-energize and isolate equipment.

## Prescribed Learning Outcomes

It is expected that students will:

1. Explain lockout requirements for various sources of energy.
  - Electrical
  - Hazardous energy
    - Mechanical
    - Gravity
    - Pressure
    - Static
  - Hydraulic
    - Steam
  - Pneumatic/vacuum
  - Hazardous gases
    - Toxic
    - Flammable
2. Use lockout procedures
  - Plant requirements
  - Use of locks
    - Scissors
    - Breaker locks
    - Cord locks
  - Lockout board
  - Tags
  - Documentation cables
  - Key-box system
  - Blinding
  - Standby person
  - Isolation of vessels
  - Matching of the lockout to the vessel being worked on



## Unit 2 – Apply Circuit Concepts - 2.1 Use Electrical Circuit Concepts

**Objective:** To be competent in this area, students will be able to:

- Describe the principles of electricity
- Apply the principles of electricity.
- Describe electrical circuit components
- Describe electrical circuit components
- Apply electrical circuit concepts.

### Prescribed Learning Outcomes

It is expected that students will:

1. Describe the structure of matter.
  - States of matter
  - Elements and compounds
  - Molecules and atoms
  - Conductors, insulators, and semiconductors
2. Describe the concepts of electric charge and current flow.
  - Laws of charges and electrostatic fields
  - Applications of static charges
  - Hazards of static charges
  - Electron flow and polarity
  - Direct current and alternating current
3. Describe electrical quantities, units, and symbols.
  - Coulomb
  - Ampere
  - Volt
  - Ohm
  - Watt
  - Joule
4. Perform calculations using Ohm's Law and Watt's Law.
  - Ohm's Law
  - Watt's Law
  - Solving problems
  - Converting between metric prefixes
5. Describe the relationship between electrical power and energy.
  - Power and energy calculations
  - Percent efficiency
  - Reasons for different voltage levels
6. Identify common drawings for electric circuits.
  - Pictorial diagram
  - Block diagram
  - One-line diagram



- Wiring diagram
- Schematic diagram
- 7. Describe the basic operation of electrical circuits.
  - Circuit terminology
  - Circuit components
  - Polarity and current flow
- 8. Calculate values of voltage, current, resistance, and power in electric circuits.
  - Ohm's Law
  - Watt's Law
  - Factors affecting resistance
  - Power dissipation in resistance devices
  - Voltage drop and power loss in conductors
- 9. Describe meters for measurements in electric circuits.
  - Safety precautions
  - Multimeter use
  - Reading scales
- 10. Describe features of resistors.
  - Common types and ratings
  - Resistor colour codes
  - Potentiometers and rheostats
- 11. Describe features of switches.
  - Terminology
  - Switch classifications
  - Circuit applications
- 12. Describe features of circuit protection devices.
  - Terminology
  - Fuses
  - Circuit breakers
- 13. Determine the ampacity of various types of conductors.
  - Factors affecting ampacity
  - Conductor charts
  - Use of Canadian electrical code

## **Unit 2 – Apply Circuit Concepts - 2.2 Analyze DC Circuits**

**Objective:** To be competent in this area, students will be able to:

- Describe the operating principles of series circuits
- Analyze series circuits
- Describe the operating principles of parallel circuits
- Analyze parallel circuits
- Describe the operating principles of combination circuits.
- Analyze combination circuits



## Prescribed Learning Outcomes

It is expected that students will:

1. Describe the characteristics of a series circuit.
  - Connection of components
  - Polarity
  - Resistance, voltage, and current
  - Effects of an open circuit
  - Circuit applications
2. Solve problems involving series circuits.
  - Development of schematic diagrams
  - Kirchhoff's Voltage Law
  - Resistance, voltage, current, and power calculations
3. Connect and test series circuits.
  - Component selection
  - Circuit connections and measurements
  - Testing and troubleshooting
4. Describe the characteristics of a parallel circuit.
  - Connection of components
  - Polarity
  - Voltage, current, and resistance
  - Effects of an open circuit
  - Circuit applications
5. Solve problems involving parallel circuits.
  - Development of schematic diagrams
  - Kirchhoff's Current Law
  - Resistance, voltage, current, and power calculations
  - Branch current proportionality
6. Describe the characteristics of a combination circuit.
  - Connection of components
  - Polarity
  - Voltage, current, and resistance
  - Effects of an open circuit
  - Circuit applications
7. Solve problems involving combination circuits.
  - Development of schematic diagrams
  - Kirchhoff's Voltage and Current laws
  - Series equivalent circuits
  - Resistance, voltage, current, and power calculations



## Unit 3 – Install Low Voltage Distribution Systems – 3.1 Apply Codes, Regulations and Standards

**Objective:** To be competent in this area, students will be able to:

- Interpret and apply codes, regulations, and standards.

### Prescribed Learning Outcomes

It is expected that students will:

1. Describe the general arrangement of CEC rules and regulations.
  - Purpose of the CEC
  - CSA and BC requirements
  - Layout of the CEC book
  - Definitions and interpretations
2. Describe the administration of CEC rules and regulations from.
  - Electrical Safety Act and Regulations
  - Directives
  - Information bulletins
  - Permits and inspections
  - Equipment certification agencies
3. Interpret applicable CEC rules and regulations.
  - Section 0
  - Section 2
  - Section 4
  - Section 8
  - Section 10
  - Section 12
  - Section 26
  - **Definitions**
  - Application of general rules
  - Conductor size and ampacity
  - Use of Tables 1 to 5c
  - Colour of conductors
  - Residential loads and demand factors
  - Branch circuit calculations
  - Purpose for grounding and bonding
  - Grounding conductor size
  - Non-metallic sheathed cables
  - Boxes, fittings, and accessories
  - Ground-fault interrupters and arc fault interrupters
  - Receptacles in residential dwellings
  - Branch circuits in residential dwellings



4. Identify applicable codes and regulations.
  - British Columbia Building Code
  - Provincial regulations
  - Municipal regulations (bylaws)
  - CSA standards
  - WorkSafeBC
5. Apply applicable codes and regulations
  - Reference installations

### **Instructional Components**

- Direct instruction
- Indirect instruction
- Interactive (peer) instruction
- Independent instruction
- Modeling
- Practical creativity
- Brainstorming
- Group work
- Analysis of own and classmates' project work
- Project-based learning

### **Assessment Component**

- Twenty per cent (20%) of the grade will be based on safety tests, unit quizzes, skill-set evaluation through Units 1-3
- Eighty per cent (80%) of the grade will be based on demonstration of proper employability skills (proper industrial work habits ranging from the safe use of equipment to good "Housekeeping" techniques, project management), demonstration of skills related to practical activities.

### **Learning Resources**

- Teacher handouts
- Guest speakers from the community in related fields
- Visit/interview local trades people in related fields
- ITA Website: <http://www.itabc.ca/>
- ITA Essential Skills: <http://www.ita.essentialskillsgroup.com/>
- BC Construction Industry Training Organization [www.bccito.com](http://www.bccito.com)
- Workplace Hazardous Materials Information System (WHMIS) and First Aid <http://www.hc-sc.gc.ca/ewh-semt/occup-travail/whmis-simdut/index-eng.php>
- WorkSafeBC (WCB) [www.worksafebc.com](http://www.worksafebc.com)





## Instructor Resources

- ILM Modules:  
[http://www.crownpub.bc.ca/Product/Details/7960003229\\_S#/?statesave=true](http://www.crownpub.bc.ca/Product/Details/7960003229_S#/?statesave=true)  
[http://www.crownpub.bc.ca/product/listing/13589\\_1st-Period#/?statesave=true](http://www.crownpub.bc.ca/product/listing/13589_1st-Period#/?statesave=true)
- ITA Level 1 Program Outline  
[http://www.itabc.ca/sites/default/files/program-information/carpenter-outline-august-2013\\_0.pdf](http://www.itabc.ca/sites/default/files/program-information/carpenter-outline-august-2013_0.pdf)

## Codes

- National Fire Code of Canada  
<http://www.nrc-cnrc.gc.ca/eng/ibp/irc/codes/2010-national-fire-code.html>
- BC Ministry of Housing [www.housing.gov.bc.ca/building](http://www.housing.gov.bc.ca/building)
- Queen's Printer for BC Code books <http://www.bccodes.ca/default.htm>
  - BC Building Code
  - BC Fire Code
  - BC Electrical Code
  - Canadian Electrical Code (CEC)
- National Fire Protection Association [www.nfpa.org](http://www.nfpa.org)
  - NFPA 80 – Standards for Fire Doors and Fire Windows
  - NFPA 101 – Life Safety Code
- Canadian National Building Code  
<http://www.nrc-cnrc.gc.ca/eng/ibp/irc/codes/2010-national-building-code.html>

## Additional Information

FACILITY REQUIREMENTS (Based on ITA Carpentry Program Guidelines)

### Classroom Area

- Minimum 30 square feet per student
- Comfortable seating and tables suitable for learning
- Compliance with the Local and National Fire Code and occupational safety requirements
- Meets applicable municipal zoning bylaws for technical instruction and education facilities
- Overhead and multimedia projectors with a projection screen and associated computer equipment
- Whiteboard with marking pens and erasers
- Lighting controls to allow easy visibility of the projection screen while allowing students to take notes
- Windows must have shades or blinds to adjust sunlight
- Heating/air conditioning for comfort all year round
- Acoustics in the room must allow audibility of the instructor



### **Shop Area**

- Minimum 2400 square feet of shop area including a tool crib and work stations
- Minimum 15' 6" ceiling height in shop areas
- White board (on wheels or fixed to walls) and markers
- Adequate heating, lighting, and ventilation
- Acoustics in the room must allow audibility of the instructor
- Refuse and recycling bins for used shop materials
- First-aid facilities

### **Student Facilities**

- Adequate eating area as per WorkSafeBC requirements (4.84 OHS Regulation and Guidelines)
- Adequate washroom facilities as per WorkSafeBC requirements (4.85 OHS Regulation and Guidelines)
- Minimum 10 cu. Ft. personal storage lockers

### **Instructor's Office Space**

- Adequate office space for student consultation
- Desk and filing space (filing cabinets for each trade taught within the Construction Sampler)
- Computer
- Internet access
- Printer access
- Adequate storage facilities for material and training aids
- Access to photocopier/scanner
- Telephone

## **Tools and Equipment**

(Based on ITA Electrical Program Guidelines)

### **Stations**

**\*Note:** "Station" refers to shop tables which are standard to the shop for each trade taught within the Construction Sampler to use, as well as the stations students will be divided into for the collaborative major project.

Each station must have a 120V/240V, 24 circuit panel fed from a main panel (4 in total). Perhaps permanently installed cables from the main panel to a centrally-located junction box would be a good plan for when we (each class) install the subpanels into the stations.

### **The following list of tools and basic materials is based on:**

- Stations
- 4 students/station
- 16 students, maximum, per class



### **Tools per student**

A tool belt with pouches containing the standard tool list for foundation apprentices (roughly \$350 per kit at any electrical wholesaler, bought as an electrician's starter kit).

### **Contents of Tool Kits:**

- Linesman pliers
- Side cutters
- Water pipe pliers
- Needle nose pliers
- Wire strippers
- Tape measure (Standard and Metric)
- Hack saw
- Assortment of screwdrivers (flat blades, Phillips heads, and Robertsons)
- Knife
- Hammer
- Level
- Code Book (current issue for year)

### **Tools per class**

- Minimum 6 – 14V cordless drills (we use Mikita)
- Speed bits – sizes ½” to 1”
- 16 – digital multimeters (Fluke 11 or equivalent with extra fuses)
- 6 – six-foot stepladders
- 2 – eight-foot stepladders
- – ½” drills with auger bits ½
- 8 – ½” EMT pipe benders
- 2 – hole saw kits (½ -2”) Greenlee brand
- 2 – knock out kits with ratcheting wrench ( ½ “-2”) Greenlee brand
- 8 – digital multimeters
- 8 – clamp on ammeters
- Outlet Analyzers
- Miscellaneous conductors, cables, and raceways for demo purposes
- Miscellaneous dimmer and snap switches
- Variety of circuit protective devices

### **Safety gear, personal protective gear (PPE), per student**

- Steel-toed boots (each student)
- Safety glasses (each student)
- Leather gloves (each student)
- Lock with key (each class)
- Scissor clip for lockout (each class)