PROGRAM OUTLINE

Construction Electrician
CONSTRUCTION ELECTRICIAN
PROGRAM OUTLINE

APPROVED BY INDUSTRY
JANUARY 2013

BASED ON
NOA 2011

Developed by
Industry Training Authority
Province of British Columbia
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Section 1

INTRODUCTION

Construction Electrician
Foreword

This revised Construction Electrician Program Outline is intended as a guide for instructors, apprentices, and employers of apprentices as well as for the use of industry organizations, regulatory bodies, and provincial and federal governments. It reflects updated standards based on the new Construction Electrician National Occupational Analysis (2011) and British Columbia industry and instructor subject matter experts.

Practical instruction by demonstration and student participation should be integrated with classroom sessions. Safe working practices, even though not always specified in each operation or topic, are an implied part of the program and should be stressed throughout the apprenticeship.

This Program Outline includes a list of recommended reference textbooks that are available to support the learning objectives and the minimum shop requirements needed to support instruction.

The Program Outline was prepared with the advice and assistance of the Electrician Review Committee and will form the basis for further updating of the British Columbia Construction Electrician Program and learning resources by the Construction Industry Training Organization on behalf of the Industry Training Authority (ITA).

Each competency is to be evaluated through the use of written examination in which the learner must achieve a minimum of 70% in order to receive a passing grade. The types of questions used on these exams must reflect the cognitive level indicated by the learning objectives and the learning tasks listed in the related competencies.

Important Program Information:

Industry strongly recommends that apprentices considering attending the Level 1 Construction Electrician program have at least one year of work-based training as an electrical apprentice before beginning their in-school technical training.

Apprentices who attain workplace competencies before attending technical training are in a better position to take advantage of the in-school portions of their apprenticeship.

General areas of competency and associated learning tasks have been identified by industry and are contained in Appendix A in this Program Outline.

SAFETY ADVISORY

Be advised that references to the WorkSafeBC safety regulations contained within these materials do not/may not reflect the most recent Occupational Health and Safety Regulation (the current Standards and Regulation in BC can be obtained on the following website: http://www.worksafebc.com). Please note that it is always the responsibility of any person using these materials to inform him/herself about the Occupational Health and Safety Regulation pertaining to his/her work.
Acknowledgements

The Program Outline was prepared with the advice and direction of an industry steering committee convened initially by the BC Construction Industry Training Organization (CITO). Members include:

Industry Subject Matter Experts retained to assist in the development of Program Outline content:

Industry Representatives

- Mario Baptista, Canem West Services
- Brent Baptiste, Western Pacific Enterprises
- Mike Baxter, Mott Electric Ltd.
- Stuart Blundell, Canfor
- Nick Bourassa, Lakewood Electric
- Dan Campbell, Keldon Electric and Data Ltd.
- Bill Card, Ross Morrison Electric
- Larry Carriere, Keldon Electric and Data Ltd.
- Dallas Crompton, Status Electrical Corp.
- Dave Fettback, Western Pacific Enterprises
- Jim Reaugh, Bridge Electric Corp.
- Al Stewart, Duke Energy Gas Transmission West
- Graham Trafford, Mott Electric Ltd.

Instructor Articulation Representatives

- Jim Gamble – Okanagan College
- Ken Holland – Camosun College
- Alain Lavoie – College of New Caledonia
- Peter Poeschek – Thompson Rivers University
- Ted Simmons – British Columbia Institute of Technology
- John Todrick – University of the Fraser Valley

The Industry Training Authority would like to acknowledge the dedication and hard work of all the industry representatives appointed to identify the training requirements of the Construction Electrician occupation.
### Introduction

**How to Use this Document**

This Program Outline has been developed for the use of individuals from several different audiences. The table below describes how each section can be used by each intended audience.

<table>
<thead>
<tr>
<th>Section</th>
<th>Training Providers</th>
<th>Employers/ Sponsors</th>
<th>Apprentices</th>
<th>Challengers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Program Credentialing Model</strong></td>
<td>Communicate program length and structure, and all pathways to completion</td>
<td>Understand the length and structure of the program</td>
<td>Understand the length and structure of the program, and pathway to completion</td>
<td>Understand challenger pathway to Certificate of Qualification</td>
</tr>
<tr>
<td><strong>OAC</strong></td>
<td>Communicate the competencies that industry has defined as representing the scope of the occupation</td>
<td>Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification</td>
<td>View the competencies they will achieve as a result of program completion</td>
<td>Understand the competencies they must demonstrate in order to challenge the program</td>
</tr>
<tr>
<td><strong>Training Topics and Suggested Time Allocation</strong></td>
<td>Shows proportionate representation of general areas of competency (GACs) at each program level, the suggested proportion of time spent on each GAC, and percentage of time spent on theory versus practical application</td>
<td>Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application</td>
<td>Understand the scope of competencies covered in the technical training, the suggested proportion of time spent on each GAC, and the percentage of that time spent on theory versus practical application</td>
<td>Understand the relative weightings of various competencies of the occupation on which assessment is based</td>
</tr>
<tr>
<td><strong>Program Content</strong></td>
<td>Defines the objectives, learning tasks, high level content that must be covered for each competency, as well as defining observable, measurable achievement criteria for objectives with a practical component</td>
<td>Identifies detailed program content and performance expectations for competencies with a practical component; may be used as a checklist prior to signing a recommendation for certification (RFC) for an apprentice</td>
<td>Provides detailed information on program content and performance expectations for demonstrating competency</td>
<td>Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels</td>
</tr>
<tr>
<td><strong>Training Provider Standards</strong></td>
<td>Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program</td>
<td>Identifies the tools and equipment an apprentice is expected to have access to; which are supplied by the training provider and which the student is expected to own</td>
<td>Provides information on the training facility, tools and equipment provided by the school and the student, reference materials they may be expected to acquire, and minimum qualification levels of program instructors</td>
<td>Identifies the tools and equipment a tradesperson is expected to be competent in using or operating; which may be used or provided in a practical assessment</td>
</tr>
</tbody>
</table>
Section 2

PROGRAM OVERVIEW

Construction Electrician
Program Overview

Program Credentialing Model

Apprenticeship Pathway with Optional Endorsement

*C of Q = Certificate of Qualification
C of A = Certificate of Apprenticeship
C of C = Certificate of Completion
WBT = Work-Based Training

CROSS-PROGRAM CREDITS
Individuals who hold the credentials listed below are entitled to receive partial credit toward the completion requirements of this program

Construction Electrician Level 4
Technical Training: 300 hours (10 weeks*)
Work-Based Training: 6,000 hours total
Interprovincial Red Seal Exam

Construction Electrician Level 3
Technical Training: 300 hours (10 weeks*)
Work-Based Training: Accumulate hours

Construction Electrician Level 2
Technical Training: 300 hours (10 weeks*)
Work-Based Training: Accumulate hours

Construction Electrician Level 1
Technical Training: 300 hours (10 weeks*)
Work-Based Training: Accumulate hours

Construction Electrician Level 4
Technical Training: 300 hours (10 weeks*)
Work-Based Training: 6,000 hours total
Interprovincial Red Seal Exam

Construction Electrician Level 3
Technical Training: 300 hours (10 weeks*)
Work-Based Training: Accumulate hours

Construction Electrician Level 2
Technical Training: 300 hours (10 weeks*)
Work-Based Training: Accumulate hours

Construction Electrician Level 1
Technical Training: 300 hours (10 weeks*)
Work-Based Training: Accumulate hours

Industry Training Authority
Industry Training Authority
# Occupational Analysis Chart

## CONSTRUCTION ELECTRICIAN

**Occupation Description:** “Construction Electrician” means a person who installs, constructs, alters, repairs, maintains, commissions, tests, services, calibrates and operates related electrical and electronic systems in any premise, place, building or structure.

### USE ESSENTIAL SKILLS

<table>
<thead>
<tr>
<th>A</th>
<th>Demonstrate Employability Skills</th>
<th>Use Effective Communication Skills</th>
<th>Demonstrate Quality Workmanship</th>
<th>Solve Problems Using Applied Mathematics</th>
<th>Solve Problems Using Applied Science</th>
<th>Describe Analytical Troubleshooting Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>A1</td>
<td>W</td>
<td>A2</td>
<td>W</td>
<td>A3</td>
<td>W</td>
</tr>
</tbody>
</table>

**Use Computers**

| W | A7 |

### USE SAFE WORK PRACTICES

<table>
<thead>
<tr>
<th>B</th>
<th>Perform Lockout Procedures</th>
<th>Apply WCB Standards and Regulations</th>
<th>Apply Safe Work Practices</th>
<th>Apply WHMIS</th>
<th>Use a Daily Safety Plan</th>
<th>Use Safe Rigging Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B1</td>
<td>B2</td>
<td>B3</td>
<td>B4</td>
<td>B5</td>
<td>B6</td>
</tr>
<tr>
<td></td>
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<tr>
<td>1</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

### USE TOOLS AND EQUIPMENT

<table>
<thead>
<tr>
<th>C</th>
<th>Use Hand Tools</th>
<th>Use Power Tools</th>
<th>Use Fastening Systems</th>
<th>Use Powder Actuated Tools</th>
<th>Use Access Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### APPLY CIRCUIT CONCEPTS

<table>
<thead>
<tr>
<th>D</th>
<th>Use Electrical Circuit Concepts</th>
<th>Analyze DC Circuits</th>
<th>Solve Problems Using the Principles of Electromagnetism</th>
<th>Analyze Single-phase AC Circuits</th>
<th>Analyze Three-phase Circuits</th>
<th>Analyze Electronic Circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>D1</td>
<td></td>
<td>D2</td>
<td>D3</td>
<td>D4</td>
<td>D5</td>
<td>D6</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>
### Program Overview

#### USE TEST EQUIPMENT
- **E1**: Use Analog Meters
- **E2**: Use Digital Meters
- **E3**: Use Scopes
- **E4**: Use Power Quality Analyzers
- **E5**: Perform Structured Cable Testing and Reporting

#### READ AND INTERPRET DRAWINGS AND MANUALS
- **F1**: Use Circuit Drawings
- **F2**: Use Construction Drawings and Specifications
- **F3**: Use Manuals and Manufacturers’ Instructions
- **F4**: Plan Time and Materials

#### INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
- **G1**: Apply Codes, Regulations and Standards
- **G2**: Install Service Equipment
- **G3**: Install Grounding and Bonding
- **G4**: Install Distribution Centres
- **G5**: Install Raceways, Boxes and Fittings
- **G6**: Install Conductors and Cables
- **G7**: Install Utilization Equipment and Devices

#### INSTALL ELECTRICAL EQUIPMENT
- **H1**: Install Lighting and Lighting Controls
- **H2**: Install Transformers
- **H3**: Install Protective Devices
- **H4**: Install DC Motors and Generators
- **H5**: Install AC Motors and Alternators
- **H6**: Install HVAC
- **H7**: Install Emergency Power Systems
- **H8**: Install Alternative Power Systems
## Program Overview

<table>
<thead>
<tr>
<th>INSTALL CONTROL CIRCUITS AND DEVICES</th>
<th>INSTALL SIGNAL AND COMMUNICATION SYSTEMS</th>
<th>INSTALL HIGH VOLTAGE SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>J</td>
<td>K</td>
</tr>
<tr>
<td>Install Manual Motor Controls</td>
<td>Install Fire Alarm and Suppression Systems</td>
<td>Apply High Voltage Safety Procedures</td>
</tr>
<tr>
<td>Install Magnetic Motor Controls</td>
<td>Install Structured Cabling Systems</td>
<td>Install High Voltage Cable</td>
</tr>
<tr>
<td>Install Electronic Motor Controls</td>
<td>Install Nurse Call Systems</td>
<td>Install High Voltage Switch Gear</td>
</tr>
<tr>
<td>Install PLCs</td>
<td>Install Building Integrated Control Systems</td>
<td>Use High Voltage Test Equipment</td>
</tr>
<tr>
<td>Install Automated Controls</td>
<td>Install Sound Systems</td>
<td></td>
</tr>
<tr>
<td>I1 1 2 3 4</td>
<td>J1 4</td>
<td>K1 4</td>
</tr>
<tr>
<td>I2 1 2 3 4</td>
<td>J2 4</td>
<td>K2 4</td>
</tr>
<tr>
<td>I3 3</td>
<td>J3 4</td>
<td>K3 4</td>
</tr>
<tr>
<td>I4 4</td>
<td>J4 4</td>
<td>K4 4</td>
</tr>
<tr>
<td>I5 4</td>
<td>J5 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>J6 4</td>
<td></td>
</tr>
</tbody>
</table>

W = Competencies for which knowledge or skills are primarily acquired in the workplace
## Training Topics and Suggested Time Allocation

### Construction Electrician – Level 1

<table>
<thead>
<tr>
<th>Line</th>
<th>Training Topic</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>USE SAFE WORK PRACTICES</td>
<td>6%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>B1</td>
<td>Perform Lockout Procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B2</td>
<td>Apply WCB Standards and Regulations</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B3</td>
<td>Apply Safe Work Practices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B4</td>
<td>Apply WHMIS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B5</td>
<td>Use a Daily Safety Plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B6</td>
<td>Use Safe Rigging Techniques</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>APPLY CIRCUIT CONCEPTS</td>
<td>52%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>D1</td>
<td>Use Electrical Circuit Concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2</td>
<td>Analyze DC Circuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D3</td>
<td>Solve Problems Using the Principles of Electromagnetism</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D6</td>
<td>Analyze Electronic Circuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>USE TEST EQUIPMENT</td>
<td>6%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>E1</td>
<td>Use Analog Meters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td>Use Digital Meters</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>READ AND INTERPRET DRAWINGS AND MANUALS</td>
<td>10%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>F1</td>
<td>Use Circuit Drawings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F2</td>
<td>Use Construction Drawings and Specifications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F3</td>
<td>Use Manuals and Manufacturers’ Instructions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F4</td>
<td>Plan Time and Materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS</td>
<td>14%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>G1</td>
<td>Apply Codes, Regulations and Standards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G2</td>
<td>Install Service Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G3</td>
<td>Install Grounding and Bonding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G4</td>
<td>Install Distribution Centres</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G5</td>
<td>Install Raceways, Boxes and Fittings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G6</td>
<td>Install Conductors and Cables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G7</td>
<td>Install Utilization Equipment and Devices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>INSTALL ELECTRICAL EQUIPMENT</td>
<td>1%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>H3</td>
<td>Install Protective Devices</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>INSTALL CONTROL CIRCUITS AND DEVICES</td>
<td>11%</td>
<td>100%</td>
<td>n/a</td>
<td>100%</td>
</tr>
<tr>
<td>I1</td>
<td>Install Manual Motor Controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I2</td>
<td>Install Magnetic Motor Controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Total Percentage for Construction Electrician Level 1 | 100%     |
### Program Overview

### Training Topics and Suggested Time Allocation

#### Construction Electrician – Level 2

<table>
<thead>
<tr>
<th>Line</th>
<th>Topic</th>
<th>% of Time</th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>USE ESSENTIAL SKILLS</td>
<td>4%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>A4</td>
<td>Solve Problems Using Applied Mathematics</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>APPLY CIRCUIT CONCEPTS</td>
<td>44%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>D1</td>
<td>Use Electrical Circuit Concepts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D4</td>
<td>Analyze Single-phase AC Circuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D6</td>
<td>Analyze Electronic Circuits</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>USE TEST EQUIPMENT</td>
<td>4%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>E3</td>
<td>Use Scopes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>F</strong></td>
<td>READ AND INTERPRET DRAWINGS AND MANUALS</td>
<td>5%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>F2</td>
<td>Use Construction Drawings and Specifications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>G</strong></td>
<td>INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS</td>
<td>12%</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>G1</td>
<td>Apply Codes, Regulations and Standards</td>
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<tr>
<td>G2</td>
<td>Install Service Equipment</td>
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</tr>
<tr>
<td>G3</td>
<td>Install Grounding and Bonding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G4</td>
<td>Install Distribution Centres</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G5</td>
<td>Install Raceways, Boxes and Fittings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G6</td>
<td>Install Conductors and Cables</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G7</td>
<td>Install Utilization Equipment and Devices</td>
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**Total Percentage for Construction Electrician Level 2**: 100%
## Program Overview

### Training Topics and Suggested Time Allocation

#### Construction Electrician – Level 3

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<td>D6</td>
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<td>Install Grounding and Bonding</td>
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<td>G4</td>
<td>Install Distribution Centres</td>
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<tr>
<td>G5</td>
<td>Install Raceways, Boxes and Fittings</td>
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<td>G6</td>
<td>Install Conductors and Cables</td>
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<td>G7</td>
<td>Install Utilization Equipment and Devices</td>
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**Total Percentage for Construction Electrician Level 3** 100%
# Training Topics and Suggested Time Allocation

## Construction Electrician – Level 4

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### Program Overview

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**Total Percentage for Construction Electrician Level 4** 100%
Section 3

PROGRAM CONTENT

Construction Electrician
Level 1

Construction Electrician
### Line (GAC): B  USE SAFE WORK PRACTICES
Competency: B1  Perform Lockout Procedures

#### Objectives
To be competent in this area, the individual must be able to:
- Explain lockout requirements and use lockout procedures for various situations.
- De-energize and isolate equipment.

#### LEARNING TASKS

<table>
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<th>1. Explain lockout requirements for various sources of energy</th>
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<tbody>
<tr>
<td>• Electrical</td>
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<td>• Hazardous energy</td>
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<tr>
<td>o Mechanical</td>
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</tr>
<tr>
<td>– Gravity</td>
<td></td>
</tr>
<tr>
<td>o Pressure</td>
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<tr>
<td>o Static</td>
<td></td>
</tr>
<tr>
<td>• Hydraulic</td>
<td></td>
</tr>
<tr>
<td>o Steam</td>
<td></td>
</tr>
<tr>
<td>o Pneumatic/vacuum</td>
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<tr>
<td>• Hazardous gases</td>
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<td>o Toxic</td>
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<td>o Flammable</td>
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<th>2. Use lockout procedures</th>
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<td>• Plant requirements</td>
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<td>• Use of locks</td>
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<td>o Scissors</td>
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<td>o Breaker locks</td>
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<td>o Cord locks</td>
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<tr>
<td>• Lockout board</td>
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<td>• Tags</td>
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<td>• Documentation</td>
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<td>• Cables</td>
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<td>• Key-box system</td>
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<td>• Blinding</td>
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<td>• Standby person</td>
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<td>• Isolation of vessels</td>
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<td>• Matching of the lockout to the vessel being worked on</td>
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</table>
Line (GAC): B USE SAFE WORK PRACTICES
Competency: B2 Apply WCB Standards and Regulations

Objectives
To be competent in this area, the individual must be able to:
• Describe the application of the parts of the Workers’ Compensation Act outlined in the Occupational 
  Health and Safety Regulations.
• Locate and apply the parts of the Occupational Health and Safety Regulation as it applies to the 
  construction electrician.

LEARNING TASKS

1. Define terms used in the Workers’ Compensation Act
   • Definitions, Section 1 of the Act

2. Describe the conditions under which compensation will be paid (Book 1)
   • Part 1, Division 2 of the Act

3. State the general duties of employers, employees and others (Book 1)
   • Part 2, Division 3, Sections 115-124 of the Act

4. State the Workers’ Compensation Act requirements for the reporting of accidents (Book 1)
   • Part 1, Division 5, Sections 53 and 54 of the Act

5. State the “Core Requirements” of the Occupational Health and Safety Regulation (Book 1)
   • Definitions
   • Application
   • Rights and Responsibilities
     o Health and safety programs
     o Investigations and reports
     o Workplace inspections
     o Right to refuse work
   • General Conditions
     o Building and equipment safety
     o Emergency preparedness
     o Preventing violence
     o Working alone
     o Ergonomics
     o Illumination
     o Indoor air quality
     o Smoking and lunchrooms
LEARNING TASKS

6. Locate the “General Hazard Requirements” of the Occupational Health and Safety Regulation (Book 2)

CONTENT

- Chemical and biological substances
- Substance specific requirements
- Noise, vibration, radiation and temperature
- Personal protective clothing and equipment
- Confined spaces
- De-energization and lockout
- Fall protection
- Tools, machinery and equipment
- Ladders, scaffolds and temporary work platforms
- Cranes and hoists
- Rigging
- Mobile equipment
- Transportation of workers
- Traffic control
- Electrical safety
Objectives
To be competent in this area, the individual must be able to:

- Apply personal safety measures.
- Identify and use shop emergency equipment.
- Prevent, identify and extinguish various classes of fires.

LEARNING TASKS

1. Apply personal safety precautions and procedures
   - Personal apparel
     - Clothing
     - Hair and beards
     - Jewellery
   - Personal protection
     - Head
     - Hands
     - Lungs
     - Eyes
     - Ears
     - Feet
   - Fall protection
   - Safety meetings
   - Housekeeping
   - Equipment and machine lockout
   - Ventilation systems
   - Clear head
   - Horseplay
   - Respect for others' safety
   - Constant awareness of surroundings
   - Lifting

2. Locate shop emergency equipment and means of egress
   - Emergency shutoffs
   - Fire control systems
   - Eye wash facilities
   - Emergency exits
   - First aid facilities
   - Emergency contact(phone) numbers
   - Outside meeting place
   - Disaster meeting place
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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<td>3. Describe the conditions necessary to support a fire</td>
<td>• Air</td>
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<td></td>
<td>• Fuel</td>
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<td>• Heat</td>
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<td>4. Describe the classes of fires according to the materials being burned</td>
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</tr>
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<td>• Class B</td>
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<tr>
<td></td>
<td>• Class C</td>
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<td></td>
<td>• Class D</td>
</tr>
<tr>
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<td>• Symbols and colours</td>
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<td>5. Apply preventative fire safety precautions when working near, handling or</td>
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<td>storing flammable liquids or gases, combustible materials and electrical</td>
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<td>• Oily rags</td>
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<td>• Combustible metals</td>
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<td>fire</td>
<td>• Evacuation of others</td>
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<td>• Fire contained and not spreading</td>
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<td>• Personal method of egress</td>
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<td>• Training</td>
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<td>○ Pull</td>
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<td>○ Aim</td>
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<td>○ Squeeze</td>
</tr>
<tr>
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<td>○ Sweep</td>
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Objectives
To be competent in this area, the individual must be able to:

- Describe the purpose of the Workplace Hazardous Materials Information System (WHMIS) Regulations.
- Explain the contents of Material Safety Data Sheets (MSDS).
- Explain the contents of a WHMIS label.
- Apply WHMIS regulations.
- Complete training and obtain WHMIS certification.

LEARNING TASKS

1. State the legislation that requires suppliers of hazardous materials to provide Material Safety Data Sheets (MSDSs) and label products as a condition of sale and importation
   - Hazardous Product Act
   - Controlled Products Regulations
   - Ingredient Disclosure List
   - Hazardous Materials Information Review Act
   - Hazardous Materials Information Review Regulations

2. State the purpose of the Workplace Hazardous Materials Information System (WHMIS)
   - Protection of Canadian workers from the adverse effects of hazardous materials through the provision of relevant information while minimizing the economic impact on industry and the disruption of trade
   - Recognition of rights
     - Workers
     - Employers
     - Suppliers
     - Regulators

3. Describe the key elements of WHMIS
   - MSDSs
   - Labeling of containers of hazardous materials
   - Worker education programs

4. Describe the responsibilities of suppliers under WHMIS
   - Provide
     - MSDSs
     - Labels
LEARNING TASKS

5. Describe the responsibilities of employers under WHMIS

6. Describe information to be disclosed on a MSDS

7. Identify symbols found on WHMIS labels and their meaning

CONTENT

- Provide
  - MSDSs
  - Labels
  - Work education programs in the workplace

- Hazardous ingredients
- Preparation information
- Product information
- Physical data
- Fire or explosion
- Reactivity data
- Toxicological properties
- Preventive measures
- First-aid measures

- Compressed gases
- Flammable and combustible materials
- Oxidizing materials
- Poisonous and infectious materials
  - Materials causing immediate and serious toxic effects
  - Materials causing other toxic effects
  - Bio hazardous infectious materials
- Corrosive materials
- Dangerously reactive materials
LEARNING TASKS

8. Apply WHMIS regulations as they apply to hazardous materials used in the shop

9. Obtain WHMIS certification

CONTENT

- Use, storage and disposal of
  - Solvents
  - Caustic cleaners
  - Cleaning solutions
  - Alcohol used for cleaning
  - Gasoline
  - Diesel fuel
  - L.P.G.
  - C.N.G.
  - Asbestos
  - Battery acid
  - Refrigerants
  - Brake fluid
  - Antifreeze
  - Lubricants
  - Tracer dyes

- Training
- Testing
- Certification
Line (GAC): B USE SAFE WORK PRACTICES
Competency: B5 Use Daily a Safety Plan

Objectives
To be competent in this area, the individual must be able to:
• Identify various possible hazards that may be encountered on the job site.
• Describe elements of a safe work plan.

LEARNING TASKS

1. Describe steps involved in performing a job safety analysis
   • Identify job steps
   • Identify hazards associated with each job step
   • Formulate a safe work plan
   • Document procedures

2. Identify and assess job hazards
   • Atmosphere
   • Confined space
   • Housekeeping
   • Hot work
   • Elevation
   • Tools
   • Energy sources
   • Hoisting and rigging

3. Describe elements of a safe work plan
   • Document procedures
   • Personal protective equipment
   • Isolation and lockout procedures
   • Ventilation
   • Gas testing
   • Fall protection
   • Guarding
   • Training
   • Inspection
   • Procedures
   • Lifting plan
**Line (GAC):** B USE SAFE WORK PRACTICES  
**Competency:** B6 Use Safe Rigging Techniques  

**Objectives**  
To be competent in this area, the individual must be able to:  
- Describe slings.  
- Demonstrate hand signals.  
- Inspect lifting devices.

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- Working load limit |
| 2. Describe basic knots, bends and hitches |  
- Types  
- Uses |
| 3. Describe slings |  
- Types of slings  
- Use of slings  
- Load ratings |
| 4. Demonstrate hand signals for crane operation |  
- Standard crane operator hand signals |
| 5. Inspect lifting devices |  
- Equipment inspection techniques |
Program Overview
Level 1

Line (GAC): D APPLY CIRCUIT CONCEPTS
Competency: D1 Use Electrical Circuit Concepts

Objectives
To be competent in this area, the individual must be able to:
• Describe the principles of electricity.
• Apply the principles of electricity.
• Describe electrical circuit components.
• Describe electrical circuit concepts.
• Apply electrical circuit concepts.

LEARNING TASKS

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 methods of producing electricity
   • Triboelectric effect
   • Electrochemical effect
   • Piezoelectric effect
   • Thermoelectric effect
   • Photovoltaic effect
   • Magneto electric effect

4. Describe electrical quantities, units and symbols
   • Coulomb
   • Ampere
   • Volt
   • Ohm
   • Watt
   • Joule

5. Perform calculations using Ohm’s Law and Watt’s Law
   • Ohm’s Law
   • Watt’s Law
   • Solving problems
   • Converting between metric prefixes
**LEARNING TASKS**

6. Describe the relationship between electrical power and energy

7. Identify common drawings for electric circuits

8. Describe the basic operation of electric circuits

9. Calculate values of voltage, current, resistance and power in electric circuits

10. Describe meters for measurements in electric circuits

11. Describe features of resistors

12. Describe features of switches

13. Describe features of circuit protection devices

14. Describe the characteristics of common conducting materials and conductor forms

**CONTENT**

- Power and energy calculations
- Percent efficiency
- Reasons for different voltage levels

- Pictorial diagram
- Block diagram
- One-line diagram
- Wiring diagram
- Schematic diagram

- Circuit terminology
- Circuit components
- Polarity and current flow

- Ohm’s Law
- Watt’s Law
- Factors affecting resistance
- Power dissipation in resistance devices
- Voltage drop and power loss in conductors

- Safety precautions
- Voltmeter use
- Ammeter use
- Ohmmeter use
- Multimeter use
- Reading scales

- Common types and ratings
- Resistor colour codes
- Potentiometers and rheostats

- Terminology
- Switch classifications
- Circuit applications

- Terminology
- Fuses
- Circuit breakers

- Properties of conducting materials
- Solid conductors
- Stranded conductors
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Program Overview
Level 1

Line (GAC): D APPLY CIRCUIT CONCEPTS
Competency: D2 Analyze DC Circuits

Objectives
To be competent in this area, the individual must 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.
• Describe the operating principles of voltage dividers.
• Analyze voltage dividers.
• Describe the operating principles of bridge circuits.
• Analyze bridge circuits.
• Describe the operating principles of three-wire circuits.
• Analyze three-wire circuits.

LEARNING TASKS
1. Describe the characteristics of a series circuit
   • Connection of components
   • Polarity
   • Resistance, voltage and current
   • Effects of an open
   • Circuit applications

2. Solve problems involving series circuits
   • Development of schematic diagrams
   • Kirchhoff’s Voltage Law
   • Resistance, voltage, current and power calculations

3. Describe effects of voltage sources in series
   • Series aiding EMFs
   • Series opposing EMFs

4. Connect and test series circuits
   • Component selection
   • Circuit connections and measurements
   • Testing and troubleshooting
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| 5. Describe the characteristics of a parallel circuit | • Connection of components  
• Polarity  
• Voltage, current and resistance  
• Effects of an open  
• Circuit applications |
| 6. Solve problems involving parallel circuits        | • Development of schematic diagrams  
• Kirchhoff’s Current Law  
• Resistance, voltage, current and power calculations  
• Branch current proportionality |
| 7. Describe effects of voltage sources in parallel   | • Polarity and connections  
• Standby (backup) systems |
| 8. Connect and test parallel circuits                | • Component selection  
• Circuit connections and measurements  
• Testing and troubleshooting |
| 9. Describe the characteristics of a combination circuit | • Connection of components  
• Polarity  
• Voltage, current and resistance  
• Effects of an open  
• Circuit applications |
| 10. Solve problems involving combination circuits     | • Development of schematic diagrams  
• Kirchhoff’s Voltage and Current laws  
• Series equivalent circuits  
• Resistance, voltage, current and power calculations |
| 11. Connect and test combination circuits            | • Component selection  
• Circuit connections and measurements  
• Testing and troubleshooting |
| 12. Describe the characteristics of a voltage divider circuit | • Connection of components  
• Polarity  
• Voltage, current and resistance  
• Loading effects  
• Positive and negative voltages  
• Potentiometer circuits  
• Applications |
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<td>14. Connect and test voltage divider circuits</td>
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<td>19. Solve problems involving three-wire circuits</td>
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<td>• Testing and troubleshooting</td>
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</table>
**Line (GAC):** D  **APPLY CIRCUIT CONCEPTS**  
**Competency:** D3  **Solve Problems Using the Principles of Electromagnetism**

**Objectives**
To be competent in this area, the individual must be able to:
- Describe the principles of electromagnetism.
- Solve problems involving magnetic circuits.

**LEARNING TASKS**

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<th>LEARNING TASKS</th>
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</table>
| 1. Describe the characteristics of magnetic lines of force                     | • Direction of magnetic fields  
• Magnetic loops  
• Magnetic tension  
• Laws of attraction and repulsion  
• Magnetic screens  
• Methods of magnetizing and demagnetizing ferromagnetic materials           |
| 2. Describe the effects of current carrying conductors and coils              | • Left hand rule for current carrying conductors  
• Parallel current carrying conductors  
• Left hand rule for coils  
• Features of electromagnets                                                   |
| 3. Describe terminology and units of measure for magnetic circuits            | • Magneto motive force  
• Magnetic flux and flux density  
• Reluctance and permeability  
• Saturation and hysteresis  
• Residual magnetism  
• Magnetic cores and air gaps                                                   |
| 4. Describe applications of magnetic devices                                 | • Lifting magnets  
• Solenoids and relays  
• Bells and buzzers  
• Magnetic circuit breaker  
• Field poles for motors and generators                                         |
| 5. Solve problems involving electromagnetic circuits                          | • Magneto motive force  
• Magnetizing force  
• Magnetic flux and flux density  
• Reluctance and permeability  
• Saturation and hysteresis  
• Magnetic cores and air gaps                                                   |
## Line (GAC): D APPLY CIRCUIT CONCEPTS
### Competency: D6 Analyze Electronic Circuits

### Objectives
To be competent in this area, the individual must be able to:

- Describe operating principles of diodes in DC circuits.
- Analyze DC electronic circuits that utilize diodes.
- Describe operating principles of BJTs in DC circuits.
- Analyze DC electronic circuits that utilize BJTs.

### LEARNING TASKS

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# Program Overview

**Level 1**

**Line (GAC):** E  USE TEST EQUIPMENT  
**Competency:** E1  Use Analog Meters

## Objectives

To be competent in this area, the individual must be able to:

- Select appropriate analog meters.
- Use analog meters.
- Maintain analog meters.

## LEARNING TASKS

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| 2. Use analog meters    | Voltmeters  
|                        | Ammeters  
|                        | Ohmmeters  
|                        | Wattmeters  
|                        | Plunge testers  
|                        | E-field testers  
|                        | Meggers  
|                        | Multimeters  
| 3. Maintain analog meters | Safety  
|                          | Circuit placement  
|                          | Function (Multimeters)  
|                          | Ranges and specifications  
|                          | Polarity  
|                          | Reading scales  
|                          | Zero adjustment  
|                          | Stray magnetic fields  
|                          | Meter loading effect  

- Inspection  
- Storage  
- Part replacement
Program Overview
Level 1

Line (GAC): E USE TEST EQUIPMENT
Competency: E2 Use Digital Meters

Objectives
To be competent in this area, the individual must be able to:
- Select appropriate digital meters.
- Use digital meters.
- Maintain digital meters.

LEARNING TASKS

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1. Describe digital multimeter functions

2. Describe power measurements

3. Describe insulation resistance

- Digital wattmeter
- Using a wattmeter
- Digital megger
- Using a megger to test insulation
  - Safety
  - Drain charge
LEARNING TASKS

4. Use digital meters
   • Describe the features of digital meters
   • Digital meter safety
   • Circuit placement
   • Polarity indicator
   • Test meter
   • DMM voltage measurement
     o AC voltage measurement with DMM
     o DC voltage measurement with DMM
   • Connecting a DMM in-line for measuring AC amps
   • Connecting a DMM in-line for measuring DC amps
   • Using DMM Ohms function to measure resistance
   • DMM category ratings
   • Meter leads
   • Personal protective equipment

5. Maintain digital meters
   • Inspection
   • Storage
   • Calibration
   • Service
   • Battery replacement
   • DMM fuse replacement

6. Explain meter readings
   • Digital display
   • Symbols
   • Bar graph readings
   • Resolution
   • Accuracy
   • Counts
   • Manual and auto-range
   • Hold function
   • MIN MAX mode
   • Ghost voltages
Line (GAC): F READ AND INTERPRET DRAWINGS AND MANUALS
Competency: F1 Use Circuit Drawings

Objectives
To be competent in this area, the individual must be able to:
- Use schematic drawings.
- Use wiring diagrams.
- Use single line diagrams.
- Interpret information contained in manuals.

LEARNING TASKS

1. Identify symbols
   - Components
   - Line weights
   - Conventions
   - Labels

2. Describe conventions for schematic diagrams
   - Use of lines
   - Arrangement of components
   - Labels and identification

3. Describe conventions for wiring diagrams
   - Use of lines
   - Arrangement of components
   - Labels and identification

4. Describe the conventions for single-line diagrams
   - Use of lines
   - Arrangement of components
   - Labels and identification

5. Use diagrams to convey information
   - Schematic
   - Wiring
   - Single-line

6. Convert between schematic and wiring diagrams
   - Diagram layouts
   - Wiring numbering system
**Program Overview**

**Level 1**

### Line (GAC): F READ AND INTERPRET DRAWINGS AND MANUALS

**Competency:** F2 Use Construction Drawings and Specifications

#### Objectives

To be competent in this area, the individual must be able to:

- Locate information found on working drawings.
- Interpret information found on working drawings.
- Coordinate information found on various drawings and supporting material.
- Modify drawings to reflect changes made during construction.

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<td>• Branch circuits</td>
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LEARNING TASKS

5. Describe common drawing conventions
   - Index page
   - Title blocks
   - Scales
   - Use of lines
   - Keys, legends and notes
   - Schedules
   - Specifications

6. Describe electrical working drawings
   - Electrical site/plot plans
   - Electrical floor plans
   - Electrical elevation drawings
   - Electrical sectional drawings
   - Electrical detail drawings
   - “As-built” drawings (record drawings)
   - Branch circuits

7. Use prints, drawings and specifications to locate information
   - Select drawings
   - Read specifications
   - Identify schedules
   - Identify symbols
   - Determine code requirements
   - Branch circuits
**Program Overview**
**Level 1**

**Line (GAC):** F  **READ AND INTERPRET DRAWINGS AND MANUALS**

**Competency:** F3  **Use Manuals and Manufacturers’ Instructions**

**Objectives**
To be competent in this area, the individual must be able to:
- Apply information normally contained in manuals and instructions.

**Learning Tasks**

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<tbody>
<tr>
<td>1. Identify information normally found in manuals and instructions</td>
<td>- Safety</td>
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<td>- Models</td>
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<td>- Manufacturers’ contact information</td>
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<td>- Warranty information</td>
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<td>2. Locate information in manuals and instructions</td>
<td>- Section layout</td>
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<td></td>
<td>- Manufacturers’ contact information</td>
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</tbody>
</table>
Line (GAC): F  READ AND INTERPRET DRAWINGS AND MANUALS
Competency: F4  Plan Time and Materials

Objectives
To be competent in this area, the individual must be able to:
• Assess material requirements for a job.
• Assess tool requirements for a job.
• Assess labour requirements for a job.

LEARNING TASKS
1. Assess material requirements
   • Lengths
   • Quantity
   • Devices

2. Assess tool requirements
   • General
   • Specialized
   • Access equipment
   • Safety

3. Assess labour requirements
   • Persons
   • Time
   • Skills
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G1 Apply Codes, Regulations and Standards

Objectives
To be competent in this area, the individual must be able to:
• Interpret and apply codes, regulations and standards.

LEARNING TASKS

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
   • Electrical Safety Act and Regulations
   • Directives
   • Information bulletins
   • Permits and inspections
   • Equipment certification agencies

3. Interpret applicable CEC rules and regulations from:
   - Section 0
   - Section 2
   - Section 4
   - Section 6
   - Section 8
   - Section 10
   - Section 12
   - Section 14
   - Section 16
   - Section 26
   - Section 76
   • Definitions
   • Application of general rules
   • Conductor size and ampacity
   • Use of Tables 1 to 5c
   • Colour of conductors
   • Service equipment
   • Residential loads and demand factors
   • Branch circuit calculations
   • Single family service demand calculations
   • Purpose for grounding and bonding
   • Grounding conductor size
   • Wiring methods - general
   • Non-metallic sheathed cables
   • Armoured cables
   • Boxes, fittings and accessories
   • Protective devices - general
   • Ground-fault interrupters and arc-fault interrupters
   • Class 2 circuits
   • Receptacles in residential dwellings
   • Branch circuits in residential dwellings
   • Temporary construction service requirements
LEARNING TASKS

4. Identify applicable codes and regulations

5. Apply applicable codes and regulations

CONTENT

- British Columbia Building Code
- Provincial regulations
- Municipal regulations (bylaws)
- CSA standards
- WorkSafeBC

- Reference installations
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G2 Install Service Equipment

Objectives
To be competent in this area, the individual must be able to:
• Determine single-phase residential service equipment requirements.

LEARNING TASKS

1. Describe the features of a single-phase, three-wire distribution system
   - Circuit connections and grounding
   - Metering
   - Protection and control
   - Shock hazards and safety

2. Describe service entrance equipment
   - Overhead and underground services
   - Meter base
   - Main service panel
   - Grounding and bonding

3. Determine single-phase service requirements
   - Permanent
   - Temporary
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G3 Install Grounding and Bonding

Objectives
To be competent in this area, the individual must be able to:
- Describe the objectives of grounding and of bonding as applied to DC and residential single-phase systems.
- Discriminate between grounding and bonding.
- Apply grounding and bonding techniques to DC and single-phase systems.

**LEARNING TASKS**

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<tr>
<td>1. Describe the objectives of grounding</td>
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<td>- System ground</td>
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<td>- Equipment ground</td>
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<td>- Limit voltage to ground</td>
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<td>- Shock hazard</td>
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<td>- Fire prevention</td>
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<td>- Overcurrent operation</td>
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<td>2. Describe the objectives of bonding</td>
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<td>- Shock hazard</td>
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<td>- Overcurrent operation</td>
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<td>- Eliminate potential differences</td>
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<td>3. Select appropriate materials for grounding and bonding</td>
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<td>- Raceways</td>
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<td>- Electrodes</td>
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<td>- Connections</td>
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<td>4. Determine grounding and bonding requirements</td>
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<td>- Sizing</td>
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<td>- Terminating</td>
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<tr>
<td>- Testing</td>
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</table>
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS  
Competency: G4 Install Distribution Centres

**Objectives**
To be competent in this area, the individual must be able to:
- Identify types of single-phase distribution centres.
- Identify appropriate single-phase distribution components.
- Determine single-phase distribution centre requirements.

**LEARNING TASKS**

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<th>LEARNING TASK</th>
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<td>1. Identify types of distribution centres</td>
<td>• Load centres</td>
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<td>• Combination panels</td>
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<td>• Switches</td>
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<td>2. Identify components of distribution centres</td>
<td>• Overcurrent protection</td>
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<td>• Busbars</td>
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<td>• Enclosure type</td>
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<td>• Enclosure rating</td>
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<td>3. Determine distribution centre requirements</td>
<td>• Mounting requirements</td>
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<td>• Clearance requirements</td>
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<td>• Seismic requirements</td>
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<td>• Torque requirements</td>
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<td>• Ventilation</td>
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<td>• Environmental considerations</td>
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</table>
Program Overview
Level 1

Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G5 Install Raceways, Boxes and Fittings

Objectives
To be competent in this area, the individual must be able to:
- Identify raceways for residential circuits.
- Identify boxes and fittings for residential circuits.
- Determine raceway, box and fitting requirements in residential circuits.
- Describe procedures to create and seal openings for residential circuits.

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<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Identify raceways | • Conduit  
  o Rigid  
  o Flexible  
  o Liquid-tight  
  • Electrical metallic tubing  
  • Electrical non-metallic tubing  
  • Surface raceways |
| 2. Identify boxes and fittings | • Boxes  
  • Cabinets  
  • Outlets  
  • Terminal fittings |
| 3. Determine raceways, boxes, cabinets and fittings requirements | • Environmental considerations  
  • Mechanical considerations  
  • Seismic requirements  
  • Fire stopping  
  • Manufacturers’ specifications  
  • Bonding  
  • Support  
  • Size  
  • Fill  
  • Pulling considerations  
  • Access  
  • Bending  
  • Spacing  
  • Underground  
  • Sealing and draining  
  • Barriers  
  • Vapour barriers |
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G6 Install Conductors and Cables

Objectives
To be competent in this area, the individual must be able to:
- Identify conductors and cables for residential circuits.
- Determine conductor and cable requirements in residential circuits.

LEARNING TASKS

1. Identify conductors
   - Insulation type
   - Insulation temperature
   - Insulation voltage rating
   - Conductor material
   - Solid or stranded
   - AWG
   - Colour coding
   - Conditions of use

2. Identify cables
   - Cable type
     - Armoured
     - Non-metallic sheath
     - Neutral supported
     - Flexible cord
   - Insulation type
   - Insulation temperature
   - Insulation voltage rating
   - Conductor material
   - Solid or stranded
   - AWG
   - Colour coding
   - Conditions of use
   - FT rating

3. Determine conductor requirements
   - Ampacities
   - Derating
   - Conditions of use
   - Conduit fill
   - Voltage rating
   - Voltage drop
   - Splicing and termination
### LEARNING TASKS

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<td>Support</td>
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<td>Mechanical protection</td>
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<td>Clearance</td>
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<td>Spacing</td>
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<td>Colour coding</td>
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<td>Protection</td>
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<td>Insulation testing</td>
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<td>Fire stopping</td>
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4. Determine cable requirements

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<td>Ampacities</td>
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<td>Derating</td>
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<td>Conditions of use</td>
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<td>Voltage rating</td>
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<td>Voltage drop</td>
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<td>Splicing and termination</td>
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<tr>
<td>Raceways</td>
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<tr>
<td>Open wiring</td>
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<tr>
<td>Support</td>
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<td>Conductor identification</td>
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<td>Protection</td>
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<td>Fire stopping</td>
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<td>Strain relief</td>
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<td>Bonding</td>
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<td>Bend radii</td>
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</table>
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G7 Install Utilization Equipment and Devices

Objectives
To be competent in this area, the individual must be able to:
• Determine device installation requirements for residential branch circuits.
• Describe device testing requirements.

LEARNING TASKS
1. Identify devices

   • Switches
     o Ratings
     o Evidence of approval
     o Poles and throws
     o Styles
     o Activation methods
     o Grades
   
   • Receptacles
     o Ratings
     o Evidence of approval
     o Configurations
     o Grades
     o Single/Duplex
     o Isolated ground
   
   • Equipment
     o Ratings
     o Evidence of approval
     o Environmental

2. Determine device installation requirements

   • Wiring methods
   • Environmental considerations
   • Orientation
   • Polarity
   • Location
   • Spacing
   • Finishes
   • Bonding
   • Support
   • Seismic considerations
   • Construction specification requirements
   • Manufacturers’ specifications
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<td>3. Describe device testing requirements</td>
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<td>• Sensor operation</td>
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<td>• Log records</td>
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<td>• Commissioning</td>
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</table>
Line (GAC): H  Install Electrical Equipment
Competency: H3  Install Protective Devices

Objectives
To be competent in this area, the individual must be able to:
• Identify protective devices for single-phase installations.
• Determine protective device requirements in single-phase installations.

LEARNING TASKS
1. Identify protective devices

   • Fuses
   • Breakers
     o Ratings
   • Ground Fault Circuit Interrupters (GFCI)
     o Class A ratings
   • Arc Fault Circuit Interrupters (AFCI)

2. Determine protective device requirements

   • Safety
   • Mounting techniques
   • Fuse pullers
   • Renewable links
Line (GAC): I  INSTALL CONTROL CIRCUITS AND DEVICES
Competency: I1 Install Manual Motor Controls

Objectives
To be competent in this area, the individual must be able to:
- Describe the features of manual motor starters.
- Draw diagrams for manual AC motor starters.
- Describe safe procedures for working around motors and controls.
- Connect and maintain manual motor starters.

LEARNING TASKS

1. Describe the features of manual motor starters
   • Toggle switch type
   • Pushbutton type
   • Drum switch type
   • Overload protection
   • Under-voltage release
   • Starter ratings

2. Draw diagrams for manual AC motor starters
   • Single-pole switch
   • Double-pole switch
   • Three-pole switch

3. Describe safe procedures for working around motors and controls
   • Mechanical hazards
   • Electrical hazards
   • WCB regulations
   • Safety lockout

4. Connect and maintain manual motor starters
   • Equipment selection
   • Connection of components
   • Testing and troubleshooting
Line (GAC):  I
Competency:  I2 Install Magnetic Motor Controls

Objectives
To be competent in this area, the individual must be able to:
• Describe the operating principles of magnetic motor control circuits.
• Connect and maintain magnetic motor control circuits.

LEARNING TASKS

1. Describe the features of three-phase, AC magnetic motor starters

2. Describe the operation of across-the-line magnetic starters

3. Develop schematic and wiring diagrams for three-phase magnetic starters

4. Describe features of control relays

5. Describe the operation of jogging circuits

6. Describe the operation of reversing magnetic starters

7. Describe safety lockout procedures

CONTENT

- Contactor types
- Overload relays
- Starter ratings
- Power circuit components
- Control circuit components
- Two-wire control circuits
- Three-wire control circuits
- Comparison of schematic and wiring diagrams
- Wire numbering systems
- Converting between schematic and wiring diagrams
- Control relays
- Timing relays
  - Off delay
  - On delay
  - Pneumatic
  - Dash-pot
- Latching relays
- Pushbutton circuits
- Selector switch circuits
- Control relay circuits
- Power circuit components
- Control circuit components
- Electrical and mechanical interlocking
- Safety isolation requirements
- WCB rules and regulations
LEARNING TASKS

8. Describe basic troubleshooting procedures

CONTENT

- Visual inspections
  - Checking for incoming power
  - Control circuit testing by measurement
Level 2
Construction Electrician
Line (GAC): A USE ESSENTIAL SKILLS  
Competency: A4 Solve Problems Using Applied Mathematics

Objectives
To be competent in this area, the individual must be able to:
• Solve problems using applied mathematics.

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<td>• Types of triangles</td>
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<td>• Symbols and labels</td>
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<td>• Pythagorean theorem</td>
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<td>2. Describe the relationship between sides and angles for right triangles</td>
<td>• Ratios of sides and angles</td>
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<td>• Sine function</td>
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<td>• Cosine function</td>
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<td>• Tangent function</td>
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<td>• Pythagorean theorem</td>
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<tr>
<td>3. Solve problems involving right triangles by applying basic trigonometry</td>
<td>• Lines, angles and triangles</td>
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<td>• Trig functions</td>
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<td>• Pythagorean theorem</td>
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<td>4. Describe standard conventions related to vectors</td>
<td>• Quadrants and coordinates</td>
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<td>• Direction and polarity</td>
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<td>5. Solve problems involving vectors</td>
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<td>• Vector additions</td>
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**Program Overview**
**Level 2**

**Line (GAC):** D  **APPLY CIRCUIT CONCEPTS**  
**Competency:** D1  **Use Electrical Circuit Concepts**

**Objectives**
To be competent in this area, the individual must be able to:
- Describe the principles of alternating current.
- Describe the principles of inductance and inductive reactance.
- Describe the principles of capacitance and capacitive reactance.
- Solve problems involving resistors, inductors, and capacitors in DC and AC circuits.

**LEARNING TASKS**

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<td>Features of alternators</td>
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<td>Development of a sine wave voltage</td>
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<td><strong>2. Describe the features of alternating current</strong></td>
<td>Advantages of AC</td>
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<td><strong>3. Describe the difference between DC ohmic and effective AC resistance</strong></td>
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<td><strong>4. Solve problems involving AC values</strong></td>
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<td><strong>5. Describe the principles of electromagnetic induction</strong></td>
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<td><strong>6. Describe the features of inductors</strong></td>
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<td><strong>7. Describe the action of inductors in DC circuits</strong></td>
<td>Counter EMF and current flow</td>
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</table>
| 8. Solve problems involving inductors in DC circuits | • Inductors in series  
• Inductors in parallel  
• Time constant curves |
| 9. Connect and test inductive DC circuits | • Component selection  
• Circuit connections and measurements  
• Testing and troubleshooting |
| 10. Describe the principles of electrostatic charges | • Electrostatic fields  
• Field force and intensity  
• Dielectric strength |
| 11. Describe the features of capacitors | • Factors affecting capacitance  
• Construction and types of capacitors  
• Units and terminology |
| 12. Describe the action of capacitors in DC circuits | • Stored charge and current flow  
• Capacitive time constants  
• Stored energy and discharge |
| 13. Solve problems involving inductors in DC circuits | • Capacitors in series  
• Capacitors in parallel  
• Time constant curves |
| 14. Connect and test capacitive DC circuits | • Component selection  
• Circuit connections and measurements  
• Testing and troubleshooting |
| 15. Describe the behaviour of inductors in AC circuits | • Voltage and current relationships  
• Inductive reactance ($X_L$)  
• Reactive power  
• Non-inductive coils  
• Saturable reactors  
• Safety hazards |
| 16. Solve problems involving inductive reactance | • Inductors in series  
• Inductors in parallel  
• Frequency and inductive reactance  
• Voltage, current and power |
| 17. Connect and test inductive AC circuits | • Component selection  
• Circuit connections and measurements  
• Testing and troubleshooting |
LEARNING TASKS

18. Describe the behaviour of capacitors in AC circuits
   • Voltage and current relationships
   • Capacitive reactance \((X_C)\)
   • Reactive power
   • Safety hazards

19. Solve problems involving capacitive reactance
   • Capacitors in series
   • Capacitors in parallel
   • Frequency and capacitive reactance
   • Voltage, current and power

20. Connect and test capacitive AC circuits
   • Component selection
   • Circuit connections and measurements
   • Testing and troubleshooting

21. Describe the factors affecting impedance
   • Effective AC resistance
   • Inductive reactance
   • Capacitive reactance
   • Impedance calculations
   • Phase angle

22. Describe the factors affecting power factor
   • True power
   • Reactive power
   • Apparent power
   • Power triangle calculations
   • Phase angle

23. Measure and calculate the impedance and power factor in an AC circuit
   • Component selection
   • Circuit connections and measurements
   • Applied calculations
Program Overview
Level 2

Line (GAC): D  APPLY CIRCUIT CONCEPTS
Competency: D4  Analyze Single-phase AC Circuits

Objectives
To be competent in this area, the individual must be able to:
• Describe the operating principles of single-phase AC series circuits.
• Analyze single-phase AC series circuits.
• Describe the operating principles of single-phase AC parallel circuits.
• Analyze single-phase AC parallel circuits.
• Describe the principles of power factor correction.
• Solve problems involving power factor correction.
• Insert capacitors for power factor correction.

LEARNING TASKS

1. Describe the effects of a series AC circuit containing resistance and inductance (R-L)
   • Current and voltage phase relationships
   • Impedance and lagging power factor
   • Vector diagrams

2. Describe the effects of a series AC circuit containing resistance and capacitance (R-C)
   • Current and voltage phase relationships
   • Impedance and leading power factor
   • Vector diagrams

3. Describe the effects of a series AC circuit containing resistance, inductance and capacitance (R-L-C)
   • Current and voltage phase relationships
   • Impedance and power factor
   • Vector diagrams
   • Series resonant circuits

4. Solve problems and describe applications involving series AC circuits
   • Voltage, current and power
   • Impedance and power factor
   • Vector diagrams
   • Applications

5. Connect and test series AC circuits
   • Component selection
   • Circuit connections and measurements
   • Testing and troubleshooting

6. Describe the effects of a parallel AC circuit containing branches of resistance and inductance (R-L)
   • Current and voltage phase relationships
   • Impedance and lagging power factor
   • Vector diagrams
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<td>• Applied calculations</td>
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<td>• Circuit connections and measurements</td>
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<td>• Testing and troubleshooting</td>
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</table>
Line (GAC): D APPLY CIRCUIT CONCEPTS
Competency: D6 Analyze Electronic Circuits

Objectives
To be competent in this area, the individual must be able to:
- Describe the application of diodes in rectifiers.
- Analyze single-phase rectifier circuits.
- Analyze AC electronic circuits that utilize bipolar-junction transistors (BJTs).
- Describe operating principles of field effect transistors (FETs) and insulated gate bipolar transistors (IGBTs).
- Analyze electronic circuits that utilize FETs and IGBTs.

LEARNING TASKS

1. Describe the operation of single-phase AC rectifier circuits
   - Half-wave rectifier circuits
   - Full-wave (bi-phase) rectifier circuits
   - Full-wave bridge rectifier circuits

2. Describe the operation of filters for rectifier circuits
   - Capacitance filters
   - Inductance filters
   - PI filters

3. Determine values for rectified power supplies
   - Diode ratings
   - Output voltage, current and power values
   - Filter devices
   - Zener regulators

4. Describe the features of the bipolar-junction transistor
   - Construction of bipolar-junction transistors
   - Transistor symbols and lead designation
   - Common transistor-case styles
     - Signal transistors
     - Power transistors

5. Describe the basic applications of the junction transistor
   - Cascaded transistor circuits
   - AC/DC amplifier circuit
   - Terms and abbreviations
6. Describe the features of field effect transistors and IGBTs

- Amplifier circuit
- Terms and abbreviations
- Ratings and specifications
- Channel types
- Advantages/disadvantages
- Data sheets
- Symbols and lead identification
- Common case styles
Line (GAC): E USE TEST EQUIPMENT
Competency: E3 Use Scopes

Objectives
To be competent in this area, the individual must be able to:
• Use an oscilloscope.
• Use a scope meter.

LEARNING TASKS
1. Describe the basic features of the oscilloscope
   • Applications
   • Basic operating principle
   • CRT construction and operation
     o Electron gun
     o Vertical-deflection plates
     o Horizontal-deflection plates
     o Fluorescent screen
     o Action of the deflecting plates
   • Digital scopes

2. Describe the basic controls on a dual-trace oscilloscope
   • Oscilloscope terms
     o Horizontal axis (x)
     o Vertical axis (y)
     o Sweep
     o Sweep time
     o Level
     o Channel
     o Dual-trace oscilloscope
     o Probes
     o Calibration
     o Beam finder
     o Stability
   • Oscilloscope controls
     o CRT and power controls
       o Power switch
       o Intensity
       o Focus
       o Trace rotation
       o Stability
       o Astigmatism
     • Vertical controls
       o Vertical position
### LEARNING TASKS

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<td>• Calibration signal source terminal</td>
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<td>• Trigger level</td>
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<td>• Slope</td>
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3. **Describe the calibration and safe use of an oscilloscope**
   - Safe usage and storage
   - Oscilloscope calibration
   - Oscilloscope probe
     - Probe calibration
     - Probe multipliers (or attenuators)
   - Precautions with oscilloscopes
     - Short circuit due to probe connection
     - Use of isolation transformer
     - Screen burning
     - Using two probes

4. **Use an oscilloscope for circuit measurements**
   - Amplitude
   - Time and frequency
   - Phase displacement

5. **Describe the use of a scope meter**
   - Safe usage and storage
   - Oscilloscope probe
   - Precautions with scope meters

6. **Use a scope meter for circuit measurement**
   - Amplitude
   - Time and frequency
   - Phase displacement
Program Overview
Level 2

Line (GAC): F READ AND INTERPRET DRAWINGS AND MANUALS
Competency: F2 Use Construction Drawings and Specifications

Objectives
To be competent in this area, the individual must be able to:
- Locate information found on working drawings.
- Interpret information found on working drawings.
- Coordinate information found on various drawings and supporting material.
- Modify drawings to reflect changes made during construction.

LEARNING TASKS

1. Describe common construction drawings and their major divisions
   - Divisions
     - Architectural
     - Structural
     - Mechanical
     - Plumbing
     - Electrical
   - Working drawings
     - Site/plot plan
     - Plan drawings
     - Elevation drawings
     - Sectional drawings
     - Detail drawings
   - Single-phase installations

2. Describe electrical working drawings
   - Electrical site/plot plans
   - Electrical floor plans
   - Electrical elevation drawings
   - Electrical sectional drawings
   - Electrical detail drawings
   - “As-built” drawings (record drawings)
   - Single-phase installations

3. Use prints, drawings and specifications to locate information
   - Select drawings
   - Read specifications
   - Identify schedules
   - Identify symbols
   - Determine code requirements
   - Single-phase installations
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G1 Apply Codes, Regulations and Standards

Objectives
To be competent in this area, the individual must be able to:
• Interpret and apply codes, regulations and standards.

LEARNING TASKS

1. Interpret applicable CEC rules and regulations from:
   ‒ Section 0
   ‒ Section 2
   ‒ Section 4
   ‒ Section 6
   ‒ Section 8
   ‒ Section 10
   ‒ Section 12
   ‒ Section 14
   ‒ Section 16
   ‒ Section 26
   ‒ Section 28
   ‒ Section 30
   ‒ Section 34
   ‒ Section 62

   CONTENT
   • Definitions and general requirements
   • Application of general rules
   • Sheath currents
   • Size of neutral conductors
   • Service requirements
   • Types of conductors
   • Use of neutral supported cables
   • Loads and demand factors
   • Service and branch circuit calculations
   • Single-phase apartment service calculations
   • Size of grounding and bonding conductors
   • Installation of grounding electrodes
   • Parallel conductors
   • High interrupting capacity (HRC) fuses
   • Knife switches
   • Class 1 circuits
   • Transformer and capacitor circuits
   • Motor branch circuits and feeders
   • Motor protection
   • Installation of lighting equipment
   • Signs and outline lighting
   • Installation of heating circuits
   • Heating circuit ampacity and overcurrent rating

2. Calculate service entrance requirements

   CONTENT
   • Total calculated loads
   • Service conductor ratings
   • Main service panel ratings
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G2 Install Service Equipment

Objectives
To be competent in this area, the individual must be able to:
• Determine single-phase service requirements.

LEARNING TASKS

1. Describe the features of a single-phase, three-wire distribution system
   • Circuit connections and grounding
   • Metering
   • Protection and control
   • Shock hazards and safety

2. Determine service entrance requirements
   • Overhead and underground services
   • Meter base
   • Main service panel
   • Grounding and bonding
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G3 Install Grounding and Bonding

Objectives
To be competent in this area, the individual must be able to:
- Describe the objectives of grounding and of bonding as applied to single-phase systems.
- Determine grounding and bonding requirements for single-phase systems.

LEARNING TASKS

1. Describe the objectives of grounding
   - System ground
   - Equipment ground
   - Limit voltage to ground
   - Shock hazard
   - Fire prevention
   - Overcurrent operation

2. Describe the objectives of bonding
   - Shock hazard
   - Overcurrent operation
   - Eliminate potential differences
   - Non-electrical equipment

3. Select appropriate materials for grounding and bonding
   - Raceways
   - Materials
   - Electrodes
   - Conductors
   - Connections
   - Equipment

4. Determine grounding and bonding requirements
   - Sizing
   - Terminating
   - Testing
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G4 Install Distribution Centres

**Objectives**
To be competent in this area, the individual must be able to:
- Identify types of single-phase distribution centres.
- Identify appropriate single-phase distribution components.
- Determine single-phase distribution centre requirements.

**LEARNING TASKS**

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<td>• Load centres&lt;br&gt;• Combination panels&lt;br&gt;• Splitters and switches&lt;br&gt;• Meter stacks&lt;br&gt;• Motor control centres</td>
</tr>
<tr>
<td>2. Identify components of distribution centres</td>
<td>• Overcurrent protection&lt;br&gt;• Overload protection&lt;br&gt;• Busbars&lt;br&gt;• Power factor correction&lt;br&gt;• Enclosure type&lt;br&gt;• Enclosure rating</td>
</tr>
<tr>
<td>3. Determine distribution centre requirements</td>
<td>• Mounting requirements&lt;br&gt;• Clearance requirements&lt;br&gt;• Seismic requirements&lt;br&gt;• Lug rating&lt;br&gt;• Torque requirements&lt;br&gt;• Means of egress&lt;br&gt;• Ventilation&lt;br&gt;• Environmental considerations</td>
</tr>
</tbody>
</table>
Program Overview
Level 2

Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G5 Install Raceways, Boxes and Fittings

Objectives
To be competent in this area, the individual must be able to:
• Identify raceways for single-phase installations.
• Identify boxes and fittings for single-phase installations.
• Determine raceway, box and fitting requirements in single-phase installations.
• Describe procedures to create and seal openings for circuits.

LEARNING TASKS

1. Identify raceways
   • Conduit
   • Tubing
   • Surface raceways
   • Under floor raceways
   • Cellular floors
   • Auxiliary gutters
   • Bus ways and splitters
   • Wire ways
   • Manufactured wiring systems

2. Identify boxes and fittings
   • Boxes
   • Cabinets
   • Outlets
   • Terminal fittings

3. Determine raceway requirements
   • Environmental considerations
   • Mechanical considerations
   • Seismic requirements
   • Manufacturers’ specifications
   • Bonding
   • Support
   • Size
   • Fill
   • Pulling considerations
   • Access
   • Bending
   • Spacing
   • Underground
   • Sealing and draining
   • Barriers
LEARNING TASKS

4. Determine box and fitting requirements

5. Describe procedures to create and seal openings

CONTENT

- Environmental considerations
- Mechanical considerations
- Seismic requirements
- Manufacturers’ specifications
- Vapour barrier
- Bonding
- Support
- Size
- Fill
- Pulling considerations
- Access
- Knockout layout
- Identification
- Barriers
- X-ray coring
- Fire stopping
- Structural considerations
- Pressurized areas
**Program Overview**  
**Level 2**

**Line (GAC):** G  INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS  
**Competency:** G6  Install Conductors and Cables

### Objectives

To be competent in this area, the individual must be able to:
- Identify conductors and cables for circuits.
- Determine conductor and cable requirements in circuits.

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<td>• Insulation types</td>
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<td>• Conductor material</td>
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LEARNING TASKS

4. Determine cable requirements

CONTENT
- Raceways
- Open wiring
- Support
- Mechanical protection
- Clearance
- Spacing
- Colour coding
- Protection
- Insulation testing
- Fire stopping

- Ampacities
- Derating factors
- Conditions of use
- Voltage ratings
- Voltage drop
- Pulling lubricants
- Pulling methods
- Parallel runs
- Temperature during installation
- Splicing and termination
- Raceways
- Open wiring
- Support
- Mechanical protection
- Clearance
- Spacing
- Colour coding
- Conductor identification
- Protection
- Insulation testing
- Sheath currents
- FT ratings
- Fire stopping
- Strain relief
- Bonding
- Bend radii
Program Overview  
Level 2

Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS  
Competency: G7 Install Utilization Equipment and Devices

Objectives
To be competent in this area the individual must be able to:
- Determine device installation requirements for branch circuits.
- Describe procedures to test devices.

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| 1. Identify devices | - Switches  
| | - Receptacles  
| | - Utilization equipment |
| 2. Determine device installation requirements | - Wiring methods  
| | - Environmental considerations  
| | - Orientation  
| | - Polarity  
| | - Location  
| | - Spacing  
| | - Finishes  
| | - Bonding  
| | - Support  
| | - Seismic considerations  
| | - Construction specification requirements  
| | - Manufacturers’ specifications |
| 3. Describe procedures to test devices | - Rotation  
| | - Sensor operation  
| | - Outlet analyzers  
| | - Log records  
| | - Commissioning |
**Program Overview**
**Level 2**

**Line (GAC):** H  **INSTALL ELECTRICAL EQUIPMENT**  
**Competency:** H1 Install Lighting and Lighting Controls

**Objectives**
To be competent in this area, the individual must be able to:
- Describe the operation of various lighting equipment.
- Select lighting equipment and controls.
- Connect and maintain lighting equipment and controls.
- Test and maintain lighting equipment.

**LEARNING TASKS**

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</table>
| 5. Describe the control of incandescent lamps | - Switches  
  - Single-pole  
  - Three-way  
  - Four-way  
- Switch ratings  
- Pull-type switches  
- Dimmer switches  
- Relays and contactors |
| 6. Describe the operation and construction of discharge lighting | - Types  
  - Fluorescent  
  - High pressure sodium  
  - Low pressure sodium  
  - Mercury vapour  
  - Metal halide  
- Operation characteristics  
- Constructional features |
| 7. Describe installation requirements for discharge lighting | - Control of discharge lighting  
- Fixtures used as raceways |
| 8. Describe troubleshooting procedures for discharge lighting circuits | - Checking ballasts  
- Checking starts  
- Mismatched components |
| 9. Describe the construction and features of high-intensity discharge lamps | - Mercury vapour lamp  
- Metal-halide lamps  
- High-pressure sodium lamp  
- Interchangeable HID lamps  
  - Shapes and sizes  
  - ANSI code designations |
| 10. Describe the components of high-intensity discharge luminaires | - Reactor ballast  
- Autotransformer ballast  
- Auto-regulator ballast  
- Regulator ballast  
- Two-lamp ballasts  
- High-pressure sodium ballasts  
- Polarization of lamp-holder  
- Ballast location  
- Controls |
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</table>
| 11. Describe basic troubleshooting for high-intensity discharge luminaires | • Checking  
  o Ballasts  
  o Lamps  
  o Supply voltage  
  o Defective controls  
  o Electrical connections |
| 12. Describe basic LED lighting | • Efficacy  
  • Life  
  • White light LEDs  
  • Advantages  
  • Disadvantages  
  • Applications |
| 13. Describe basic induction lighting | • Basic principle of operation  
  • Induced current in the lamp bulb  
  • Efficacy  
  • Life  
  • Advantages  
  • Disadvantages  
  • Applications |
Program Overview
Level 2

Line (GAC): H  INSTALL ELECTRICAL EQUIPMENT
Competency: H2  Install Transformers

Objectives
To be competent in this area, the individual must be able to:
- Connect and maintain single-phase transformers.
- Describe how to connect and operate transformers in parallel.
- Describe voltage-regulation and tap-changer equipment.
- Connect and maintain auto transformers.
- Describe how to connect and maintain instrument transformers.

LEARNING TASKS

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<th>LEARNING TASK</th>
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</table>
| 1. Describe the operating principles of a transformer | • Mutual induction  
• Basic construction  
• Voltage, current and flux relationships  
• Turns ratios  
• Transformer symbols  
• Terminology |
| 2. Calculate transformer values using ratios | • Voltage, current and turns ratios  
• Volt-ampere ratings  
• Impedance matching |
| 3. Describe transformer markings and ratings | • High voltage leads  
• Low voltage leads  
• Polarity  
• Transformer losses and efficiency  
• Use of nameplate data |
| 4. Describe transformer types and applications | • Remote control and signal transformers  
• Power and distribution transformers  
• Instrument transformers  
• Autotransformers  
• Special transformers |
| 5. Connect and maintain transformers for step-down and step-up applications | • Equipment selection  
• Circuit connections and measurements  
• Mounting  
• Seismic |
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• Step-up autotransformers  
• Multi-tap autotransformers  
• Variable autotransformers  
• Safety hazards |
| 16.  | Describe how standard two-winding transformers can be connected as autotransformers | • Buck-boost connections  
• Step-type voltage regulators |
| 17.  | Solve problems involving autotransformer calculations | • Voltage, current and turns ratios  
• kVA ratings  
• Multi-tap circuits  
• Buck-boost connections |
| 18.  | Connect and maintain autotransformer circuits | • Equipment selection  
• Circuit connections and measurements  
• Mounting  
• Seismic  
• Testing and troubleshooting |
| 19.  | Describe the features and applications of instrument transformers | • Current transformers  
• Potential transformers  
• Polarity markings  
• Safety hazards |
| 20.  | Illustrate instrument transformer connections | • Potential metering  
• Current metering  
• Power and energy metering  
• Protection circuits |
| 21.  | Solve problems involving instrument transformer calculations | • Voltage, current and turns ratios  
• Instrument multipliers |
| 22.  | Connect and maintain instrument transformer circuits | • Equipment selection  
• Circuit connections and measurements  
• Testing and troubleshooting |
Objectives
To be competent in this area, the individual must be able to:
- Identify protective devices for single-phase installations.
- Determine protective device requirements in single-phase installations.
- Describe procedures to test protective devices in single-phase installations.

LEARNING TASKS
1. Identify protective devices

CONTENT
- Fuses
  o Plug
  o Cartridge
  o Knife blade
  o Time delay
  o Class H (Code)
  o HRC
- Breakers
  o Magnetic (Instantaneous)
  o Thermal
- Ground fault circuit interrupters (GFCI)
  o Class A
    - Breakers
    - Receptacles
  o Class B
- Arc fault circuit interrupters (AFCI)
- Overloads
  o Thermal
  o Magnetic
  o Solid state
- Specifications
  o Continuous current
  o Interrupting capacity
  o Voltage rating
  o Time current characteristics
  o Body size
- Rejection features
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• Fault current calculations  
• Load calculations  
• Mounting techniques  
• Specifications  
  o Continuous current  
  o Interrupting capacity  
  o Voltage rating  
  o Body size  
  o Rejection features  
  o Fuse coordination  
  o Series rating  
• Fuse pullers  
• Renewable links |
| 3. Describe procedures to test protective devices | • Safety  
• Fuse troubleshooting  
  o Criss-cross method  
  o Visual inspection  
• GFCI  
• AFCI |
Line (GAC): I INSTALL CONTROL CIRCUITS AND DEVICES
Competency: I2 Install Magnetic Motor Controls

Objectives
To be competent in this area, the individual must be able to:
• Describe the operating principles of magnetic motor control circuits.
• Install and maintain magnetic motor control circuits.

LEARNING TASKS

1. Describe features of common control devices
   • Pressure switches
   • Float switches
   • Flow switches
   • Temperature switches
   • Limit switches
   • Proximity switches
   • Photoelectric switches

2. Describe features of control and time delay relays
   • Configurations and ratings
   • On-delay timers
   • Off-delay timers
   • Electronic timers
   • Programmable relays

3. Describe features and applications of plugging switches
   • Zero-speed switches
   • Lockout relay
   • Control circuits
     o Anti-plugging
     o Plugging

4. Develop circuit diagrams involving automatic and sequence control
   • Definite sequence control
   • Timed sequence control
   • Anti-plugging and plugging using timing relays
   • Pump motor control
   • Reversing starter control
   • Other applications

5. Connect and test circuits utilizing auxiliary control devices
   • Equipment selection
   • Connection of components
   • Testing and troubleshooting
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Level 3
Construction Electrician
**Program Overview**  
**Level 3**

**Line (GAC):** D  
**Competency:** D5  
**APPLY CIRCUIT CONCEPTS**  
**Analyze Three-phase Circuits**

**Objectives**
To be competent in this area, the individual must be able to:
- Describe the characteristics of three-phase AC circuits.
- Calculate voltage, current, impedance, power and power factor in three-phase AC circuits.
- Apply power factor correction to three-phase AC circuits.

**LEARNING TASKS**

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<td>- Delta source, delta load</td>
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- Circuit connections and measurements  
- Test equipment  
  o Power factor meters  
  o VAR meters  
- Testing and troubleshooting |
| 8. Calculate power and power factor in balanced three-phase systems | - Power in balanced systems  
- Power factor in balanced systems  
- Wattmeter connections for power measurements |
| 9. Describe the connection of capacitors for three-phase, power factor correction | - Wye-connected capacitor banks  
- Delta-connected capacitor banks  
- Safety hazards |
| 10. Calculate the ratings of capacitors for three-phase, power factor correction | - Capacitor values for PF correction  
- Resulting line current values |
Line (GAC): D APPLY CIRCUIT CONCEPTS
Competency: D6 Analyze Electronic Circuits

Objectives
To be competent in this area, the individual must be able to:
• Describe operating principles of thyristors.
• Analyze electronic circuits that utilize thyristors.
• Describe operating principles of op amps.
• Analyze electronic circuits that utilize op amps.
• Describe coding and decoding information.

LEARNING TASKS

1. Describe features of the silicon controlled rectifier (SCR)
   • Symbol and lead identification
   • Case styles
   • Specifications and ratings

2. Describe the basic action of the SCR
   • Voltage and current characteristics
   • DC circuit action
   • AC circuit action
   • Terms and definitions

3. Describe SCR triggering circuits for AC phase control
   • Resistance triggering
   • Resistance-capacitance triggering
   • Phase control circuits

4. Describe features of the triac
   • Symbol and lead identification
   • Case styles
   • Voltage and current characteristics
   • Ratings and specifications

5. Describe features of specialty thyristors
   • DIAC
   • Unijunction transistor
   • Light-activated SCR
   • Gate turnoff thyristors (GTOs)

6. Describe the application of thyristors
   • Oscillator circuits
   • Battery charging circuits
   • Lamp dimmer circuits
   • Motor control circuits
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Program Overview
Level 3

Line (GAC): E USE TEST EQUIPMENT
Competency: E4 Use Power Quality Analyzers

Objectives
To be competent in this area, the individual must be able to:
• Identify problems with power quality.
• Identify causes of poor power quality.
• Describe the use of power quality analyzers to identify power quality problems.

LEARNING TASKS

1. Identify problems with power quality
   • Sags (dips)
   • Swells
   • Transient over voltages
   • Harmonics
   • Flicker
   • Voltage regulation
   • Frequency variations
   • High frequency noise
   • Extremely fast transients (EFTs)
   • Unbalance

2. Identify possible causes of poor power quality
   • Sags and swells
     o Abrupt load changes
     o Abrupt impedance changes
       - Poor connections
   • Low frequency transients
     o Capacitor switching
   • High frequency transients
     o Lightning
     o Inductive loads
   • EFTs
     o Arcing faults
     o Bad brushes
   • Harmonics
     o Transformers
     o Switching power supplies
LEARNING TASKS
3. Describe the use of power quality analyzers

CONTENT
- Tests
  o Voltage unbalance
  o Total harmonic distortion
  o Increasing phase current
  o Voltage sags/swells
  o Peak demand
  o Power factor and reactive demand
- Interpretation of test results and graphs
Line (GAC): F  READ AND INTERPRET DRAWINGS AND MANUALS
Competency: F2  Use Construction Drawings and Specifications

Objectives
To be competent in this area, the individual must be able to:
• Locate information found on working drawings.
• Interpret information found on working drawings.
• Coordinate information found on various drawings and supporting material.

LEARNING TASKS
1. Use prints, drawings and specifications for three-phase installations

CONTENT
• Select drawings
• Read specifications
• Identify schedules
• Determine code requirements
• Three-phase systems
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G1 Apply Codes, Regulations and Standards

Objectives
To be competent in this area, the individual must be able to:
- Interpret and apply codes, regulations and standards.

LEARNING TASKS

1. Interpret applicable CEC rules and regulations from:
   - Section 0
   - Section 2
   - Section 4
   - Section 6
   - Section 8
   - Section 10
   - Section 12
   - Section 14
   - Section 16
   - Section 26
   - Section 28
   - Section 62

2. Calculate service entrance requirements

CONTENT
- Definitions and general requirements
- Selection of conductors - general
- Neutral and common conductors
- Installation of service equipment
- Grounding and bonding requirements
- Wiring methods and installations
- Cable tray and box fill calculations
- Pull box sizing
- Selection of circuit protective devices
- Remote control circuits
- Capacitor and transformer installations
- Motor and control installations
- Fixed electric space and surface heating system installations
- Apartments
- Other occupancies
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G2 Install Service Equipment

Objectives
To be competent in this area, the individual must be able to:
• Determine low-voltage, three-phase service equipment requirements.

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<td>• Three-phase, three-wire systems</td>
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### Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
### Competency: G3 Install Grounding and Bonding

#### Objectives
To be competent in this area, the individual must be able to:
- Describe the objectives of grounding and of bonding as applied to three-phase installations.
- Discriminate between grounding and bonding.
- Determine grounding and bonding requirements to three-phase installations.

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Line (GAC): G  INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G4  Install Distribution Centres

Objectives
To be competent in this area, the individual must be able to:
• Identify types of three-phase, low voltage distribution centres and components.
• Determine three-phase, low voltage distribution centre requirements.

### LEARNING TASKS

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Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G5 Install Raceways, Boxes and Fittings

Objectives
To be competent in this area, the individual must be able to:
• Identify raceways for three-phase, low voltage installations.
• Identify boxes and fittings for three-phase, low voltage installations.
• Determine raceway, box and fitting requirements in three-phase, low voltage installations.
• Describe procedures to create and seal openings in three-phase, low voltage installations.

LEARNING TASKS
1. Identify raceways
   • Conduit
   • Tubing
   • Surface raceways
   • Under floor raceways
   • Cellular floors
   • Auxiliary gutters
   • Busways and splitters
   • Wireways
   • Cable trays
   • Manufactured wiring systems

2. Identify boxes and fittings
   • Boxes
   • Cabinets
   • Outlets
   • Terminal fittings
LEARNING TASKS

3. Determine raceway requirements
   - Environmental considerations
   - Mechanical considerations
   - Seismic requirements
   - Manufacturers’ specifications
   - Bonding
   - Support
   - Size
   - Fill
   - Pulling considerations
   - Access
   - Bending
   - Spacing
   - Underground
   - Sealing and draining
   - Barriers

4. Determine box and fitting requirements
   - Environmental considerations
   - Mechanical considerations
   - Seismic requirements
   - Manufacturers’ specifications
   - Vapour barrier
   - Bonding
   - Support
   - Size
   - Fill
   - Pulling considerations
   - Access
   - Knockout layout
   - Identification
   - Barriers

5. Describe procedures to create and seal openings
   - X-ray coring
   - Fire stopping
   - Structural considerations
   - Pressurized areas
**Line (GAC):** G  **INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS**  
**Competency:** G6  Install Conductors and Cables

### Objectives

To be competent in this area, the individual must be able to:
- Identify conductors and cables for three-phase, low voltage installations.
- Determine conductor and cable requirements in three-phase, low voltage installations.

### LEARNING TASKS

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LEARNING TASKS

CONTENT

- Raceways
- Open wiring
- Support
- Mechanical protection
- Clearance
- Spacing
- Colour coding
- Protection
- Insulation testing
- Fire stopping

4. Determine cable requirements

- Ampacities
- Derating
- Conditions of use
- Voltage ratings
- Voltage drop
- Pulling lubricants
- Pulling methods
- Parallel runs
- Temperature during installation
- Splicing and termination
- Raceways
- Open wiring
- Support
- Mechanical protection
- Clearance
- Spacing
- Colour coding
- Conductor identification
- Protection
- Insulation testing
- Sheath currents
- FT ratings
- Fire stopping
- Strain relief
- Bonding
- Bend radii
Program Overview
Level 3

Line (GAC): G
Competency: G7 Install Utilization Equipment and Devices

Objectives
To be competent in this area, the individual must be able to:
• Determine device installation requirements for industrial branch circuits.
• Describe procedures to test devices.

LEARNING TASKS

1. Identify devices
   CONTENT
   • Switches
   • Receptacles
   • Utilization equipment

2. Determine device installation requirements
   CONTENT
   • Wiring methods
   • Environmental considerations
   • Orientation
   • Polarity
   • Location
   • Spacing
   • Finishes
   • Bonding
   • Support
   • Seismic considerations
   • Construction specification requirements
   • Manufacturers’ specifications

3. Describe procedures to test devices
   CONTENT
   • Rotation
   • Sensor operation
   • Outlet analyzer
   • Log records
   • Commissioning
### Program Overview
#### Level 3

**Line (GAC):** H  **INSTALL ELECTRICAL EQUIPMENT**  
**Competency:** H2  Install Transformers

#### Objectives
To be competent in this area, the individual must be able to:
- Connect and maintain three-phase transformers.
- Describe three-phase applications of auto transformers.
- Describe three-phase applications of instrument transformers.
- Determine installation requirements for three-phase transformers.

#### LEARNING TASKS

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• Insulation and cooling  
• Advantages and disadvantages |
| 2. Describe the connections of three-phase transformer banks  | • Wye-wye connection  
• Delta-delta connection  
• Wye-delta connection  
• Delta-wye connection  
• Special four-wire delta connection  
• Open-wye and open-delta connections |
| 3. Calculate voltage, current and values for three-phase transformer banks | • Step-down and step-up applications  
• Wye and delta configurations  
• Phase and line values  
• Percent impedance and short circuit currents |
| 4. Connect and maintain three-phase transformer banks | • Equipment selection  
• Circuit connections and measurements  
• Mounting  
• Seismic  
• Testing and troubleshooting |
| 5. Describe common connections for autotransformers in three-phase circuits | • Wye connection  
• Delta connection  
• Open-delta connection  
• Extended-delta connection  
• Zigzag connection |
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<td>9. Calculate instrument transformer ratings and meter readings in three-phase circuits</td>
<td>• Potential transformer ratings and voltmeter multipliers and readings</td>
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</table>
Line (GAC): H INSTALL ELECTRICAL EQUIPMENT
Competency: H3 Install Protective Devices

Objectives
To be competent in this area, the individual must be able to:
- Identify protective devices for three-phase installations.
- Determine protective device requirements in three-phase installations.
- Describe procedures to test protective devices in three-phase installations.

LEARNING TASKS

1. Identify protective devices

   - Fuses
   - Breakers
     - Magnetic (Instantaneous)
     - Thermal
   - Ground fault protection
   - Ground fault circuit interrupters (GFCI)
   - Arc fault circuit interrupters (AFCI)
   - Overloads
     - Thermal
     - Magnetic
     - Solid state
   - Specifications
   - Rejection features

2. Determine protective device requirements

   - Safety
   - Fault current calculations
   - Load calculations

3. Describe procedures to test protective devices

   - Safety
   - Overcurrent troubleshooting
   - Infrared scanning
LEARNING TASKS

1. Describe the constructional features of DC machines
   - Armature and commutator
   - Field poles and coils
   - Brushes and rigging
   - Frames and bearings

2. Describe the operating principles of generators
   - Factors affecting induced voltage
   - Methods of field excitation
   - Requirements for voltage build-up
   - Armature reaction and interpoles
   - Voltage regulation
   - Motor effect in generators

3. Describe the characteristics of the various types of DC generators
   - Series generator
   - Shunt generator
   - Compound generators

4. Describe the operating principles of DC motors
   - Right-hand motor rule
   - Commutator action and neutral plane
   - Torque development
   - Counter EMF and armature current
   - Mechanical loading effects
   - Speed regulation
   - Speed control
   - Reversing rotation

5. Describe the features and operating characteristics of the shunt motor
   - Lead identification and connections
   - Torque-speed-current characteristics
   - Speed control and reversing
   - Applications
LEARNING TASKS

6. Describe the features and operating characteristics of the series motor

7. Describe the features and operating characteristics of the compound motor

8. Describe the features of DC motor controllers

9. Describe the operation of magnetic DC motor controllers

10. Describe methods of deceleration for DC motors

11. Describe basic maintenance and troubleshooting procedures for DC motor controls

12. Describe basic maintenance and troubleshooting for DC motors

CONTENT

- Lead identification and connections
- Torque-speed-current characteristics
- Speed control and reversing
- Applications

- Lead identification and connections
- Cumulative and differential compounding
- Torque-speed-current characteristics
- Speed control and reversing
- Applications

- Manual starters
- Drum controller
- Faceplate starter
- Magnetic starters
- Solid-state starters

- Across-the-line starting
- Current-limit acceleration
- Definite-time acceleration
- Timers
  - Dashpot
  - Pneumatic
  - Electronic
- Field loss protection
- Reversing
- Speed control

- Electromechanical braking
- Dynamic braking
- Regenerative braking

- Mechanical checks
- Electrical checks

- Visual inspections
- Electrical faults
- Mechanical faults
- Brush and commutator maintenance
Program Overview
Level 3

Line (GAC): H INSTALL ELECTRICAL EQUIPMENT
Competency: H5 Install AC Motors and Alternators

Objectives
To be competent in this area, the individual must be able to:
- Describe the operating principles of AC machines.
- Connect and maintain AC machines.

LEARNING TASKS

1. Describe the constructional features of three-phase induction motors
   - Stator
   - Squirrel-cage rotor
   - End bells and bearings
   - Enclosure types
   - Nameplate data

2. Describe the operating principles of three-phase induction motors
   - Development of rotating magnetic field
   - Synchronous speed
   - Rotor speed and slip
   - Speed regulation and control
   - Reversing rotation
   - Rotor design and torque
   - Speed-torque-current characteristics
   - Efficiency
   - Linear-induction motors

3. Identify common connections for squirrel-cage induction motors
   - Terminal marking conventions
   - Six-lead motors
   - Nine-lead motors
   - Twelve-lead motors

4. Describe basic maintenance and troubleshooting for three-phase induction motors
   - Visual inspections
   - Electrical faults
   - Mechanical faults
   - Cause and remedy
   - Bearings
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LEARNING TASKS

20. Describe basic maintenance and troubleshooting for single-phase motors

21. Describe the constructional features of three-phase alternators

22. Describe operating principles of three-phase alternators

23. Identify common connections for three-phase alternators

24. Describe the conditions for operating alternators in parallel (synchronizing)

25. Connect and maintain three-phase alternators

26. Describe basic maintenance and troubleshooting for alternators

CONTENT

• Visual inspections
• Electrical faults
• Mechanical faults
• Bearings

• Revolving armature types
• Revolving field types
• Field excitation and brushless exciters
• Nameplate data

• Frequency control
• Voltage control
• Voltage regulation characteristics

• Terminal marking conventions
• Wye-connected alternators
• Delta-connected alternators
• Exciter field connections

• Conditions for synchronizing
• Synchronizing procedure
• Load sharing characteristics

• Equipment selection
• Connections and measurements
• Synchronizing and load sharing

• Visual inspections
• Electrical faults
• Mechanical faults
• Brushes and slip-rings
• Bearings
Line (GAC): I INSTALL CONTROL CIRCUITS AND DEVICES
Competency: I2 Install Magnetic Motor Controls

Objectives
To be competent in this area, the individual must be able to:
• Connect and maintain reduced voltage starters.
• Connect and maintain wound-rotor motor control circuits.
• Connect and maintain synchronous motor control circuits.
• Connect and maintain braking and deceleration control circuits.

LEARNING TASKS

1. Describe the considerations in selecting AC and DC motor starting equipment
   • Full-voltage starting
   • Reduced-voltage starting
   • Motor current and torque
   • Load requirements
   • Duty cycles and supply requirements

2. Describe primary impedance type starters
   • Resistor starting
   • Reactor starting

3. Describe the operation of autotransformer type starters
   • Wye-connection
   • Open-delta connection
   • Open and closed transition types
   • Current-torque characteristics
   • Schematic and wiring diagrams

4. Describe the operation of wye-delta type starters
   • Open and closed transition types
   • Current-torque characteristics
   • Schematic and wiring diagrams

5. Describe basic maintenance and troubleshooting for reduced voltage starters
   • Visual inspections
   • Troubleshooting equipment
   • Maintenance procedures

6. Connect and maintain reduced voltage starters
   • Equipment selection
   • Connection of components
   • Testing and troubleshooting
**LEARNING TASKS**

7. Describe the methods of automatic acceleration for wound-rotor motors

8. Describe basic maintenance and troubleshooting for wound-rotor motor controllers

9. Connect and maintain wound-rotor motor controllers

10. Describe the special control features for synchronous motor starters

11. Describe the operation of synchronous motor starters

12. Describe basic maintenance and troubleshooting for synchronous motor starters

13. Connect and maintain synchronous motor starters

**CONTENT**

- Definite-time acceleration
- Speed-sensing acceleration
- Reversing
- Speed regulators
- Regeneration
- Schematic and wiring diagrams

- Visual inspections
- Electrical faults
- Mechanical faults

- Equipment selection
- Connection of components
- Testing and troubleshooting

- Old and new methods
- Starting methods
  - Auto synchronization (PFR)
  - VFD
- Speed detection
- Field application
- Timing of field application
- Field protection
- Field rheostat

- Power circuit
- Control circuit
- Schematic and wiring diagrams

- Visual inspections
- Electrical faults
- Mechanical faults

- Equipment selection
- Connection of components
- Testing and troubleshooting
## LEARNING TASKS

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<tr>
<th>No.</th>
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<tr>
<td>14.</td>
<td>Describe the common methods used for motor deceleration</td>
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<tr>
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<tr>
<td>15.</td>
<td>Connect and maintain motor braking and deceleration controls</td>
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</table>

## CONTENT

- Friction braking
- Plugging
- Dynamic braking
- Regenerative braking
- Eddy-current braking
- Schematic and wiring diagrams
- Equipment selection
- Connection of components
- Testing and troubleshooting
Line (GAC): I INSTALL CONTROL CIRCUITS AND DEVICES
Competency: I3 Install Electronic Motor Controls

Objectives
To be competent in this area, the individual must be able to:
• Describe the operating principles of electronic motor controls.
• Connect and maintain electronic motor controls.

LEARNING TASKS

1. Describe the features of adjustable speed DC drives

CONTENT
• Control panel features
• Speed and current regulators
• Sizes and ratings
• Start-up and adjustments

2. Describe the operation of power converters

CONTENT
• Single-phase converters
• Three-phase converters
• Voltage control

3. Describe the operation of DC motors used with adjustable speed drives

CONTENT
• Motor types and connections
• Braking and reversing
• Protection

4. Connect and maintain adjustable speed DC drives

CONTENT
• Selection of components
• Circuit connections
• Testing and troubleshooting

5. Describe the features of AC soft start controllers

CONTENT
• Sizes and ratings
• Advantages
• Cost
• Start-up and adjustment

6. Describe the operation of AC soft start controllers

CONTENT
• Phase control
• Adjustable parameters

7. Connect and maintain AC soft start controllers

CONTENT
• Program
• Testing and troubleshooting

8. Describe the features of variable frequency AC drives

CONTENT
• Control panel features
• Sizes and ratings
• Start-up and adjustments
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<tr>
<th>LEARNING TASKS</th>
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</table>
| 9. Describe the operation of inverters | • Single-phase inverters  
• Three-phase inverters  
• Single-phase to three-phase  
• Variable voltage inverters  
• Current source inverters  
• Pulse width modulation inverters |
| 10. Describe the operation of AC motors used with variable frequency drives | • Motor types and connections  
• Applications  
• Torque-speed characteristics  
• Braking and reversing  
• Ventilation  
• Protection |
| 11. Connect and maintain variable frequency AC drives | • Safety  
• Selection of components  
• Circuit connections  
• Setting parameters  
• Harmonics  
• Cabling  
• Inductors  
• Testing and troubleshooting |
Level 4

Construction Electrician
Line (GAC): D APPLY CIRCUIT CONCEPTS
Competency: D2 Analyze DC Circuits

Objectives
To be competent in this area, the individual must be able to:
- Apply DC circuit concepts.

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<th>CONTENT</th>
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<tbody>
<tr>
<td>1. Solve problems involving DC circuits</td>
<td>• Applications involving resistance and conductors</td>
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<tr>
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<td>• Applications involving inductance and capacitance</td>
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<tr>
<td></td>
<td>• Troubleshooting series, parallel, and combination circuits</td>
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</table>
Program Overview
Level 4

Line (GAC): D APPLY CIRCUIT CONCEPTS
Competency: D4 Analyze Single-phase AC Circuits

Objectives
To be competent in this area, the individual must be able to:
• Apply AC circuit concepts.

LEARNING TASKS

1. Solve problems involving AC waveforms
   • Conversion of sine wave values
   • Period and frequency calculations
   • Plotting of waveforms for voltage, current and power
   • Out-of-phase waveforms
   • Harmonics and transient voltages

2. Solve problems involving AC circuits
   • Ohm’s Law and power calculations
   • Meter loading effects
   • Grounding and bonding
   • Applications involving series, parallel, and combinations circuits
   • Applications of three-wire circuits
   • Determining percent voltage drop in branch circuits
   • Applications of practical R-L-C circuits
   • Selection of power factor correction capacitors
   • Protection and control requirements
   • Applications involving single-phase transformers and motors
   • Troubleshooting two-wire and three-wire distribution circuits
Program Overview
Level 4

Line (GAC): D APPLY CIRCUIT CONCEPTS
Competency: D5 Analyze Three-phase Circuits

Objectives
To be competent in this area, the individual must be able to:
• Apply AC circuit concepts.

LEARNING TASKS

1. Solve problems involving three-phase AC circuits
• Applications involving three-phase transformers and power distribution
• Applications involving three-phase motors and controls
• Troubleshooting wye and delta circuits

2. Solve problems involving single-phase transformer installations
• Voltage, current, kVA ratings
• Practical effects of percent impedance
• Transformer tap connections
• Protection and control requirements
• Application of instrument transformers

3. Solve problems involving three-phase transformer installations
• Voltage, current, kVA ratings
• Practical effects of percent impedance
• Transformer tap connections
• Protection and control requirements
• Application of instrument transformers
Program Overview
Level 4

Line (GAC): D APPLY CIRCUIT CONCEPTS
Competency: D6 Analyze Electronic Circuits

Objectives
To be competent in this area, the individual must be able to:
- Describe operating principles of logic gates.
- Convert between numbering systems.
- Analyze electronic circuits that utilize logic gates.

LEARNING TASKS

1. Describe common number systems used in digital electronics
   - Decimal system
   - Octal system
   - Binary system
   - Hexadecimal system
   - Binary-coded-decimal
   - Number conversions

2. Describe the operation of common logic gates
   - AND gate
   - OR gate
   - NOT gate
   - NAND gate
   - NOR gate
   - XOR gate

3. Describe the operation of logic gates
   - Truth tables
   - Boolean expressions
   - DeMorgan’s Theorems
   - Development of combination circuits

4. Describe the operation of special combination logic circuits
   - Flip-flop circuits
   - Multivibrator circuits
   - Counters and shift registers

5. Describe the features of integrated circuits (IC)
   - Classifications of ICs
   - Pin configuration
   - Use of data sheets
   - Connections and handling

6. Connect and test digital logic circuits
   - Selection of components
   - Circuit connections
   - Testing and troubleshooting
Line (GAC): E USE TEST EQUIPMENT
Competency: E5 Perform Structured Cable Testing and Reporting

Objectives
To be competent in this area, the individual must be able to:
• Describe the tests conducted on cables.
• Describe tests.
• Describe how to create and save cable test reports.

LEARNING TASKS

1. Describe the tests conducted on twisted pair cable
   • Wire mapping
   • Resistance
   • Length
   • Propagation delay and delay skew
   • Characteristic impedance
   • Attenuation
   • NEXT
   • FEXT
   • NEXT@remote
   • ELFEXT
   • ACR
   • ACR@remote
   • Return loss
   • RL@remote
   • PSNEXT
   • PSNEXT
   • PSACR

2. Describe how to perform tests
   • Time domain reflectometer
   • Auto tests
   • Individual tests
   • Commands
     o Ping
     o Tracer

3. Describe how to create and save cable test reports
   • Auto functions
   • Downloading
LEARNING TASKS

4. Describe fibre optic tests

5. Describe coaxial cable tests

CONTENT

- Visual inspection for continuity
- Connector cleaning
- Connector checking
- Loss testing
- Network testing

- Length
- Return loss
- Attenuation
- Propagation delay
- Cable (input) impedance
- Insertion loss as a function of the signal transmission
Program Overview
Level 4

Line (GAC): F READ AND INTERPRET DRAWINGS AND MANUALS
Competency: F2 Use Construction Drawings and Specifications

Objectives
To be competent in this area, the individual must be able to:
- Locate information found on working drawings.
- Interpret information found on working drawings.
- Coordinate information found on various drawings and supporting material.
- Interpret high-voltage installation requirements.

LEARNING TASKS

1. Describe common construction drawings and their major divisions
   - Divisions
   - Working drawings
   - High voltage systems

2. Describe electrical working drawings
   - Electrical site/plot plans
   - Electrical floor plans
   - Electrical elevation drawings
   - Electrical sectional drawings
   - Electrical detail drawings
   - High voltage systems

3. Use prints, drawings and specifications to locate information
   - Select drawings
   - Read specifications
   - Identify schedules
   - Identify symbols
   - Determine code requirements
   - High voltage systems
Objectives
To be competent in this area, the individual must be able to:
• Interpret and apply codes, regulations and standards.

LEARNING TASKS

1. Interpret applicable rules and regulations from:
   - Section 0
   - Section 2
   - Section 4
   - Section 6
   - Section 8
   - Section 10
   - Section 12
   - Section 14
   - Section 16
   - Section 18
   - Section 20
   - Section 22
   - Section 24
   - Section 26
   - Section 28
   - Section 32
   - Section 46
   - Section 50
   - Section 54
   - Section 56
   - Section 60
   - Section 62
   - Section 68

   • Definitions
   • Application of general rules
   • Conductors
   • Services and service equipment
   • Circuit loading and demand factors
   • Grounding and bonding
   • Wiring methods
   • Protection and control devices
   • Class 1 and Class 2 circuits
   • Hazardous locations
   • Patient care areas
   • Installation of electrical equipment
   • Motor and generator installations
   • Fire alarm systems and fire pumps
   • Emergency systems and equipment
   • Solar photovoltaic systems
   • Fibre optic and data cable installations
   • Electrical communication systems
   • Electric heating systems
   • Pools, tubs and spas

2. Calculate service entrance requirements
   • Apartments
   • Schools
   • Hospitals
   • Other occupancies

3. Describe the installation requirements for hazardous areas
   • Types of hazardous locations
   • Approved equipment and wiring methods
   • Boundary of hazardous locations
Program Overview
Level 4

Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G2 Install Service Equipment

Objectives
To be competent in this area, the individual must be able to:
• Determine service equipment requirements.

LEARNING TASKS

1. Describe the features of power distribution centres (PDCs)
   • Shock hazards and safety
   • Transformer section
   • Low-voltage section
   • Metering
   • Features of grounding
   • Resistance grounding
   • Reactance grounding

2. Determine power distribution centre requirements (PDCs)
   • Reference installations
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G3 Install Grounding and Bonding

Objectives
To be competent in this area, the individual must be able to:
- Describe the objectives of grounding and of bonding as applied to DC and AC systems.
- Discriminate between grounding and bonding.
- Apply grounding and bonding techniques to DC and AC systems.

LEARNING TASKS

1. Describe the objectives of grounding
   • System ground
   • Equipment ground
   • Limit voltage to ground
   • Shock hazard
   • Fire prevention
   • Overcurrent operation

2. Describe the objectives of bonding
   • Shock hazard
   • Overcurrent operation
   • Eliminate potential differences
   • Non-electrical equipment

3. Select appropriate materials for grounding and bonding
   • Raceways
   • Materials
   • Electrodes
   • Conductors
   • Connections
   • Equipment

4. Determine grounding and bonding requirements
   • Sizing
   • Terminating
   • Testing
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G4 Install Distribution Centres

Objectives
To be competent in this area, the individual must be able to:
• Identify types of DC and AC systems.
• Determine DC and AC systems.

LEARNING TASKS
1. Identify types of distribution centres
   • Load centres
   • Combination panels
   • Splitters and switches
   • Meter stacks
   • Motor control centres

2. Identify components of distribution centres
   • Overcurrent protection
   • Overload protection
   • Busbars
   • Power factor correction
   • Enclosure type
   • Enclosure rating

3. Determine distribution centre requirements
   • Mounting requirements
   • Clearance requirements
   • Seismic requirements
   • Lug rating
   • Torque requirements
   • Means of egress
   • Ventilation
   • Environmental considerations
Program Overview
Level 4

Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G5 Install Raceways, Boxes and Fittings

Objectives
To be competent in this area, the individual must be able to:
- Identify raceways for electrical installations.
- Identify boxes and fittings for electrical installations.
- Determine raceway, box and fitting requirements in electrical installations.
- Describe procedures to create and seal openings in electrical installations.

LEARNING TASKS

1. Identify raceways
   - Conduit
   - Tubing
   - Surface raceways
   - Under floor raceways
   - Cellular floors
   - Auxiliary gutters
   - Busways and splitters
   - Wireways
   - Cable trays
   - Manufactured wiring systems

2. Identify boxes and fittings
   - Boxes
   - Cabinets
   - Outlets
   - Terminal fittings

3. Determine raceway requirements
   - Environmental considerations
   - Mechanical considerations
   - Seismic requirements
   - Manufacturer’s specifications
   - Bonding
   - Support
   - Size
   - Fill
   - Pulling considerations
   - Access
   - Bending
   - Spacing
   - Underground
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<td>• Barriers</td>
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<td>4. Determine box and fitting requirements</td>
<td>• Environmental considerations</td>
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<td>• Mechanical considerations</td>
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<td>• Vapour barrier</td>
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<td>• Bonding</td>
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<td>• Size</td>
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<td>5. Describe procedure to create and seal openings</td>
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<td>• Structural considerations</td>
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<td>• Pressurized areas</td>
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</tbody>
</table>
**Program Overview**  
**Level 4**

**Line (GAC):**  
G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS

**Competency:**  
G6 Install Conductors and Cables

**Objectives**

To be competent in this area, the individual must be able to:

- Identify conductors and cables for electrical installations.
- Determine conductor and cable requirements for electrical installations.

**LEARNING TASKS**  

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
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</thead>
</table>
| 1. Identify conductors          | - Insulation types  
|                                 |    - Insulation temperature                                          |
|                                 |    - Insulation voltage ratings                                      |
|                                 |    - Conductor material                                               |
|                                 |    - Solid or stranded                                                |
|                                 |    - AWG                                                              |
|                                 |    - Colour coding                                                    |
|                                 |    - Conditions of use                                                |
| 2. Identify cables              | - Cable types                                                         |
|                                 |    - Insulation types                                                 |
|                                 |    - Insulation temperature                                           |
|                                 |    - Insulation voltage rating                                         |
|                                 |    - Conductor material                                                |
|                                 |    - Solid or stranded                                                |
|                                 |    - AWG                                                              |
|                                 |    - Colour coding                                                    |
|                                 |    - Conditions of use                                                |
|                                 |    - FT ratings                                                       |
| 3. Determine conductor requirements | - Ampacities                                                          |
|                                 |    - Derating                                                         |
|                                 |    - Conditions of use                                                |
|                                 |    - Conduit fill                                                     |
|                                 |    - Voltage ratings                                                  |
|                                 |    - Voltage drop                                                     |
|                                 |    - Pulling lubricants                                                |
|                                 |    - Pulling methods                                                  |
|                                 |    - Parallel runs                                                    |
|                                 |    - Temperature during installation                                  |
|                                 |    - Splicing and termination                                          |
## Program Overview

### Level 4

**LEARNING TASKS**

4. Determine cable requirements

**CONTENT**

- Raceways
- Open wiring
- Support
- Mechanical protection
- Clearance
- Spacing
- Colour coding
- Protection
- Insulation testing
- Fire stopping

- Ampacities
- Derating
- Conditions of use
- Voltage ratings
- Voltage drop
- Pulling lubricants
- Pulling methods
- Parallel runs
- Temperature during installation
- Splicing and termination
- Raceways
- Open wiring
- Support
- Mechanical protection
- Clearance
- Spacing
- Colour coding
- Conductor identification
- Protection
- Insulation testing
- Sheath currents
- FT ratings
- Fire stopping
- Strain relief
- Bonding
- Bend radii
Line (GAC): G INSTALL LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: G7 Install Utilization Equipment and Devices

Objectives
To be competent in this area, the individual must be able to:
• Determine device installation requirements for branch circuits.
• Describe procedures to test devices.

LEARNING TASKS

1. Identify devices
   • Switches
   • Receptacles
   • Utilization equipment

2. Determine device installation requirements
   • Wiring methods
   • Environmental considerations
   • Orientation
   • Polarity
   • Location
   • Spacing
   • Finishes
   • Bonding
   • Support
   • Seismic considerations
   • Construction specification requirements
   • Manufacturers’ specifications

3. Describe procedures to test devices
   • Rotation
   • Sensor operation
   • Outlet analyzer
   • Log records
   • Commissioning
Line (GAC): H INSTALL ELECTRICAL EQUIPMENT
Competency: H3 Install Protective Devices

Objectives
To be competent in this area, the individual must be able to:
- Identify protective devices for electrical installations.
- Determine protective device requirements in electrical installations.
- Describe procedures to test protective devices in electrical installations.

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<td>• Ground fault protection (GFP)</td>
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<td>• Ground fault circuit interrupters (GFCI)</td>
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<td>2. Determine protective device requirements</td>
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<td>• Fault current calculations</td>
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<td>3. Describe procedures to test protective devices</td>
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<td>• Maintenance</td>
</tr>
</tbody>
</table>
Line (GAC): H INSTALL ELECTRICAL EQUIPMENT
Competency: H6 Install HVAC

Objectives
To be competent in this area, the individual must be able to:
• Describe the components of an HVAC system.
• Describe the application of energy management devices.
• Connect and maintain controls for heating, ventilating and air conditioning.

LEARNING TASKS
1. Describe common heating and cooling systems
   • Types of area climate control
     o Baseboard heaters
     o Unit heaters
     o Forced-air furnaces
     o Duct and plenum heaters
     o Series heating cable sets
     o Heating panel sets
     o Hot water heating
     o Heat pumps
     o Geothermal
   • Operation
     o Open loop
     o Closed loop
   • Electronic air cleaners
   • Humidifiers
   • System layout
   • Domestic water heaters
     o Tank
     o Tankless
   • Thermostats and controls
   • Code requirements

2. Describe the components of HVAC systems
   • System layout
   • Power and control circuits
   • Fans and pumps
   • Dampers and valves
   • Heating and cooling equipment
### LEARNING TASKS

3. Describe the application of energy management devices

4. Connect and maintain controls for heating, ventilating, and air conditioning

### CONTENT

- Time clocks
- Programmable thermostats
- Computer-based systems
- Meter alarms and load shedders
- Selection of components
- System layout
- Circuit connections
- Testing and troubleshooting
**Program Overview**

**Level 4**

**Line (GAC):** H  
**Competency:** H7  
**INSTALL ELECTRICAL EQUIPMENT**  
**Install Emergency Power Systems**

**Objectives**

To be competent in this area, the individual must be able to:
- Identify types of emergency power systems.
- Determine emergency power system requirements.
- Describe procedures to test emergency power systems.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>LEARNING TASKS</th>
</tr>
</thead>
</table>
|Identify types of emergency power systems|• Emergency lighting equipment  
  o Unit lighting  
  o Exit lighting  
  • Battery banks  
  o Primary  
  o Secondary  
  • Standby generators  
  Uninterruptible power supplies (UPS)|1. Identify types of emergency power systems|
|Describe battery requirements for emergency lighting systems|• Types  
• Maintenance  
• Charging  
• Testing  
• Safety  
• Disposal  
• Code requirements|2. Describe battery requirements for emergency lighting systems|
|Describe standby generators|• Features of engine-driven generators  
  o Critical loads  
  o Non-critical loads  
  • Alternator wiring  
  • Control panel functions  
  • Transfer switches  
  • Code requirements|3. Describe standby generators|
|Describe uninterruptible power supplies|• Rectifiers  
• Invertors  
• Filters  
• Specifications  
• Code requirements|4. Describe uninterruptible power supplies|
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<td>5. Determine emergency power system requirements</td>
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<td>• Commissioning records</td>
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Program Overview
Level 4

Line (GAC): H  INSTALL ELECTRICAL EQUIPMENT
Competency: H8  Install Alternative Power Systems

Objectives
To be competent in this area, the individual must be able to:
• Describe alternative power systems.
• Install alternative power systems.
• Test alternative power systems.

LEARNING TASKS

1. Describe alternative power systems
   • Types
     o Wind-generated
     o Thermal
     o Solar
     o Hydrokinetic
   • Operation
   • Characteristics

2. Install alternative power systems
   • Safety
   • Selection
   • Location for maximum efficiency
   • Code requirements and other related standards
     o Signage
     o Supply authority
     o Other associated authorities
   • Mounting components
   • Power conditioning unit (PCU)
     o Utility interactive inverter
   • Connection
     o Grid-tie and stand-alone

3. Test alternative power systems
   • Safety
   • Commissioning
   • Maintenance
   • Troubleshooting
   • Recording
Line (GAC): I INSTALL CONTROL CIRCUITS AND DEVICES
Competency: I2 Install Magnetic Motor Controls

Objectives
To be competent in this area, the individual must be able to:

• Solve problems involving the installation of magnetic controls.

LEARNING TASKS
1. Solve problems involving switching and control circuits

CONTENT
• Mechanical switch circuits
• Solid state switch circuits
• Magnetic relay circuits
• Motor control circuits
Line (GAC): I INSTALL CONTROL CIRCUITS AND DEVICES
Competency: I4 Install PLCs

Objectives
To be competent in this area, the individual must be able to:
- Describe the operating principles of programmable logic controllers (PLCs).
- Describe the installation procedures and requirements.
- Write basic PLC programs and use a programming terminal.
- Connect and maintain PLCs.

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<td>6. Describe basic programming instructions</td>
<td>• Types of programming languages&lt;br&gt;• Relay ladder logic instructions&lt;br&gt;• Output energize instruction&lt;br&gt;• Examine if on instruction (XIC)&lt;br&gt;• Examine if off instruction (XIO)&lt;br&gt;• Latching and unlatching instructions&lt;br&gt;• Internal relay instructions&lt;br&gt;• Timer and counter instructions</td>
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<td>7. Describe the interaction of hardware and software</td>
<td>• Effects of input status on input image tables&lt;br&gt;• Program logic scanning sequence&lt;br&gt;• True-false instruction status&lt;br&gt;• Control of program over output image tables&lt;br&gt;• Effects of output image tables on output devices&lt;br&gt;• Fail-safe wiring practices</td>
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<td>8. Write basic PLC programs</td>
<td>• Single motor control&lt;br&gt;• Multi-motor sequences&lt;br&gt;• Reversing motor control&lt;br&gt;• Three-way switch controls&lt;br&gt;• Toggle operation&lt;br&gt;• Pumping systems&lt;br&gt;• Up and down counters&lt;br&gt;• Latching circuits</td>
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<td>9. Use a programming terminal</td>
<td>• Application software and PLC logic&lt;br&gt;• Saving PLC documentation&lt;br&gt;• Downloading/uploading programs&lt;br&gt;• On-line monitoring&lt;br&gt;• Editing/modifying programs</td>
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<td>10. Describe PLC operating modes</td>
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<td>11. Connect and maintain PLC systems</td>
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<td>• Use I/O image tables for bit status</td>
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<td>• Monitor/test program on-line</td>
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<td>• Update documentation</td>
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</table>
**Line (GAC):** I  INSTALL CONTROL CIRCUITS AND DEVICES  
**Competency:** I5  Install Automated Controls

### Objectives

To be competent in this area, the individual must be able to:
- Describe the operating principles of automated control.
- Connect and maintain automated control systems.

### LEARNING TASKS

<table>
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<th>Learning Tasks</th>
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</table>
| 1. Describe the components of an automatic control system | - Open loop control systems  
- Closed loop control systems  
- Process variables  
- Control system elements |
| 2. Describe common types of sensors and transducers | - Motion sensors  
- Force sensors  
- Fluid sensors  
- Temperature sensors  
- Light sensors  
- Hall effect sensors  
- Level sensors |
| 3. Describe the action of the controller in automatic control systems | - Basic comparator circuits  
- Application of feedback signals  
- Modes of control |
| 4. Describe common types of electrical actuators | - Solenoids, clutches and brakes  
- DC servo motors  
- AC servo motors  
- Encoders and resolvers  
- Stepper motor controls |
| 5. Connect and maintain automatic control systems | - Troubleshooting sensors  
- Adjust set-points  
- Program |
Line (GAC): J INSTALL SIGNAL AND COMMUNICATION SYSTEMS
Competency: J1 Install Fire Alarm and Suppression Systems

Objectives
To be competent in this area, the individual must be able to:
• Describe the operation of fire alarm and suppression systems.
• Describe procedures to install and test fire alarm and suppression systems.

LEARNING TASKS
1. Describe the features of fire alarm systems
   • Types of fire alarm systems
     o Addressable
     o Non-addressable
   • Fire alarm system operation
   • Common initiation and signal devices
   • Control panel functions
   • Suppression systems
   • Pre-action systems
   • Ancillary system tie-in
   • Supervision
   • Paging systems
   • Monitoring
   • Annunciator
   • Fire pumps

2. Determine installation requirements and test fire alarm systems
   • Selection of components
   • Circuit connections
   • Device placement
   • Routing
   • Verification
   • Installation and wiring requirements
   • Standards, specifications and codes
   • Testing and troubleshooting
Line (GAC): J
Competency: J2

INSTALL SIGNAL AND COMMUNICATION SYSTEMS

Install Structured Cabling Systems

Objectives

To be competent in this area, the individual must be able to:

- Describe structured cabling systems.
- Describe procedures to install and test structured cabling systems.

LEARNING TASKS

1. Describe structured cabling system

   • Voice
     o POTs
   • Data
   • Copper
     o STP
     o UTP
     o Coaxial
   • Fibre
     o Single-mode
     o Multi-mode
   • Patch block/panels
   • Typical topography
   • Generic layout of structured cable systems
   • Standards
   • Safety
   • Construction of cable
   • Design of the system
   • Prints and specifications

2. Describe procedures to install a structured cable system

   • Safety
   • Manufacturer’s installer certification
   • Certification and warranty procedures
   • Cable layout
   • Installation techniques
   • Tools
   • Colour coding
   • Support systems and pathways
   • Placing cable
   • Work area (field end)
   • Terminations of cables
LEARNING TASKS

3. Describe procedures to complete testing and follow-up

4. Describe the basic features of fibre optic installations

CONTENT

- Testing of cables and terminations
- Troubleshoot failures
- As-built prints (record drawings)
- Test data reports
- Fire stopping

- Components of a fibre optic communication system
- Features of fibre optic cables
- Installation and wiring requirements
Line (GAC): J  INSTALL SIGNAL AND COMMUNICATION SYSTEMS
Competency: J3  Install Nurse Call Systems

Objectives
To be competent in this area, the individual must be able to:
• Describe the operating principles of nurse call systems.
• Describe procedures to install and test nurse call systems.

LEARNING TASKS

1. Describe the operating principles of nurse call systems
   • Types
   • Components
   • Applications

2. Describe procedures to install and test nurse call systems
   • Installation procedures
   • Mounting system components
   • Connecting systems components
   • Verification of system
Line (GAC): J  INSTALL SIGNAL AND COMMUNICATION SYSTEMS
Competency: J4  Install Building Integrated Control Systems

Objectives
To be competent in this area, the individual must be able to:
- Describe the operating principles of building automation systems.
- Describe procedures to install and test building automation systems.

**LEARNING TASKS**

<table>
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<th>Task Description</th>
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| 1.  | Describe the operating principles of building automation systems                 | • Lighting  
• Fire systems  
• Security systems  
• HVAC  
• Irrigation  
• Sound  
• Load shedding  
• Window coverings  
• DCS  
• Computer interface  
• Communication protocols |
| 2.  | Describe procedures to install and test building automation systems               | • Standards and manufacturers’ specifications  
• Maintenance  
• Testing and verification |
Line (GAC): J INSTALL SIGNAL AND COMMUNICATION SYSTEMS
Competency: J5 Install Sound Systems

Objectives
To be competent in this area, the individual must be able to:
• Describe the operating principles of sound systems.
• Describe procedures to install and test sound systems.

LEARNING TASKS
1. Describe the operating principles of sound systems
   • Public address
   • Ambient music

2. Describe procedures to install and test sound systems
   • Manufacturers’ specifications
   • Environmental considerations
   • Plenum ratings on cable
   • Speaker placement
   • Cable routing
   • Verification
Line (GAC): J    INSTALL SIGNAL AND COMMUNICATION SYSTEMS
Competency: J6 Install Entertainment Systems

Objectives
To be competent in this area, the individual must be able to:
• Describe the operating principles of entertainment systems.
• Describe procedures to install and test entertainment systems.

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<td>2. Describe procedures to install and test entertainment systems</td>
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<td>□ Video</td>
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<td>• Verification</td>
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</table>
Line (GAC): J INSTALL SIGNAL AND COMMUNICATION SYSTEMS
Competency: J7 Install CATV systems

Objectives
To be competent in this area, the individual must be able to:
• Describe the operating principles of CATV systems.
• Describe procedures to install and test CATV systems.

LEARNING TASKS

1. Describe the operating principles of CATV systems
   • Regulatory authorities
   • Cable construction and types
   • Cable termination
   • Signal generation
   • Attenuation

2. Describe the components of CATV systems
   • Tools and equipment
   • Terminations
   • Boosters
   • Splitters
   • Satellite dishes
   • Modems

3. Describe procedures to install and test CATV systems
   • Wiring methods and techniques
   • Supply authority requirements
   • System grounding
   • Shielding
   • Cable routing
   • Terminations
   • Boosters
   • Splitters
   • Programming
   • Verification
   • Troubleshooting
Objectives
To be competent in this area, the individual must be able to:
• Describe the operating principles of security alarm systems.
• Describe procedures to install and test security alarm systems.

LEARNING TASKS

1. Describe the operating principles of security alarm systems
   • Regulatory authorities
   • Types of security systems
     o Silent/Audible
     o Addressable
   • Security alarm system operation
   • Common detection and alarm devices
   • Control panel functions
   • Monitoring and recording
   • Layout
   • Surveillance

2. Describe the components of security alarm systems
   • Panels
   • Programming devices
   • Initiation and signal
   • Surveillance
   • Cable types
   • Access control

3. Describe procedures to install and test security alarm systems
   • Mounting
   • Cable routing
   • Interfacing
   • Verification
   • Troubleshooting
Line (GAC): K INSTALL HIGH VOLTAGE SYSTEMS
Competency: K1 Apply High Voltage Safety Procedures

Objectives
To be competent in this area, the individual must be able to:

- Describe the purpose of high voltage safety equipment and procedures.
- Describe high voltage safety procedures.

LEARNING TASKS

1. Describe common terms and concepts associated with high voltage systems
   - Voltage classifications
   - Effects of electrostatic fields
   - Strike and creepage distances
   - Tracking and flashovers
   - Impulse voltage ratings

2. Describe features of distribution systems and substation equipment
   - Radial, ring and network systems
   - Unit substations and vaults
   - Switch yards
   - Protection and metering

3. Describe hazards and safety precautions for high voltage installations
   - Arc blast hazards
     - Z460 and Z462 (CSA standard)
     - Shock and arc flash protection
   - Safe switching and key interlocking
   - Limits of approach
   - Step voltage and touch voltage
   - Ground mats
   - Clearance requirements
   - Grounding of structures and equipment
   - Station ground electrode
   - Lightning arrestors
   - Pole bands

4. Interpret CEC rules and supply authority regulations concerning high voltage installations
   - Supply authority regulations
   - Use of CEC sections 10, 26 and 36
   - Applicable tables in CEC
Program Overview
Level 4

Line (GAC): K INSTALL HIGH VOLTAGE SYSTEMS
Competency: K2 Install High Voltage Cable

Objectives
To be competent in this area, the individual must be able to:
• Describe the construction and operating principles of high voltage cables and their terminations.
• Describe procedures to install and terminate high voltage cable.

LEARNING TASKS

1. Describe features of high voltage cables
   • Types of dielectrics
   • Methods of shielding
   • Insulation levels
   • Cable armour

2. Describe the construction of common medium-voltage cables
   • Concentric neutral cable (URD)
   • Shielded cable
   • TECK cable
   • Voltage ratings
   • AWG size and ampacity

3. Describe practical considerations for high voltage cable installations
   • Cable pulling techniques
   • Types of stress relief
   • Termination classifications
   • Termination techniques
   • Cable splicing techniques

4. Interpret CEC rules and regulations concerning wiring methods for high voltage installations
   • Conductors, cables and raceways
   • Radii of bends
   • Spacing and supports
   • Joints, terminations and shielding
   • Clearance requirements

5. Describe procedures to install a high voltage, single conductor, solid-dielectric cable
   • Cable preparation
   • Stress cone installation
   • Grounding and shielding
Line (GAC): K INSTALL HIGH VOLTAGE SYSTEMS
Competency: K3 Install High Voltage Switch Gear

Objectives
To be competent in this area, the individual must be able to:
- Describe the operating principles of high voltage switch gear and protective devices.
- Describe procedures to install and test high voltage switch gear and protective devices.

LEARNING TASKS

1. Describe the features of high voltage switch gear
   - Metal-clad and metal-enclosed switch gear
   - Ratings of switches
   - Types of operating mechanisms
   - Types of switches

2. Describe the features of high voltage fuses
   - Expulsion and non-expulsion categories
   - Ratings of fuses
   - Types of high voltage fuses

3. Describe the features of high voltage AC circuit breakers
   - Ratings of circuit breakers
   - Arc suppression
   - Types of operating mechanisms
   - Types of circuit breakers and re-closers

4. Describe safety procedures for operating high voltage switches and circuit breakers
   - Safety lockout procedures and grounding
   - Arc blast hazards
     - Z460 and Z462 (CSA standard)
     - Shock and arc flash protection
   - Safety inspections
   - Approved live-line tools
   - Voltage testing

5. Interpret CEC rules and regulations concerning high voltage control and protective equipment
   - Service equipment and disconnect means
   - Overcurrent protection
   - Potential and current transformers
   - Indoor installations
   - Outdoor installations
### LEARNING TASKS

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<td>7.</td>
<td>Describe safety precautions when working with protective relay circuits</td>
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### Line (GAC): K INSTALL HIGH VOLTAGE SYSTEMS

**Competency:** K4 Use of High Voltage Test Equipment

### Objectives

To be competent in this area, the individual must be able to:

- Describe the operating principles and use of high voltage test equipment.

### LEARNING TASKS

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<th>LEARNING TASKS</th>
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</thead>
</table>
| **1.** Describe characteristics of cable insulation | • Capacitance and dielectric absorption  
• Cable deterioration  
  o Treeing  
  o Partial discharge  
  o Manufacturing defects |
| **2.** Describe the use of a megger for insulation testing of high voltage circuits | • Types and ratings of meggers  
• Hazards and safety precautions  
  o Testing procedures  
• Insulation resistance  
• Insulation currents  
• Insulation test types  
  o Proof test  
  o Short time test  
  o Polarization index  
  o Step  
  o Step voltage test  
  o Dielectric absorption test |
| **3.** Describe field testing methods for high voltage cables | • Cable failure causes  
• IEEE standards 400  
• Type 1 tests  
• Type 2 tests  
• AC hypot testing  
  o Power frequency  
  o Very low frequency (VLF dissipation factor)  
• DC hypot testing  
• Partial discharge testing  
  o Online  
  o Offline  
• Applications of hypot testing |
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</table>
| 4. Describe the use and care of high voltage test equipment | • Hot sticks  
• Test probes  
• Personal Protective Equipment (PPE)  
• Grounding leads  
• Care and maintenance of equipment |
| 5. Describe the use of high voltage test equipment | • Hot sticks  
• Test probes  
• Personal Protective Equipment (PPE)  
• Grounding leads  
• High pot testers  
• Care and maintenance of equipment |
Section 4

TRAINING PROVIDER STANDARDS
Facility Requirements

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 3,000 square feet of shop area including a tool crib and work stations
- Minimum 10 foot ceiling height in shop areas
- 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 equipment

Lab Requirements
- Minimum 3,200 square feet in lab
- Minimum 8 foot ceiling in lab areas
- Adequate heating, lighting and ventilation
- Acoustics in the room must allow audibility of the instructor
- Refuse and recycling bins for used lab materials

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
- Computer
- Internet access
- Printer access
- Adequate storage facilities for material and training aids
- Access to photocopier/scanner
- Telephone

Other

- N/A
Tools and Equipment

Shop Equipment

*Required*

Equipment List is based on the standard class size of 16 apprentices. The facilities must be suitable for instructional use.

**Level 1**

- 8 Power supply stations (with fixed and variable AC and DC outputs and metering)
- 8 Sets of resistors for circuit analysis labs
- *Misc. magnetic devices such as relays, solenoids, bells, buzzers, chimes, etc.
- 8 Motor Control Stations (with manual and magnetic starters, reversing starters, assorted switches, TD relays and pilot devices as necessary)
- 8 Small 3-phase motors
- 4 Single-phase, split-phase, dual-voltage motors
- 8 Analogue multimeters
- 8 Digital multimeters
- 8 Wattmeters
- 8 Clamp-on ammeters
- 4 Solenoid-plunger (wiggy) testers
- 4 Meggers
- 2 Wheatstone bridges
- 4 Outlet analyzers
- 2 Watt-hour meters
- 8 Wire gauges, micrometers, calipers
- *Misc. conductors, cables and raceways for demo purposes
- *Misc. dimmer and snap switches
- *Variety of circuit protective devices
- 8 Electronic trainers
- 16 Computer stations with CD Rom, modem, software, etc.
- 1 Printer

**Level 2**

- 8 Power supply stations (with fixed and variable AC and DC outputs and metering)
- 8 Sets of resistors, capacitors and inductors for circuit analysis labs
- *Misc. magnetic devices such as relays, solenoids, bells, buzzers, chimes, etc.
- 8 Motor Control Stations (with manual and magnetic starters, reversing starters, control and time-delay relays, electronic relays, assorted switches, plugging and anti-plugging devices, programmable relays and pilot devices, as necessary)
- 8 Small 3-phase motors
- 4 Single-phase, split-phase, dual-voltage motors
- 8 Oscilloscopes, dual-trace
- 8 Digital scopes
- 8 Analogue multimeters
- 8 Digital multimeters
- 8 Wattmeters
- 8 Clamp-on ammeters
- 4 Solenoid-plunger (wiggy) testers
- 4 Meggers
2 Wheatstone bridges
4 Outlet analyzers
4 Light (photo) meters
2 Watt-hour meters
8 Transformers, dual-winding type (3 kVA typical)
4 Autotransformers, multi-tap type (1.5 kVA typical)
4 Current metering transformers
4 Potential metering transformers
* Misc. conductors, cables and raceways for demo purposes
4 Recessed incandescent fixtures
* Misc. dimmer and snap switches
4 Fluorescent lights (rapid start)
4 Fluorescent lights (instant start)
2 Mercury vapour lights
2 Metal halide lights
2 H.P. Sodium lights
2 L.P. Sodium lights
4 LED lights
* Variety of circuit protective devices
8 Electronic trainers
8 Function (signal) generators
16 Computer stations with CD Rom, modem, software, etc.
1 Printer

Level 3

8 Power supply stations (with fixed and variable AC and DC outputs and metering)
8 Sets of resistors, capacitors and inductors for 3-phase circuit analysis labs
8 Three-phase auto-transformer stations
8 Three-phase isolation transformer stations
8 Three-phase motor control stations (with assorted reduced-voltage/current magnetic starters, reversing starters, electronic starters, control and time-delay relays, assorted pilot devices as necessary)
8 Three-phase squirrel-cage motors (assorted 6-lead, 9-lead and 12-lead)
4 Three-phase wound-rotor motors and controllers
4 Three-phase synchronous motors and controllers
4 Power factor correction capacitors, single-phase
2 Power factor correction capacitors, three-phase
8 Single-phase, capacitor-start, dual-voltage motors
1 Single-phase, shaded-pole motor
1 Single-phase, universal motor
8 Single-phase magnetic starters
4 Reversing drum switches
2 Three-phase alternator synchronizing panel with metering and controls
2 Three-phase alternators with prime movers
8 DC motor control stations (with assorted magnetic starters)
8 DC electronic motor drives
8 DC motors, compound type
8 Oscilloscopes, dual-trace
8 Analogue multimeters
8 Digital multimeters
8 Wattmeters
8 Clamp-on ammeters
4 Phase-sequence indicators
4 Meggers
4 Hand-held tachometers
2 Motor rotation indicators
2 Watt-hour meters
* Misc. conductors and raceways for demo purposes
8 Three-phase rectifier boards
8 Electronic trainers for discrete components
2 Electronic soft start controllers
8 Function (signal) generators
4 Power quality analyzers
8 VFDs
8 OpAmp Trainers

Level 4

8 Power supply stations (with fixed and variable AC and DC outputs and metering)
8 Sets of resistors, capacitors and inductors for 3-phase circuit analysis labs
8 Three-phase transformer stations
8 Three-phase motor control stations (with assorted reduced-voltage/current magnetic starters, reversing starters, electronic starters, control and time-delay relays, assorted pilot devices as necessary)
8 Three-phase squirrel-cage motors (assorted 6-lead, 9-lead and 12-lead)
4 Three-phase wound-rotor motors and controllers
4 Three-phase synchronous motors and controllers
2 Power factor correction capacitors, three-phase
8 Oscilloscopes, dual-trace
8 Analogue multimeters
8 Digital multimeters
8 Wattmeters
8 Clamp-on ammeters
4 Meggers
4 Hand-held tachometers
8 Electronic (semiconductor devices) trainers
8 Function (signal) generators

16 Computer workstations with associated software programs and 1 laser printer
1 Multimedia (computer) projector
8 PLC workstations, with associated software
8 PLC simulator display boards
8 Digital Logic trainers
8 Transducer fundamentals trainer for automated controls
4 Adjustable speed DC drive c/w motors
4 Variable frequency AC drive c/w motors
2 Conventional non-addressable fire alarm systems c/w initiating, signal and alarm devices
2 Addressable fire alarm systems c/w initiating, signal and alarm devices
2 Nurse call trainers
2 Intrusion alarm systems
2 Intercom systems
1 Gas fired furnace trainer
1 Electric furnace trainer
1 HVAC roof top trainer
1 UPS System
1 Standby power system c/w M-G set, automatic transfer switch and load bank
1 Demonstration high voltage vault c/w transformers, unit equipment, distribution switchgear, protective relaying and metering
1 High voltage test equipment including approved gloves, hot stick, voltage tester, mats, and personal protective equipment
* HV cable stress cone termination kits
8 Data cabling installation and test equipment
1 Fibre optic tool kit
1 Geothermal trainer
1 Heat pump trainer
2 Photovoltaic trainers
2 Sound system trainers
3 Home entertainment systems
2 CATV

* As Required

Student Tools (supplied by student)

Required

• Contact Training Facility for recommended tools and equipment that students need to supply.
Reference Materials

Required Reference Materials

- Contact Training Facility for Required Reference Material

Recommended Resources

- Industry Training Authority (ITA) www.itabc.ca
- WorkSafeBC (WCB) www.worksafebc.com

Codes

  - BC Building Code
  - BC Fire Code
  - BC Electrical Code
- National Fire Protection Association www.nfpa.org
  - NFPA 80 – Standards for Fire Doors and Fire Windows

Suggested Texts

- AC FUNDAMENTALS
  by Duff and Herman

- BRITISH COLUMBIA BUILDING CODE
  Building Standards Branch
  Ministry of Municipal Affairs……………………………………………………………………… ISBN 0-7726-1574-8

- CABLES AND WIRING
  AVO Multi-Amp Institute

- DC FUNDAMENTALS
  by Loper and Tedson
  Delmar Publishers…………………………………………………………………………… ISBN 0-8273-6572-1
• DELMAR’S STANDARD GUIDE TO TRANSFORMERS
  by Herman and Singleton
  Delmar Publishers............................................................. ISBN 0-8273-7209-4

• ELECTRIC MOTOR REPAIR, 3rd EDITION
  by Robert Rosenburg and August Hand

• ELECTRICAL CONTROL FOR MACHINES
  by Rexford

• ELECTRICAL MOTOR CONTROLS AUTOMATED INDUSTRIAL SYSTEMS
  by Rockis and Mazur

• ELECTRICAL RACEWAYS AND OTHER WIRING METHODS
  by Loyd

• ELECTRICAL WIRING
  by Seale

• ELECTRICAL WIRING - COMMERCIAL
  by Mullin, Smith, Fraser and Jackson
  Nelson Canada................................................................. ISBN 0-17-604839-1

• ELECTRICAL WIRING - INDUSTRIAL
  by Smith and Herman
  Delmar Publishers............................................................. ISBN 0-8273-6653-1

• ELECTRICAL WIRING - RESIDENTIAL
  by Mullin and Fraser
  Nelson Canada................................................................. ISBN 0-17-604839-7

• ELECTRICITY FOR REFRIGERATION, HEATING AND AIR CONDITIONING
  by Smith

• ELECTRONIC DRIVES
  by Carrow

• ELECTRONIC VARIABLE SPEED DRIVES
  by Brumbach

• ELECTRONICS FOR ELECTRICIANS
  By Stephen Herman

• EMERGENCY, STANDBY AND OTHER AUXILIARY POWER SYSTEMS
  by Editor, EC&M Magazine
  InterTec Publishing Corp.................................................. ISBN 0-87288-603-4
• FIBER OPTIC CABLE SYSTEM INSTALLATION  
  by Pearson  

• FIRE ALARM SYSTEMS - A REFERENCE MANUAL  
  by Canadian Fire Alarm Association  
  Prosafe Publications Ltd............................................................................ISBN 0-9692433-2-4

• HAZARDOUS CLASSIFIED LOCATIONS  
  by Loyd  
  Delmar Publishers....................................................................................ISBN 0-8273-6982-4

• HEATING, VENTILATING AND AIR CONDITIONING  
  by Swenson  

• IES LIGHTING HANDBOOK - APPLICATION VOLUME  
  by Illuminating Engineering  

• IES LIGHTING HANDBOOK - REFERENCE VOLUME  
  by Illuminating Engineering  

• INTRODUCTION TO DIGITAL SYSTEMS  
  by Palmer and Perlman  

• INTRODUCTION TO THE FIRE DETECTION AND ALARM INDUSTRY  
  by Canadian Fire Alarm Association  
  Prosafe Publications Ltd............................................................................ISBN 0-9692433-2-4

• MODERN CONTROL TECHNOLOGY - COMPONENTS AND SYSTEMS  
  by Kilian  

• PROGRAMMABLE CONTROLLER CIRCUITS  
  by Bertrand  
  Delmar Publishers....................................................................................ISBN 0-8273-7066-0

• SMART HOUSE WIRING  

• SOLID STATE FUNDAMENTALS FOR ELECTRICIANS  
  by Rockis  

• TECHNICIAN’S GUIDE TO PROGRAMMABLE CONTROLLERS  
  by Cox  

• TROUBLESHOOTING ELECTRIC MOTORS  
  by Mazur and Proctor  
• TROUBLESHOOTING ELECTRICAL/ELECTRONIC SYSTEMS
  by Mazur and Proctor

NOTE:
This list of Reference Materials is for training providers. Apprentices should contact their preferred training provider for a list of recommended or required texts for this program.
Instructor Requirements

Occupation Qualification
The instructor must possess:

- For Levels 1 & 2:
  - A Construction Electrician or Industrial Electrician BC Certificate of Qualification preferably with Red Seal Endorsement
  - A Construction Electrician or Industrial Electrician Certificate of Qualification from another Canadian jurisdiction with Red Seal Endorsement only

- For Levels 3 & 4:
  - A Construction Electrician BC Certificate of Qualification preferably with Red Seal Endorsement
  - A Construction Electrician Certificate of Qualification from another Canadian jurisdiction with Red Seal Endorsement only

Work Experience
A minimum of 5 years’ experience working in the industry as a journeyperson.

Instructional Experience and Education
It is preferred that the instructor also possesses one of the following:

- An Instructors Diploma or equivalent
- A Bachelor’s Degree in Education
- A Master’s Degree in Education
Appendices
Appendix A

Work-Based Training

Prior to attending Technical Training

Construction Electrician
Appendix A
Work-Based Training

Line (GAC): A USE ESSENTIAL SKILLS
Competency: A1 Demonstrate Employability Skills

Objectives
To be competent in this area, the individual must be able to:
• Acquire this competency prior to attending technical training.

LEARNING TASKS

1. Describe the electrical trade
   • Types of businesses
   • Types of work
   • Initial clothing, tools and personal protective equipment required
   • Safety

2. Describe expectations and responsibilities of employers and employees
   • Employer responsibilities and expectations
   • Employee expectations
   • Effective workplace behaviour
   • Apprenticeship system
Appendix A  
Work-Based Training

**Line (GAC):** A  
**Competency:** A2  
**USE ESSENTIAL SKILLS**

**Use Effective Communication Skills**

**Objectives**
To be competent in this area, the individual must be able to:
- Acquire this competency prior to attending technical training.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>1. Demonstrate communication skills</td>
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<tr>
<td>• Trade terminology</td>
</tr>
<tr>
<td>• Apprentice/journeyperson relations</td>
</tr>
<tr>
<td>• Employee/employer relations</td>
</tr>
<tr>
<td>• Customer relations</td>
</tr>
<tr>
<td>• Basic sales skills</td>
</tr>
<tr>
<td>• Communicate with other trades people</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>2. Use trade related documentation</td>
</tr>
<tr>
<td>• Types</td>
</tr>
<tr>
<td>• Procedures used to complete documentation</td>
</tr>
<tr>
<td>• Installation instructions and requirements</td>
</tr>
<tr>
<td>• Proprietary product documentation</td>
</tr>
<tr>
<td>• Certification agencies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Use reference material</td>
</tr>
<tr>
<td>• Tables</td>
</tr>
<tr>
<td>• Charts</td>
</tr>
<tr>
<td>• Product specifications</td>
</tr>
<tr>
<td>• Technical bulletins</td>
</tr>
<tr>
<td>• Wholesaler catalogues</td>
</tr>
<tr>
<td>• Manufacturers’ websites</td>
</tr>
<tr>
<td>• Warranty information</td>
</tr>
<tr>
<td>o Activation</td>
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<tr>
<td>o Claims</td>
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</tbody>
</table>
Appendix A  
Work-Based Training

Line (GAC): A  USE ESSENTIAL SKILLS
Competency: A3  Demonstrate Quality Workmanship

Objectives
To be competent in this area, the individual must be able to:
- Acquire this competency prior to attending technical training.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe organization of a project | • Project specifications  
- Safety  
- Sequence of operation  
- Prioritization  
- Coordination with other trades  
- Estimate  
- Tools and equipment  
• Inventory requirements  
  - Secure storage  
  - Time delivery  
  - Labelling materials  
  - Stock maintenance  
  - Consumables  
- Checklist utilization  
- Cost efficiency  
- Post job efficiency analysis |

| 2. Describe considerations when handling materials | Safety  
- Availability  
- Storage  
- Timing/sequencing  
- Work platforms  
- Labelling  
- Moving  
- Product protection  
- Disposal  
- Recycling  
- Procedures  
- Securing  
- Packaging/shipping |
Appendix A
Work-Based Training

Line (GAC): A   USE ESSENTIAL SKILLS
Competency: A4  Solve Problems Using Applied Mathematics

Objectives
To be competent in this area, the individual must be able to:
• Acquire this competency prior to attending technical training.

LEARNING TASKS
1. Solve problems using mathematics

CONTENT
• Use a calculator
• Whole numbers
• Fractions and decimals
• Ratios and proportions
• Percentages
• Roots and powers
• Simple equations
• Basic geometry
• Trigonometry
Appendix A
Work-Based Training

Line (GAC): A USE ESSENTIAL SKILLS
Competency: A5 Solve Problems Using Applied Science

Objectives
To be competent in this area, the individual must be able to:
- Acquire this competency prior to attending technical training.

LEARNING TASKS
1. Apply trade science concepts

CONTENT
- Convert metric and imperial units
- Solve problems involving work, power and energy
- Describe simple machine applications
- Describe properties of common materials
- Describe principles of magnetism
Appendix A
Work-Based Training

Line (GAC): A USE ESSENTIAL SKILLS
Competency: A6 Describe Analytical Troubleshooting Techniques

Objectives
To be competent in this area, the individual must be able to:
• Describe systematic procedures to efficiently identify the source and type of malfunction or fault in circuits and equipment.

LEARNING TASKS

1. Describe techniques to accurately break systems down into units of function to narrow trouble search
   • Units of function

2. Describe techniques to determine equipment specifications and operating parameters
   • Manual
   • Schematics
   • Internet resources

3. Describe and use flow charts and process charts in troubleshooting
   • Flow charts
   • Logic charts
   • Process charts
## Appendix A
### Work-Based Training

**Line (GAC):** A **USE ESSENTIAL SKILLS**  
**Competency:** A7 Use Computers

### Objectives
To be competent in this area, the individual must be able to:
- Describe the components of a computer system.
- Install, use and uninstall software.
- Create and store data.
- Use the internet.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>Number</th>
<th>Task Description</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1.     | Describe the components of a computer                  | • Central processing units  
                                                                 • Memory types and cache  
                                                                 • Power supply and battery  
                                                                 • Disk drives, controllers  
                                                                 • Monitors, keyboards and mice |
| 2.     | Install common peripheral interfaces                   | • Video display interface  
                                                                 • Sound cards  
                                                                 • Internal modem cards  
                                                                 • Network interface cards  
                                                                 • Serial/parallel port cards |
| 3.     | Connect peripheral hardware components                 | • Monitor and keyboard  
                                                                 • Mouse  
                                                                 • Printer/plotter  
                                                                 • Scanner |
| 4.     | Install, use and uninstall software                    | • Operating system  
                                                                 • Application software  
                                                                 • Security software |
| 5.     | Create and store data                                 | • Drives  
                                                                 • Folders  
                                                                 • Networks |
| 6.     | Access and use the internet                           | • Search engines  
                                                                 • E-mail  
                                                                 • Research |
Line (GAC): B USE SAFE WORK PRACTICES
Competency: B6 Use Safe Rigging Techniques

Objectives
To be competent in this area, the individual must be able to:
- Acquire this competency prior to attending technical training.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe ropes</td>
<td>• Uses</td>
</tr>
<tr>
<td></td>
<td>• Working load limit</td>
</tr>
<tr>
<td>2. Describe basic knots, bends and hitches</td>
<td>• Types</td>
</tr>
<tr>
<td></td>
<td>• Uses</td>
</tr>
<tr>
<td>3. Describe slings</td>
<td>• Types of slings</td>
</tr>
<tr>
<td></td>
<td>• Use of slings</td>
</tr>
<tr>
<td></td>
<td>• Load ratings</td>
</tr>
<tr>
<td>4. Demonstrate hand signals for crane operation</td>
<td>• Standard crane operator hand signals</td>
</tr>
<tr>
<td>5. Inspect lifting devices</td>
<td>• Equipment inspection techniques</td>
</tr>
</tbody>
</table>
Appendix A
Work-Based Training

Line (GAC): C USE TOOLS AND EQUIPMENT
Competency: C1 Use Hand Tools

Objectives
To be competent in this area, the individual must be able to:
• Acquire this competency prior to attending technical training.

LEARNING TASKS

1. Describe hand tools used in the trade

CONTENT
• Standards tools
  o Wrenches
  o Cable cutters
  o Pliers
  o Files
  o Drill bits
  o Fish tape
  o Fuse puller
  o Measuring tape
  o Pipe benders, cutters, threader
  o Reamers
  o Wire strippers

2. Use hand tools

• Purpose/uses
• Procedures/operations
• Safety
• Adjustment
• Inspection
• Maintenance
• Storage
Appendix A
Work-Based Training

Line (GAC): C USE TOOLS AND EQUIPMENT
Competency: C2 Use Power Tools

Objectives
To be competent in this area, the individual must be able to:
• Acquire this competency prior to attending technical training.

LEARNING TASKS

1. Describe power tools used in the trade
   • Types
     ○ Stationary power tools
     ○ Air-powered tools
     ○ Hydraulic tools
     ○ Gasoline powered tools

2. Use power tools
   • Parts
   • Purpose/uses
   • Procedures/operations
   • Safety
   • Adjustment
   • Inspection
   • Maintenance
   • Storage
Line (GAC): C USE TOOLS AND EQUIPMENT
Competency: C3 Use Fastening Systems

Objectives
To be competent in this area, the individual must be able to:
• Acquire this competency prior to attending technical training.

LEARNING TASKS
1. Use fastening systems

CONTENT
• Types
• Purpose/use
• Procedures/operations
• Safety
• Adjustment
• Inspection
• Maintenance
• Storage
Line (GAC): C USE TOOLS AND EQUIPMENT
Competency: C4 Use Powder Actuated Tools

Objectives
To be competent in this area, the individual must be able to:
• Acquire this competency prior to attending technical training.

LEARNING TASKS
1. Use powder-actuated tools

CONTENT
• Types
• Licencing requirements and procedures
• Tool assembly
• Loading procedure
• Fastener selection
• Personal protective equipment
• Safe handling and storage
Appendix A
Work-Based Training

Line (GAC): C USE TOOLS AND EQUIPMENT
Competency: C5 Use Access Equipment

Objectives
To be competent in this area, the individual must be able to:
• Acquire this competency prior to attending technical training.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe access equipment</td>
<td>Types</td>
</tr>
<tr>
<td></td>
<td>• Ladders</td>
</tr>
<tr>
<td></td>
<td>• Lift table</td>
</tr>
<tr>
<td></td>
<td>• Scaffolds</td>
</tr>
<tr>
<td></td>
<td>• Scissor lift</td>
</tr>
<tr>
<td></td>
<td>• Swing stage</td>
</tr>
<tr>
<td>2. Use access equipment</td>
<td>Purpose/uses</td>
</tr>
<tr>
<td></td>
<td>• Procedures/operations</td>
</tr>
<tr>
<td></td>
<td>• Safety</td>
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<td>• Adjustment</td>
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<td>• Inspection</td>
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<td>• Maintenance</td>
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<td>• Storage</td>
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</table>