PROGRAM OUTLINE

Industrial Electrician
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Section 1
INTRODUCTION
Industrial Electrician
Foreword

Industrial Electricians install and maintain the electrical fixed assets of industrial operations. Operations which are likely to employ Industrial Electricians are:

- Oil and gas processing plants
- Mining and smelting operations
- Food processing plants
- Sawmills
- Manufactured wood product plants
- Printing plants
- Pulp and paper mills
- Light and heavy manufacturing operations
- Industrial Construction Contract Operations
- Water and sewage treatment plants
- Other utility installations

Industrial Electricians are relied upon to troubleshoot and diagnose electrical and process failures in manufacturing and processing facilities. Troubleshooting requires a broad base of electrical competence in order to isolate and repair faults and failures. When a plant or process is down, time is of the essence in finding and repairing faults, but speed must not come at the expense of safety.

As almost all plant processes and equipment are electrically energized the Industrial Electrician is likely to be involved in all aspects of an operation, often working with Millwrights, process operators and Instrument Mechanics to troubleshoot equipment and optimize processes.

Industrial Electricians are competent working at extra low, low and high voltages and can be called on to install lighting right through to installation of high voltage transformers. They are able to build and install electrical systems, although the amount of time spent doing this varies widely between place so employment.

Electrical technology and equipment changes rapidly. Industrial Electricians are required to continually learn and develop new skills to keep current with new technology and processes.

Industrial Electricians can move into maintenance planning and other supervisory positions as well as develop specialized skills in areas of the trade beyond the apprenticeship program.

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.
Introduction

Acknowledgements

This Program Outline was prepared with the advice and direction of an industry steering committee, led by the Resource Training Organization (RTO). The Resource Training Organization (RTO) assumed responsibility for the development and maintenance of the Industrial Electrician apprenticeship training program in 2007.

This Program Outline is based on the 2007 Industrial Electrician Competency Standards. Development of the competency standards was led by HITAC/Labour Industrial Electrical Apprenticeship Development Committee. The competency standards were developed through extensive consultation with a broad cross-section of stakeholders in BC’s heavy industry sectors – mining and smelting, oil and gas, pulp and paper and solid wood processing. The program received extensive support by industry, unions and both Federal government and Provincial government agencies.

Industry Subject Matter Experts (SMEs) retained to assist in the development of Program Outline content.

**PHASE 1 – 2005**
- Stuart Blundell, Canfor Pulp Trust
- Ainsley Encinas, Alcan
- Bruce Reeds, Highland Valley Copper
- Al Stewart, Spectra Energy
- Brent Masuch, Terasen Gas
- Carl These, Tolko
- Kevin Zornes, Weyerhaeuser
- Bernie Radfux, Western Forest Products
- Richard Wittman, Eurocan Pulp and Paper
- Karl Luszszak, Pope & Talbot
- Buff Wilkinson, Elk Valley Coal
- Ross Turvey, Domtar
- Frank Gervais, Terasen Gas
- Duncan Gable, Catalyst Paper

**PHASE 2 – 2006 – 2007**
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- Bruce Reeds, Highland Valley Copper
- Alan Stewart, Spectra Energy
- Ernst Pfanner, Spectra Energy
- Brent Masuch, Terasen Gas
- Stuart Blundell, Canfor
- Richard Wittman, Eurocan Pulp & Paper
- Dave Lord, Catalyst Paper
- Karl Luszszak, Pope & Talbot Pulp & Paper
- Art Foote, West Fraser
- Carl These, Tolko
- Kevin Zornes, Weyerhaeuser

The Industrial Electrical Training Provider Consortium, a group of four colleges, supported development of the Theory Competency Standards and the integration of those standards into the overall Qualification.

- Thompson Rivers University, Ralph Finch, Dean
- North Island College, Don Gillingham, Dean
- College of New Caledonia, Jan Jonkers, Dean
- College of the Rockies, Ron McRae, Dean

The Instructor SMEs who participated in development of these competency standards are:

- Peter Poeschek, Thompson Rivers University
- Andrew Marr, North Island College
- Steven Campbell, College of New Caledonia
- Ian Goring, College of the Rockies

**Program revised in 2011**

Construction Electrician Level 1 and Level 2 were approved as common core for the Industrial Electrician program. This Program Outline and Occupational Analysis Chart have been revised to reflect this change.

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 Industrial Electrician occupation.
## 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>Program Assessment</strong></td>
<td>Communicate program completion requirements and assessment methods</td>
<td>Understand the various assessment requirements for the program</td>
<td>Understand the various assessment requirements for the program</td>
<td>Understand the assessment requirements they would have to fulfill in order to challenge the program</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>Section</td>
<td>Training Providers</td>
<td>Employers/ Sponsors</td>
<td>Apprentices</td>
<td>Challengers</td>
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<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>
Understanding Competency Standards

This Program Outline contains the set of industry defined competency standards against which apprentice Industrial Electricians are to be assessed as they learn the knowledge and skills through their apprenticeship.

Program completion requires completion of four periods of technical training, six thousand documented hours (four years) of industrial electrical work experience and the completion of the required competency standards as documented by the Workplace Logbook.

Program completion results in the award of a BC Certificate of Qualification: Industrial Electrician, a Certificate of Completion: Apprenticeship, and, with a passing mark on the Interprovincial Examination (written in the apprentice’s fourth and final year) as well as six thousand hours of documented work experience, the Industrial Electrician Red Seal Endorsement.

This Program Outline contains two distinct types of competency standards, Theory Competency Standards and Workplace Competency Standards.

Theory Competency Standards

• Typically achieved in post secondary settings.
• Assessed in the post secondary (classroom) setting.
• May have a practical lab component which takes the form of ‘theory proof and applied understanding’ exercises.
• Once achieved the Theory Competency Standards equip the apprentice with the ‘underpinning knowledge’ to go into the workplace and develop competence.

Workplace Competency Standards

• Typically achieved on the job.
• The apprentice gathers evidence of competent performance to present to the assessor or certified Industrial Electrician with Red Seal endorsement.
• Assessed on the job by ITA registered workplace assessors or certified Industrial Electricians with Red Seal endorsement.
• Workplace Competency Standards are achieved by combining theory covered during technical training with practical experience and applied learning.
• Workplace Competency Standards are organized into two categories:
  1. Compulsory – every Industrial Electrician apprentice must demonstrate competence in these standards to complete the apprenticeship
  2. Elective – apprentices select from the elective competencies and must complete 35 credits to complete their apprenticeship
Section 2

PROGRAM OVERVIEW

Industrial Electrician
Program Overview

Program Credentialing Model

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

**Industrial Electrician Level 3**
- Technical Training: 300 hours (10 weeks*)
- ITA Standardized Written Exam
- Accumulate Work-Based Training hours
- Logbook: Accumulate Competencies

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

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

**Construction Electrician Foundation**
- Technical Training: 24 weeks*

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

*Suggested duration based on 30-hour week

**APPRENTICESHIP - DIRECT ENTRY**

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

- Construction Electrician Level 1 & 2 Technical Training: Levels 1 & 2
- Work-Based Training: None
Program Assessment

Assessment of Apprentices

The competency based assessment of apprentices in the Industrial Electrician program is significantly different than most other apprenticeship programs. This approach requires a much higher degree of employer and apprentice responsibility in tracking and assessing the apprentice’s progress throughout the apprenticeship. A comprehensive logbook is provided to guide the apprentice development, record their achievements, and verify their assessments. To achieve the B.C. Industrial Electrician Certificate of Qualification (C of Q) the apprentice must achieve the industry standard in each competency which will be assessed by a designated assessor or certified Industrial Electrician with Red Seal endorsement. Although there will be more emphasis on practical assessment, theory examinations will still be taken by the apprentice for each in-school training level and Interprovincial certification.

Apprentices will be assessed fairly and consistently throughout the program on the various skills required to be a professional tradesperson. Assessment activities are designed to provide feedback and allow for further development of skills that have been identified as essential for on the job performance.

Forms of Assessment

The forms of assessment used in this program are described below.

<table>
<thead>
<tr>
<th>Completion Requirement</th>
<th>Evidence of Achievement</th>
<th>Level of Achievement Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1 Technical Training (Electrician Common Core)</td>
<td>In-school testing and practical assessment</td>
<td>Minimum 70%</td>
</tr>
<tr>
<td>Level 2 Technical Training (Electrician Common Core)</td>
<td>In-school testing and practical assessment</td>
<td>Minimum 70%</td>
</tr>
<tr>
<td>Level 3 Technical Training</td>
<td>In-school testing and practical assessment; ITA standardized written exam</td>
<td>Minimum 70% (based on 80% in-school mark and 20% ITA standardized written exam)</td>
</tr>
<tr>
<td>Level 4 Technical Training</td>
<td>In-school testing and practical assessment; ITA standardized written exam</td>
<td>Minimum 70%</td>
</tr>
<tr>
<td>Qualification exam</td>
<td>Interprovincial Red Seal exam</td>
<td>Minimum 70%</td>
</tr>
<tr>
<td>Logbook completion</td>
<td>Formal workplace assessment, as per industry standards</td>
<td>Completion of compulsory and elective workplace competency standards – signed off by registered assessor or certified Industrial Electrician with Red Seal endorsement</td>
</tr>
<tr>
<td>Recommendation for certification</td>
<td>Approval/sign-off by sponsor, employer or other individual with sign-off authority</td>
<td>Declared competent</td>
</tr>
</tbody>
</table>
What is Achievement Criteria?

Achievement Criteria sets a common minimum standard for training providers to measure achievement of practical competencies. Achievement Criteria is included only for competencies that require a practical assessment during the technical training portion of the program. Where Achievement Criteria is specified the trainee must achieve 100% within the specifications, safety standards and timeframes described.

Competencies that are solely theory-based will be assessed through multiple choice test(s) in which the trainee must achieve a minimum score of 70%.
Program Overview

Occupational Analysis Chart
INDUSTRIAL ELECTRICIAN

Occupation Description
"Industrial Electrician" means a person who inspects, installs, tests, troubleshoots, repairs, and services industrial electrical equipment and associated electrical and electronic controls. Service includes calibration and preventative/predictive maintenance. Industrial Electricians are employed by maintenance departments of plants, mines, smelters, oil and gas rigs as well as platforms, mills, shipyards, factories and other industrial establishments. Some are employed by electrical contractors.

Note: Refer to Construction Electrician Program Outline for Level 1 and Level 2 (common core) competency descriptions.

WC = Workplace Compulsory  WE = Workplace Elective (EL)  TC = Technical Compulsory

<table>
<thead>
<tr>
<th>ESSENTIAL SKILLS</th>
<th>Use effective communication skills</th>
<th>Solve problems using applied mathematics</th>
<th>Use analytical troubleshooting techniques</th>
<th>Use computers</th>
<th>Lead teams and manage electrical installation and maintenance projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>IE127-3WC</td>
<td>IE107-1WC</td>
<td>IE104-3WC</td>
<td>IE125-3WC</td>
<td>IE128-3WC</td>
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<tr>
<th>SAFE WORK PRACTICES</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 jumpers and forces safely</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>IE102-1WC</td>
<td>IE103-1WC</td>
<td>IE106-1WC</td>
<td>IE109-9WE</td>
<td>IE110-9WE</td>
<td>IE111-9WE</td>
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<thead>
<tr>
<th>TOOLS AND EQUIPMENT</th>
<th>Use hand tools</th>
<th>Use powder actuated tools</th>
<th>Use safe rigging techniques</th>
<th>Use liquid-fuel powered tools</th>
<th>Use pneumatic and hydraulic tools</th>
<th>Operate personnel lifting devices</th>
</tr>
</thead>
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<tr>
<td>C</td>
<td>IE114-1WC</td>
<td>IE197-9WE</td>
<td>IE104-3WC</td>
<td>IE199-9WE</td>
<td>IE115-1WC</td>
<td>IE198-9WE</td>
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<td>C6</td>
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<td>EL</td>
</tr>
</tbody>
</table>
### Program Overview

<table>
<thead>
<tr>
<th>CIRCUIT CONCEPTS</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 electronic circuits</th>
<th>Demonstrate knowledge of three-phase theory</th>
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<table>
<thead>
<tr>
<th>TEST EQUIPMENT</th>
<th>Use analog meters</th>
<th>Use digital meters</th>
<th>Use scopes</th>
<th>Use phase rotation meter</th>
<th>Demonstrate knowledge of measurement and calibration test equipment</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>E</td>
<td>E1</td>
<td>E2</td>
<td>E3</td>
<td>IE130-3WC                                                  E4</td>
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<td>EL                                                       EL</td>
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<table>
<thead>
<tr>
<th>DRAWINGS AND MANUALS</th>
<th>Use circuit drawings</th>
<th>Use construction drawings and specifications</th>
<th>Use manuals and manufacturer’s instructions</th>
<th>Plan time and materials</th>
<th>Design and draw electrical and electronic drawings</th>
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<thead>
<tr>
<th>CEC, REGULATIONS AND STANDARDS</th>
<th>Describe the application of the Canadian Electrical Code (CEC)</th>
<th>Apply the CEC to installations</th>
<th>Apply other regulations and codes</th>
<th>Access and comply with mining electrical regulations</th>
<th>Demonstrate and apply knowledge of onshore pipeline regulations</th>
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<td>IE211-9WE                                      G5</td>
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</table>

<table>
<thead>
<tr>
<th>LOW VOLTAGE DISTRIBUTION SYSTEMS</th>
<th>Install service equipment</th>
<th>Install grounding and bonding</th>
<th>Install distribution centers</th>
<th>Install raceways, boxes and fittings</th>
<th>Install conductors and cables</th>
<th>Install protective devices</th>
</tr>
</thead>
<tbody>
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<table>
<thead>
<tr>
<th>Install devices</th>
<th>Install and maintain low voltage circuits</th>
<th>Demonstrate knowledge of installing and terminating fibre optic cables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>H7</td>
<td>H142-3WC                                                            H8</td>
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</tbody>
</table>
# Program Overview

<table>
<thead>
<tr>
<th>ELECTRICAL EQUIPMENT</th>
<th>Install lighting and electrical equipment</th>
<th>Install transformers</th>
<th>Demonstrate knowledge of installing and maintaining HVAC equipment</th>
<th>Demonstrate knowledge of pumps</th>
<th>Demonstrate knowledge of the installation and maintenance of Robotic Control Systems</th>
<th>Install and maintain HVAC equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>IE132-2WC</td>
<td>IE146-2WC</td>
<td>IE156-4TC</td>
<td>IE158-4TC</td>
<td>IE176-4TC</td>
<td>IE157-4WC</td>
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<thead>
<tr>
<th>Install and maintain pumps</th>
<th>Maintain electronic precipitators</th>
<th>Install and maintain Robotic Control Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE159-9WE</td>
<td>IE195-9WE</td>
<td>IE177-9WE</td>
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<td>I7</td>
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</tbody>
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<thead>
<tr>
<th>CONTROL CIRCUITS</th>
<th>Install manual motor controls</th>
<th>Install Magnetic motor controls</th>
<th>Demonstrate knowledge of AC motor controls</th>
<th>Demonstrate knowledge of variable speed drive (VSD) and starting systems</th>
<th>Install and maintain motor control, voltage control and power distribution centers</th>
<th>Install and maintain variable frequency drives (VFD)</th>
</tr>
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<tbody>
<tr>
<td>J</td>
<td>J1</td>
<td>J2</td>
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<th>Install and maintain DC drive systems</th>
<th>Install and maintain wound rotor drives</th>
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<tr>
<td>IE180-9WE</td>
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<th>COMPUTER SYSTEMS</th>
<th>Use computerized maintenance management systems and electronic log books</th>
<th>Demonstrate and apply knowledge of network diagnostic tools</th>
<th>Demonstrate and apply knowledge of communications protocols</th>
<th>Install and maintain computer networks</th>
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<tr>
<td>K</td>
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<td>IE147-4TC</td>
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<th>Demonstrate knowledge of AC machines</th>
<th>Demonstrate knowledge of DC machines</th>
<th>Design and demonstrate knowledge of motor controls and motor control programs</th>
<th>Install and maintain AC motors</th>
<th>Install and maintain DC electric motors</th>
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<tr>
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<td>IE226-4TC</td>
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### Program Overview

#### Programmable Logic Controllers

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#### Power Generation Equipment

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**Program Overview**

<table>
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<tr>
<th>CONTROL AND MONITORING SYSTEMS AND DEVICES</th>
<th>Demonstrate knowledge of control systems</th>
<th>Describe signal, communication and alarm systems</th>
<th>Install and maintain process control hardware</th>
<th>Install and maintain signal, communication and alarm systems</th>
<th>Install and maintain servo and proportional valve control loops</th>
<th>Install and maintain hydraulic or pneumatic controls</th>
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<tr>
<td>IE168-4TC Q1</td>
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<th>Install and maintain analytical measurement equipment</th>
<th>Install and maintain encoders</th>
<th>Install and maintain numeric controllers</th>
<th>Maintain crane control systems</th>
<th>Install and maintain boiler furnace system monitors and controls</th>
<th>Install and maintain wireless radio controllers</th>
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<th>Install and maintain a Global Positioning System (GPS)</th>
<th>Install and maintain gas detection equipment</th>
<th>Install and maintain controls for liquid separation and refractionation</th>
<th>Install and maintain gas metering equipment</th>
<th>Install and maintain data and process monitoring systems</th>
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<th>Maintain recovery boiler control systems</th>
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<td>R</td>
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<td>S</td>
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## Training Topics and Suggested Time Allocation

**INDUSTRIAL ELECTRICIAN – LEVEL 3**

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**Total Percentage for Industrial Electrician Level 3**: 100%
## Training Topics and Suggested Time Allocation
### INDUSTRIAL ELECTRICIAN – LEVEL 4

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<td>Demonstrate knowledge of the installation and maintenance of Robotic Control Systems [IE176-4TC]</td>
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<td>J4</td>
<td>Demonstrate knowledge of variable speed drive (VSD) and starting systems [IE178-4TC]</td>
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<td>Demonstrate and apply knowledge of network diagnostic tools [IE147-4TC]</td>
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<td>K3</td>
<td>Demonstrate and apply knowledge of communication protocols [IE148-4TC]</td>
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<td>Design and demonstrate knowledge of motor controls and motor control programs [IE226-4TC]</td>
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<td>Demonstrate knowledge of back-up power equipment, UPS, battery banks and battery charging systems [IE181-4TC]</td>
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<td>P2</td>
<td>Describe co-generation principles and operations [IE164-4TC]</td>
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<td>P3</td>
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<tr>
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<td>Describe signal, communication and alarm systems [IE185-4TC]</td>
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## Workplace Competencies

**Level 1 and Level 2 – Workplace Compulsory (WC)**

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<th>General Area of Competence</th>
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<td>B Safe Work Practices</td>
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<td>C Tools and Equipment</td>
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<td>I Electrical Equipment</td>
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**Level 3 – Workplace Compulsory (WC)**

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<td>B7</td>
<td>IE105-3WC</td>
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<td>C TOOLS AND EQUIPMENT</td>
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<td>E TEST EQUIPMENT</td>
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<td>H LOW VOLTAGE DISTRIBUTION SYSTEMS</td>
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<td>K COMPUTER SYSTEMS</td>
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<td>L ELECTRIC MOTORS</td>
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<td>M PROGRAMMABLE LOGIC CONTROLLERS</td>
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## Program Overview

### Level 4 – Workplace Compulsory

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<td>SYSTEMS AND DEVICES</td>
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<td>IE185-4WC IE186-4WC</td>
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### Workplace Competencies

**Workplace Elective (WE)**

Apprentice must complete 35 credits of elective competency standards to complete the Apprenticeship.

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<td>G  CEC, REGULATIONS AND STANDARDS</td>
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## Program Overview

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<tr>
<td><strong>Q</strong> CONTROL AND MONITORING SYSTEMS AND DEVICES</td>
<td>Q5 Install and maintain servo and proportional valve control loops</td>
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<td>Q6 Install and maintain hydraulic and pneumatic controls</td>
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<td>Q7 Install and maintain analytical measurement equipment</td>
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<td>Q8 Install and maintain encoders</td>
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<td>Q9 Install and maintain numeric controllers</td>
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<td>Q10 Maintain crane control systems</td>
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<td>Q11 Install and maintain boiler furnace system monitors and controls</td>
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<td>Q12 Install and maintain wireless radio controllers</td>
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<td>Q13 Install and maintain a Global Positioning System (GPS)</td>
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<td>Q14 Install and maintain gas detection equipment</td>
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<td>Q15 Install and maintain controls for liquid separation and refractionation</td>
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<td>Q16 Install and maintain gas metering equipment</td>
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<td>Q17 Install and maintain data and process monitoring systems</td>
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<td>Q18 Install and maintain video monitoring systems</td>
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<td><strong>R</strong> INDUSTRY SECTOR SPECIFIC</td>
<td>R1 Maintain electric arc furnace</td>
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<td>R2 Maintain induction furnace</td>
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<td>R3 Maintain recovery boiler control systems</td>
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<td>R4 Install and maintain scanning and optimization equipment</td>
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Section 3
PROGRAM CONTENT
Industrial Electrician
Technical Training
Level 3
Industrial Electrician
Program Content
Technical Training – Level 3

LINE (GAC): D CIRCUIT CONCEPTS
Competency: D6 Demonstrate knowledge of three-phase theory [IE129-3TC]

Objectives
To be competent in this area, the individual must be able to:
• Describe electrical theory of three-phase circuits.

LEARNING TASKS

1. List the advantages of three-phase over single-phase supply systems
2. Describe three-phase alternator with the aid of a sketch
3. Sketch alternator output through one revolution
4. Calculate number of poles, speed, and frequency for three-phase generators given data
5. Define and explain three-phase terms with the aid of sketches
6. Explain relationship between line and phase voltages and between phase currents for wye and delta systems
7. Calculate values of line and phase voltages and current from given data for wye and delta connected loads
8. Determine the relationship between power in wye connected loads and power in delta connected loads and discuss conclusions
9. Explain the effects of balanced and unbalanced loads on neutral current

CONTENT
• Conductor size and volume
• Switch gear current rating
• Induction motor construction
• Winding requirements
• Running torque
• Size and power output to size ratio
• Construction
• Principles of operation
• Phase displacement of completed output waveforms
• Specific formula
• Line
• Phase
• Balanced/Unbalanced
• Wye
• Delta
• Phase sequence
• Line and phase voltages
• Line and phase currents for wye and delta systems
• Line and phase voltages
• Line and phase currents for wye and delta connected loads
• Relationship between line and phase voltages and currents
• Calculate resultant power values
• Relationship between power in wye vs power connected loads
• Instantaneous sum of three-phase currents
LEARNING TASKS

10. Describe the advantages of balanced loads

11. Explain the need for a neutral conductor on an unbalanced wye connected load

12. Determine values of neutral current for a given wye connected three-phase loads by drawing phasor diagrams to scale and by measurement

CONTENT

- Low or no neutral current
- Improved efficiency for generation and distribution companies
- Neutral carries unbalanced current
- Calculate value of unbalanced neutral current
- Purely resistive
- Mixed reactive

Achievement Criteria

Performance  The individual will be able to connect and test three-phase circuits.

Conditions  In a lab setting as part of a practical project, given the required tools and equipment.

Criteria  Within specifications, safety standards and time frames acceptable to industry.
LINE (GAC): J CONTROL CIRCUITS
Competency: J3 Demonstrate knowledge of AC motor controls [IE27-3TC]

Objectives
To be competent in this area, the individual must be able to connect and test:
- Motor braking and deceleration controls.
- Reduced-voltage starters.
- Wound-rotor starters.
- Synchronous motor starters.

LEARNING TASKS
1. Explain the advantages of using motor starters
   - Reduced voltage and current during starting
   - Reduced transients

2. Describe protective features incorporated in starters for common faults
   - Overcurrent
   - Under voltage
   - Over voltage - MOV
   - Phase reversal
   - Phase loss
   - Mechanical stress

3. Describe motor starters with the aid of diagrams with reference to principles of operation
   - Block diagram of starter
   - Circuit diagrams of
     - Across the line
     - Wye-delta
     - Auto-transformer
     - Reduced voltage
     - Primary resistance
     - Secondary resistance

4. Connect and test three-phase induction motor starters
   - Types
     - Across The Line (ATL) starting
       - cage induction with two and three-wire control and remote start-stop stations
     - Auto transformer
     - Wye-delta
     - Secondary resistance
     - ATL forward and reversing
   - Connection requirements (safe practice)
   - Testing circuits for proper operation
LEARNING TASKS

5. Connect and test motor speed controllers

6. Install induction motors

7. Perform commissioning tests and adjustments of induction motors to confirm control equipment is operating in accordance with specifications
**LEARNING TASKS**

8. Compare characteristics of motor starters

**CONTENT**

- Types of motor starters
  - Across the line
  - Wye-delta
  - Auto-transformer
  - Primary resistance
  - Secondary resistance
- Characteristics
  - Starting current and torque of motor and starter
  - Full load current and torque of motor and starter
  - Relative cost

9. Describe wound-rotor motors and controllers

**CONTENT**

- Methods of automatic acceleration
- Basic maintenance and troubleshooting
- Connect and test wound motor controllers

10. Describe synchronous motor starters

**CONTENT**

- Operation of synchronous motor starters
- Basic maintenance and troubleshooting

11. Describe types of motor deceleration methods

**CONTENT**

- Friction or let the mechanical braking
- Plugging
- Dynamic braking
- Regenerative braking
- Eddy current braking

**Achievement Criteria**

**Performance**

The individual will be able to:

- Connect and test motor braking and deceleration controls
- Connect and test reduced voltage-starters
- Connect and test wound-rotor motors and controllers
- Connect and test synchronous motors and starters
- Connect and test three-phase squirrel cage induction motor starters

**Conditions**

In a lab setting as part of a practical project, given the required tools and equipment.

**Criteria**

Within specifications, safety standards and time frames acceptable to industry.
LINE (GAC): L ELECTRIC MOTORS
Competency: L1 Demonstrate knowledge of AC machines [IE150-3TC]

Objectives
To be competent in this area, the individual must be able to:
• Demonstrate knowledge of the operation and construction of single-phase, three-phase and wound rotor AC motors, AC alternators and AC servo motors.

LEARNING TASKS
1. Describe the operation of single-phase AC motors
2. Describe the construction and operating parameters of single-phase AC motors
3. Describe single-phase AC motor maintenance
4. Describe the operation of three-phase AC motors
5. Describe the construction and operating parameters of three-phase AC motors
6. Describe three-phase AC motor maintenance
7. Describe the operation of synchronous AC motors

CONTENT
• Types of single-phase motors
• Rotating magnetic field characteristics
• Manuals and specifications
• Rotation change
• Starting methods
• Starting and running circuits
• Frame sizing
• Motor cooling
• Bearing and lube replacement
• Motor cooling
• Common failures and prevention
• Types of three-phase motors
• Rotating magnetic field characteristics
• Uses of these motors
• Three-phase AC voltage and current
• Manuals and specifications
• Rotation change, starting methods
• Starting and running circuits
• SCIM
• Pole pairs
• Speed and frequency
• Frame sizes
• Bearing and lube replacement
• Motor cooling
• Common failures and prevention
• Types of synchronous motors
• Speed control precision
• Rotor excitation
• Power factor
• Power factor correction
• Rotating magnetic field characteristics
## LEARNING TASKS

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>CONTENT</th>
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</table>
| 8. Describe the construction and operating parameters of synchronous AC motors | • Manuals and specifications  
• Rotation change  
• Starting methods  
• Self excitation  
• Excited DC motors  
• Starting and running  
• Starting and running circuits |
| 9. Describe synchronous AC motor maintenance | • Bearing and lube replacement  
• Motor cooling  
• Common failures and prevention  
• Slip rings and brushes |
| 10. Describe the operation of wound rotor AC motors | • Types of wound rotor mounts  
• Rotating magnetic field characteristics  
• Large load inertia  
• Uses of this type of motor |
| 11. Describe the construction and operating parameters of wound rotor AC motors | • Manuals and specifications  
• Rotation change  
• Starting methods  
• Starting and running circuits  
• Rotor circuit external resistances  
• Resistance calculation  
• Current ratings  
• Heat dissipation ratings |
| 12. Describe wound rotor AC motor maintenance | • Bearing and lube replacement  
• Motor cooling  
• Common failures and prevention  
• Speed and torque controls |
| 13. Describe the operation of three-phase AC alternators | • Constructional features  
• Operating principles  
• Identifying common connections  
• Conditions for paralleling and synchronizing |
| 13. Describe the operation of common AC servo motors | • Types of servo motors  
• Rotating magnetic field characteristics  
• Pulse coded modulation  
• Feedback principles in electronics |
LEARNING TASKS

14. Describe the construction and operating parameters of AC servo motors

15. Describe AC servo motor maintenance

16. Describe the installation and operation of AC motors appropriate to the type of motor and application for which it is employed

CONTENT

- Manuals and specification
- Rotation change
- Potentiometers and modulation
- Starting and running circuits
- Proportional speed control
- Potentiometers and modulation
- Servo shaft angles
- Common failures and prevention
- Vendor systems and compatibility
- Control system types
- Types of motors and their applications
- Access and interpret operation and specification manual

Achievement Criteria

Performance

The individual will be able to:

- Connect and test three-phase, squirrel-cage induction motors
- Connect and test single-phase motors
- Connect and test three-phase alternators

Conditions

In a lab setting as part of a practical project, given the required tools and equipment.

Criteria

Within specifications, safety standards and time frames acceptable to industry.
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<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 1. Describe the constructional features of DC machines | • Generators  
• Motors  
• Armature  
• Commutator  
• Brushes  
• Field poles  
• Bearings |
| 2. Describe the theory of operation of DC generators | • Permanent-magnet field poles  
• Electromagnetic field poles  
  o Series and shunt field windings  
  o Separately excited fields  
  o Self-excited fields  
• Requirements for voltage buildup  
• Residual magnetism  
• Direction of rotation  
• Critical field resistance  
• Prime mover speed  
• Armature reaction  
• Interpoles  
• Compensating windings  
• Losses and efficiency  
  o Rotational losses  
  o Core losses  
  o Copper losses  
• Efficiency calculation  
• Shunt generator  
• Series generator  
• Compound generator  
• Cumulative compound  
  o Flat-compound  
  o Over-compound  
  o Under-compound  
• Differential compound |
| 3. Describe the characteristics of the types of DC generators |
LEARNING TASKS

4. Describe the theory of operation of DC shunt motors

5. Describe construction and operating parameters of DC shunt motors

6. Describe DC shunt motor maintenance

7. Describe the theory of operation and principles of construction of DC series motors

8. Describe construction and operating parameters of DC series motors

9. Describe maintenance of DC series motor

10. Describe the theory of operation of DC compound motors

11. Describe construction and operating parameters of DC compound motors

12. Describe maintenance of DC compound motors

CONTENT

- Types of DC shunt motors
- Shunt field control
- Field speed and torque relationship
- Rotating magnetic field characteristics

- Manuals and specifications
- Rotation change
- Starting methods
- Starting and running circuits
- Base speed
- Shunt motor controls
- Common applications

- Bearing and lube replacement
- Motor cooling
- Operating parameters
- Common failures and prevention

- Types of DC series motors
- Rotating magnetic field characteristic

- Manuals and specifications
- Rotation change
- Starting methods
- Starting and running circuits

- Beariing and lube replacement
- Motor cooling
- Common failures and prevention
- Commutator damage interpretation

- Types of DC compound motors
- Rotating magnetic field characteristics

- Manuals and specifications
- Rotation change
- Starting methods
- Starting and running circuits
- Common applications

- Bearing and lube replacement
- Motor cooling
- Common failures and prevention
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
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</thead>
<tbody>
<tr>
<td>13. Describe the theory of operation of DC servo motors</td>
<td>• Types of servo motors</td>
</tr>
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<td>• Rotating magnetic field characteristics</td>
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<td>• Robotic applications</td>
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<td>• Pulse coded modulation</td>
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<td>• Feedback principles in electronics</td>
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<tr>
<td>14. Describe construction and operating parameters of DC servo motors</td>
<td>• Manuals and specifications</td>
</tr>
<tr>
<td></td>
<td>• Rotation change</td>
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<td></td>
<td>• Potentiometers and modulation</td>
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<tr>
<td></td>
<td>• Starting and running circuits</td>
</tr>
<tr>
<td></td>
<td>• Proportional speed control</td>
</tr>
<tr>
<td>15. Describe maintenance of DC servo motors</td>
<td>• Potentiometers and modulation</td>
</tr>
<tr>
<td></td>
<td>• Servo shaft angle</td>
</tr>
<tr>
<td></td>
<td>• Common failures and prevention</td>
</tr>
<tr>
<td>16. Describe correct installation and operation of DC motors to applicable CEC rules and manufacturer requirements</td>
<td>• Vendor systems and compatibility</td>
</tr>
<tr>
<td></td>
<td>• Control system types</td>
</tr>
<tr>
<td></td>
<td>• Types of motors and their applications</td>
</tr>
<tr>
<td></td>
<td>• Access and interpret operation and specification manuals</td>
</tr>
</tbody>
</table>

**Achievement Criteria**

**Performance**
The individual will be able to:

- Connect and test DC generators
- Connect and test DC motors

**Conditions**
In a lab setting as part of a practical project, given the required tools and equipment.

**Criteria**
Within specifications, safety standards and time frames acceptable to industry.
LINE (GAC): M PROGRAMMABLE LOGIC CONTROLLERS
Competency: M1 Demonstrate and apply knowledge of PLC operation, installation and maintenance [IE134-3TC]

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate and apply knowledge for the installation and maintenance of integrated control system and general operation and uses of a PLC.
- Demonstrate knowledge of PLC hardware components.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Demonstrate knowledge of the design philosophies and uses of PLCs</td>
</tr>
<tr>
<td>2.</td>
<td>Describe PLC hardware components</td>
</tr>
<tr>
<td>3.</td>
<td>Compare the types of PLC and interoperability between vendor components</td>
</tr>
<tr>
<td>4.</td>
<td>Describe the theory of operation of integrated control systems</td>
</tr>
<tr>
<td>5.</td>
<td>Demonstrate and apply knowledge of installing and setting up integrated control systems to CEC rules and manufacturer installation and operation guidelines</td>
</tr>
</tbody>
</table>

**CONTENT**

- Advantages and disadvantages of each design type
- I/O modules
- I/O addressing
- Component types
- Purpose and use of PLC components
- Linkage and communication between devices
- Common parts
- Vendor specific parts and terminology
- Control logic
- Scan rates
- Programming conventions
- Communication protocols
- Vendor systems and compatibility
- Control system types
- Wiring techniques and sizing
- Grounding, shielding and bonding
- Access and interpret operation and specification manuals
- Tooling for communication wiring, termination and EMF insulation
- Control strategies
- Programming parameters
- Communication linkages
LEARNING TASKS

6. Demonstrate knowledge of maintenance of integrated control systems to CEC rules and manufacturer installation and operation guidelines

CONTENT

- Safety procedures
- Access and interpret operation and specification manuals
- Troubleshooting techniques
- Preventative maintenance procedures
- Instrumentation to read programming
- Maintain control strategies under changing operating conditions
**Program Content**  
**Technical Training – Level 3**

**LINE (GAC):** M  **PROGRAMMABLE LOGIC CONTROLLERS**  
**Competency:** M2  Demonstrate and apply knowledge of communication buses and PLC interfaces [IE135-3TC]

**Objectives**
To be competent in this area, the individual must be able to:
- Demonstrate knowledge of the installation of PLC networks, communication protocols.
- Demonstrate knowledge of types of communications buses and different network types.

**LEARNING TASKS**

<table>
<thead>
<tr>
<th>Learning Task</th>
<th>Content</th>
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</thead>
<tbody>
<tr>
<td>1. Describe communication buses</td>
<td>- Communications standards</td>
</tr>
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<td></td>
<td>- Limitations</td>
</tr>
<tr>
<td></td>
<td>- Controllers</td>
</tr>
<tr>
<td></td>
<td>- Uses and optimization</td>
</tr>
<tr>
<td>2. Demonstrate knowledge of the installation of communication buses for common applications and CEC rules</td>
<td>- Wiring types</td>
</tr>
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<td></td>
<td>- Signal strength</td>
</tr>
<tr>
<td></td>
<td>- Terminations</td>
</tr>
<tr>
<td></td>
<td>- Routers and modems</td>
</tr>
<tr>
<td></td>
<td>- PLC networks</td>
</tr>
<tr>
<td>3. Demonstrate knowledge of communications protocols used by PLCs</td>
<td>- IEEE and ISO international protocols and standards</td>
</tr>
<tr>
<td></td>
<td>- Vendor proprietary protocols</td>
</tr>
<tr>
<td></td>
<td>- Software and hardware settings</td>
</tr>
<tr>
<td></td>
<td>- Principles and theory of data communication</td>
</tr>
<tr>
<td>4. Describe communications devices including settings and tests</td>
<td>- Cards</td>
</tr>
<tr>
<td></td>
<td>- Communications ports</td>
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<tr>
<td></td>
<td>- Hardware settings</td>
</tr>
<tr>
<td></td>
<td>- Software settings</td>
</tr>
<tr>
<td></td>
<td>- Setting readings</td>
</tr>
<tr>
<td></td>
<td>- Testing procedures</td>
</tr>
<tr>
<td>5. Describe and compare different network types and the way each operates, to CEC rules and manufacturer specifications</td>
<td>- Communication protocols</td>
</tr>
<tr>
<td></td>
<td>- Hardware settings</td>
</tr>
<tr>
<td></td>
<td>- Modem types and settings</td>
</tr>
<tr>
<td></td>
<td>- IEEE and ISO standards</td>
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<td></td>
<td>- Remote I/O racks</td>
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<tr>
<td></td>
<td>- Communication software</td>
</tr>
<tr>
<td></td>
<td>- Communication cards</td>
</tr>
<tr>
<td></td>
<td>- Configuration and addressing</td>
</tr>
</tbody>
</table>
Achievement Criteria

**Performance**  
The individual will be able to:
- Use a programming terminal
- Monitor/test programs on-line
- Use PLC software

**Conditions**  
In a lab setting as part of a practical project, given the required tools and equipment.

**Criteria**  
Within specifications, safety standards and time frames acceptable to industry.
LINE (GAC): M PROGRAMMABLE LOGIC CONTROLLERS
Competency: M3 Demonstrate knowledge of programming language and of installing and maintaining PLC software [IE138-3TC]

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate knowledge of reading and writing programming language for PLCs.
- Demonstrate knowledge of the installation and maintenance of common software applications to operate PLCs.

LEARNING TASKS
1. Describe operating software

CONTENT
- Software types
- Languages
- Hardware compatibility
- Operating system requirements

2. Demonstrate knowledge of the requirements for the loading and running of programs

CONTENT
- PC interface
- Configuration
- Advantages and disadvantages of different configurations
- Network communication requirements
- ‘Online’, ‘offline’ and ‘equal’ states
- Awareness of company conventions

3. Describe the considerations for the maintenance of PLC software

CONTENT
- Programming terminals
- Hand held programmers
- Communication software
- PLC programs and diagnostics

4. Describe different programming languages

CONTENT
- Vendor types and proprietary standards
- Manufacturer manuals and programming specifications and guides
LEARNING TASKS

5. Read and write programming language

CONTENT
- Ladder logic
- Function blocks
- Scaling
- Symbols
- PLC operating modes
- On-line/off-line programming
- Programming instructions
- I/O image tables
- Integer files
- Timers and counters
- Math instructions
- Sequencers
- Shift registers
- Bit manipulation instructions

6. Demonstrate knowledge of requirements to document and secure programs

CONTENT
- Uploading and back-up
- Programming notes
- Logic diagrams
- Test and debug programs safely
- Create reports and produce hard copy of programming
Objectives
To be competent in this area, the individual must be able to:
• Demonstrate knowledge of connecting, grounding, installing and maintaining transformers.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Describe the construction and features of three-phase transformers</td>
<td>• Construction&lt;br&gt;• Three-phase transformer connections&lt;br&gt;• Advantages of a single, three-phase transformer&lt;br&gt;• Advantages of a bank of three, single-phase transformers</td>
</tr>
<tr>
<td>2. Describe the connections of three-phase transformer banks</td>
<td>• Wye-to-wye&lt;br&gt;• Delta-to-delta&lt;br&gt;• Wye-to-delta&lt;br&gt;• Delta-to-wye&lt;br&gt;• Four-wire delta&lt;br&gt;• Open-delta&lt;br&gt;• Buck-boost</td>
</tr>
<tr>
<td>3. Calculate voltage, current and kVA values for three-phase transformer banks</td>
<td>• Wye connection&lt;br&gt;• Delta connection&lt;br&gt;• Open-delta connection&lt;br&gt;• Extended-delta connection&lt;br&gt;• Zig-zag transformer connection&lt;br&gt;  o Unbalanced load&lt;br&gt;  o Harmonic currents</td>
</tr>
<tr>
<td>4. Describe the common connection for autotransformers in three-phase circuits</td>
<td>• Wye connection&lt;br&gt;• Open-delta connection&lt;br&gt;• Buck-boost</td>
</tr>
</tbody>
</table>
LEARNING TASKS

6. Describe instrument transformer connections in three-phase circuits

7. Calculate instrument transformer ratings and meter readings in three-phase circuits

8. Describe the considerations for placement, connection and grounding of transformers

9. Describe the installation of transformers

10. Describe the considerations for the maintenance of transformers

CONTENT

- Potential-transformer (PT) connections
- Current-transformer (CT) connections
- Energy and power metering circuits
- Motor circuits
- Ground-fault detection
- High voltage systems
- Potential-transformer (PT)
- Current transformer (CT)
- Energy and power metering
- Grounding and safe work procedures
- Mounting and restraints
- EMI interference
- Load/break disconnect
- Zig zag transformers
- Manufacturer and proprietary standards
- Access manufacturer standards manuals and part catalogues
- Environmental considerations
- Cooling methods
- Preventative maintenance procedures
- Protective coatings
- Silica breathers
- Oil cooling
- Air cooling
- Documentation requirements

Achievement Criteria

Performance The individual will be able to:
- Connect and test three-phase transformer banks
- Connect and test three-phase auto-transformers
- Connect and test three-phase instrument transformers

Conditions In a lab setting as part of a practical project, given the required tools and equipment.

Criteria Within specifications, safety standards and time frames acceptable to industry.
Program Content
Technical Training – Level 3

LINE (GAC): N

POWER DISTRIBUTION SYSTEMS

Competency: N2 Calculate power factor correction [IE144-3TC]

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate knowledge of AC power factor and calculate capacitance.

<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Calculate power and power factor in balanced three-phase systems</td>
<td>• Power factor</td>
</tr>
<tr>
<td></td>
<td>• True power (P, Watts)</td>
</tr>
<tr>
<td></td>
<td>• Reactive power (Q, volt-amps reactive or VAR)</td>
</tr>
<tr>
<td></td>
<td>• Apparent power (S, volt-amps or VA)</td>
</tr>
<tr>
<td></td>
<td>• Wye-connected system</td>
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<tr>
<td></td>
<td>• Delta-connected system</td>
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<tr>
<td></td>
<td>• Power measurement using wattmeters</td>
</tr>
<tr>
<td></td>
<td>o Three-wattmeter method</td>
</tr>
<tr>
<td></td>
<td>o Two-wattmeter method</td>
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<tr>
<td></td>
<td>o Analysis of wattmeter’s voltage and current values</td>
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<td></td>
<td>o Leading</td>
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<td></td>
<td>o Lagging</td>
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<tr>
<td></td>
<td>o Unity</td>
</tr>
<tr>
<td></td>
<td>o Single-wattmeter method</td>
</tr>
<tr>
<td></td>
<td>• Power factor improvement</td>
</tr>
<tr>
<td></td>
<td>• Low lagging power factor</td>
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<tr>
<td></td>
<td>o Low useful power</td>
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<td></td>
<td>o Increased current for a given power</td>
</tr>
<tr>
<td></td>
<td>o Requirements for increased capacity of supply equipment</td>
</tr>
</tbody>
</table>
LEARNING TASKS

2. Describe the connection of capacitors for power factor correction in three-phase circuits

CONTENT
- Methods of correcting power factor
  - Individual capacitor units
  - Large bank of capacitor units
  - Combination of individual units and larger banks
  - Practical limitations to improvement of power factor beyond 0.95
- Construction of three-phase PF correction capacitors
- Connection of PF correction capacitors
- Capacitor problems
- Harmonics
- Safety precautions with capacitors
  - Connecting corrective capacitors
    - Three-phase
    - Motors
- Calculate power factor
  - Apparent power
  - True power
  - Reactive power
  - Phase angle
  - Reduction to line current
- Ratings

Achievement Criteria

Performance
The individual will be able to connect wattmeters for three-phase power measurement and power factor correct three-phase motor loads.

Conditions
In a lab setting as part of a practical project, given the required tools and equipment.

Criteria
Within specifications, safety standards and time frames acceptable to industry.
LINE (GAC): S ELECTRONICS
Competency: S1 Demonstrate knowledge of electronics [IE111-3TC]

Objectives
To be competent in this area, the individual must be able to:
- Convert between numbering systems.
- Describe the operating principles of logic gates.
- Describe the operating principles and circuit analysis of op-amps.

LEARNING TASKS
1. Describe common numbering systems used in digital electronics

2. Describe the operation of common logic gates

3. Describe the features of operational amplifiers

CONTENT
- Decimal (in every day usage)
- Octal (PLCs)
- Binary (computers)
- Hexadecimal (PLCs)
- Binary-coded decimal (BCD)
- Conversions between numbering systems
- ASCII
- Gray code

- Types of gates
  - AND gate
  - OR gate
  - NOT gate
  - NAND gate
  - NOR gate
  - XOR gate

- New logic symbols
- Timing diagrams

- Op-amp symbol
- Power supply voltage
- Op-amp packaging
- Open-loop and closed-loop operation
  - Feedback vs no feedback
- Differential amplifier
- Op-amp comparator
- Squaring a sine wave
4. Describe common circuit applications for the operational amplifier
   - Voltage follower (unity gain)
   - Inverting amplifier
   - Non-inverting amplifier
   - Summing amplifier
   - Op-amp integrator
   - Digital-to-analogue converter (DAC)
   - Analogue-to-digital converter (ADC)

**Achievement Criteria**

**Performance**

The individual will be able to:

- Test digital gates and interpret results
- Test op-amps and interpret results
  - Measure voltage and current values using an oscilloscope and compare with expected values in terms of wave shape and magnitude

**Conditions**

In a lab setting as part of a practical project, given the required tools and equipment.

**Criteria**

Within specifications, safety standards and time frames acceptable to industry.
Program Content
Technical Training – Level 3

LINE (GAC): S  ELECTRONICS
Competency: S2  Demonstrate knowledge of semiconductor power devices [IE228-3TC]

Objectives
To be competent in this area, the individual must be able to:
- Connect and test Thyristor circuits.
- Connect and test three-phase rectifiers.

LEARNING TASKS

1. Describe the features of the silicon-controlled rectifier (SCR)
   - SCR symbol and leads
   - Typical ratings
   - Common case styles

2. Describe the basic action of the SCR
   - SCR characteristics
   - Electrical equivalent
   - Operation in a DC circuit
     - Triggering the SCR
     - Commutating the SCR
     - Forced commutation
   - Operation in an AC circuit
     - Half-wave rectification
     - Phase control
     - Conduction and firing angles
     - Full-wave rectification
   - Analogue ohmmeter testing of SCRs

3. Describe SCR triggering circuits for AC phase control
   - Resistor (R) triggering
   - Resistor-capacitor (RC) triggering
   - Paralleling SCRs for full AC load control

4. Describe the features of the Triac
   - Symbols and leads
   - Triac characteristics
   - Triac ratings
   - Common case styles
   - Triac operation
   - Triac trigger control
   - Triac testing with an analogue ohmmeter
LEARNING TASKS

5. Describe the features of specialty thyristors

CONTENT

- Diac
  - Breakover voltage
  - Symbol and leads
  - Ratings
  - Diac oscillator circuit
- Unijunction transistor (UJT)
  - Symbol and leads
  - Ratings
  - UJT operation
  - UJT oscillator
- Light-activated SCR
  - Symbol and leads
  - Typical ratings

6. Describe the application of thyristors

CONTENT

- Speed control of DC motors
- Regulated battery charger
- Incandescent lamp dimmer
  - Light dimmer using Diac and Triac
  - Light dimmer using unijunction trigger
- Triac motor-starting switch

7. Describe the operation of three-phase rectifier circuits

CONTENT

- Three-phase, half-wave rectifier
- Three-phase, full-wave bridge rectifier
- 12 pulse, three-phase rectifier

8. Determine values for rectified power supplies

CONTENT

- Average DC voltage to the load
- DC ammeter readings
- Ripple frequency
- Diode PIV rating
- Diode average DC current
LEARNING TASKS
9. Describe the causes of static electricity and the effect of electrostatic discharge (ESD) in the workplace

CONTENT
- Triboelectric charging and separation and the amount of static charge generated
- Causes of static electricity
  - Induction
  - No earthing
  - Poor air-conditioning
  - Low humidity
  - Type of floor covering
  - Clothing
  - Materials
  - Aerosol sprays
- Solder suckers
- Results of ESD
  - Immediate failure
  - Intermittent faults
  - Reservicing
  - Delayed breakdown
- Minimizing ESD
  - Selection or treatment of clothing, materials, furnishings, and floor coverings
  - Anti-static floor and bench mats
  - Anti-static wrist or ankle straps
  - Anti-static containers for transportation
  - Use of tools with approved electrostatic conducting handles

Achievement Criteria
Performance
The individual will be able to test power semiconductors.

Conditions
In a lab setting as part of a practical project, given the required tools and equipment.

Criteria
Within specifications, safety standards and time frames acceptable to industry.
Technical Training
Level 4

Industrial Electrician
LINE (GAC): E TEST EQUIPMENT
Competency: E5 Demonstrate knowledge of measurement and calibration test equipment [IE225-4TC]

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate knowledge of calibration test equipment to adjust instrumentation and precision equipment.

LEARNING TASKS
1. Calculate and interpret polarity index readings
   - Calculating polarity index using polarization index meter
   - Interpreting results

2. Use a vibration meter to accurately calculate dynamic forces
   - Safety procedures for vibration measurement
   - Interpretation of results

Achievement Criteria
Performance
The individual will be able to:
- Calculate and interpret polarity index readings
- Perform vibration analysis of a motor

Conditions
In a lab setting as part of a practical project, given the required tools and equipment.

Criteria
Within specifications, safety standards and time frames acceptable to industry.
Program Content
Technical Training – Level 4

LINE (GAC): H LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: H9 Demonstrate knowledge of installing and terminating fibre optic cables [IE194-4TC]

Objectives
To be competent in this area, the individual must be able to:
• Describe installation and maintenance of fibre optic cable and terminations.

LEARNING TASKS
1. Describe principles of fibre optic transmission
   • Cable routing
   • Optical/electrical interface
   • Manufacturer and other specifications

2. Demonstrate knowledge of installation and termination of fibre optic cable and CEC rules
   • Environmental concerns
   • Protection
   • Splicing
   • Optical/electrical interface
   • Signal controls

3. Demonstrate knowledge of diagnosing and fixing faults in cable and interfacing
   • Test equipment
   • Field splicing
Program Content
Technical Training – Level 4

LINE (GAC):  I ELECTRICAL EQUIPMENT
Competency:  I3 Demonstrate knowledge of installing and maintaining HVAC equipment [IE156-4TC]

Objectives
To be competent in this area, the individual must be able to:
• Demonstrate knowledge of installing and maintaining HVAC equipment.

LEARNING TASKS

1. Explain the principles of refrigeration and heating machinery

2. Describe the installation of heating and cooling equipment

3. Describe the maintenance of heating and cooling equipment in accordance with CEC rules and CFC recovery regulations

CONTENT
• Heat pumps and compressors
• Pressures
• Fluid and gas flow
• Fans and air movement
• Compressors
• Heat exchange circuits
• Control circuits and relays
• Dampers
• Thermostats
• Solenoids
• Specification manuals and construction prints
• Cleaning
• Safety principles
• Common faults and troubleshooting techniques
• Diagnosis tools and gauges
• Specification manuals and construction prints

Achievement Criteria
Performance The individual will be able to connect and test low and mid efficiency gas furnaces.
Conditions In a lab setting as part of a practical project, given the required tools and equipment.
Criteria Within specifications, safety standards and time frames acceptable to industry.
LINE (GAC):  I  ELECTRICAL EQUIPMENT
Competency:  I4  Demonstrate knowledge of pumps [IE158-4TC]

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate knowledge of sub-surface and surface pumps, including installation and maintenance.

LEARNING TASKS
1. Describe the types, process controls and applications of pump technology
2. Describe pump installation
3. Describe pump maintenance

CONTENT
- Centrifugal
- Positive displacement
- Grounding
- Wiring methods
- Confined space procedures
- Applicable BC Plumbing Code
- Alignment
- CEC and any other applicable standards
- Sealed motors
- Mechanical seals
- Pump packing
- Noise and vibration (bearings)
- Controllers
- Pressure and control circuits
- Cavitation
LINE (GAC): I ELECTRICAL EQUIPMENT
Competency: I5 Demonstrate knowledge of the installation and maintenance of Robotic Control Systems [IE176-4TC]

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

- Describe Robotic Control Systems and remote control systems.

LEARNING TASKS

1. Explain principles of operation

2. Describe considerations for RCS installation and CEC rules

3. Describe considerations for RCS maintenance

4. Explain the principles of radio frequency transmission

5. Describe considerations for the installation and maintenance of wireless controllers

CONTENT

- Computer numeric controllers
- Manufacturer documentation
- Control parameters
- Safety and environmental considerations
- Location
- Power supply
- Control features
- Program controller
- Design requirements
- Troubleshooting techniques
- Preventative maintenance for micro-electronic controllers
- Safety control systems
- Spectrum
- Encoding
- Signal integrity
- Communication protocols
- Set-up and reception verification
- Shielding and interference
- Wiring and bonding
LINE (GAC): J CONTROL CIRCUITS
Competency: J4 Demonstrate knowledge of variable speed drive (VSD) and starting systems [IE178-4TC]

Objectives
To be competent in this area, the individual must be able to:
• Demonstrate knowledge of AC and DC speed drives.

LEARNING TASKS
1. Describe the features of adjustable-speed DC drives

CONTENT
• DC motor
• Control panel
  o Acceleration and deceleration
  o Stability and gain
  o Current limit
  o Maximum speed or armature voltage
• Operator’s control station
• Sizes and ratings
• Mounting and wiring
• External cabling and wiring

2. Describe the operation of power converters

CONTENT
• Three-phase, half-wave converter
• Three-phase, full-wave converter
• Single-phase, full-wave SCR converter
• Three-phase, full-wave SCR converter
• Trigger circuits and voltage control
• Motor code letters
• Connections
• Braking
  o Dynamic braking
  o Regenerative braking
  o Reversing
• Protection
• Start-up and adjustments
  o Before applying power
  o Control circuit operational tests
  o Initial operation of the motor
• Troubleshooting

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

4. Describe the features of variable frequency AC drives

CONTENT
- Advantages
- Disadvantages
- Basic sections of a variable frequency drive
  - DC power section
  - Filter section
  - AC power section
  - Control section
- Sizes and ratings
- Mounting and wiring
  - Control panel
  - Operator’s station
  - AC motor
- External cabling and wiring
- Problems using VFDs
  - Harmonics
  - Electromagnetic interference (EMI)
  - Motor insulation voltage stress
  - Increased iron losses

5. Describe the operation of frequency converters (inverters)

CONTENT
- Basic inverter principles
- Three-phase bridge inverter
- Variable voltage inverter (VVI) drives
- Current source inverter (CSI) drive
- Advantages and disadvantages of VVI and CSI drives
- Pulse width modulation (PWM) drives
  - PWM drive characteristics
- DC links section
- Flux vector drives

6. Describe the operation of AC motors used with variable frequency drives

CONTENT
- Speed characteristics
- Torque characteristics
- Voltage and frequency relationship
- Braking
- Reversing
- Software
- Protection
- Motor filtering
- Motor wiring
  - Power wiring
  - Control wiring
- Start-up and adjustments
- Troubleshooting
Program Content
Technical Training – Level 4

Achievement Criteria

Performance  The individual will be able to:
  • Connect and test adjustable-speed DC drives
  • Connect and test variable frequency AC drives

Conditions  In a lab setting as part of a practical project, given the required tools and equipment.

Criteria  Within specifications, safety standards and time frames acceptable to industry.
LINE (GAC): K COMPUTER SYSTEMS
Competency: K2 Demonstrate and apply knowledge of network diagnostic tools [IE147-4TC]

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

- Demonstrate and apply knowledge of software and hardware diagnostic tools to troubleshoot networks and control circuits.

LEARNING TASKS

1. Demonstrate knowledge of hardware and software network test tools
   - Cat 5 tester
   - Time domain reflectometer
   - Software testing tools example: PING, trace commands, etc.

2. Install network circuits and components
   - Cabling
   - Creating network cables
   - Installing local area network

3. Apply network troubleshooting techniques
   - Select proper test device
   - Network test locations
   - Interpretation of test results
   - Safe working procedures

Achievement Criteria
Performance
The individual will be able to:
- Install network circuits and components
- Test and troubleshoot a network

Conditions
In a lab setting as part of a practical project, given the required tools and equipment.

Criteria
Within specifications, safety standards and time frames acceptable to industry.
LINE (GAC): K COMPUTER SYSTEMS
Competency: K3 Demonstrate and apply knowledge of communications protocols [IE148-4TC]

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

- Demonstrate knowledge of and use communications protocols used in networking computers and devices together.

LEARNING TASKS
1. Demonstrate knowledge of the principles and components of network and inter-network communication
   - Ethernet
   - Intranet
   - Internet
   - Awareness of other communications protocols

2. Use network server commands and protocols to set up and maintain a simple computer network
   - Windows
   - UNIX
   - LINUX

3. Use TCP/IP communications protocol to set up and maintain a simple computer network
   - Network addressing
   - Device addressing
   - Security
   - Reliability considerations

Achievement Criteria
Performance
The individual will be able to:

- Set up and maintain a simple computer network through use of TCP/IP commands
- Demonstrate knowledge of hardware and wiring components of a networked computer system

Conditions
In a lab setting as part of a practical project, given the required tools and equipment.

Criteria
Within specifications, safety standards and time frames acceptable to industry.
LINE (GAC): L ELECTRIC MOTORS
Competency: L3 Design and demonstrate knowledge of motor controls and motor control programs [IE226-4TC]

Objectives
To be competent in this area, the individual must be able to:
- Design and implement motor controls on hard-wired and software based control mechanisms and control networks.

LEARNING TASKS

1. Explain principles of hard-wired motor controls in terms of operation
   - Circuit diagrams
   - Circuit board assembly
   - Hard-wire devices
   - Regulations and standards
   - Equipment manufacturer manuals
   - Operating specifications
   - Component selection criteria
   - Control devices
   - Overloads
   - Magnetics and contacts
   - Equipment manufacturer manuals
   - Advanced digital logic circuits

2. Demonstrate knowledge of the principles of software based programmable motor controls
   - Software based programming overview
   - PLC logic
   - Other applicable software logic
   - DCS
   - SCADA
   - Control devices
   - Overloads
   - Magnets and contacts
   - Equipment manufacturer manuals and operating specifications
   - Circuit board installation

3. Compare PLCs with hard-wired logic and explain the advantages and disadvantages of each
   - Auxiliary contacts and relays
   - Variety of control tasks
   - Ease of alteration and duplication
   - Time and cost savings
   - On-line documentation
### LEARNING TASKS

<table>
<thead>
<tr>
<th>Task</th>
<th>Content</th>
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<tbody>
<tr>
<td>4. Design, document and install an efficient motor control program</td>
<td>- Programming language rules and logic scan direction</td>
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<tr>
<td>control program using hard wiring and software-based control</td>
<td>- Symbols and logic</td>
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<td>protocols</td>
<td>- Inputs</td>
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<td>- Internal relays or flags</td>
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<td>- Enter program in accordance with manufacturer instructions and industry practice</td>
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<td>- Verify program operation against the specifications</td>
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<tr>
<td>5. Install motor control program and document according to industry</td>
<td>- Switch gear and field wiring</td>
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<tr>
<td>practice</td>
<td>- Instrumentation to observe and load programming</td>
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<td></td>
<td>- Electrical interlocks</td>
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<td></td>
<td>- Test and commission</td>
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</tbody>
</table>

### Achievement Criteria

**Performance**

- Design an efficient motor control program using hard wiring and software based control protocols
- Install motor control program and document according to industry practice

**Conditions**

In a lab setting as part of a practical project, given the required tools and equipment.

**Criteria**

Within specifications, safety standards and time frames acceptable to industry.
**LINE (GAC):** N  
**POWER DISTRIBUTION SYSTEMS**

**Competency:** N3  
Demonstrate knowledge of the installation and maintenance of high voltage circuits [IE152-4TC]

### Objectives
To be competent in this area, the individual must be able to:
- Demonstrate knowledge of the installation and maintenance of high voltage circuits.

### LEARNING TASKS

<table>
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<td>Appropriate safety standards</td>
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<td>2.</td>
<td>Describe standards that dictate the method and standard of installation</td>
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<td>Wiring standards</td>
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<td>Load and resistance calculations</td>
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<td>Safe high voltage working procedure</td>
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<td>Grounding</td>
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<td>3.</td>
<td>Describe the considerations for the installation and maintenance of high voltage circuits to meet CEC rules</td>
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<td>Testing equipment</td>
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<td>Termination</td>
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<td>Distribution equipment and connectors</td>
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<td>Environmental specifications</td>
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<td>PT</td>
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<td>CT</td>
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<td>4.</td>
<td>Explain the requirement of power distribution equipment types and power distribution standards</td>
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<tr>
<td></td>
<td>Types of equipment</td>
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<td>CEC</td>
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<td>Load ratings</td>
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<td></td>
<td>Load protection</td>
</tr>
</tbody>
</table>
LEARNING TASKS

5. Describe the considerations for the installation of power distribution equipment to CEC rules
   - Environmental factors
   - Wiring, shielding and bonding
   - Access manufacturer specifications and manuals
   - Commission
   - Secure and restrain
   - PT
   - CT

6. Describe the considerations for the maintenance of power distribution equipment to CEC rules
   - Test and troubleshoot
   - Protect and clean components
   - Safety procedures for component replacement
   - Grounding
   - Manufacturer specifications
   - Preventative maintenance routines

7. Describe types of protective relays and their principles of operation in terms of appropriate safety standards
   - Types or protective relays and principles of operation
     - Protective coordination theory
     - CEC, ULC and CSA relay standards
     - Relays and trips
     - PT
     - CT
   - Install protective relays (CEC rules)
     - Read prints and schematics
     - Access and interpret manuals and specifications
     - Overcurrent/undercurrent states
     - Safety procedures
     - PT
     - CT
   - Maintenance (CEC rules)
     - Access and interpret trip logs
     - Safe working procedures
     - May include
       - Ground fault
       - Phase loss
       - Dead bus

8. Demonstrate and apply knowledge of insulation and circuit integrity on high voltage equipment using a hi-pot tester
   - Principles of operation of a hi-pot tester
   - Uses and types of hi-pot testers
     - Insulation
     - Cable and circuit integrity testing
   - Safety requirements for use
   - Circuit
LEARNING TASKS

9. Use a hi-pot tester to test circuit integrity and insulation observing all safety requirements

10. Test the integrity of insulation on high voltage circuits and identify faults and failures using a doble tester and or thumper

11. Use a doble tester and or a thumper to check high voltage insulation integrity observing all safety requirements

CONTENT

- High voltage safety procedures
- Connection and operation
- Analyze test results
- Principles of operation
  - Types of instrument, uses and limitations
  - Destructive test with thumper
- Safety requirements
- High voltage safety considerations
- Performance of high voltage insulation
- Record and analyze results
- Destructive test with thumper

Achievement Criteria

Performance The individual will be able to:
- Test the integrity of insulation on high voltage circuits and identify faults and failures
- Use a doble tester and or a thumper to check high voltage insulation integrity observing all safety requirements

Conditions In a lab setting as part of a practical project, given the required tools and equipment.

Criteria Within specifications, safety standards and time frames acceptable to industry.
Program Content  
Technical Training – Level 4 

LINE (GAC): O POWER SUPPLIES 
Competency: O1 Demonstrate knowledge of back-up power equipment, UPS, battery banks and battery charging systems [IE181-4TC] 

Objectives 
To be competent in this area, the individual must be able to: 
- Demonstrate knowledge of the procedures and approaches to regulation of power supplies, power regulation equipment, uninterruptible power systems (UPS), and battery banks.

LEARNING TASKS

1. Demonstrate knowledge of the selection of backup power equipment 
   - Equipment types and uses 
   - Advantages and disadvantages of different equipment types 
   - Load specifications 
   - Transfer switch function 

2. Demonstrate knowledge of the installation of backup power equipment 
   - Interpret drawings and diagram 
   - Voltage 
   - Frequency 
   - Alarms 
   - Transfer switch parameters 
   - CEC rules 

3. Describe the considerations for the maintenance of backup power equipment 
   - Preventative maintenance procedures 
   - Test transfer switch 
   - Verify component viability 

4. Identify different types of UPS in common use 
   - Types of UPS 
   - Manufacturer manuals and specifications 
   - Uses and advantages of common types 

5. Describe the considerations for the installation and maintenance of a UPS system and CEC rules 
   - Installation and security 
   - Wiring, bonding and shielding 
   - Set transfer switch 
   - Set alarms 
   - Set operating parameters with reference to distribution circuit standards 
   - Interpret drawings and schematics 
   - Electronic components of a UPS 

6. Describe and compare the common types of battery chemistry 
   - Liquid 
   - Gelled
LEARNING TASKS

7. Demonstrate knowledge of the considerations for the selection and installation of batteries and battery chargers

8. Demonstrate knowledge of the considerations for the maintenance of batteries and battery chargers

9. Describe the construction and operation of a primary cell and of a lead-acid battery with the aid of labelled sketches

10. Define battery capacity in terms of current and time

11. State the characteristics and typical applications of cells in common use

12. State situations where electrical energy creates a chemical effect

CONTENT

- Off gassing hazards
- Proper ventilation
- Charge holding characteristics
- Load and recharge rate
- Wiring and grounding
- CEC rules for mounting and connection of batteries
- Program charge regime
- Battery chargers
- Ambient temperature
- Electrolyte and specific gravity
- Equalization
- Float charging
- Testing voltages and characteristics of Battery types
- Battery and cell replacement
- Battery chargers
- Ambient temperature
- Primary cell
- Secondary cell
- Battery
- Electrolyte
- Specific gravity
- Electrodes
- Cathode
- Anode
- Charging
- Discharging.
- Amp hour rating
- Types of cells
  - Lead-acid
  - Nickel-iron
  - Nickel-cadmium
  - Lithium-ion
- Characteristics
  - Size
  - Nominal voltage
  - Typical capacity
  - Primary or secondary
- Electroplating
- Corrosion
LEARNING TASKS
13. Describe electrochemical corrosion
14. State methods of reducing corrosion

CONTENT
- Electrode potentials between metals
- Electrolytic action of surroundings
- Alloying
- Protective coatings
- Cathodic protection
- Neutralizing of components
### Program Content
**Technical Training – Level 4**

**LINE (GAC):** P  
**POWER GENERATION EQUIPMENT**

**Competency:** P1 Demonstrate knowledge of power generation controls and standby power generating systems [IE160-4TC]

### Objectives
To be competent in this area, the individual must be able to:
- Demonstrate knowledge of the principles and operation of common types of prime movers.
- Demonstrate knowledge of the installation and maintenance of prime mover controls and equipment.
- Describe types of power generating systems.

### LEARNING TASKS

<table>
<thead>
<tr>
<th>Task</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Describe different types of prime movers used for the generation of electricity and give reasons for the selection of one type over another in 3 common power generation applications.</td>
</tr>
<tr>
<td>2.</td>
<td>Describe the operating characteristics and installation requirements of common types of prime movers in accordance with CEC rules.</td>
</tr>
<tr>
<td>3.</td>
<td>Describe problems that can occur with the different types of prime mover.</td>
</tr>
<tr>
<td>4.</td>
<td>Describe different types of power control.</td>
</tr>
<tr>
<td>5.</td>
<td>Describe maintenance procedures, CEC rules and power authority requirements for different types of power control.</td>
</tr>
</tbody>
</table>

### CONTENT
- Types of prime movers
  - Gas turbines
  - Reciprocating engines
  - Diesel turbines
  - Hydro turbines
  - Steam turbines
  - Wind turbines
- Selecting appropriate type of prime mover
- Start to load times
- Energy requirements
- Efficiency
- Power transfer
- Maintenance requirements
- Speed control
- Cost
- Load sharing
- Load swings
- Vibrations
- Temperatures
- Governor controls
- Lubrication
- Transfer switches
- Distribution centres
- Electronic programmable and non-programmable unit controls
- Transfer switches, breakers and disconnects
- Distribution centres
- Electronic programmable and non-programmable unit controls
LEARNING TASKS

6. Describe standard operation of protective relays, and operating conditions and associated fault conditions of power generation units in terms of CEC rules and manufacturer guidelines

7. Describe principles of power regulation

8. Describe types of power generating systems

CONTENT
- Circuit drawings and equipment manuals
- Synchronizers
- Start, run, stop logic
- Integration to plant power supply and operations
- Reverse power
- Temperature
- Synchronization check relays
- Power factors
- Correction requirements
- Microelectronics and demands on power supply
- Demand surges
- Overcurrent/undervoltage protection
- Manufacturer standards and specifications
- Selection for application
- CEC rules
- Ground fault
- Under/over frequency
- Under/over voltage
- Phase unbalance
- Overcurrent
- Negative phase
- Solar cell
- Photovoltaic
- Wind turbine
- Co-generation
LINE (GAC):       P       POWER GENERATION EQUIPMENT
Competency:       P2       Describe co-generation principles and operations [IE164-4TC]

Objectives
To be competent in this area, the individual must be able to:
• Describe the principles and operations of electrical co-generation facilities.

LEARNING TASKS
1. Describe co-generation in terms of types of systems, applications, feasibility, and efficiency

2. Describe the operating principles of co-generation

3. Describe the advantages and disadvantages of generating power using co-generation equipment and identify factors limiting its implementation

CONTENT
• Definitions
• Characteristics
• Implementations
• Steam turbines
• Other prime movers
• Power grid and surplus capacity
• Switching and control methods
• Distributed generation
• Advantages
• Disadvantages
• Factors limiting implementation of co-generation
LINE (GAC): P  POWER GENERATION EQUIPMENT
Competency:  P3  Demonstrate knowledge of portable generator and portable electric welding equipment [IE165-4TC]

Objectives
To be competent in this area, the individual must be able to:
Describe the operation of portable generator and portable electric welding equipment.

LEARNING TASKS
1. Describe common portable generator equipment and its applications

   • Applications in an industrial setting
   • Basic theory of its design and operation
     o Prime mover – internal combustion engines
     o Generating theory
     o Load limits
     o Capacities
     o CEC rules

2. Describe portable electric welding equipment

   • Types of portable welding equipment and their applications
     o TIG
     o MIG
     o Electric arc
   • Basic theory of its design and operation
     o Prime mover – internal combustion engine or main supply
     o AC and DC power supply
     o Transformer
     o CEC rules
LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q1 Demonstrate knowledge of control systems [IE168-4TC]

Objectives
To be competent in this area, the individual must be able to:
• Demonstrate knowledge of control systems.

LEARNING TASKS
1. Demonstrate knowledge of servo and proportional valve control loops

CONTENT
• Types and operating principles of servo and proportional valve control loops
  o Position transducers
  o RVDTs
  o LVDTs
  o Synchro resolvers
  o Signal conditioning
  o Hydraulic valves
  o Pneumatic valves
  o Controllers and reference signals
  o Input signal and output position
• Installation
• Maintenance
• Documentation requirements
  o Installation
  o Maintenance

2. Demonstrate knowledge of encoders on machinery and equipment in terms of CEC rules and manufacturer specifications

• Encoder types and operating characteristics
  o Belt driven
  o Gear driven
  o Direct drive
  o Output
  o BCD
  o Pulse
  o Gray code
  o Absolute positioning
  o Incremental positioning
  o Multi-turn
• Installation
• Maintenance
  o SCADA
  o DDC
  o DCS monitoring systems
• Documentation requirements
  o Installation
  o Maintenance
<table>
<thead>
<tr>
<th>LEARNING TASKS</th>
<th>CONTENT</th>
</tr>
</thead>
</table>
| 3. Demonstrate knowledge of numeric controllers including programming controllers for different purposes | **•** Principle of operation of numeric controllers  
  - Numeric controller types  
  - Program languages  
  - Electro-mechanical interfaces  
  - XY grid coordination  
  - Installation  
  - Maintenance  
  - Documentation requirements |
| 4. Demonstrate knowledge of process control sensors, hardware and controllers in terms of equipment manufacturer specifications | **•** Process control principles  
  - Feedback  
  - Pneumatic  
  - Hydraulic  
  - Electronic  
  - Open loop/closed loop  
  - Operational amplifiers and PID control  
  - Installation  
  - Maintenance  
  - Documentation requirements |
| 5. Demonstrate knowledge of SCADA, DDC, and DCS monitoring systems | **•** Concepts of supervisory data gathering  
  - Control system principles  
  - Ladder logic  
  - Programming languages  
  - Data highways  
  - Block diagramming  
  - Discrete and analogue I/O  
  - Access and interpret manufacturer technical data and specifications  
  - Installation  
  - Maintenance  
  - Documentation requirements |
| 6. Demonstrate knowledge of hydraulic and pneumatic circuit controls and pumps and compressors associated with the control circuit | **•** Types of control circuits  
  - Hydraulic  
  - Pneumatic  
  - Installation  
  - Maintenance  
  - Documentation requirements |
LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q2 Describe signal, communication and alarm systems [IE185-4TC]

Objectives
To be competent in this area, the individual must be able to:
• Describe the basic features of security systems and fire alarm systems.

LEARNING TASKS

1. Describe the basic features of security systems
   • Purposes of security systems
   • Alarm systems
   o Deterrence
   o Detection of intruders
   o Response
   • Perimeter protection
   • Space protection
   • Spot protection
   • Basic alarm system security
   o Detection circuit
   o Control circuit
   o Output circuit
   • Closed-loop circuits
   o Two-wire
   o Two-wire with end-of-line resistor
   o Four-wire
   o Four-wire ULC
   • Common detection and alarm devices
   o Magnetic contacts
   o Passive infrared (PIR) detectors
   o Microwave and ultrasonic motion detectors
   o Dual-technology detectors
   o Photoelectric beam detectors
   o Gas break detectors
   o Audio detectors
   o Shock sensors
   • Control panel functions

2. Describe the basic features of fire alarm systems
   • Initiating devices
   • Signal devices
LEARNING TASKS

CONTENT

- Control panel
- System classifications
  - Single-stage
  - Two-stage system
- Fire alarm zones
- Common detection and alarm devices
  - Manual pull-stations
  - Key-operated manual pull stations
  - Heat detectors
    - Fixed temperature heat detectors
    - Rate-of-rise temperature detectors
    - Combination fixed-temperature and rate-of-rise detectors
    - Rate-of-anticipation detector
  - Smoke detectors
    - Ionization detector
    - Photoelectric detector
    - Light obscuration detector
  - Flame detectors
  - Signal devices
    - Vibrating bell
    - Single-stroke bell
    - Chimes
    - Horns and sirens
    - Visual devices
    - Loudspeakers
- Control panels
  - Single zone
  - Multi-zone
  - Addressable control panel
- Electrical supervision
- Class A wiring
- Class B wiring
- Annunciators
- Addressable fire alarm systems
- Installation and wiring requirements
  - Equipment mounting heights
  - CEC rules
  - Agencies
LEARNING TASKS

CONTENT

- Testing and inspection of FA system wiring
  - Opens and shorts (initiating circuits)
  - Opens and shorts (signal circuits)
  - Ground faults
  - Checking Class A wiring circuits
  - Checking Class B wiring circuits
  - Faults after connection
  - Checking trouble signal operation
  - False alarms
  - Testing the FA installation
- FA system maintenance

Achievement Criteria

Performance

The individual will be able to:

- Test and operate conventional fire alarm systems and addressable fire alarm systems
- Test and operate Class A and Class B wiring
- Recognize control panel indicating lights for proper operation, ground fault and trouble and describe appropriate corrective measures

Conditions

In a lab setting as part of a practical project, given the required tools and equipment.

Criteria

Within specifications, safety standards and time frames acceptable to industry.
Workplace Compulsory
Level 1 and Level 2

Industrial Electrician Level 1 and Level 2 technical training shares a common core with Construction Electrician.

Refer to the Construction Electrician Program Outline (2006) for Level 1 and Level 2 technical training requirements.

In addition, Industrial Electrician apprentices must complete workplace competencies associated with Levels 1 and 2.

It is recommended that these workplace competencies be completed prior to entering Level 3. However, they must be completed before certification will be issued.

This section includes only the workplace competencies associated with Levels 1 and 2.
LINE (GAC): B SAFE WORK PRACTICES

Competency: B2 Apply WCB standards and regulations [IE102-1WC]

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

- Interpret and comply with health and safety regulations, standards and guidelines.

LEARNING TASKS
1. Demonstrate knowledge of the purpose and role of WorkSafeBC, Mines Inspector and the National Energy Board

2. Demonstrate knowledge of and comply with health and safety regulations, standards and guidelines

CONTENT
- Rights and responsibilities of employers and employees
- Reporting procedures
- Workplace inspections
- All regulations applicable in the apprentice’s workplace

Achievement Criteria – Workplace Assessment [IE102-1WC]

Performance
The individual will be able to demonstrate knowledge of and comply with health and safety regulations and procedures applicable to workers in the industrial workplace.

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE102-1WC in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): B SAFE WORK PRACTICES
Competency: B3 Apply safe work practices [IE103-1WC and IE106-1WC]

Objectives
To be competent in this area, the individual must be able to:
• Describe and demonstrate safe work practices in an electrical workplace.
• Describe and demonstrate safe response to fire emergencies.

LEARNING TASKS

1. Assess and minimize workplace risks
   - Environmental risks
   - Slips
   - Trips and falls
   - Injury to others
   - Injury from moving machinery

2. Communicate risks and risk situations to others
   - Signage
   - Tagging
   - Verbal and written communications
   - Safe work cards
   - Risk hazard assessment procedures
   - Accident reporting

3. Apply Workplace Hazardous Materials Information System (WHMIS) and use proper procedures for personal protection from hazardous materials
   - Material Safety Data Sheets (MSDS)
   - Labelling
   - Spill containment
   - Personal exposure to hazardous materials
   - Protective equipment for hazardous materials
     - Breathing protection
     - Eye protection
     - Spill protection

4. Follow evacuation and fire emergency response procedures in accordance with organizational practice
   - Sound alarm
   - Isolate power
   - Use of elevators and stairs
   - Use of firefighting equipment
   - CO2 systems
   - Halon
   - Emergency shutdown
Achievement Criteria – Workplace Assessment [IE103-1WC and IE106-1WC]

Performance
The individual will be able to:

- Identify risk of injury and equipment damage in common industrial work situations, act to minimize risk to self and communicate risks to minimize risks of others
- Apply workplace hazardous materials information system (WHMIS) and use proper procedures for personal protection from hazardous materials
- Respond to fire emergencies in accordance with organizational requirements

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE103-1WC and 106-1WC in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Compulsory
Level 1 and 2

LINE (GAC): C TOOLS AND EQUIPMENT

Competency: C1 Use hand tools [IE114-1WC]

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

- Demonstrate the proper use of hand tools, portable power tools and machine tools used by electricians.

LEARNING TASKS

1. Select and demonstrate use of non-powered hand tools

2. Demonstrate proper use, application and maintenance of portable power tools

3. Demonstrate proper use, application and maintenance of machine tools and equipment used by electricians

CONTENT

- Tools for electrical maintenance
- Tools for electrical installation
- Electric drill
- Grinders
- Saws
- Threaders
- Blades
- Bits and cutters
- Personal protection equipment
- Guards
- Safe working conditions
- Drill press
- Bench grinder
- Circular saw
- Table saw
- Radial arm saw
- Blades
- Bits and cutters
- Personal protection equipment
- Guards

Achievement Criteria – Workplace Assessment [IE114-1WC]

Performance The individual will be able to:

- Demonstrate proper use of non-powered hand tools
- Demonstrate proper use, application and handling of portable power tools
- Demonstrate proper use, application and handling of machine tools

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE114-1WC in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Compulsory
Level 1 and 2

LINE (GAC): C TOOLS AND EQUIPMENT
Competency: C8 Use pneumatic and hydraulic tools [IE115-1WC]

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

- Demonstrate safe and proper use of pneumatic and hydraulic tools.

LEARNING TASKS

1. Use and maintain pneumatic tools and attachments

- Air safety
- Safe working conditions
- Personal protective equipment
- Types of tools
  - Impact drill
  - Impact wrench
  - Air grinder
  - Air lance
  - Air gun
  - Air chisel
- Components and attachments
  - Guards
  - Bits
  - Blades
  - Pressure regulators
  - Lubricators
- Alignment
- Maintenance

2. Select, use and maintain hydraulic tools and attachments

- Hydraulic safety
- Safe working conditions
- Personal protective equipment
- Components and attachments
  - Guards
  - Blades
  - Punches
  - Shoes
- Maintenance
Achievement Criteria – Workplace Assessment [IE115-1WC]

Performance  The individual will be able to:

- Demonstrate proper use, application and handling of pneumatic tools used by electricians
- Demonstrate proper use, application and handling of hydraulic tools used by electricians

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE115-1WC in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): G  CEC, REGULATIONS AND STANDARDS
Competency: G2  Apply the CEC to installations [IE108-1WC]

Objectives
To be competent in this area, the individual must be able to:
• Follow procedures for working safely with energized and de-energized electrical circuit and power sources.

LEARNING TASKS

1. Carry out isolation activities safely in accordance with industry practice
   • Tagging/locking/circuit isolation
   • Fuses and links
   • Barriers
   • Warning signs
   • Permits
   • Back feed awareness
   • Zero energy state test
   • Energize and de-energize breakers and equipment

2. Use protective equipment to ensure personal safety, the safety of others and the safety of equipment
   • Best practices
     o Arc flash assessment requirements
     o Company requirements
   • Gloves
   • Safety glasses

3. Demonstrate safe use of test equipment
   • Correct usage
   • Verifying safe function

4. Install grounding equipment
   • Portable grounding
   • Ground cable
   • Ground chains

5. De-energize and test equipment
   • Lockout and tag locations
   • Communication with personnel

6. Test and re-energize equipment
   • Ensuring that it is safe to re-energize
   • Communication with personnel
   • Removal of tags and lockouts
Achievement Criteria – Workplace Assessment [IE108-1WC]

Performance The individual will be able to:
- Follow safe procedures for de-energizing, tagging, locking out, removing tags and lockouts, testing, and re-energizing equipment
- Reference procedures and codes outlined in CEC, Mines Act BC, Use of Electricity in Mines (CSA) and WorkSafeBC OHS regulations

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE108-1WC in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
**LINE (GAC):** I  **ELECTRICAL EQUIPMENT**  
**Competency:** I1  Install lighting and electrical equipment [IE132-2WC and 146-2WC]

**Objectives**  
IE132-2WC: Install electrical equipment  
To be competent in this area, the individual must be able to:
- Install distribution panels, cable trays, cable conduit and explosion proof equipment to CEC rules and manufacturer specifications.

**LEARNING TASKS**

<table>
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<tr>
<th>CONTENT</th>
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| 1. Install distribution panels to which are easily serviced and meet design specifications | CEC rules and design specifications  
Fittings  
Termination of conductors  
Overcurrent protections  
Fault current calculations  
Fuse sequencing and selection  
Documentation |
| 2. Install equipment for use in hazardous locations | CEC rules and design specifications  
Hazardous locations  
Explosion-proof equipment  
Installation of equipment  
- Terminations  
- Enclosures  
- Pressure venting |
| 3. Install conduit and cable tray to safely route cable | CEC rules and design specifications  
Bend and shape conduit  
- Types of bending tools  
- Calculating lengths and bends  
Routing conduit  
- Fasteners and strapping  
  - Types of fasteners and supports  
  - Methods of attachment  
- Environmental considerations  
Install conduit and fasteners  
- Wire fishing techniques and hazards  
- Conductor vulnerability  
Install cable tray  
- Tools  
- Types of tray and hangar systems  
- Selection of system  
- Future expansion considerations  
- Cable service and troubleshooting  
- Hardware supports  
Adjusting drawings to reflect installation |
LEARNING TASKS

4. Install and maintain grounding, bonding and cathodic protection circuits

5. Install cable and protection equipment ensuring protected cable circuits can withstand environmental stress

6. Terminate conductors

7. Label and document wiring

CONTENT

- CEC rules
- Grounding and bonding circuitry
  - Designing circuits
  - Modifying to resolve problems
  - Ground fault indicators
  - Ground grids
  - Ground testing meters
  - Installation tools
- Cathodic protection equipment and circuits
  - Designing cathodic protection circuits
  - Modifying to resolve corrosion problems
  - Corrosion measurement
  - Bonding and grounding in cathodic circuits
- CEC rules and design specifications
- Installing cable
  - Hangar devices
  - Environmental considerations
  - Stapling and strapping
  - Routing and design
  - Cable sizing
  - Special usage cable
- Securing cable protection
  - Environmental considerations
  - Armoured
  - Weatherproof
- CEC rules and applicable regulatory codes
- Environmental requirements
- Terminating conductors
  - Crimpers
  - Wire strippers
  - Soldering
  - Torque wrenches
  - Correct wire sizing
  - Terminal blocks
  - Wire markers
  - Vulcanizing equipment (heat shrink)
- CEC rules and applicable regulatory codes
- Labeling and numbering standards
- Documentation systems
- Wire markers
- Color coding
LEARNING TASKS

8. Splice wiring

CONTENT

- CEC rules
- Low voltage
- Splicing techniques
- Safety considerations
- May include:
  - Exothermic welders (CAD welders)
  - High voltage

Achievement Criteria – Workplace Assessment [132-2WC]

Performance
The individual will be able to install distribution panels, cable trays, cable conduit and explosion proof equipment to CEC rules and manufacturer specifications.

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE132-2WC in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Compulsory
Level 1 and 2

LINE (GAC): I  ELECTRICAL EQUIPMENT
Competency: I1  Install lighting and electrical equipment [IE132-2WC and 146-2WC]

Objectives  IE146-2WC: Install lighting controls and equipment
To be competent in this area, the individual must be able to:
• Determine installation requirements and select and install components to meet those requirements.
• Install lighting controls and equipment.

LEARNING TASKS

1. Select light equipment in accordance with industry practice
   • Emergency lighting
   • Code requirements
   • ULC and CSA applicable codes
   • Light color required
   • Ambient temperature
   • Environmental requirements
   • Size of illuminated space
   • Wall light refraction

2. Install lighting equipment and controls
   • Hang lighting fixtures
   • Wire
   • Shield and ballast
   • Bulbs and bulb handing considerations
   • Starters and breakers
   • Access equipment catalogues and parts orders
   • Low voltage control
   • May include
     o Photocells and timers
     o Infrared detectors

Achievement Criteria – Workplace Assessment [146-2WC]

Performance  The individual will be able to select and install lighting equipment and controls appropriate for the application and in accordance with CEC and manufacturer standards and guidelines.

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE146-2WC in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
Workplace Compulsory
Level 3
LINE (GAC): A ESSENTIAL SKILLS
Competency: A6 Use analytical and troubleshooting techniques [IE127-3WC]

Objectives
To be competent in this area, the individual must be able to:
  • Apply knowledge of systematic procedures for efficiently identifying the source and type of malfunction or fault in equipment.

LEARNING TASKS

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| 1. Apply troubleshooting techniques
  • Break down systems into units of function
  • Isolate problems areas
| 2. Use available resources to determine equipment specifications and operating parameters
  • Manuals
  • Schematics
  • Internet resources
| 3. Use charts and systems information interfaces to identify problems and determine solutions
  • Flow charts
  • Logic charts
  • Process charts
  • Blueprints
  • Programmable logic controllers/digital control systems interfaces

Achievement Criteria – Workplace Assessment [IE127-3WC]

Performance
The individual will be able to use flow charts, process charts and other analytical troubleshooting techniques to identify malfunctions and recommend solutions to repair equipment and circuits.

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE127-3WC in the Industrial Electrician logbook:
  • Apprentice Diary includes dates and details of work performed covering tasks listed
  • Assessor or certified Industrial Electrician Observation of completion of relevant tasks
  • Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
  • Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): A ESSENTIAL SKILLS
Competency: A8 Lead teams and manage electrical installation and maintenance projects [IE125-3WC]

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

- Demonstrate principles of leadership to support a team of personnel in safely and efficiently realizing assigned objectives.

LEARNING TASKS

1. Demonstrate elements of effective communication
   - Active communication
   - Planning according to the resources of team members
   - Motivation
   - Mentorship
   - Goal setting
   - Achieving objectives under pressure

2. Use industry supervisory and reporting practice
   - Industry standard

3. Demonstrate effective leadership
   - Leadership skills

4. Use methods for describing and managing complex procedures so that the work is carried out safely
   - Task and step breakdown
   - Feedback loop
   - Contingency plan
   - Non-verbal signalling

5. Demonstrate planning skills in mapping out tasks
   - Make instructions relevant to the audience’s level of technical understanding
   - Plan ahead of task

Achievement Criteria – Workplace Assessment [IE125-3WC]

Performance
The individual will be able to:

- Use principles of effective communication working with, planning the work of and leading a team to accomplish assigned goals safely and efficiently
- Use techniques to ensure the safe execution of maintenance and installation procedures with a variety of personnel and in a variety of industrial setting

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE125-3WC in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): B SAFE WORK PRACTICES

Competency: B7 Follow safe procedures for working in confined spaces [IE105-3WC]

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate safe practices and procedures when working in confined spaces.

LEARNING TASKS

1. Comply with WorkSafeBC requirements for work in confined spaces
   - Safety equipment
   - Air movers
   - Emergency response plan

2. Use gas testing equipment to measure the state of the atmosphere
   - Poisonous gases
   - Explosive gases
   - Oxygen depleted atmosphere

Achievement Criteria – Workplace Assessment [IE105-3WC]

Performance The individual will be able to demonstrate safe practices and procedures when working in confined spaces.

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE105-3WC in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Objects
To be competent in this area, the individual must be able to:

- Practice safe techniques for lifting and rigging heavy objects.

LEARNING TASKS

1. Use slings following safe industry practice
   - Sling type
   - Load ratings
   - Secure load

2. Use standard hand signals for crane operation to international practice
   - Hand signals

3. Inspect lifting devices to ensure they meet design specifications
   - Logical equipment inspection techniques
   - Label data
   - Signs of wear and fatigue

Achievement Criteria – Workplace Assessment [IE104-3WC]

Performance
The individual will be able to demonstrate safe rigging techniques and perform lifting operations safely in accordance with best practice.

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE104-3WC in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): E TEST EQUIPMENT
Competency: E4 Use phase rotation equipment [IE130-3WC]

Objectives
To be competent in this area, the individual must be able to:
• Use the phase rotation meter to troubleshoot and check installation of three-phase power circuits.

LEARNING TASKS
1. Demonstrate use of phase rotation meter
   • Proper maintenance
   • Safety considerations
   • Compliance with current regulations and accepted practices

2. Use the phase rotation meter to troubleshoot and test three-phase circuits
   • Measure circuit (may include voltage)
   • Safety considerations
   • Missing phases
   • Proof testing
   • Direction of rotation
   • May include
     o Voltage levels

Achievement Criteria – Workplace Assessment [IE130-3WC]
Performance The individual will be able to demonstrate proper techniques to troubleshoot and test three-phase circuits with the phase meter, correctly identifying missing phases.

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE130-3WC in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): H LOW VOLTAGE DISTRIBUTION SYSTEMS
Competency: H8 Install and maintain low voltage circuits [IE142-3WC]

Objectives
To be competent in this area, the individual must be able to:
- Install, maintain and document low voltage circuits to CEC rules and all applicable installation guidelines.

LEARNING TASKS

1. Use low voltage circuit diagrams and drawings
   - Symbol sets
   - Standards
   - Schematics and construction blueprints
   - Drawing updates and standards

2. Install low voltage circuits
   - Commission
   - Test equipment
   - Appropriate termination
   - Finalize layout and secure safely
   - Install wire and cable
   - Determine control points
   - Environmental considerations

3. Maintain low voltage circuits
   - Test operation
   - Check terminal blocks
   - Inspect layout and securing
   - Inspect running wire
   - Confirm control points
   - Check connections

4. Select the appropriate low voltage distribution equipment types
   - CEC
   - CSA
   - ULC
   - ISO
   - NEMA
   - Load ratings

5. Install low voltage equipment
   - Wiring
   - Shielding, bonding and grounding
   - Access manufacturer specifications and manuals
   - Test
   - Secure and restrain

6. Maintain low voltage equipment
   - Test and troubleshoot
   - Protect and clean components
   - Grounding
   - Check connections
   - Component replacement
Achievement Criteria – Workplace Assessment [IE142-3WC]

Performance
- The individual will be able to:
  - Install and maintain low voltage circuits to equipment specifications and safety standards
  - Install and maintain low voltage distribution equipment to applicable safety standards and manufacturer specifications

Conditions
- To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
- Completion of standard IE142-3WC in the Industrial Electrician logbook:
  - *Apprentice Diary* includes dates and details of work performed covering tasks listed
  - *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
  - *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
  - *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): K  COMPUTER SYSTEMS

Competency: K1 Use computerized maintenance management systems and electronic logbooks [IE196-3WC]

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

- Use a computerized maintenance management system to schedule and record preventative and emergency maintenance.

LEARNING TASKS

1. Demonstrate knowledge of the relationship between maintenance, purchasing inventory/stores, and planning functions

   - Maintenance schedules
   - Repair schedules
   - Inventory principles
   - Work planning
   - Parts and equipment requisition and ordering

2. Use a computerized maintenance management system to identify and record maintenance work

   - Life cycle maintenance
   - Vendors’ maintenance requirements
   - Warranty and service details

3. Use a computerized maintenance management system to schedule works and order materials

   - Costing
   - Scheduling
   - Planning
   - Time entry

4. Use a computerized maintenance management system to examine equipment history and maintenance work

   - Life cycle maintenance
   - Previous maintenance
   - Previous emergency repairs
   - Past parts consumption

Achievement Criteria – Workplace Assessment [IE196-3WC]

Performance
The individual will be able to use a computerized maintenance management database to record equipment maintenance.

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE196-3WC in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Compulsory
Level 3

LINE (GAC):  L  ELECTRIC MOTORS
Competency:  L4  Install and maintain AC motors [IE151-3WC]

Objectives
To be competent in this area, the individual must be able to:
- Install and maintain AC motors to CEC rules and equipment manufacturer specifications.

LEARNING TASKS
1.  Prepare for installation and set-up of single and three-phase AC motors

   CONTENT
   - Pre-installation communication
   - Access and interpret operation and specification manuals
   - Junction box positioning
   - Verify manufacturer and name plate data
     - Frame size and characteristics
     - Horsepower
     - Amps
     - Voltage
     - Rotation speed
     - Service factor
     - Insulation class
     - Ambient temperature class
     - Grease type
     - Manufacturer
     - Weight
     - Efficiency
   - Type, size and verify rotation
   - Electrical classification
   - Verify starter
   - Insulation test
   - Leads/conductor sizing
   - Motor terminal wiring configuration
   - Supply conductor temperature and voltage rating
   - Cooling methods
   - Commissioning procedures
   - Grounding, shielding and bonding
   - Motor and wiring protection
   - Checks and tests
     - Load test
     - Current check
     - Rotation verification
   - Company standards

2.  Install and set-up single and three-phase AC motors

3.  Document installation
LEARNING TASKS

4. Prepare for maintenance of AC motors
   • Access and interpret operation and specification manuals
   • Maintenance records

5. Maintain AC motors
   • Safety procedures
   • Troubleshooting techniques
   • Preventative maintenance
   • Lubrication/ lubrication schedule
   • Vibration analysis
   • Clean
   • Current check
   • Insulation test
   • Listen to pump/motor
   • Assessment note
   • Company standards

6. Document maintenance

CONTENT

Achievement Criteria – Workplace Assessment [IE151-3WC]

Performance  The individual will be able to:
   • Install single-phase and three-phase induction AC motors to CEC code standards and manufacturer specifications appropriate to the type of motor and the application
   • Maintain and troubleshoot single-phase induction and three-phase induction AC applicable CEC rules and manufacturer specifications

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement

Criteria  Completion of standard IE151-3WC in the Industrial Electrician logbook:
   • Apprentice Diary includes dates and details of work performed covering tasks listed
   • Assessor or certified Industrial Electrician Observation of completion of relevant tasks
   • Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
   • Verification by a 3rd party confirming tasks were completed to appropriate standard
**Program Content**

**Workplace Compulsory**

**Level 3**

**LINE (GAC): M** **PROGRAMMABLE LOGIC CONTROLLERS**

**Competency:** M4 Install and maintain PLC hardware [IE136-3WC]

### Objectives

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

- Install PLC hardware in accordance with CEC rules and maintain an acceptable operational standard.

### LEARNING TASKS

1. **Prepare for installation of PLC components**
   - Access system specifications and manufacturer installation parameters
   - Environmental considerations
   - Power supply suitability and regulation
   - Locate blueprints and drawings
   - Develop/locate I/O lists
   - Determine I/O modules

2. **Install PLC hardware components to manufacturer specifications**
   - Wiring and terminations
   - Grounding and shielding
   - Software installation and diagnostics
   - Fusing and overload protection
   - Blueprints and drawings

3. **Document installation**
   - Company standards

4. **Diagnose faults using logical troubleshooting techniques and apply appropriate solutions**
   - Test procedures and entering commands
   - Wiring faults and corrosion
   - Hardware adjustment and repair
   - Procedures to verify system integrity
   - Check connections/terminations
   - Backing up software prior to diagnosis
   - Terminating cables
   - May include checking PLC status, proper operation and correct state

5. **Document maintenance**
   - Company standards
### Achievement Criteria – Workplace Assessment [IE136-3WC]

**Performance**

The individual will be able to:

- Install common PLC hardware in accordance with CEC rules and manufacturer specifications
- Maintain PLC hardware components to acceptable operational standard

**Conditions**

To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

**Criteria**

Completion of standard IE136-3WC in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Compulsory
Level 3

LINE (GAC): M PROGRAMMABLE LOGIC CONTROLLERS
Competency: M5 Install and maintain PLC networks [IE137-3WC]

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

- Maintain PLC networks to manufacturer specifications, CEC rules and to acceptable operational standards.

LEARNING TASKS

1. Prepare for installation and connection of PLC networks

   - Access system specifications and manufacturer installation parameters
   - Electrical drawings
   - Suitability of installation for operating environment
   - Cable types and environmental considerations

2. Install and connect PLC networks

   - Network installations
     - Set-up and install switching racks
     - Install and set-up routers
     - Modems and converters
     - Optimize system speed
   - Terminating conductors

3. Document installation

   - Company standards

4. Maintain PLC network installations

   - Testing procedures
   - Entering test commands
   - Identify and repair device conflicts
   - Identify and rectify communications errors
   - Adjust and repair software
   - Check terminations and remedy faults
   - Add cable terminations
   - Back-up and network PLC
   - May include
     - Ensure PLC is in correct mode

5. Document maintenance

   - Company standards
Achievement Criteria – Workplace Assessment [IE137-3WC]

**Performance**

The individual will be able to:
- Install PLC communication networks that allow PLC devices to communicate to operational standards
- Maintain PLC networks to allow PLC devices to communicate

**Conditions**

To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

**Criteria**

Completion of standard IE137-3WC in the Industrial Electrician logbook:
- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): M PROGRAMMABLE LOGIC CONTROLLERS
Competency: M6 Read and write programming language and install and maintain PLC software [IE139-3WC]

Objectives
To be competent in this area, the individual must be able to:
• Read and write programming language for PLCs and install and maintain common software applications to operate PLCs.

LEARNING TASKS

1. Load and run programs
   • PC interface
   • Configuration
   • Advantages and disadvantages of different configurations
   • Network communication requirements
   • ‘Online’, ‘offline’ and ‘equal’ states

2. Maintain PLC software
   • Programming terminals
   • Hand held programmers
   • Communication software
   • Back ups
   • PLC programs
   • Diagnostics

3. Select appropriate software programs for the situation
   • Vendor types and proprietary standards
   • Manufacturer manuals
   • Programming specifications and guides

4. Read and write programming language
   • Ladder logic
   • Function blocks
   • Scaling
   • Symbols
   • PLC operating modes
   • On-line/off-line programming
   • Programming instructions
   • I/O image tables
   • Integer files
   • Timers and counters

5. Document and secure programs to company standards
   • Uploading and back-up
   • Programming notes
   • Logic diagrams
   • Test and debug programs safely
   • Create reports and produce hard copy of programming
   • May include trending
Achievement Criteria – Workplace Assessment [IE139-3WC]

Performance  The individual will be able to:
- Install and maintain PLC software to manufacturer specifications, adjust as required to fit operating parameters and to allow error free communication between devices
- Read programming to troubleshoot PLCs and write functional programming to install and adjust PLCs and associated networks so they function in accordance with manufacturer specifications

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE139-3WC in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Workplace Compulsory
Level 4
Program Content
Workplace Compulsory
Level 4

LINE (GAC): F DRAWINGS AND MANUALS
Competency: F5 Design and draw electrical and electronic drawings [IE119-4WC]

Objectives
To be competent in this area the individual must be able to:
- Demonstrate and apply knowledge of design and drawing practice, symbols and conventions for electricians, and the maintenance of those drawings.
- Create as-built drawings.

LEARNING TASKS
1. Describe principles of efficient circuit design and equipment layout and how these will be addressed in the design

2. Identify installation requirements and design constraints for circuits and equipment

3. Explain regulatory requirements that must be addressed in the design

4. Design electrical circuits and installation layouts

5. Interpret existing document and drawing specifications

CONTENT
- Panel layout
- Cable runs and exposure
- Access
- Safety
- Progressive numbering systems
- Access
- Safety
- Service life
- Panel layout
- CEC
- ULC
- IEEE
- ISO
- Ease of assembly/disassembly of types of components, fastenings and restraints
- Selecting components
  - Flexibility between proprietary standards
  - Standards of interoperability and interchangeability
  - Parts catalogue standards
  - Cost considerations
- Regulatory requirements
- According to organizational technical data management practice
LEARNING TASKS

6. Create new drawings with standard symbols, which can be interpreted in accordance with organizational technical data management practice

7. Create new document specifications

8. Draw wire and installation changes on existing documents to organizational technical data management practice

9. Create electrotechnology drawings using computer aided design technology

10. Make appropriate use of CAD technology in the drafting process and outcomes

CONTENT

- Title blocks
- Scales when performing design work
- Projection
- Legend
- Schedules
- Drawing and document filing specifications
- Symbol conventions
- IEEE conventions
- Revision key
- Detail breakouts
- Organizational technical data management standards
- Field modification documentation
- Software tools (Autoview) and cross-referenced tracking system for drawings
- Using field numbering system to document as-built status
- Select conventions relevant to application
  - Layout
  - Content
  - Symbols
  - Labelling
- Use established drafting practices
  - Drawing content
  - Scaling
  - Labelling
  - Reference points
- Drawings conform to organizational technical data management standards
  - Content
  - Drawing entities and symbols
  - Drawing attributes
- File creation
- File saving and storage
- CAD tools
- CAD symbol libraries
- CAD applications
Achievement Criteria – Workplace Assessment [IE119-4WC]

Performance
The individual will be able to:

- Plan a new electrical installation or a revision to an existing installation (may include new or revised drawings)
- Design electrical circuits and installation layouts
- Interpret existing and create new documents and drawing specifications according to organizational technical data management practice
- Update drawings to 'as-built' status using common symbol sets and numbering standards, and file correctly to comply with organizational technical data management practice
- Create electrotechnology drawings using computer aided design technology

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE119-4WC in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
**LINE (GAC):** I  **ELECTRICAL EQUIPMENT**

**Competency:** I6 Install and maintain HVAC equipment [IE157-4WC]

**Objectives**

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

- Install and maintain heating, ventilation and air conditioning equipment.

**LEARNING TASKS**

1. Install heating and cooling equipment
   - Fans and air movement
   - Compressors
   - Heat exchange circuits
   - Control circuits and relays
   - Dampers
   - Thermostats
   - Solenoids

2. Document installation
   - Company standards

3. Maintain heating and cooling equipment
   - Safety principles
   - Common faults and troubleshooting techniques
   - Diagnosis tools and gauges
   - Specification manuals and construction prints
   - Cleaning
   - Company standards

4. Document maintenance

**Achievement Criteria – Workplace Assessment [IE157-4WC]**

**Performance**

The individual will be able to:

- Install heating and cooling equipment in HVAC and production processes to meet CEC rules and manufacturer specifications
- Maintain heating and cooling equipment in HVAC and production processes to meet CEC rules and manufacturer specifications

**Conditions**

To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

**Criteria**

Completion of standard IE-157-4WC in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): J CONTROL CIRCUITS
Competency: J5 Install and maintain motor control, voltage control and power distribution centers [IE155-4WC]

Objectives
To be competent in this area, the individual must be able to:
- Install and maintain motor control centers, voltage control and power distribution centers to appropriate standards.

LEARNING TASKS
1. Properly install motor control centres
   - Manufacturer specifications
   - Installation specifications
   - Location and optimization
   - Seismic considerations
   - Safety standards
   - CEC
   - ULC

2. Maintain MCC and equipment to CEC and company standards
   - Design specifications
   - Manufacturer specifications
   - Troubleshooting techniques
   - Magnetic contactors
   - Ground fault relays and motor protection relays
   - Check terminations
   - Fuses
   - Insulation test
   - Cleaning
   - Blueprint reading (identify cable and wires)
   - Check contacts
   - Overload protection
   - Grounding and bonding
   - Cubicle safety procedures
   - May include
     o Vacuum contactors
     o SF6 contactors
LEARNING TASKS

3. Properly install VCC in accordance with CEC rules

4. Use appropriate tools

5. Maintain VCC in accordance with CEC rules

6. Properly install PDC in accordance with CEC rules

7. Use appropriate tooling

8. Maintain PDC in accordance with CEC rules

CONTENT

- Adjust to specification
- Identification signs and labels
- Interpret drawings and blueprints
- Modify drawings and blueprints
- CEC rules 2300v standards
- CEC rules 600v standards
- Trip circuits
- Electrical ground hazards
- Hot sticks
- Contact closure testers
- Standard test equipment
- Isolation points
- Use of common test equipment on VCC
- External trip device location
- Interpret prints and schematics
- Deviation from specifications (overheating, noise)
- Load current
- Voltage balance
- Preventative maintenance procedures
- Isolation points
- Use of common test equipment on PDC
- External trip device location
- Interpret prints and schematics
- Deviation from specifications (overheating, noise)
- Load current
- Voltage balance
- Preventative maintenance procedures
LEARNING TASKS

9. Install protective relays

10. Maintain protective relays

CONTENT

- Read and modify prints and schematics
- Access and interpret manuals and specifications
- Overcurrent/undercurrent states
- Safety procedures

- Access and interpret trip logs
- Safe working procedures
- May include
  - Ground fault
  - Phase loss
  - Dead bus

Achievement Criteria – Workplace Assessment [IE155-4WC]

Performance
The individual will be able to:

- Install and maintain motor control centres (MCC) to CEC rules and manufacturer specifications
- Install and maintain voltage control centres (VCC) to CEC rules
- Install and maintain power distribution centres (PDC) to CEC rules
- Select, install and maintain protective relays on power distribution equipment, to all applicable safety standards and manufacturer guidelines

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE155-4WC in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Compulsory
Level 4

LINE (GAC):   J  CONTROL CIRCUITS
Competency:  J6  Install and maintain variable frequency drives (VFD)  [IE179-4WC]

Objectives
To be competent in this area, the individual must be able to:
- Install and maintain variable frequency drives (VFD) to appropriate CEC codes, guidelines and standards.

LEARNING TASKS

1. Prepare for installation of drive set-up
   - Access and interpret operation and specification manuals

2. Properly install and set up drive systems
   - Control parameters
   - Frequency and motor speed
   - Ramping speed vs. time
   - Soft start
   - VFD self tune
   - Controller/PC interface

3. Document installation
   - Company standards

4. Properly maintain drive systems
   - Diagnostic tools
   - PC interface and analysis
   - Access and interpret operation and specification manuals

5. Document maintenance
   - Company standards

Achievement Criteria – Workplace Assessment [IE179-4WC]

Performance
The individual will be able to:
- Install VFD drive systems and related controls to CEC rules and manufacturer specifications
- Maintain VFD drive systems and related controls to CEC rules and manufacturer specifications

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE179-4WC in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): O  POWER SUPPLIES
Competency: O3 Install and maintain UPS system [IE183-4WC]

Objectives
To be competent in this area, the individual must be able to:
• Install and maintain a UPS system in a common application wired to CEC rules in accordance with equipment manufacturer specifications.

LEARNING TASKS
1. Prepare to install a UPS system in accordance with industry practice
   • Interpret and drawings and schematics
   • Manufacturer specifications
2. Install a UPS system in accordance with industry practice
   • Installation and security
   • Wiring, bonding and shielding
   • Set transfer switch
   • Set alarms
3. Document installation
   • Company standards
   • Update drawings and schematics
4. Maintain a UPS system in accordance with industry practice
   • Security
   • Wiring, bonding and shielding
   • Check transfer switch
   • Check alarms
5. Document maintenance
   • Check operating parameters with reference to distribution circuit standards
   • Electronic components of a UPS
   • Company standards
Achievement Criteria – Workplace Assessment [IE183-4WC]

Performance
The individual will be able to:

- Install a UPS system in a common application wired to CEC rules in accordance with equipment manufacturer specifications
- Maintain a UPS system in a common application wired to CEC rules in accordance with equipment manufacturer specifications

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE183-4WC in the Industrial Electrician logbook:

- **Apprentice Diary** includes dates and details of work performed covering tasks listed
- **Assessor or certified Industrial Electrician Observation** of completion of relevant tasks
- **Additional Supporting Evidence** is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- **Verification** by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC):  O  POWER SUPPLIES
Competency:  O4  Install and maintain batteries [IE184-4WC]

Objectives
To be competent in this area, the individual must be able to:
• Select, install and maintain batteries to supply emergency or operating power.

LEARNING TASKS

1. Select and install batteries in accordance with industry practice
   • Off gassing hazards
   • Charge holding characteristics
   • Load and recharge rate
   • Wiring and grounding
   • CEC rules for mounting and connection of batteries
   • Program charge regime

2. Document installation
   • Company standards

3. Prepare and document a battery maintenance plan
   • Electrolyte and specific gravity testing
   • Voltage testing

4. Maintain batteries in accordance with industry practice
   • Electrolyte and specific gravity
   • Equalization
   • Float charging
   • Testing voltages and characteristics of battery types
   • Replace batteries and cells
   • Maintenance schedule

5. Document maintenance
   • Company standards

Achievement Criteria – Workplace Assessment [IE184-4WC]

Performance
The individual will be able to:
• Select and install batteries according to CEC rules and manufacturer specifications
• Maintain batteries in accordance with CEC rules and manufacturer specifications

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE184-4WC in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Compulsory
Level 4

LINE (GAC): P  POWER GENERATION EQUIPMENT
Competency: P7  Install and maintain power generation controls [IE162-4WC]

Objectives
To be competent in this area, the individual must be able to:
• Install and maintain power generation controls to CEC rules; and power authority and manufacturer specifications and installation guidelines.

LEARNING TASKS
1. Prepare for installation of power generation controls
   • Safety codes and procedures
   • Access and interpret operation and specification manuals

2. Install power generation controls in accordance with industry practice
   • Power loading characteristics and capacities
   • Control parameters
   • Wire, shield and ground controls
   • Emergency shutdown procedure

3. Document installation
   • Meets company standards

4. Maintain power generation controls in accordance with industry practice
   • Error codes and messages
   • Software interrogation
   • Test procedures
   • Live bus safety precautions
   • Time delay adjustments
   • Coordination with plant/process controllers, indicator lights and alarms
   • Cabinet maintenance
   • Meets company standards

5. Document maintenance

Achievement Criteria – Workplace Assessment [IE162-4WC]

Performance  The individual will be able to:
• Install power generation controls matched to duty expectations and in accordance with CEC rules, manufacturer specifications and power authority requirements
• Maintain power generation controls matched to duty expectations and in accordance with CEC rules, manufacturer specifications and power authority requirements

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE162-4WC in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): P POWER GENERATION EQUIPMENT
Competency: P8 Install and maintain power generator protective relays [IE163-4WC]

Objectives
To be competent in this area, the individual must be able to:
- Select, install and maintain power generator protective relays to applicable code and manufacturer guidelines.

LEARNING TASKS

1. Select and prepare for installation of protective relays for primary power supplies
   - Specifications and schematics

2. Properly install protective relays for primary power supplies in accordance with industry practice
   - Set up electronic load sharing controls
   - Set up speed controls
   - Voltage regulator static set up
   - Program equipment parameters
   - Reverse power relay settings

3. Document installation
   - Meets company standards

4. Maintain protective relays in accordance with industry practice
   - Error codes and messages
   - Bench test synchronizers
   - Synchronizer dynamic adjustments
   - Voltage regulator adjustment
   - Ramp time
   - Current transformer phasing
   - Load gain adjustment
   - Meets company standards

5. Document maintenance

Achievement Criteria – Workplace Assessment [IE163-4WC]

Performance
The individual will be able to:
- Select appropriate protective relays and install to CEC rules and manufacturer specifications in accordance with industry practice (for example, a diesel power generator)
- Maintain protective relays to CEC rules and manufacturer specifications

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE163-4WC in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Compulsory
Level 4

LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q3 Install and maintain process control hardware [IE172-4WC]

Objectives
To be competent in this area, the individual must be able to:
• Install and maintain process control hardware in accordance with CEC rules and equipment manufacturer specifications.

LEARNING TASKS
1. Prepare for installation of process controllers
   • Electronics power supplies
   • Voltage and current calibration
   • Controller tuning parameters, such as proportional band, gain, reset, derivative, etc.
   • Quarter decay
   • Installation specifications

2. Install process control sensors and controllers in accordance with industry practice
   • Sensor types
   • Location
   • Control logic
   • PLC routines
   • Load change during tuning
   • Optimum control/minimum oscillation
   • Testing
   • May include
     o Install and maintain process control hardware and software on a pressurized pneumatic plywood machine
     o Adjust for best function and document a preventative maintenance schedule for the controllers

3. Document installation
   • Meets company standards

4. Maintain process controls
   • Analyze faults using software
   • Adjust control parameters
   • Logic tests
   • Access manufacturer specifications and service manuals
   • Maintenance schedules
   • Document maintenance to company standards

5. Document maintenance
   • Meets company standards
Achievement Criteria – Workplace Assessment [IE172-4WC]

Performance  The individual will be able to:
  - Install process control sensors, hardware and controllers to CEC rules and equipment manufacturer specifications
  - Maintain process control sensors, hardware and controllers to equipment manufacturer specifications and company standards

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE172-4WC in the Industrial Electrician logbook:
  - *Apprentice Diary* includes dates and details of work performed covering tasks listed
  - *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
  - *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
  - *Verification* by a 3rd party confirming tasks were completed to appropriate standard
**LINE (GAC):** Q  CONTROL AND MONITORING SYSTEMS AND DEVICES

**Competency:** Q4  Install and maintain signal, communication and alarm systems [IE185-4WC and IE186-4WC]

**Objectives**

IE185-4WC: Demonstrate knowledge of safety and security systems (credit 3)

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

- Demonstrate knowledge of the theory of detection and alarm, fire and security systems.

**LEARNING TASKS**

| 1.  | Describe types and characteristics of detection and alarm circuits |
| 2.  | Describe alarm system installation and related CEC rules |

**CONTENT**

- Fire
- Smoke
- Heat
- Motion
- Intrusion
- Oil
- Vibration
- Air and water quality
- Alarm circuitry characteristics
- Alarm history and data storage
- Supervisory currents
- Horns
- Strobes
- Printers
- Dialers and lights
- End of line resistors
- Fail safe logic
- Calibration and verification techniques for correct detection target
- Correct placement of sensors/monitors
- Test alarm points through to final annunciation
- Ambient temperature and humidity
Achievement Criteria – Workplace Assessment [IE185-4W]

**Performance**
The individual will be able to describe the installation of alarm systems.

**Conditions**
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

**Criteria**
Completion of standard IE185-4WC in the Industrial Electrician logbook:
- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Compulsory
Level 4

LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES

Competency: Q4 Install and maintain signal, communication and alarm systems [IE185-4WC and IE186-4WC]

Objectives
IE186-4WC: Install and maintain detection and alarm systems
(credit 9)

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

• Install and maintain detection and alarm systems in accordance with CEC rules, application requirements and manufacturer specifications.

LEARNING TASKS

1. Properly install detection and alarm circuits

   CONTENT
   • Alarm circuitry characteristics
   • Supervisory currents
   • Horns
   • Strobes
   • Printers
   • Diallers and lights
   • End of line resistors
   • Fail safe logic
   • Calibration and verification techniques for correct detection target
   • Correct placement of sensors/monitors
   • Test alarm points through to final annunciation

2. Program the alarm parameters to perform to specification in accordance with industry practice

   • Programming alarm parameters

3. Test and verify installation

   • Meets CEC rules and specifications

4. Document installation

   • Meets company standards

5. Establish a preventative maintenance regime for the alarm circuit and sensors

   • Electric circuits
   • Sensors
6. Maintain detection and alarm circuits to meet CEC rules and industry practice
   - Alarm circuitry characteristics
   - Supervisory currents
   - Horns
   - Strobes
   - Printers
   - Diallers and lights
   - End of line resistors
   - Fail safe logic
   - Calibration and verification techniques for correct detection target
   - Correct placement of sensors/monitors
   - Test alarm points through to final annunciation
   - Maintenance schedules

7. Document maintenance
   - Meets company standards

Achievement Criteria – Workplace Assessment [IE186-4WC]

Performance
The individual will be able to:
- Install an alarm system in accordance with industry practice and CEC rules
- Maintain detection and alarm circuits in accordance with industry practice

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement

Criteria
Completion of standard IE186-4WC in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Workplace Elective Competencies

Apprentices must complete 35 credits of Workplace Elective competency standards to complete the Apprenticeship.
LINE (GAC):  B  SAFE WORK PRACTICES
Competency:  B6  Use jumpers and forces safely [IE109-9WE]

Credit 3

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

- Follow procedures for working safely with jumpers and forces.

LEARNING TASKS

1. Obtain permits to use jumpers and forces and complete all documentation requirements

2. Install jumpers and forces in accordance with requirements and industry practice

3. Manage changes in control strategy when using jumpers and forces.

CONTENT

- Permits
- Documentation requirements
- Safety hazards for jumpers and forces
- Communicating hazards to other personnel
- Logic checks
- Logic change when required
- Appropriately documented
- Awareness of effects of jumper
- Force or logic edit on equipment operation

Achievement Criteria – Workplace Assessment [IE109-9WE]

Performance The individual will be able to use jumpers and forces safely using permits, authorizations sheet, and change management system.

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE109-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): C TOOLS AND EQUIPMENT
Competency: C4 Use powder actuated tools [IE197-9WE]

Credit 1

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

- Demonstrate and apply knowledge of safe and proper use of powder actuated tools.

1. Demonstrate and apply knowledge of safe and proper use of powder actuated tools
   - Manufacturer procedures for the tool in use
   - Assembly and maintenance
   - Personal protective equipment required

2. Explain load and fastener selection and combinations for three different situations
   - Selection
   - Combinations

3. Demonstrate load and fastener selection for powder actuated tools
   - Load selection
   - Fastener selection

4. Explain and demonstrate safe handling and storage of powder actuated tools
   - Safe handling
   - Storage

Achievement Criteria – Workplace Assessment [IE197-9WE]

Performance The individual will be able to:
- Select load and fasteners for powder actuated tools
- Demonstrate safe and proper use of powder actuated tools

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE197-9WE in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): C TOOLS AND EQUIPMENT
Competency: C7 Use liquid-fuel powered tools [IE199-9WE]

Credit 1

Objectives
To be competent in this area, the individual must be able to:
• Demonstrate safe and proper use of liquid-fuel powered tools.

LEARNING TASKS
1. Select and properly use liquid-fuel powered tools
   - Safe working conditions
   - Personal protection equipment
   - Blades
   - Guards
   - Safe mixing, handling, and storage of liquid fuel

2. Maintain liquid-fuel powered tools
   - Maintain is to leave the tool in good working order but not to perform repair and refurbishment of the tool

Achievement Criteria – Workplace Assessment [IE199-9WE]

Performance
The individual will be able to demonstrate proper and safe application and handling of liquid-fuel powered tools used by electricians, including:
• Two cycle
• Four cycle
• And one of: chainsaw, cut-off saw, generator, string trimmer, power washer

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE199-9WE in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
**Program Content**

**Workplace Elective Competencies**

**LINE (GAC):** C

**TOOLS AND EQUIPMENT**

**Competency:** C9  Operate personal lifting device [IE198-9WE]

**Credit** 1

**Objectives**

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

- Demonstrate and apply knowledge of safe and proper use of personnel lifting devices.

**LEARNING TASKS**

1. Demonstrate knowledge of safety procedures and regulations for the safe use of a boom truck personnel lifting device

2. Demonstrate proper and safe procedures for use of a boom truck personnel lifting device, with an empty personnel platform

3. Describe safety procedures and regulations for the safe use of personnel lifting devices

4. Demonstrate use of personnel lifting devices

**CONTENT**

- Loading
- Capacity
- Inspection and testing
- Backup controls
- Fall arrest equipment
- Safety regulations and classes of certification

- WorkSafeBC OHS regulations require Class 2 certification before assessment can occur; this must be sighted
- Class 3 certification is required before personnel can be lifted

- Loading
- Capacity
- Inspection and testing
- Backup controls
- Fall arrest equipment
- Safety regulations
- Procedures
- Safety
Achievement Criteria – Workplace Assessment [IE198-9WE]

Performance  The individual will be able to:

- Describe and demonstrate proper and safe procedures for use of a boom truck personnel lifting device according to manufacturer specifications and company standards
- Describe and demonstrate proper and safe procedures for use of other personnel lifting devices according to manufacturer specifications and company standards (including telescopic boom and scissor lift)

Conditions   To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria      Completion of standard IE198-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): G CEC, REGULATIONS AND STANDARDS
Competency: G4 Access and comply with mining electrical regulations [IE211-9WE]

Credit 2

Objectives

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

- Access and comply with standards in the Mines Act and CSA pertaining to industrial electrical applications, installations, operations and standards.

LEARNING TASKS

1. Describe the Mines Act and the sections and content pertinent to electrical installations on mine sites

CONTENT

- Purpose
- Layout
- Legal force
- Organization
- Indexing
- Section organization
- Media – print, CD, online

2. Comply with content of the Mines Act

- Information pertinent to electrical installations on mine sites

3. Describe the CSA – and the sections and content pertinent to the use of electricity in mines

- Purpose
- Layout
- Legal force
- Organization
- Indexing
- Section organization
- Media – print, CD, online

4. Comply with content of the CSA

- Use of electricity in mines

Achievement Criteria – Workplace Assessment [IE211-9WE]

Performance The individual will be able to:

- Demonstrate and apply knowledge of the Mines Act
- Demonstrate and apply knowledge of the CSA – Use of electricity in mines

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE211-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): G

CEC, REGULATIONS AND STANDARDS

Competency: G5  Demonstrate and apply knowledge of onshore pipeline regulations [IE218-9WE]

Credit  2

Objectives

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

- Demonstrate and apply knowledge of OPR 99 of the National Energy Board regulations in all operations involving the piped transmission of hydrocarbons.

LEARNING TASKS

1. Describe onshore pipeline regulations

- Purpose of the OPR 99 of the National Energy Board Act
- Application
- Legal force
- Method of organization
- Access to the Act
- Mediums available (print, CD-ROM, online)
- Hydrocarbon service

2. Explain and apply the OPR 99 in terms of work sites involved in piping hydrocarbons in accordance with industry practice and codes

- Material specifications
- Emergency requirements
- Environmental impacts
- Pipeline control competencies

Achievement Criteria – Workplace Assessment [IE218-9WE]

Performance  The individual will be able to demonstrate knowledge of and comply with onshore pipeline regulations in terms of the OPR 99.

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard  IE218-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): I  ELECTRICAL EQUIPMENT

Competency: I7  Install and maintain pumps [IE159-9WE]

Credit  2

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

- Install and maintain pumps, both sub-surface and surface (i.e. deep well, de-watering, compressor).

LEARNING TASKS

1. Install pumps to CEC rules

   • Power supplies
   • Grounding
   • Insulation
   • Confined space procedures
   • BC plumbing code standards
   • Line up

2. Document installation

   • Company standards

3. Maintain pumps to CEC rules

   • Sealed motors
   • Controllers
   • Pressure and control circuits
   • Cavitation
   • Confined space procedures

4. Document maintenance

   • Company standards

Achievement Criteria – Workplace Assessment [IE159-9WE]

Performance  The individual will be able to:

- Install surface and sub-surface pumps to CEC rules and manufacturer specifications
- Maintain surface and sub-surface pumps to CEC rules and manufacturer specifications

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE159-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): I ELECTRICAL EQUIPMENT
Competency: I8 Maintain electronic precipitators [IE195-9WE]

Credit 5

Objectives
To be competent in this area, the individual must be able to:
• Maintain and operate electronic precipitators.

LEARNING TASKS
1. Maintain electronic precipitators
   • Electrodes
   • Flushing
   • Power controls
   • Clearances
   • Operation of safety lockouts

2. Document maintenance
   • Meets company standards

3. Operate electronic precipitators in accordance with company standards and manufacturer specifications
   • Control parameter adjustments
   • Flushing

Achievement Criteria – Workplace Assessment [IE195-9WE]
Performance The individual will be able to
• Maintain and operate electronic precipitators in accordance with CEC rules and manufacturer specifications
• Operate electronic precipitators in accordance with company standards and manufacturer specifications

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE195-9WE in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Elective
Competencies

LINE (GAC): I

ELECTRICAL EQUIPMENT

Competency: I9 Install and maintain Robotic Control Systems [IE177-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
- Install and maintain Robotic Control Systems in accordance with CEC rules and manufacturer specifications.

LEARNING TASKS

1. Prepare for installation of RCS
   - Location
   - Power supply

2. Install RCS to meet design requirements
   - Control features
   - Program controller

3. Document installation
   - Meets company standards

4. Maintain robotic and remote control systems
   - Troubleshooting techniques
   - Preventative maintenance for micro-electronic controllers
   - Safety control systems

5. Document maintenance
   - Meets company standards

Achievement Criteria – Workplace Assessment [IE177-9WE]

Performance The individual will be able to:
- Install robotic and remote control systems to CEC rules and manufacturer specifications
- Maintain robotic and remote control systems to CEC rules and manufacturer specifications

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE177-9WE in the Industrial Electrician logbook:
- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): J  CONTROL CIRCUITS

Competency: J7  Install and maintain DC drive systems [IE180-9WE]

Credit 9

Objectives
To be competent in this area, the individual must be able to:
- Install and maintain direct current (DC) drives to CEC rules and manufacturer specifications.

LEARNING TASKS

1. Prepare for installation of DC drives
   - Access and interpret operation and specification manuals
   - Environmental operating conditions

2. Properly install and set-up DC drives
   - Control system operation
   - Environmental operating conditions
   - Tuning and calibration
   - Wiring techniques and sizing
   - Grounding, shielding and bonding per manufacturer specifications
   - Access and interpret operation and specification manuals

3. Document installation
   - Meets company standards

4. Properly maintain DC drives
   - Troubleshooting techniques
   - Safety procedures
   - Preventative maintenance procedures
   - Access and interpret operation and specification manuals

5. Document maintenance
   - Meets company standards

Achievement Criteria – Workplace Assessment [IE180-9WE]

Performance  The individual will be able to:
- Install digital DC drives and associated motor controls to CEC rules (may also include analogue DC drives)
- Maintain digital DC drives and associated motor controls to CEC rules (may also include analogue DC drives)

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE180-9WE in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): J  CONTROL CIRCUITS
Competency: J8  Install and maintain wound rotor drives [IE200-9WE]

Credit 7

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate knowledge of operation.
- Install and maintain wound rotor drives to CEC rules and to manufacturer installation and operation specifications.

LEARNING TASKS
1. Demonstrate knowledge of the operation of wound rotor drives

2. Prepare for installation of wound rotor drives

3. Install and set-up of wound rotor drives

4. Document installation

5. Maintain wound rotor drives to CEC rules and manufacturer requirements

6. Document maintenance

CONTENT
- Vendor systems and compatibility with other drive types
- Control system types
- Applications
- Safety procedures
- Access and interpret operation and specification manuals
- Safety procedures
- Wiring techniques and sizing
- Grounding, shielding and bonding
- Meets company standards
- Safety procedures
- Access and interpret operation manuals
- Troubleshooting techniques
- Preventative maintenance procedures
- Meets company standards
Achievement Criteria – Workplace Assessment [IE200-9WE]

Performance  The individual will be able to:
  - Demonstrate knowledge of the operation of a wound rotor drive to CEC rules and manufacturer specifications
  - Install a wound rotor drive to CEC rules and manufacturer specifications
  - Maintain/troubleshoot wound rotor drives to ensure reliability and longevity of the drive

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE200-9WE in the Industrial Electrician logbook:
  - *Apprentice Diary* includes dates and details of work performed covering tasks listed
  - *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
  - *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
  - *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): K  COMPUTER SYSTEMS
Competency: K4  Install and maintain computer networks [IE149-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
• Install and maintain reliably networked equipment and devices in an efficient manner.

LEARNING TASKS

1. Demonstrate knowledge of the principles of network and inter-network communication
   • Workstation
   • Workgroup
   • Servers
   • Switches
   • Firewalls

2. Place and wire network components and workstations
   • Cat 5e cabling
   • Conventions and terminations
   • Network design and security.
   • May include
     o Fibre optics
     o Co-axial
     o Teck cable
     o Cat 6

3. Install wireless networks and describe basic features of operation
   • 802.11 bgn communications protocols
   • Standards for equipment placement
   • Device and network limitations

Achievement Criteria – Workplace Assessment [IE149-9WE]

Performance The individual will be able to demonstrate and apply knowledge of the principles of both wired and wireless networks, factors dictating installation types and required components for efficient function.

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE149-9WE in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): L ELECTRIC MOTORS
Competency: L5 Install and maintain DC electric motors [IE193-9WE]

Credit 9

Objectives
To be competent in this area, the individual must be able to:
• Demonstrate correct installation and maintenance of DC motors to CEC rules and manufacturer specifications.

Learning Tasks
1. Prepare for installation and setup of DC motors
   • Pre-installation communication
   • Hand-off procedures
   • Access and interpret operation and specification manuals
   • Blueprints
   • Name plate data

2. Install and set up DC motors to CEC rules
   • Access motor information
   • Wiring techniques and sizing
   • Grounding, shielding and bonding
   • Fuses and overloads
   • Brush characteristics
   • Seating and positioning
   • Motor and wiring protection
   • Field coil and armature checks and tests
   • Current check
   • Rotation check
   • May include
     • Neutral plane

3. Document installation
   • Meets company standards

4. Prepare for maintenance of DC motors
   • Access and interpret operation and specification manuals
   • Maintenance records
**LEARNING TASKS**

5. Properly maintain DC motors to manufacturer specifications

<table>
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<th>CONTENT</th>
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<td>Safety procedures</td>
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<td>- Neutral plane analysis</td>
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<td>- Vibration analysis</td>
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<tr>
<td>- Cooling fins, fans and filters</td>
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<tr>
<td>- Meets company standards</td>
</tr>
</tbody>
</table>

6. Document maintenance

**Achievement Criteria – Workplace Assessment [IE193-9WE]**

*Performance*  
The individual will be able to:

- Install DC motors to applicable regulatory code standards and equipment manufacturer specifications
- Maintain and troubleshoot DC motors to ensure reliability and longevity of the drive

*Conditions*  
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

*Criteria*  
Completion of standard IE193-9WE in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
**LINE (GAC):** L ELECTRIC MOTORS  
**Competency:** L6 Install and maintain wheel motors [IE204-9WE]

**Credit** 9

**Objectives**
To be competent in this area, the individual must be able to:
- Demonstrate and apply knowledge of installation and maintenance of wheel motors to manufacturer specifications and service standards.

**LEARNING TASKS**

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<th>CONTENT</th>
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<td>1. Describe wheel motors and wheel motor operation</td>
<td>1. Outline wheel motor applications</td>
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<td>2. Outline wheel motor applications</td>
<td>2. Install wheel motors in accordance with industry practice and regulatory codes</td>
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<tr>
<td>3. Install wheel motors in accordance with industry practice and regulatory codes</td>
<td>4. Maintain wheel motors in accordance with industry practice and regulatory codes</td>
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<td>4. Maintain wheel motors in accordance with industry practice and regulatory codes</td>
<td>5. Document maintenance</td>
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<tr>
<td>5. Document maintenance</td>
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</tbody>
</table>
Achievement Criteria – Workplace Assessment [IE204-9WE]

Performance: The individual will be able to:
- Demonstrate knowledge of wheel motors and wheel motor operation
- Install wheel motors in the field to manufacturer service standards and specifications
- Maintain wheel motors in the field to manufacturer service standards and specifications

Conditions: To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria: Completion of standard IE204-9WE in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Line (GAC): N

Power Distribution Systems

Competency: N4 Install and maintain high voltage circuits [IE153-9WE]

Credit: 12

Objectives

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

- Install, maintain and document high voltage circuits to code standards and all applicable installation guidelines.

Learning Tasks

1. Install high voltage circuits to CEC rules and complete appropriate documentation to company standards

2. Maintain high voltage circuits to CEC rules and complete appropriate documentation to company standards

3. Install power distribution equipment to CEC rules and complete appropriate documentation to company standards

4. Maintain power distribution equipment to CEC rules and complete appropriate documentation to company standards

Content

- Testing equipment
- Termination
- Layout and secure
- Running wire
- Control points
- Environmental specifications
- Testing equipment
- Control points
- Circuit breakers – latch and trip
- Arc chutes
- Sequencing
- Symmetrical and asymmetrical load rating
- Breaker safety features
- OCB oil deterioration
- Contact resistance checks
- Environmental specifications
- Load calculation
- Environmental factors
- Wiring, shielding and bonding
- Access manufacturer specifications and manuals
- Test and tune
- Secure and restrain
- Test and troubleshoot
- Protect and clean components
- Safety procedures for component replacement
- Grounding
- Manufacturer specifications
- Preventative maintenance routines
LEARNING TASKS

5. Select and install protective relays to CEC rules and complete appropriate documentation to company standards

6. Maintain protective relays to CEC rules and complete appropriate documentation to company standards

CONTENT

- Read and modify prints and schematics
- Access and interpret manuals and specifications
- Overcurrent/undercurrent states
- Safety procedures
- Access and interpret trip logs
- Safe working procedures
- May include:
  - Ground fault
  - Phase loss
  - Dead bus

Achievement Criteria – Workplace Assessment [IE153-9WE]

Performance

The individual will be able to:

- Install, document and maintain high voltage circuits to CEC rules and manufacturer specifications
- Install and maintain high voltage distribution centre equipment to CEC rules and manufacturer specifications
- Select, install and maintain protective relays on power distribution equipment, to CEC rules and manufacturer guidelines

Conditions

To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria

Completion of standard IE153-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): N POWER DISTRIBUTION SYSTEMS
Competency: N5 Maintain portable switch houses [IE202-9WE]

Credit 4

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate and apply knowledge of maintenance of portable switch houses and ensure readiness for use.

LEARNING TASKS
1. Describe portable switch house components and construction
   - High voltage systems
   - Main power/load power
   - Transformers
   - OCBs
   - Breakers and cables
   - Bus
   - Pilot circuits
   - Purpose

2. Explain portable switch house operation and applications
   - High voltage safety
   - Danger points in switch houses
   - Load target and incoming supply
   - Protection and control circuits
   - Bus work
   - Integrity of insulation
   - Relay calibration
   - Stand-off insulators tests
   - Ground fault testing
   - Ground monitoring circuit testing
   - PM Routine
   - Making amendments

3. Maintain portable switch house houses in accordance with regulatory codes and industry practice

4. Describe and amend PM routine
**Achievement Criteria – Workplace Assessment [IE202-9WE]**

**Performance**  The individual will be able to:
- Demonstrate knowledge of portable switch houses
- Maintain portable switch houses so that they are ready for use and reliable in the field

**Conditions**  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

**Criteria**  Completion of standard IE202-9WE in the Industrial Electrician logbook:
- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC):  N  POWER DISTRIBUTION SYSTEMS
Competency:  N6  Demonstrate knowledge of line installation, maintenance, and repair procedures [IE203-9WE]

Credit  3

Objectives
To be competent in this area, the individual must be able to:
• Demonstrate knowledge of safe line maintenance repair and installation procedures, including applicable installation codes and safety standards.

LEARNING TASKS
1. Demonstrate knowledge of line installation procedures in accordance with industry practice and regulatory codes

2. Describe line installation equipment and safety requirements

3. Demonstrate knowledge of line maintenance and repair procedures in accordance with industry practice and regulatory codes

4. Demonstrate knowledge of the requirements of line maintenance equipment

CONTENT
• Grounding
• Isolation
• Hoist safety
• Harnessing and restraints
• Lines
• Pole transformers
• Shunts
• Towers and poles

• Line trucks
• Scissor lifts
• Pole climbing equipment
• High voltage safety gear
• Protective clothing

• Grounding
• Isolation
• Hoist safety
• Harnessing and restraints
• Lines
• Pole transformers
• Shunts
• Towers and poles

• Line trucks
• Scissor lifts
• Pole climbing equipment
• High voltage safety gear
• Protective clothing

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Achievement Criteria – Workplace Assessment [IE203-9WE]

Performance
The individual will be able to:

- Demonstrate knowledge of safe line installation procedures including applicable installation codes and safety standards
- Demonstrate knowledge of safe line maintenance and repair procedures including applicable installation codes and safety standards

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE203-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): N  POWER DISTRIBUTION SYSTEMS
Competency: N7  Make-up and repair trailing cable (4160-13.8kV) (2300-600V) [IE205-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate and apply knowledge of how to make up and repair trailing able to withstand field use in accordance with regulations and codes.

LEARNING TASKS
1. Describe trailing power cable in terms of applications and the requirements to meet regulatory standards and the rigours of field use

2. Make-up trailing power cables to CEC rules

3. Repair trailing power cables to CEC rules

CONTENT
- Standards
- Insulation requirements
- Armoured jackets
- Flexibility
- Temperature
- Load requirement
- Bench tools
- Field tools
- Winding and rotation
- Weather seals and waterproofing
- Chafe guards and kink protection
- Bench tools
- Field tools
- Repair techniques
- Winding and rotation
- Weather seals and waterproofing
- Chafe guards and kink protection
Achievement Criteria – Workplace Assessment [IE205-9WE]

Performance  The individual will be able to:

- Demonstrate knowledge of trailing power cables
- Make-up trailing power cable to meet regulatory codes and the rigours of field use in accordance with industry practice
- Repair trailing power cable to meet regulatory codes and the rigours of field use in accordance with industry practice

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE205-9WE in the Industrial Electrician logbook:

- **Apprentice Diary** includes dates and details of work performed covering tasks listed
- **Assessor or certified Industrial Electrician Observation** of completion of relevant tasks
- **Additional Supporting Evidence** is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- **Verification** by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Elective
Competencies

LINE (GAC): O  POWER SUPPLIES
Competency: O2  Install and maintain power supplies [IE182-9WE]

Credit 9

Objectives
To be competent in this area the individual must be able to:
• Select, install and maintain power regulation equipment according to applicable codes and manufacturer guidelines.
• Document the installation and maintenance of power generation equipment to company standards.

LEARNING TASKS

1. Select power regulation equipment in accordance with specification and industry practice
   • Equipment types and uses
   • Load specifications
   • Transfer switch function

2. Install and commission power regulation equipment in accordance with specification and industry practice
   • Interpret drawings and diagram symbols
   • Voltage
   • Frequency
   • Alarms
   • Set transfer switch parameter

3. Document installation
   • Company standards

4. Maintain power regulation equipment in accordance with manufacturer specifications and industry standards
   • Preventative maintenance procedures
   • Test transfer switch
   • Verify component viability
   • Maintenance schedules

5. Document maintenance
   • Company standards

Achievement Criteria – Workplace Assessment [IE182-9WE]

Performance The individual will be able to:
• Select and install power regulation equipment to CEC rules and equipment manufacturer specifications
• Maintain power regulation equipment to CEC rules and equipment manufacturer specifications

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE182-9WE in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): 0  POWER SUPPLIES
Competency: O5  Demonstrate knowledge of electrolytic cell technology and safety considerations [IE210-9WE]

Credit  2

Objectives
To be competent in this area, the individual must be able to:
• Demonstrate knowledge of electrolytic cell technology and safety considerations.

LEARNING TASKS

1. Describe electrolytic cell construction and operation
   - Power unit for lead
   - Silver refinery cell house/pot house production
   - Low voltage
   - High current circuits
   - Large capacity bus connections

2. Describe electrolytic cell installation requirements and considerations
   - Isolation and installation
   - Electronic controllers
   - Cooling water and air ventilation units
   - Rectifier room

3. Describe electrolytic cell control, protection, and safety requirements and regulatory codes
   - Control board environmental considerations
   - Heat sink and bus-bar weld joints
   - Electrolyte

Achievement Criteria – Workplace Assessment [IE210-9WE]

Performance  The individual will be able to describe electrolytic cell construction, operation and installation requirements.

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE210-9WE in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): P

POWER GENERATION EQUIPMENT

Competency: P4 Troubleshoot and maintain power generation prime movers [IE161-9WE]

Credit 5

Objectives

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

- Troubleshoot a prime mover problem and record a preventative maintenance procedure for a common type of prime mover.

LEARNING TASKS

1. Troubleshoot prime movers using logical techniques in accordance with industry practice

   - Gas turbines
   - Reciprocating engines
   - Diesel turbines
   - Hydro turbines
   - Steam turbines
   - Wind turbines
   - Dynamic and static specifications
   - Equipment manufacturer service manuals

2. Maintain prime movers in accordance with industry practice

   - Combustion engine operation and fluid checks
   - Turbine bearings and oil cooling
   - Regulation equipment
   - Generators and alternators
   - Test dynamic and static operation
   - Adjust control parameters
   - Consult and update drawings and schematics
   - Switching operations and plant procedures
   - Record load-up and synchronization time of generators
   - Preventative maintenance schedules
   - Offline and shut down procedures
   - Insulation and resistance checks on rotors, stators and diodes
   - Company standards

3. Document maintenance
Achievement Criteria – Workplace Assessment [IE161-9WE]

Performance
The individual will be able to troubleshoot a prime mover problem, maintain and record a preventative maintenance procedure for a common type of prime mover.

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE161-9WE in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Elective
Competencies

LINE (GAC): P POWER GENERATION EQUIPMENT
Competency: P5 Maintain portable generators [IE166-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
- Maintain portable generators to original equipment manufacturer specifications and to the specific needs of field operations.

LEARNING TASKS
1. Maintain portable generators in a safe and reliable state to meet the specific needs of field operations in accordance with manufacturer specifications and industry practice

   - Service internal combustion engine and repair faults
   - Service generating equipment and repair faults
   - Wiring and relay faults
   - Mechanical connectors
   - Starting mechanisms and batteries
   - Fusing and breakers
   - Company standards

2. Document maintenance carried out on portable generator sets

   - Company standards

Achievement Criteria – Workplace Assessment [IE166-9WE]
Performance The individual will be able to maintain portable generator sets to ensure safe and reliable operation.

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE166-9WE in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): P  POWER GENERATION EQUIPMENT
Competency: P6  Maintain portable electric welding equipment [IE167-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
- Maintain portable welding equipment to manufacturer specifications.

LEARNING TASKS
1. Maintain portable welding equipment to manufacturer specifications in accordance with industry best practice

CONTENT
- Diesel or main supply
- AC/DC power supply
- Transformer
- TIG
- MIG
- Electric arc
- Access manufacturer specifications and maintenance guidelines
- Electronic control board and mounts
- Capacitor connections
- Control rheostat
- Transformer and wiring connections
- Cooling and fusing
- Test welds
- Thick and thin rods
- Variety of alloys
- Rectifier check

2. Document maintenance carried out on portable welding equipment

CONTENT
- Company standards

Achievement Criteria – Workplace Assessment [IE167-9WE]

Performance  The individual will be able to maintain portable electric welders to operate safely and reliably in field conditions and document preventative maintenance carried out.

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE167-9WE in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES

Competency: Q5 Install and maintain servo and proportional valve control loops [IE169-9WE]

Credit 3

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

- Install and maintain servo and proportional valve control loops in accordance with CEC rules and equipment manufacturer specifications.

LEARNING TASKS

1. Prepare for installation of servo and proportional valves control loops

2. Install servo and proportional valve control loops in accordance with industry practice

3. Perform full range verification and set operating parameters

4. Document installation of circuit components

5. Access manufacturer service manuals and preventative maintenance routine for circuit components

6. Maintain proportional valves and control loops in accordance with industry practice

CONTENT

- Safety procedure
- Access manufacturer operating specifications
- CEC rules
- Control circuits
- Verify controls
- Operating parameters
- Wiring
- Shielding and grounding
- Bench set and control valve calibration
- Calibration safe state
- Safety procedures for working with live circuits (fluid or air, and electrical)
- Use of test equipment to calibrate and analyze feedback errors
- Verifications
- Operating parameters
- Meets company standards
- Circuit components
- Preventative maintenance routine
- Control circuits
- Operating parameters
- Bench set and control valve calibration
- Calibration safe state
- Safety procedures for working with live circuits (fluid or air, and electrical)
- Use of test equipment to calibrate and analyze feedback errors
- Wiring, shielding and grounding
- Document maintenance to company standards
Achievement Criteria – Workplace Assessment [IE169-9WE]

Performance  The individual will be able to:
- Install servo and proportional valve control loops to CEC rules and equipment manufacturer specifications (may include hydraulic / pneumatic)
- Maintain servo and proportional valve control loops to CEC rules and equipment manufacturer specifications (may include hydraulic / pneumatic)

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE169-9WE in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Elective
Competencies

LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q6 Install and maintain hydraulic or pneumatic controls [IE174-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
• Install and maintain electrical/electronic control circuits (including electrical and electronic pumps and compressors) that operate hydraulic or pneumatic machines.

LEARNING TASKS
1. Prepare to install hydraulic or pneumatic circuit controls

2. Install control circuits in accordance with industry practice

3. Document installation

4. Maintain control circuits in accordance with industry practice

5. Document maintenance

CONTENT
• Safety procedure
• Access manufacturer operating Specifications
• CEC rules
• Solenoids
• PLC operation
• Alternate controls
• Set and adjust operating voltages
• Set and regulate pressures
• Test with overrides or PLC forces
• Check feedback pulses and inputs
• Meets company standards

Solenoids
PLC operation
Alternate controls
Set and adjust operating voltages
Set and regulate pressures
Test with overrides or PLC forces
Check feedback pulses and inputs
Meets company standards
Achievement Criteria – Workplace Assessment [IE174-9WE]

Performance The individual will be able to:

- Install hydraulic or pneumatic circuit controls on machinery and equipment to CEC rules and manufacturer specifications
- Maintain hydraulic or pneumatic circuit controls on machinery and equipment to CEC rules and manufacturer specifications

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE174-9WE in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q7 Install and maintain analytical measurement equipment [IE217-9WE]

Credit 4

Objectives
To be competent in this area, the individual must be able to:
- Demonstrate and apply knowledge of the installation and maintenance of analytical measurement equipment for industrial process plants.

LEARNING TASKS

1. Explain aspects of analytical measurement standards and equipment including hazards of mediums
   - Hazards of mediums measured (corrosive, poisonous gas, etc.)
   - Analyzers
   - Laboratory standards of precision
   - Conductivity
   - PH
   - H₂S
   - Flue gas
   - Calibration

2. Install analyzers, in compliance with regulatory code requirements and complete documentation requirements to meet industry best practice
   - Record logging
   - Gas measurement tubing and piping practice
   - ‘Zero’, ‘span’, ‘linearity’ adjustments
   - Control loop voltages
   - Alarms
   - Shutdowns and parameter adjustment
   - Safe work permitting
   - Access and interpret process documentation and field manuals

3. Maintain analyzers, in compliance with regulatory code requirements and complete documentation requirements to meet industry best practice
   - Record logging
   - Gas measurement tubing and piping practice
   - ‘Zero’, ‘span’, ‘linearity’ adjustments
   - Control loop voltages
   - Alarms
   - Shutdowns and parameter adjustment
   - Safe work permitting
   - Access and interpret process documentation and field manuals
Achievement Criteria – Workplace Assessment [IE217-9WE]

Performance  The individual will be able to install and maintain analytical measurement equipment to regulatory code requirements and manufacturer specifications.

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE217-9WE in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q8 Install and maintain encoders [IE170-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
• Install and maintain encoders in accordance with CEC rules and manufacturer specifications.

LEARNING TASKS
1. Prepare for installation of encoders
   • Safety procedure
   • Access manufacturer operating specifications
   • CEC rules

2. Properly install encoders in accordance with industry practice
   • Safety procedure
   • Machinery lock out
   • Set up with PLC programming software
   • Set up adjustments
   • Test equipment

3. Document installation
   • Meets company standards

4. Maintain encoders in accordance with industry practice
   • Safety procedure
   • Machinery lock out
   • Diagnosis and set up with PLC programming software
   • Diagnosis and set up with test equipment
   • Access manufacturer service manuals
   • Parts sourcing and orders

5. Document maintenance
   • Meets company standards

Achievement Criteria – Workplace Assessment [IE170-9WE]

Performance The individual will be able to:
• Install an encoder on machinery, set up, and test in accordance with CEC rules and manufacturer specifications
• Maintain encoders on machinery to CEC rules and equipment manufacturer specifications

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE170-9WE in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES

Competency: Q9 Install and maintain numeric controllers [IE171-9WE]

Credit 3

Objectives

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

- Install and maintain numeric controllers including programming controllers for different purposes.

LEARNING TASKS

1. Install and connect numeric controllers

   CONTENT
   - Servo motors
   - Control signal
   - May include
     - Design a simple program to control CNC machinery
     - Install simple programs to manufacturer specifications
     - Test installation and de-bug simple programs

2. Load programs and adjust programming

   CONTENT
   - Load programming
   - Adjust using PC

3. Document installation

   CONTENT
   - Meets company standards

4. Maintain numeric controllers by reading and writing controller software

   CONTENT
   - Troubleshoot programming
   - Read and write programs
   - Access part programs and equipment specifications
   - Adjust programming to repurpose machinery
   - Convert CAD drawings to controller language and install

5. Document maintenance

   CONTENT
   - Meets company standards

Achievement Criteria – Workplace Assessment [IE171-9WE]

Performance

The individual will be able to:

- Install numeric controllers including programming controllers for different purposes
- Maintain numeric controllers including programming controllers for different purposes

Conditions

To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria

Completion of standard IE171-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q10 Maintain crane control systems [IE189-9WE]

Credit 4

Objectives
To be competent in this area, the individual must be able to:
• Maintain control systems on common crane types to all applicable codes and standards and in accordance with manufacturer service recommendations.

LEARNING TASKS
1. Inspect and replace crane control systems to applicable codes and standards

CONTENT
• Manufacturer service recommendations
• Crane control systems
  o Electric cables and pendants
  o VFDs and motors
  o Contactor contacts

2. Carry out procedures to check the operation of crane controls

CONTENT
• Contactors
• Timers
• Limit switches
• Wound rotor motors
• Soft starters
• Brakes

3. Test and if necessary repair limitation devices

CONTENT
• Test limitation devices
• Repair limitation devices

4. Complete log book and record keeping procedures

CONTENT
• Logbook procedures
• Record keeping procedures

Achievement Criteria – Workplace Assessment [IE189-9WE]
Performance The individual will be able to inspect and repair as necessary the different common crane control systems in use, in accordance with regulatory requirements and manufacturer specifications.

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement. Assessment note: if VFDs are replaced, use Competency standard IE179-4WC, Install and maintain variable frequency drive (VFD), to assess competency in installation and maintenance of these drives. This competency standard covers the process as a step in crane maintenance

Criteria Completion of standard IE189-9WE in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): Q  CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q11  Install and maintain boiler furnace system monitors and controls [IE191-9WE]

Credit 6

Objectives
To be competent in this area, the individual must be able to:
- Install and maintain boiler furnace system monitors and controls in accordance with CEC rules and industry practice.

LEARNING TASKS
1. Prepare for installation of boiler and furnace controls
2. Properly install boiler and furnace controls in accordance with manufacturer installation instructions, and test and commissioning schedule
3. Document installation
4. Maintain boiler and furnace controls in accordance with industry requirements
5. Document maintenance

CONTENT
- Installation schedule
- Access and interpret manufacturer specifications and installation schematics
- Safety procedures
- Controller regulation
- Controller logic
- Monitoring
- Safety mechanisms
- Start up and shut down cycles
- Emergency damping controllers and sensors
- Meets company standards
- Controller regulation
- Controller logic
- Access and interpret manufacturer schematics
- Monitoring
- Safety mechanisms
- Start up and shut down cycles
- Emergency damping controllers and sensors
- Meets company standards
Achievement Criteria – Workplace Assessment [IE191-9WE]

**Performance**  
The individual will be able to:
- Install boiler and furnace monitors and controls in accordance with CEC rules and industry practice
- Maintain boiler and furnace controls (Must include: maintenance schedule, manufacturer maintenance instructions, test schedule, test points, safety procedures)

**Conditions**  
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
*Assessment note: re-installing may be used to assess competency on installing as long as all required installation aspects are demonstrated*

**Criteria**  
Completion of standard IE191-9WE in the Industrial Electrician logbook:
- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC):  Q  CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency:  Q12  Install and maintain wireless radio controllers [IE201-9WE]

Credit  4

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

- Install and maintain wireless controllers to applicable standards and manufacturer specifications.

LEARNING TASKS

1. Install wireless controller systems in accordance with manufacturer manuals and spectrum management guidelines

   CONTENT
   - Set-up and reception verification
   - Shielding and interference
   - Wiring and bonding

2. Document installation

   CONTENT
   - Meets company standards

3. Maintain wireless controllers in accordance with manufacturer service specifications and spectrum management guidelines

   CONTENT
   - Reception verification
   - Shielding and interference
   - Wiring and bonding
   - Maintenance schedules

4. Document maintenance

   CONTENT
   - Meets company standards

Achievement Criteria – Workplace Assessment [IE201-9WE]

Performance  The individual will be able to:

- Install wireless controller systems in accordance with regulations and manufacturer specifications
- Maintain wireless controller systems in accordance with regulations and manufacturer specifications

Conditions  To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria  Completion of standard IE201-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): Q  CONTROL AND MONITORING SYSTEMS AND DEVICES

Competency: Q13  Install and maintain Global Positioning System (GPS)  
[IE206-9WE]

Credit 3

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

- Demonstrate and apply knowledge of the installation and maintenance of Global Positioning Receivers and antennae.

LEARNING TASKS
1. Describe GPS networks, components, and operation
   - Antenna
   - Receiver
   - Display
   - Power supply
   - Satellite visibility
   - Limitations
   - Standards of accuracy
   - Data transmission
   - Ground based error correction
   - WAAS and DGPS
   - Shielding and bonding
   - Location and environmental factors

2. Describe industrial GPS applications
   - GPS applications
   - Satellite visibility
   - Standards of accuracy
   - Data transmission
   - Ground based error correction
   - WAAS and DGPS
   - Codes

3. Explain installation considerations, requirements, and procedure for GPS systems
   - Manufacturer specifications
   - Maintenance schedules
   - Power supplies
   - Shielding and bonding
   - Location and environmental factors
   - Test and adjust GPS receivers
     - Manufacturer installation specifications, industry practice and regulatory codes
     - Satellite visibility
     - Standards of accuracy
     - Data transmission

4. Explain maintenance considerations, requirements, and procedure for GPS systems

5. Install GPS receivers, displays, and antennas in accordance with manufacturer installation specifications, industry practice and regulatory codes
LEARNING TASKS

6. Document installation

7. Maintain GPS receivers, displays and antennas in accordance with manufacturer specifications, maintenance schedules industry practice and regulatory codes

8. Document maintenance

CONTENT

- Ground based error correction
- WAAS and DGPS

- Meets company standards
- Satellite visibility
- Standards of accuracy
- Data transmission
- Ground based error correction
- WAAS and DGPS
- Power supplies
- Shielding and bonding
- Location and environmental factor
- Meets company standards

Achievement Criteria – Workplace Assessment [IE206-9WE]

Performance
The individual will be able to:
- Demonstrate knowledge of GPS operation, applications, installation, and maintenance
- Install and commission GPS receivers, displays, and antennas
- Maintain GPS receivers, displays, and antennas

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE206-9WE in the Industrial Electrician logbook:
- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q14 Install and maintain gas detection equipment [IE212-9WE]

Credit 4

Objectives
To be competent in this area, the individual must be able to:
• Install and maintain detection systems to warn of the presence of these H₂S, methane LEL, O₂ deficiency, SO₂, CO₂.

LEARNING TASKS

1. Identify potential gas hazards and identify legislative requirements that govern installation and maintenance

2. Install gas sensors and detection equipment to manufacturer specifications and regulatory code requirements

3. Complete log book and documentation of installation

4. Maintain gas sensors and detection equipment to manufacturer specifications and regulatory code requirements

5. Complete log book and documentation of maintenance

CONTENT
• Explosive limits
• Poisoning
• Asphyxiation
• Deficient atmospheres
• Regulatory codes
• O₂ deficiency
• %LEL and H₂S detection
• Alarm circuits
• Failsafe power supplies
• Control bus
• Shutdown circuits
• Detection and alarm parameters
• May include: SO₂ and CO
• Legal requirements
• Company standards
• %LEL and H₂S detection
• Control bus
• Alarm circuits
• Failsafe power supplies
• Detection and alarm parameters
• May include: SO₂ and CO
• Legal requirements
• Company standards
Achievement Criteria – Workplace Assessment [IE212-9WE]

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<thead>
<tr>
<th>Performance</th>
<th>The individual will be able to:</th>
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<tbody>
<tr>
<td></td>
<td>• Install gas detection systems</td>
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<tr>
<td></td>
<td>• Maintain gas detection systems</td>
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<table>
<thead>
<tr>
<th>Conditions</th>
<th>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</th>
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<th>Criteria</th>
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<tbody>
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</tbody>
</table>
LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES

Competency: Q15 Install and maintain controls for liquid separation and refractionation [IE213-9WE]

Credit 4

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

- Demonstrate and apply knowledge of the installation and maintenance of liquid separation and refractionation controls to equipment manufacturer standard, process design parameters, and regulatory codes.

LEARNING TASKS

1. Describe liquid separation and refractionation, and regulatory code requirements

2. Identify processes, and controls for installation

3. Identify the requirements that govern the installation of liquid separation and refractionation controls

4. Install controllers for liquid separation control, liquid level control and refractionation control, in accordance with regulatory code requirements for electrical applications in explosive environments

5. Document installation

CONTENT

- Integration into plant processes
- Techniques and related process controls
- Pneumatic controls
- Electronic controls
- Radioactive and float controls
- Refining processes
- Regulatory codes
- Liquid separation controls
- Liquid level controls
- Refractionation controls
- Engineering standards
- Manufacturer specifications
- Legal requirements
- Regulatory codes
- May include
  - Integration into plant processes
  - Techniques and related process controls
  - Liquid separation
  - Level controls
  - Refining processes
- Engineering standards
- Manufacturer specifications
- Regulatory codes
- Integration into plant processes
- Techniques and related process controls
- Meets company standards
LEARNING TASKS

6. Maintain controllers for liquid separation control, liquid level control and refractionation control, in accordance with regulatory code requirements for electrical applications in explosive environments

7. Document maintenance

CONTENT

- Engineering standards
- Manufacturer specifications
- Regulatory codes
- Integration into plant processes
- Techniques and related process controls
- Meets company standards

Achievement Criteria – Workplace Assessment [IE213-9WE]

Performance
The individual will be able to:

- Demonstrate knowledge of liquid separation and refractionation
- Install controllers for process plant control
- Maintain controllers for process plant control

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE213-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): Q  CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q16  Install and maintain gas metering equipment [IE215-9WE]

Credit 4

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

• Install and maintain gas metering equipment and controls in stations and remote metering sites.

LEARNING TASKS

1. Identify and comply with regulatory code requirements that govern installation and maintenance of gas metering and control equipment

2. Install metering and control equipment and complete the appropriate documentation to meet legal requirements in accordance with regulatory code requirements and manufacturer specifications

3. Maintain metering and control equipment and complete the appropriate documentation to meet legal requirements in accordance with regulatory code requirements manufacturer specifications

CONTENT

- Regulatory code requirements
- May include
  - Gas measurement tubing and piping practice
- Remote metering stations – safety hazards, emergency respiration equipment (Scott air packs)
- Read and interpret piping and valving diagrams
- Gas quality analyzers
- Specific gravity, chemical makeup and heating value
- Personal LEL detection
- Transmitters
- Turbines
- PDI meters
- Records and maintenance
- Legal record keeping standards
- May include
  - Remote metering and pumping stations – safety hazards, emergency respiration equipment (Scott air packs)
  - Read and interpret piping and valving diagrams
  - Gas quality analyzers
  - Test instruments
  - Specific gravity, chemical makeup and heating value
  - Personal LEL detection
  - Transmitters
  - Turbines
  - PDI meters
  - Records and maintenance
  - Legal record keeping standards
Achievement Criteria – Workplace Assessment [IE215-9WE]

Performance  The individual will be able to Install and maintain gas metering and control equipment in remote metering stations.

Conditions    To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria     Completion of standard IE215-9WE in the Industrial Electrician logbook:

- Apprentice Diary includes dates and details of work performed covering tasks listed
- Assessor or certified Industrial Electrician Observation of completion of relevant tasks
- Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- Verification by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Elective
Competencies

LINE (GAC): Q

CONTROL AND MONITORING SYSTEMS AND DEVICES
Competency: Q17 Install and maintain data and process monitoring systems [IE173-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
• Install and maintain data and process monitoring systems in accordance with industry practice.

LEARNING TASKS
1. Program SCADA and DDC systems

CONTENTS
• C++
• Visual Basic
• Block diagrams
• Ladder logic
• May include system integration in plant wide operations

2. Build and program GUI on HMI

3. Test and adjust GUI on HMI and feedback loops

4. Apply signal conditioning and scaling to blocks

5. Document installation

6. Test and adjust programming for optimal process control

7. Verify operation

8. Document maintenance

Achievement Criteria – Workplace Assessment [IE173-9WE]
Performance
The individual will be able to:
• Program SCADA systems, DDC and monitoring systems
• Install SCADA systems, DDC and monitoring systems in accordance with industry practice (must include adjusting logic programming and wire, shield and bond equipment)

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE173-9WE in the Industrial Electrician logbook:
• Apprentice Diary includes dates and details of work performed covering tasks listed
• Assessor or certified Industrial Electrician Observation of completion of relevant tasks
• Additional Supporting Evidence is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
• Verification by a 3rd party confirming tasks were completed to appropriate standard

Industrial Electrician
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LINE (GAC): Q CONTROL AND MONITORING SYSTEMS AND DEVICES

Competency: Q18 Install and maintain video monitoring systems [IE187-9WE]

Credit 4

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

- Install and maintain audio and video monitoring systems to monitor processes and security.

LEARNING TASKS

1. Select and prepare to install audio and video monitoring systems

   - Access manufacturer installation specifications
   - Test manuals

2. Properly install audio and video monitoring systems

   - Wiring
   - Shielding and grounding
   - Cable terminations and standardized connections
   - Test display
   - Sound and recording media
   - Determine ambient light match with camera
   - Installation specification
   - Test and calibrate systems in accordance with industry practice

3. Document installation

   - Meets company standards

4. Maintain audio and video monitoring systems

   - Troubleshooting techniques
   - Common faults
   - Test equipment
   - Effects of corrosion on signal strength
   - Calibration procedures
   - Analyze noise
   - Ripple
   - Harmonics and inductance
   - Verify shielding integrity
   - Access manufacturer equipment specifications and test manuals
   - Maintenance schedule
   - Meets company standards

5. Document maintenance
Achievement Criteria – Workplace Assessment [IE187-9WE]

Performance
The individual will be able to:
- Install audio and video monitoring systems to display the important functions of machinery to an operator in a control booth
- Maintain audio and video monitoring systems

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE187-9WE in the Industrial Electrician logbook:
- **Apprentice Diary** includes dates and details of work performed covering tasks listed
- **Assessor or certified Industrial Electrician Observation** of completion of relevant tasks
- **Additional Supporting Evidence** is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- **Verification** by a 3rd party confirming tasks were completed to appropriate standard
Program Content
Workplace Elective
Competencies

LINE (GAC): R INDUSTRY SECTOR SPECIFIC
Competency: R1 Maintain electric arc furnace [IE208-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
• Maintain electric arc furnace in accordance with regulatory standards, manufacturer specifications and company maintenance standards.

LEARNING TASKS
1. Identify key components of electric arc furnaces that require maintenance
   • Arc-furnace transformers and tap changers
   • Capacitor banks
   • Bus systems and live bus water cooled systems
   • Flow
   • Pressure
   • Temperature indicators and moisture detectors
   • Basic control circuits
   • Arc furnace in relationship to plant processes

2. Maintain electric arc furnaces in accordance with industry practice and regulatory codes
   • Transformer oil testing
   • Hydraulic control adjustments
   • PLC and stand alone computer operation
   • Oil pump alarm verifications
   • Test tap-changer
   • Phase imbalances or errors on feeder management and incoming switchgear
   • Cooling water temperature adjustment
   • Pumps and alarms
   • Outgoing bus connections
   • Routing and slipping equipment
   • Infrared scanning of bus work
   • Access manufacturer wear recommendations
   • Monitor signs of arching on frameworks
   • Arc furnace PLC mainframe and remote I/O
   • Battery integrity
   • Alarm panel parameters
   • Meets company standards

3. Complete maintenance documentation
Achievement Criteria – Workplace Assessment [IE208-9WE]

Performance The individual will be able to maintain electric arc furnaces in accordance with manufacturer specifications and company maintenance standards.

Conditions To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria Completion of standard IE208-9WE in the Industrial Electrician logbook:

- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): R INDUSTRY SECTOR SPECIFIC
Competency: R2 Maintain induction furnace [IE209-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
- Maintain induction furnaces in accordance with regulatory standards, manufacturer specifications and company maintenance standards.

LEARNING TASKS
1. Identify key components of induction furnaces that require maintenance
   - Inductors
   - SCRs
   - Capacitors
   - Auto transformers
   - Live bus water cooling
   - Breaker control circuits and settings
   - Integration into plant processes
   - Basic control circuits and metering

2. Maintain induction arc furnaces in accordance with industry practice and regulatory codes
   - High voltage
   - High current safety
   - Thermocouple control and alarm units
   - Safety interlocking and breaker circuits
   - Induction pot shell thermocouple operation
   - Trip and light settings on alarm and control circuits
   - Auto transformer grounds and specified resistance standards
   - Test capacitor value range against name tag data
   - Maintenance schedules
   - Meets company standards

3. Complete maintenance documentation
Achievement Criteria – Workplace Assessment [IE209-9WE]

Performance
The individual will be able to maintain induction furnaces in accordance with manufacturer specifications and company maintenance standards.

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE209-9WE in the Industrial Electrician logbook:
- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
LINE (GAC): R INDUSTRY SECTOR SPECIFIC
Competency: R3 Maintain recovery boiler control systems [IE220-9WE]

Credit 3

Objectives
To be competent in this area, the individual must be able to:
- Describe basic recovery boiler control system operation.
- Maintain recovery boiler control systems in accordance with safety regulations and plant operational requirements.

LEARNING TASKS

1. Describe boiler operation and principles of control

2. Access and correctly interpret process diagrams and manufacturer specifications and manuals

3. Maintain boiler control systems in accordance with safety regulations and plant operational requirements

4. Shutdown boiler control systems

CONTENT
- Pressure vessel types
- Fuel and burners
- Flame safety systems and associated peripheral drives and sensors
- Emergency shutdown procedures
- Regulatory and safety codes
- Process diagrams
- Manufacturer specifications
- Manuals
- Operations interface
- Logic systems
- Gas controls
- Flame sensors
- Cameras and fuel systems
- Motor operated valves
- Gas valves
- Fuel shut offs
- Fuel safeties and input/expulsions of fuels and gases, precipitators and scrubbers
Achievement Criteria – Workplace Assessment [IE220-9WE]

<table>
<thead>
<tr>
<th>Performance</th>
<th>The individual will be able to:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Describe recovery boiler operation and principles of control</td>
</tr>
<tr>
<td></td>
<td>• Maintain recovery boiler control systems in accordance with safety regulations and plant operational requirements</td>
</tr>
</tbody>
</table>

| Conditions | To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement. |

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Completion of standard IE220-9WE in the Industrial Electrician logbook:</th>
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<tbody>
<tr>
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<td>• <strong>Verification</strong> by a 3rd party confirming tasks were completed to appropriate standard</td>
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</tbody>
</table>
LINE (GAC):  R  INDUSTRY SECTOR SPECIFIC
Competency:  R4  Install and maintain scanning and optimization equipment [IE223-9WE]

Credit 4

Objectives
To be competent in this area, the individual must be able to:
- Install and maintain scanning and optimization equipment to manufacturer specifications.

LEARNING TASKS

1. Install and calibrate scanning and optimization equipment
   - Environmental considerations
   - Calibration and process integration
   - Access and interpret manufacturer manuals and specifications
   - Wire, bond and shield components
   - Process correction and feedback loops
   - Optimizer computer and machinery
   - PLC interfaces and communication

2. Maintain and calibrate scanning and optimization equipment
   - Maintenance procedures
   - Maintenance schedules
   - Calibration
   - Meets company standards

3. Document maintenance

Achievement Criteria – Workplace Assessment [IE223-9WE]

Performance
The individual will be able to install, calibrate and maintain scanning and optimization equipment to manufacturer specifications.

Conditions
To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.

Criteria
Completion of standard IE223-9WE in the Industrial Electrician logbook:
- *Apprentice Diary* includes dates and details of work performed covering tasks listed
- *Assessor or certified Industrial Electrician Observation* of completion of relevant tasks
- *Additional Supporting Evidence* is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement
- *Verification* by a 3rd party confirming tasks were completed to appropriate standard
Section 4

TRAINING PROVIDER STANDARDS
Facility Requirements

Classroom Area
- 1,000 sq. ft. for a class size of 16 students
- Comfortable seating (moveable tables and chairs) suitable for training, teaching, lecturing and drafting
- Instructional media to include multimedia projector, projection screen, DVD player, and whiteboard (optional: flip chart)
- In-room temperature regulation and ventilation
- Lighting controls (for lights and shades or blinds)
- Compliance with all local and national fire code and occupational safety requirements

Shop Area
- 200 sq. ft. per student
- Well heated and ventilated
- 20 ft. high ceilings
- Lighting appropriate to detailed work

Lab Requirements
- Fully operational, representative equipment
  (refer to Shop and Laboratory Equipment for requirements by level – next page)

Student Facilities
- Adequate lunch room as per WorkSafeBC requirements
- Adequate washroom facilities as per WorkSafeBC requirements
- Personal storage lockers

Instructor’s Office Space
- 150 sq. ft. per instructor, with a desk, chairs and materials storage / filing system

Storage
- 100 sq. ft. per student for storage of materials (may be outdoors)
- 25 sq. ft. per student for tools storage
- 15 sq. ft. per student for individual project and materials storage
Tools and Equipment

The equipment list below is based on the standard class size of 16 apprentices. The facilities must be in compliance with the appropriate zone bylaw for instructional use.

Shop and Laboratory Equipment

Level 1 and Level 2

Refer to Construction Electrician Program Outline Level 1 and Level 2 for equipment requirements

Level 3 and Level 4

The equipment listed below is required for both Level 3 and Level 4. Additional equipment required for level 4 only is listed on the next page.

- Power supply stations (with fixed and variable AC and DC outputs and metering)
- Sets of resistors, capacitor and inductors for circuit analysis labs
- 3-phase transformer stations
- 3-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)
- 3-phase Squirrel-cage motors (assorted 6-lead, 9-lead and 12-lead)
- 3-phase wound-rotor motors and controllers
- Multi-speed motors and controllers
- 3-phase synchronous motor and controller
- Power factor correction capacitors, 3-phase
- Single-phase, capacitor-start, dual-voltage motors
- Single-phase, shaded-pole motor
- Single-phase, universal motor
- Single-phase magnetic starters
- Reversing drum switches
- 3-phase alternator Synchronizing panel with metering and controls
- 3-phase alternators with prime movers
- DC motor control stations (with assorted magnetic and/or electronic starters)
- DC motors, compound type
- Oscilloscopes, dual-trace
- Analogue multimeters
- Digital multimeters
- Wattmeters
- Clamp-on ammeters
- Phase-sequence indicators
- Meggers
- Hand-held tachometers
- Motor rotation indicators
- Watt-hour meters
- Misc. conductors and raceways for demo purposes
- Electronic trainers for discrete components
- Function (signal) generators
Level 4 – additional equipment

17  Computer workstations with associated software programs and 1 laser printer
1  Multi (computer) projector
8  PLC workstation, with associated software
8  PLC simulator display board
8  Digital Logic and OpAmp trainer
8  Transducer Fundamentals Trainer for automated controls
4  Adjustable Speed DC Drive c/w motor
4  Variable Frequency AC Drive c/w motor
2  Electronic Soft Start Controller
2  Conventional Zoned Fire Alarm System c/w initiating, signal and alarm devices
2  Addressable Fire Alarm system c/w initiating, signal and alarm devices
2  Intrusion Alarm System
2  Intercom System
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  8 data cabling installation and test equipment
1  Fibre optic tool kit
1  Photovoltaic Trainer
Reference Materials

**Required Textbooks: ALL LEVELS**

CANADIAN ELECTRICAL CODE HANDBOOK PART 1: AN EXPLANATION OF THE RULES OF THE CE CODE  
by the Canadian Standards Association

TECHNICIAN'S GUIDE TO PROGRAMMABLE CONTROLLERS  

**Recommended Textbooks: ALL LEVELS**

AC FUNDAMENTALS  
by Duff and Herman, Delmar Publishers .......................................................... ISBN 0-8273-6527-6

DC FUNDAMENTALS  
by Loper and Tedson, Delmar Publishers .......................................................... ISBN 0-8273-6572-1

ELECTRIC MOTOR REPAIR, 3rd EDITION  

UGLY'S ELECTRICAL REFERENCES 2005  
by George Hart, Burleson Distributing Corp .......................................................... ISBN13: 9780962322976  
ISBN10: 0962322970
Print and On-Line Reference Materials

Following is a list of useful print and online reference resources. Some are available as free downloads, others have a cost attached.

**Free Electrical Training Publications**

<table>
<thead>
<tr>
<th>Publication</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Be A Survivor</td>
<td><a href="http://www.worksafebc.com/publications/health_and_safety/by_topic/electrical/default.asp">http://www.worksafebc.com/publications/health_and_safety/by_topic/electrical/default.asp</a></td>
</tr>
<tr>
<td>Electrical Hazards Analysis</td>
<td>Free publication online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a></td>
</tr>
<tr>
<td>Electricity and Magnetism</td>
<td>Electricity and Magnetism University of Winnipeg: online book <a href="http://theory.uwinnipeg.ca/mod_tech/node83.html">http://theory.uwinnipeg.ca/mod_tech/node83.html</a></td>
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<tr>
<td>Electrical Safety and Maintenance Training</td>
<td>Free publication online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a></td>
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<tr>
<td>Electrical Safety in Battery Maintenance and Testing</td>
<td>Free publication online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a></td>
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<tr>
<td>Electrical Safety in Motor Maintenance and Testing</td>
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<tr>
<td>Electrical Safety in the Mining Industry</td>
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</tr>
<tr>
<td>Electricity - The Silent Killer</td>
<td>Free publication online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a></td>
</tr>
<tr>
<td>Title</td>
<td>Publication Details</td>
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<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
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<tr>
<td><strong>Establishing an Electrical Safety Program</strong></td>
<td>Free publication online or download in PDF format.</td>
</tr>
<tr>
<td>3/2/2006</td>
<td>Establishing an effective electrical safety program is vital to the safety of employees. The employer is required to develop and implement an electrical safety program that addresses employee exposure to each specific hazard that exists. This program and the related training must be appropriate for all existing conditions and is required to be written, published and available to all employees who might be exposed to the hazards.</td>
</tr>
<tr>
<td><strong>How to Develop an Effective Training Program</strong></td>
<td>Free publication online or download in PDF format.</td>
</tr>
<tr>
<td>6/1/2006</td>
<td>The typical method utilized for developing an effective training program is the &quot;Systematic Approach to Training&quot; or SAT, which utilizes the &quot;Instructional Design System&quot; or ISD methodology for performing the analysis, design development, implementation and evaluation for a training program in order to meet the specific needs of a company. The ISD provides a systematic procedure for identifying the job-related skills and knowledge necessary for performance-based training.</td>
</tr>
<tr>
<td><strong>The Hazards of Electricity - Do You Know What They Are?</strong></td>
<td>Free publication online or download in PDF format.</td>
</tr>
<tr>
<td>2/15/2006</td>
<td>Electrical accidents are largely preventable through safe work practices. But, you must know the three hazards of electricity hazards and their characteristics. If you can't STAY OUT OF THE CIRCUIT, know how to properly protect yourself!</td>
</tr>
<tr>
<td><strong>Lockout</strong></td>
<td>PDF 2.4mb, WorkSafeBC, Order #: BK21</td>
</tr>
<tr>
<td></td>
<td>This booklet defines lockout, explains lockout policy and procedures, and provides guidance on compliance with Regulation requirements.</td>
</tr>
<tr>
<td></td>
<td>Increasingly, the responsibilities of a power supply designer extend beyond merely meeting a functional specification, with designing to meet safety standards an important collateral task. Since all commercial and home-use supplies must eventually be certified as to safety, knowledge of the requirements should be a part of every designer’s repertoire. This simplified overview has been prepared with the collaboration of Underwriters Laboratories, Inc. to provide a basic introduction to the issues and design solutions implicit in assuring the safety for both the user and service personnel of your power supply products, as well as easing the certification process.</td>
</tr>
<tr>
<td><strong>Working Safely Around Electricity</strong></td>
<td>(PDF 1.8mb) WorkSafeBC Order #: BK19</td>
</tr>
<tr>
<td></td>
<td>This booklet explains the dangers of working on and around energized low and high-voltage equipment and conductors. It is written for supervisors and workers who work around and with electrical circuits and power lines as part of their job and who are familiar with the basic hazards of electrical contact. The three sections include the dangers of low-voltage contact, the dangers of high-voltage contact, and how to deal with electrical shock injuries. Workers who work around electrical conductors, such as painters and equipment operators, and who are unfamiliar with all the hazards of electrical contact, will also find this booklet useful.</td>
</tr>
</tbody>
</table>
## Other Reference Material

<table>
<thead>
<tr>
<th>Reference Material</th>
<th>Details</th>
<th>Publisher</th>
<th>Link</th>
<th>Additional Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blueprint Interpretation Manual</td>
<td>594-000 <strong>Blueprint Interpretation Manual</strong> US$34.00</td>
<td>DAC Industrial Training Products</td>
<td><a href="http://www.dac-3d.com">www.dac-3d.com</a></td>
<td>This recently published 380 page manual, written by Grant E. Jacobs, is a complete introduction to trades-related blueprint reading. Useful in the field or as a textbook for vocational or technical college courses in basic blueprint reading, it includes a wealth of information on drawing types, conventions, and interpretation. The book's format, larger than other IPT manuals, allows for inclusion of complete industrial drawings. Each section includes review questions. Based on its focus on industrial skills, it is a perfect complement to the IPT Pipe Trades and IPT Metal Trades manuals. If you layout, weld, fabricate, or hoist steel pipe, plate or structural shapes this is will be an indispensable resource.</td>
</tr>
<tr>
<td>Canadian Electrical Code and Standards</td>
<td>Available from the CSA Online Store - prices range from $50 per unit to over $500.</td>
<td></td>
<td><a href="http://www.csa-intl.org/onlinestore/GetCatalogDrillDown.asp?Parent=428">http://www.csa-intl.org/onlinestore/GetCatalogDrillDown.asp?Parent=428</a></td>
<td>Here you will find the Canadian Electrical Code and a section dedicated to harmonized electrical standards. Many “Smart” Products, handbooks and CD-ROMs are also included. Member and multi-volume discounts are available.</td>
</tr>
<tr>
<td>Electrical Trades Training Manual</td>
<td>560-000 <strong>Electrical Trades Training Manual (Electrical)</strong> US$34.00</td>
<td>DAC Industrial Training Products</td>
<td><a href="http://www.dac-3d.com">www.dac-3d.com</a></td>
<td>This conveniently organized and recently written book can be used as self-directed course, classroom text or toolbox troubleshooting resource related to a broad range of fundamental electrical installation and maintenance topics. Written by Herb Putz, it includes 12 major subject matter areas. The book consists of 508 pages and includes 115 useful tables and 264 illustrations. The book is based on and refers to both the US and Canadian electrical codes (the US code is primary). The book has been adopted for use by a broad range of maintenance training programs, technical college courses and as a toolbox resource by tradesmen, apprentices, instructors, designers and engineers.</td>
</tr>
<tr>
<td>Electrical Trades Handbook</td>
<td>560-001 <strong>Electrical Trades Handbook</strong> US$20.00</td>
<td>DAC Industrial Training Products</td>
<td><a href="http://www.dac-3d.com">www.dac-3d.com</a></td>
<td>This conveniently organized and recently written book can be used as self-directed course, classroom text or toolbox troubleshooting resource related to a broad range of fundamental electrical installation and maintenance topics. Written by Herb Putz, it includes 12 major subject matter areas. The book consists of 508 pages and includes 115 useful tables and 264 illustrations. The book is based on and refers to both the US and Canadian electrical codes (the US code is primary). The book has been adopted for use by a broad range of maintenance training programs, technical college courses and as a toolbox resource by tradesmen, apprentices, instructors, designers and engineers.</td>
</tr>
<tr>
<td>Electrical Generation Fundamentals</td>
<td></td>
<td>DAC Industrial Training Products</td>
<td><a href="http://www.dac-3d.com">www.dac-3d.com</a></td>
<td>Training rig with supporting course.</td>
</tr>
</tbody>
</table>
Instructor Requirements

Occupation Qualification
The instructor must possess:
- Industrial Electrician Certificate of Qualification with Interprovincial Red Seal endorsement

Work Experience
- A minimum of 5 years’ experience working in the industry as a journeyperson
- Must have diverse work experience

Instructional Experience and Education
It is preferred that the instructor also possesses one of the following:
- Instructors Certificate (minimum 30 hr course)
- Instructors must have or be registered in an Instructor’s Diploma Program, to be completed within a five year period
- Or, hold a Bachelors or Masters degree in Education
Section 5

ASSESSOR REQUIREMENTS
Workplace Assessors

Employers are no longer required to designate assessors that have successfully completed an assessor training program but may continue to use a workplace assessor if they have one on staff. The assessors or certified Industrial Electricians with Red Seal endorsement are responsible to ensure the apprentice has the practical skills and is proficient in all of the on-the-job competencies.

Assessors and certified Industrial Electricians with Red Seal endorsement are expected to:

- Understand and explain the concepts of competency-based assessment
- Prepare apprentices for their assessments
- Plan the assessment with apprentice
- Conduct the assessment
- Make the assessment decision
- Give feedback
- Complete the necessary paperwork in the apprentice logbook

Non-Electrical Workplace Competency Standards

To assess against the following competency standards, assessors and certified Industrial Electricians with Red Seal endorsement must meet the criteria listed at each competency standard or group of standards.

<table>
<thead>
<tr>
<th>Competency Standard</th>
<th>Assessor Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE102-1WC</td>
<td>Care safe and proper use of pneumatic and hydraulic tools</td>
</tr>
<tr>
<td>IE116-1WC</td>
<td>Demonstrate and apply knowledge of PC hardware and software</td>
</tr>
<tr>
<td>IE122-2WC</td>
<td>Communicate technical information clearly and check for understanding</td>
</tr>
<tr>
<td>IE104-3WC</td>
<td>Use safe lifting and rigging techniques</td>
</tr>
<tr>
<td>IE105-3WC</td>
<td>Follow safe procedures for working in confined spaces</td>
</tr>
<tr>
<td>IE197-9WE</td>
<td>Use powder actuated tools</td>
</tr>
<tr>
<td>IE198-9WE</td>
<td>Operate personnel lifting devices</td>
</tr>
<tr>
<td>IE199-9WE</td>
<td>Use liquid-fuel powered tools</td>
</tr>
</tbody>
</table>