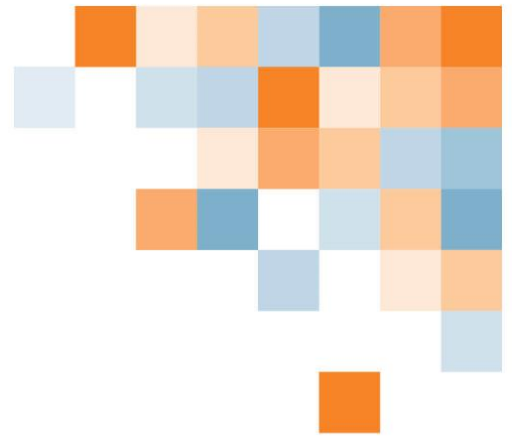


**ita**  
**YOUR TICKET.**



## PROGRAM OUTLINE

### Industrial Electrician





The latest version of this document is available in PDF format on the ITA website  
[www.itabc.ca](http://www.itabc.ca)

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# **INDUSTRIAL ELECTRICIAN PROGRAM OUTLINE**

**APPROVED  
FEBRUARY 2012**

**BASED ON  
NOA 2008**

**Developed by  
Industry Training Authority  
Province of British Columbia**



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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.



## 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 Thesen, Tolko
- Kevin Zornes, Weyerhaeuser
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- Richard Wittman, Eurocan Pulp and Paper
- Karl Luszcak, Pope & Talbot
- Buff Wilkinson, Elk Valley Coal
- Ross Turvey, Domtar
- Frank Gervais, Terasen Gas
- Duncan Gable, Catalyst Paper

### PHASE 2 – 2006 – 2007

- Ainsley Encinas, Alcan Inc.
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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.

Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
<b>Program Credentialing Model</b>	Communicate program length and structure, and all pathways to completion	Understand the length and structure of the program	Understand the length and structure of the program, and pathway to completion	Understand challenger pathway to Certificate of Qualification
<b>Program Assessment</b>	Communicate program completion requirements and assessment methods	Understand the various assessment requirements for the program	Understand the various assessment requirements for the program	Understand the assessment requirements they would have to fulfill in order to challenge the program
<b>OAC</b>	Communicate the competencies that industry has defined as representing the scope of the occupation	Understand the competencies that an apprentice is expected to demonstrate in order to achieve certification	View the competencies they will achieve as a result of program completion	Understand the competencies they must demonstrate in order to challenge the program
<b>Training Topics and Suggested Time Allocation</b>	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	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	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	Understand the relative weightings of various competencies of the occupation on which assessment is based
<b>Program Content</b>	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	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	Provides detailed information on program content and performance expectations for demonstrating competency	Allows individual to check program content areas against their own knowledge and performance expectations against their own skill levels





Section	Training Providers	Employers/ Sponsors	Apprentices	Challengers
<b>Training Provider Standards</b>	Defines the facility requirements, tools and equipment, reference materials (if any) and instructor requirements for the program	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	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	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



## 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



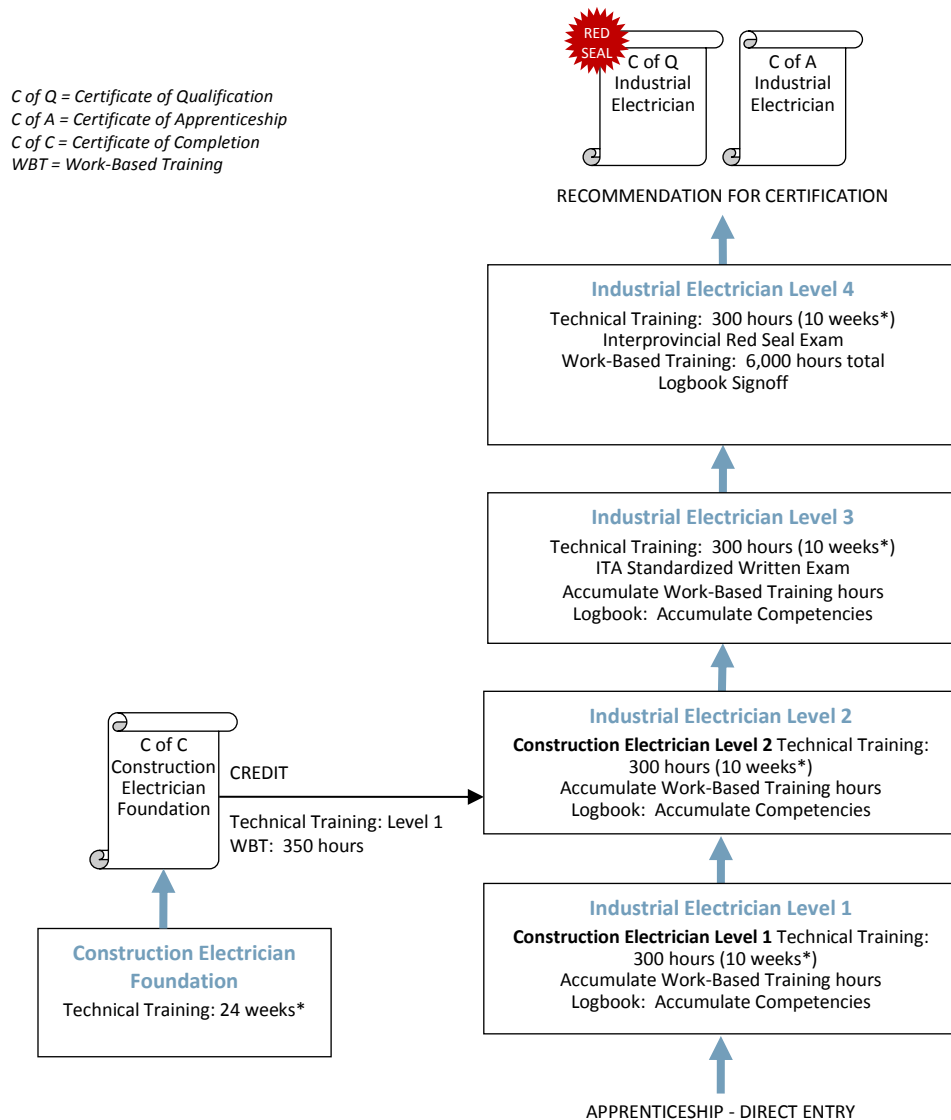
# **Section 2**

## **PROGRAM OVERVIEW**

### **Industrial Electrician**



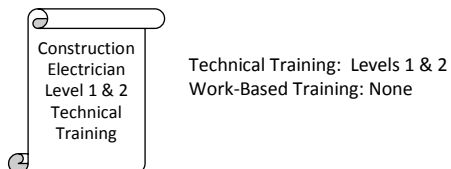
## Program Credentialing Model



\*Suggested duration based on 30-hour week

### CROSS-PROGRAM CREDITS

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





## 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.

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



### 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%.



## 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

<b>ESSENTIAL SKILLS</b>  <b>A</b>	Use effective communication skills  <div>A2</div> <div>1</div>	Solve problems using applied mathematics  <div>A4</div> <div>2</div>	Use analytical troubleshooting techniques  IE127-3WC <div>A6</div> <div>1</div> <div>3</div>	Use computers  <div>A7</div> <div>1</div>	Lead teams and manage electrical installation and maintenance projects  IE125-3WC <div>A8</div> <div>3</div>	
<b>SAFE WORK PRACTICES</b>  <b>B</b>	Perform lockout procedures  <div>B1</div> <div>1</div>	Apply WCB standards and regulations  IE102-1WC <div>B2</div> <div>1</div>	Apply safe work practices  IE103-1WC IE106-1WC <div>B3</div> <div>1</div>	Apply WHMIS  <div>B4</div> <div>1</div>	Use a daily safety plan  <div>B5</div> <div>1</div>	Use jumpers and forces safely  IE109-9WE <div>B6</div> <div>EL</div>
	Follow safe procedures for working in confined spaces  IE105-3WC <div>B7</div> <div>3</div>					
<b>TOOLS AND EQUIPMENT</b>  <b>C</b>	Use hand tools  IE114-1WC <div>C1</div> <div>1</div>	Use powder actuated tools  IE197-9WE <div>C4</div> <div>EL</div>	Use safe rigging techniques  IE104-3WC <div>C6</div> <div>3</div>	Use liquid-fuel powered tools  IE199-9WE <div>C7</div> <div>EL</div>	Use pneumatic and hydraulic tools  IE115-1WC <div>C8</div> <div>1</div>	Operate personnel lifting devices  IE198-9WE <div>C9</div> <div>EL</div>



<b>CIRCUIT CONCEPTS</b>  D	Use electrical circuit concepts  D1 1 2	Analyze DC Circuits  D2 1	Solve problems using the principles of electromagnetism  D3 1	Analyze single-phase AC circuits  D4 2	Analyze electronic circuits  D5 1 2	Demonstrate knowledge of three-phase theory  IE129-3TC D6 3
<b>TEST EQUIPMENT</b>  E	Use analog meters  E1 1	Use digital meters  E2 1	Use scopes  E3 2	Use phase rotation meter  IE130-3WC E4 3	Demonstrate knowledge of measurement and calibration test equipment  IE225-4TC E5 4	
<b>DRAWINGS AND MANUALS</b>  F	Use circuit drawings  F1 1	Use construction drawings and specifications  F2 1	Use manuals and manufacturer's instructions  F3 1	Plan time and materials  F4 1	Design and draw electrical and electronic drawings  IE119-4WC F5 4	
<b>CEC, REGULATIONS AND STANDARDS</b>  G	Describe the application of the Canadian Electrical Code (CEC)  G1 1	Apply the CEC to installations  IE108-1WC G2 1 2	Apply other regulations and codes  G3 1	Access and comply with mining electrical regulations  IE211-9WE G4 EL	Demonstrate and apply knowledge of onshore pipeline regulations  IE218-9WE G5 EL	
<b>LOW VOLTAGE DISTRIBUTION SYSTEMS</b>  H	Install service equipment  H1 1 2	Install grounding and bonding  H2 1	Install distribution centers  H3 2	Install raceways, boxes and fittings  H4 1 2	Install conductors and cables  H5 1 2	Install protective devices  H6 2
	Install devices  H7 1 2	Install and maintain low voltage circuits  IE142-3WC H8 3	Demonstrate knowledge of installing and terminating fibre optic cables IE194-4TC H9 4			





<div>ELECTRICAL EQUIPMENT</div> <div>I</div>	<div>Install lighting and electrical equipment</div> <div>IE132-2WC IE146-2WC</div> <div>I1</div> <div><div></div><div>2</div><div></div><div></div><div></div></div>	<div>Install transformers</div> <div></div> <div>I2</div> <div><div></div><div>2</div><div></div><div></div><div></div></div>	<div>Demonstrate knowledge of installing and maintaining HVAC equipment</div> <div>IE156-4TC</div> <div>I3</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>	<div>Demonstrate knowledge of pumps</div> <div>IE158-4TC</div> <div>I4</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>	<div>Demonstrate knowledge of the installation and maintenance of Robotic Control Systems</div> <div>IE176-4TC</div> <div>I5</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>	<div>Install and maintain HVAC equipment</div> <div>IE157-4WC</div> <div>I6</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>
	<div>Install and maintain pumps</div> <div>IE159-9WE</div> <div>I7</div> <div><div></div><div></div><div></div><div></div><div>EL</div></div>	<div>Maintain electronic precipitators</div> <div>IE195-9WE</div> <div>I8</div> <div><div></div><div></div><div></div><div></div><div>EL</div></div>	<div>Install and maintain Robotic Control Systems</div> <div>IE177-9WE</div> <div>I9</div> <div><div></div><div></div><div></div><div></div><div>EL</div></div>			
<div>CONTROL CIRCUITS</div> <div>J</div>	<div>Install manual motor controls</div> <div></div> <div>J1</div> <div><div>1</div><div></div><div></div><div></div><div></div></div>	<div>Install Magnetic motor controls</div> <div></div> <div>J2</div> <div><div>1</div><div>2</div><div></div><div></div><div></div></div>	<div>Demonstrate knowledge of AC motor controls</div> <div>IE227-3TC</div> <div>J3</div> <div><div></div><div></div><div>3</div><div></div><div></div></div>	<div>Demonstrate knowledge of variable speed drive (VSD) and starting systems</div> <div>IE178-4TC</div> <div>J4</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>	<div>Install and maintain motor control, voltage control and power distribution centers</div> <div>1E155-4WC</div> <div>J5</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>	<div>Install and maintain variable frequency drives (VFD)</div> <div>IE179-4WC</div> <div>J6</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>
	<div>Install and maintain DC drive systems</div> <div>IE180-9WE</div> <div>J7</div> <div><div></div><div></div><div></div><div></div><div>EL</div></div>	<div>Install and maintain wound rotor drives</div> <div>IE200-9WE</div> <div>J8</div> <div><div></div><div></div><div></div><div></div><div>EL</div></div>				
<div>COMPUTER SYSTEMS</div> <div>K</div>	<div>Use computerized maintenance management systems and electronic log books</div> <div>IE196-3WC</div> <div>K1</div> <div><div></div><div></div><div>3</div><div></div><div></div></div>	<div>Demonstrate and apply knowledge of network diagnostic tools</div> <div>IE147-4TC</div> <div>K2</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>	<div>Demonstrate and apply knowledge of communications protocols</div> <div>IE148-4TC</div> <div>K3</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>	<div>Install and maintain computer networks</div> <div>IE149-9WE</div> <div>K4</div> <div><div></div><div></div><div></div><div></div><div>EL</div></div>		
	<div>Demonstrate knowledge of AC machines</div> <div>IE150-3TC</div> <div>L1</div> <div><div></div><div></div><div>3</div><div></div><div></div></div>	<div>Demonstrate knowledge of DC machines</div> <div>IE192-3TC</div> <div>L2</div> <div><div></div><div></div><div>3</div><div></div><div></div></div>	<div>Design and demonstrate knowledge of motor controls and motor control programs</div> <div>IE226-4TC</div> <div>L3</div> <div><div></div><div></div><div></div><div>4</div><div></div></div>	<div>Install and maintain AC motors</div> <div>IE151-3WC</div> <div>L4</div> <div><div></div><div></div><div>3</div><div></div><div></div></div>	<div>Install and maintain DC electric motors</div> <div>IE193-9WE</div> <div>L5</div> <div><div></div><div></div><div></div><div></div><div>EL</div></div>	<div>Install and maintain wheel motors</div> <div>IE204-9WE</div> <div>L6</div> <div><div></div><div></div><div></div><div></div><div>EL</div></div>



<b>PROGRAMMABLE LOGIC CONTROLLERS</b>  M	Demonstrate and apply knowledge of PLC operation, installation and maintenance IE134-3TC M1 [ ][ ][3][ ][ ]	Demonstrate and apply knowledge of communication buses and PLC interfaces IE135-3TC M2 [ ][ ][3][ ][ ]	Demonstrate knowledge of programming language and of installing and maintaining PLC software IE138-3TC M3 [ ][ ][3][ ][ ]	Install and maintain PLC hardware IE136-3WC M4 [ ][ ][3][ ][ ]	Install and maintain PLC networks IE137-3WC M5 [ ][ ][3][ ][ ]	Read and write programming language and install and maintain PLC software IE139-3WC M6 [ ][ ][3][ ][ ]
<b>POWER DISTRIBUTION SYSTEMS</b>  N	Demonstrate knowledge of installation and maintenance of transformers IE143-3TC N1 [ ][ ][3][ ][ ]	Calculate power factor correction IE144-3TC N2 [ ][ ][3][ ][ ]	Demonstrate knowledge of the installation and maintenance of high voltage circuits IE152-4TC N3 [ ][ ][ ][4][ ]	Install and maintain high voltage circuits IE153-9WE N4 [ ][ ][ ][ ][EL]	Maintain portable switch houses IE202-9WE N5 [ ][ ][ ][ ][EL]	Demonstrate knowledge of line installation, maintenance, and repair procedures IE203-9WE N6 [ ][ ][ ][ ][EL]
	Make-up and repair trailing cable (4160 – 13.8kV) (2300 – 600V) IE205-9WE N7 [ ][ ][ ][ ][EL]					
<b>POWER SUPPLIES</b>  O	Demonstrate knowledge of back-up power equipment, UPS, battery banks and battery charging systems IE181-4TC O1 [ ][ ][ ][4][ ]	Install and maintain power supplies IE182-9WE O2 [ ][ ][ ][ ][EL]	Install and maintain a UPS system IE183-4WC O3 [ ][ ][ ][4][ ]	Install and maintain batteries IE184-4WC O4 [ ][ ][ ][4][ ]	Demonstrate knowledge of electrolytic cell technology and safety considerations IE210-9WE O5 [ ][ ][ ][ ][EL]	
<b>POWER GENERATION EQUIPMENT</b>  P	Demonstrate knowledge of power generation controls and standby power generating systems IE160-4TC P1 [ ][ ][ ][4][ ]	Describe co-generation principles and operations IE 164-4TC P2 [ ][ ][ ][4][ ]	Demonstrate knowledge of portable generator and portable electric welding equipment IE165-4TC P3 [ ][ ][ ][4][ ]	Troubleshoot and maintain power generation prime movers IE161-9WE P4 [ ][ ][ ][ ][EL]	Maintain portable generators IE166-9WE P5 [ ][ ][ ][ ][EL]	Maintain portable electric welding equipment IE167-9WE P6 [ ][ ][ ][ ][EL]
	Install and maintain power generation controls IE162-4WC P7 [ ][ ][ ][4][ ]	Install and maintain power generator protective relays IE163-4WC P8 [ ][ ][ ][4][ ]				

## Program Overview



### CONTROL AND MONITORING SYSTEMS AND DEVICES

**Q**

Demonstrate knowledge of control systems IE168-4TC Q1 4	Describe signal, communication and alarm systems IE185-4TC Q2 4	Install and maintain process control hardware IE172-4WC Q3 4	Install and maintain signal, communication and alarm systems IE185-4WC Q4 IE186-4WC Q4 4	Install and maintain servo and proportional valve control loops IE169-9WE Q5 EL	Install and maintain hydraulic or pneumatic controls IE174-9WE Q6 EL
Install and maintain analytical measurement equipment IE217-9WE Q7 EL	Install and maintain encoders IE170-9WE Q8 EL	Install and maintain numeric controllers IE171-9WE Q9 EL	Maintain crane control systems IE189-9WE Q10 EL	Install and maintain boiler furnace system monitors and controls IE191-9WE Q11 EL	Install and maintain wireless radio controllers IE201-9WE Q12 EL
Install and maintain a Global Positioning System (GPS) IE206-9WE Q13 EL	Install and maintain gas detection equipment IE212-9WE Q14 EL	Install and maintain controls for liquid separation and refractionation IE213-9WE Q15 EL	Install and maintain gas metering equipment IE215-9WE Q16 EL	Install and maintain data and process monitoring systems IE173-9WE Q17 EL	Install and maintain video monitoring systems IE187-9WE Q18 EL

### INDUSTRY SECTOR SPECIFIC

**R**

Maintain electric arc furnace IE208-9WE R1 EL	Maintain induction furnace IE209-9WE R2 EL	Maintain recovery boiler control systems IE220-9WE R3 EL	Install and maintain scanning and optimization equipment IE223-9WE R4 EL
---	--	--	--

### ELECTRONICS

**S**

Demonstrate knowledge of electronics IE111-3TC S1 3	Demonstrate knowledge of semiconductor power devices IE228-3TC S2 3
---	---



## Training Topics and Suggested Time Allocation

### INDUSTRIAL ELECTRICIAN – LEVEL 3

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line D</b>	<b>CIRCUIT CONCEPTS</b>	<b>11%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
D6	Demonstrate knowledge of three-phase theory [IE129-3TC]		✓	✓	
<b>Line J</b>	<b>CONTROL CIRCUITS</b>	<b>11%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
J3	Demonstrate knowledge of AC motor controls [IE227-3TC]		✓	✓	
<b>Line L</b>	<b>ELECTRIC MOTORS</b>	<b>19%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
L1	Demonstrate knowledge of AC machines [IE150-3TC]		✓	✓	
L2	Demonstrate knowledge of DC machines [IE192-3TC]		✓	✓	
<b>Line M</b>	<b>PROGRAMMABLE LOGIC CONTROLLERS</b>	<b>23%</b>	<b>90%</b>	<b>10%</b>	<b>100%</b>
M1	Demonstrate and apply knowledge of PLC operation, installation and maintenance [IE134-3TC]		✓		
M2	Demonstrate and apply knowledge of communication buses and PLC interfaces [IE135-3TC]		✓	✓	
M3	Demonstrate knowledge of programming language and of installing and maintaining PLC software [IE138-3TC]		✓		
<b>Line N</b>	<b>POWER DISTRIBUTION SYSTEMS</b>	<b>18%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
N1	Demonstrate knowledge of installation and maintenance of transformers [IE143-3TC]		✓	✓	
N2	Calculate power factor correction [IE144-3TC]		✓	✓	
<b>Line S</b>	<b>ELECTRONICS</b>	<b>18%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
S1	Demonstrate knowledge of electronics [IE111-3TC]		✓	✓	
S2	Demonstrate knowledge of semiconductor power devices [IE228-3TC]		✓	✓	
<b>Total Percentage for Industrial Electrician Level 3</b>		<b>100%</b>			



## Training Topics and Suggested Time Allocation

### INDUSTRIAL ELECTRICIAN – LEVEL 4

		% of Time Allocated to:			
		% of Time	Theory	Practical	Total
<b>Line E</b>	<b>TEST EQUIPMENT</b>	<b>5%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
E5	Demonstrate knowledge of measurement and calibration test equipment [IE225-4TC]		✓	✓	
<b>Line H</b>	<b>LOW VOLTAGE DISTRIBUTION SYSTEMS</b>	<b>5%</b>	<b>100%</b>	<b>0%</b>	<b>100%</b>
H9	Demonstrate knowledge of installing and terminating fibre optic cables [IE194-4TC]		✓		
<b>Line I</b>	<b>ELECTRICAL EQUIPMENT</b>	<b>21%</b>	<b>90%</b>	<b>10%</b>	<b>100%</b>
I3	Demonstrate knowledge of installing and maintaining HVAC equipment [IE156-4TC]		✓	✓	
I4	Demonstrate knowledge of pumps [IE158-4TC]		✓		
I5	Demonstrate knowledge of the installation and maintenance of Robotic Control Systems [IE176-4TC]		✓		
<b>Line J</b>	<b>CONTROL CIRCUITS</b>	<b>11%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
J4	Demonstrate knowledge of variable speed drive (VSD) and starting systems [IE178-4TC]		✓	✓	
<b>Line K</b>	<b>COMPUTER SYSTEMS</b>	<b>9%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
K2	Demonstrate and apply knowledge of network diagnostic tools [IE147-4TC]		✓	✓	
K3	Demonstrate and apply knowledge of communication protocols [IE148-4TC]		✓	✓	
<b>Line L</b>	<b>ELECTRIC MOTORS</b>	<b>7%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
L3	Design and demonstrate knowledge of motor controls and motor control programs [IE226-4TC]		✓	✓	
<b>Line N</b>	<b>POWER DISTRIBUTION SYSTEMS</b>	<b>7%</b>	<b>80%</b>	<b>20%</b>	<b>100%</b>
N3	Demonstrate knowledge of the installation and maintenance of high voltage circuits [IE152-4TC]		✓	✓	
<b>Line O</b>	<b>POWER SUPPLIES</b>	<b>11%</b>	<b>100%</b>	<b>0%</b>	<b>100%</b>
O1	Demonstrate knowledge of back-up power equipment, UPS, battery banks and battery charging systems [IE181-4TC]		✓		
<b>Line P</b>	<b>POWER GENERATION EQUIPMENT</b>	<b>11%</b>	<b>100%</b>	<b>0%</b>	<b>100%</b>
P1	Demonstrate knowledge of power generation controls and standby power generating systems [IE160-4TC]		✓		
P2	Describe co-generation principles and operations [IE164-4TC]		✓		
P3	Demonstrate knowledge of portable generator and portable electric welding equipment [IE165-4TC]		✓		



% of Time Allocated to:

		% of Time	Theory	Practical	Total
Line Q	<b>CONTROL AND MONITORING SYSTEMS AND DEVICES</b>	13%	80%	20%	100%
Q1	Demonstrate knowledge of control systems [IE168-4TC]		✓		
Q2	Describe signal, communication and alarm systems [IE185-4TC]		✓	✓	
<b>Total Percentage for Industrial Electrician Level 4</b>		<b>100%</b>			



## Workplace Competencies

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

General Area of Competence	Competency	IE Code
<b>B Safe Work Practices</b>	B2 Apply WCB standards and regulations	IE102-1WC
	B3 Apply safe work practices	IE103-1WC IE106-1WC
<b>C Tools and Equipment</b>	C1 Use hand tools	IE114-1WC
	C8 Use pneumatic and hydraulic tools	IE115-1WC
<b>G CEC, Regulations and Standards</b>	G2 Apply the CEC to installations	IE108-1WC
<b>I Electrical Equipment</b>	I1 Install lighting and electrical equipment	IE132-2WC IE146-2WC

### Level 3 – Workplace Compulsory (WC)

General Area of Competence	Competency	IE Code
<b>A ESSENTIAL SKILLS</b>	A6 Use analytical troubleshooting techniques	IE127-3WC
	A8 Lead teams and manage electrical installation and maintenance projects	IE125-3WC
<b>B SAFE WORK PRACTICES</b>	B7 Follow safe procedures for working in confined spaces	IE105-3WC
<b>C TOOLS AND EQUIPMENT</b>	C6 Use safe rigging techniques	IE104-3WC
<b>E TEST EQUIPMENT</b>	E4 Use phase rotation meter	IE130-3WC
<b>H LOW VOLTAGE DISTRIBUTION SYSTEMS</b>	H8 Install and maintain low voltage circuits	IE142-3WC
<b>K COMPUTER SYSTEMS</b>	K1 Use computerized maintenance management systems and electronic logbooks	IE196-3WC
<b>L ELECTRIC MOTORS</b>	L4 Install and maintain AC motors	IE151-3WC
<b>M PROGRAMMABLE LOGIC CONTROLLERS</b>	M4 Install and maintain PLC hardware	IE136-3WC
	M5 Install and maintain PLC networks	IE137-3WC
	M6 Read and write programming language and install and maintain PLC software	IE139-3WC



## Level 4 – Workplace Compulsory

General Area of Competence	Competency	IE Code
<b>F DRAWINGS AND MANUALS</b>	F5 Design and draw electrical and electronic drawings	IE119-4WC
<b>I ELECTRICAL EQUIPMENT</b>	I6 Install and maintain HVAC equipment	IE157-4WC
<b>J CONTROL CIRCUITS</b>	J5 Install and maintain motor control, voltage control and power distribution centers	IE155-4WC
	J6 Install and maintain variable frequency drives (VFD)	IE179-4WC
<b>O POWER SUPPLIES</b>	O3 Install and maintain a UPS system	IE183-4WC
	O4 Install and maintain batteries	IE184-4WC
<b>P POWER GENERATION EQUIPMENT</b>	P7 Install and maintain power generation controls	IE162-4WC
	P8 Install and maintain power generator protective relays	IE163-4WC
<b>Q CONTROL AND MONITORING SYSTEMS AND DEVICES</b>	Q3 Install and maintain process control hardware	IE172-4WC
	Q4 Install and maintain signal, communication and alarm systems	IE185-4WC IE186-4WC





## Workplace Competencies

### Workplace Elective (WE)

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

General Area of Competence	Competency	Credit	IE Code
<b>B SAFE WORK PRACTICES</b>	B6 Use jumpers and forces safely	3	IE109-9WE
<b>C TOOLS AND EQUIPMENT</b>	C4 Use powder actuated tools	1	IE197-9WE
	C7 Use liquid-fuel powered tools	1	IE199-9WE
	C9 Operate personnel lifting devices	1	IE198-9WE
<b>G CEC, REGULATIONS AND STANDARDS</b>	G4 Access and comply with mining electrical regulations	2	IE211-9WE
	G5 Demonstrate and apply knowledge of onshore pipeline regulations	2	IE218-9WE
<b>I ELECTRICAL EQUIPMENT</b>	I7 Install and maintain pumps	2	IE159-9WE
	I8 Maintain electronic precipitators	5	IE195-9WE
	I9 Install and maintain Robotic Control Systems	3	IE177-9WE
<b>J CONTROL CIRCUITS</b>	J7 Install and maintain DC drive systems	9	IE180-9WE
	J8 Install and maintain wound rotor drives	7	IE200-9WE
<b>K COMPUTER SYSTEMS</b>	K4 Install and maintain computer networks	3	IE149-9WE
<b>L ELECTRIC MOTORS</b>	L5 Install and maintain DC electric motors	9	IE193-9WE
	L6 Install and maintain wheel motors	9	IE204-9WE
<b>N POWER DISTRIBUTION SYSTEMS</b>	N4 Install and maintain high voltage circuits	12	IE153-9WE
	N5 Maintain portable switch houses	4	IE202-9WE
	N6 Demonstrate knowledge of line installation, maintenance, and repair procedures	3	IE203-9WE
	N7 Make-up and repair trailing cable (4160 – 13.8kV and 2300 – 600V)	3	IE205-9WE
<b>O POWER SUPPLIES</b>	O2 Install and maintain power supplies	9	IE182-9WE
	O5 Demonstrate knowledge of electrolytic cell technology and safety considerations	2	IE210-9WE
<b>P POWER GENERATION EQUIPMENT</b>	P4 Troubleshoot and maintain power generation prime movers	5	IE161-9WE
	P5 Maintain portable generators	3	IE166-9WE
	P6 Maintain portable electric welding equipment	3	IE167-9WE



General Area of Competence	Competency	Credit	IE Code
<b>Q CONTROL AND MONITORING SYSTEMS AND DEVICES</b>	Q5 Install and maintain servo and proportional valve control loops	3	IE169-9WE
	Q6 Install and maintain hydraulic and pneumatic controls	3	IE174-9WE
	Q7 Install and maintain analytical measurement equipment	4	IE217-9WE
	Q8 Install and maintain encoders	3	IE170-9WE
	Q9 Install and maintain numeric controllers	3	IE171-9WE
	Q10 Maintain crane control systems	4	IE189-9WE
	Q11 Install and maintain boiler furnace system monitors and controls	6	IE191-9WE
	Q12 Install and maintain wireless radio controllers	4	IE201-9WE
	Q13 Install and maintain a Global Positioning System (GPS)	3	IE206-9WE
	Q14 Install and maintain gas detection equipment	4	IE212-9WE
	Q15 Install and maintain controls for liquid separation and refractionation	4	IE213-9WE
	Q16 Install and maintain gas metering equipment	4	IE215-9WE
	Q17 Install and maintain data and process monitoring systems	3	IE173-9WE
	Q18 Install and maintain video monitoring systems	4	IE187-9WE
<b>R INDUSTRY SECTOR SPECIFIC</b>	R1 Maintain electric arc furnace	3	IE208-9WE
	R2 Maintain induction furnace	3	IE209-9WE
	R3 Maintain recovery boiler control systems	3	IE220-9WE
	R4 Install and maintain scanning and optimization equipment	4	IE223-9WE



# **Section 3**

## **PROGRAM CONTENT**

### **Industrial Electrician**



# **Technical Training**

## **Level 3**

### **Industrial Electrician**



**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 [IE227-3TC]**

**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**

**CONTENT**

- |   |   |
|---|---|
| 1. Explain the advantages of using motor starters   | <ul style="list-style-type: none"> <li>• Reduced voltage and current during starting</li> <li>• Reduced transients</li> </ul>   |
| 2. Describe protective features incorporated in starters for common faults                    | <ul style="list-style-type: none"> <li>• Overcurrent</li> <li>• Under voltage</li> <li>• Over voltage - MOV</li> <li>• Phase reversal</li> <li>• Phase loss</li> <li>• Mechanical stress</li> </ul>   |
| 3. Describe motor starters with the aid of diagrams with reference to principles of operation | <ul style="list-style-type: none"> <li>• Block diagram of starter</li> <li>• Circuit diagrams of                             <ul style="list-style-type: none"> <li>○ Across the line</li> <li>○ Wye-delta</li> <li>○ Auto-transformer</li> <li>○ Reduced voltage</li> <li>○ Primary resistance</li> <li>○ Secondary resistance</li> </ul> </li> </ul>  |
| 4. Connect and test three-phase induction motor starters                                      | <ul style="list-style-type: none"> <li>• Types                             <ul style="list-style-type: none"> <li>○ Across The Line (ATL) starting (cage induction with two and three-wire control and remote start-stop stations)</li> <li>○ Auto transformer</li> <li>○ Wye-delta</li> <li>○ Secondary resistance</li> <li>○ ATL forward and reversing</li> </ul> </li> <li>• Connection requirements (safe practice)</li> <li>• Testing circuits for proper operation</li> </ul> |



## 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

## CONTENT

- Verify and adjust motor protection for effectiveness and adjust to suit motor
  - Overcurrent
  - Overload
  - Phase
  - Motor management relays
- Types
  - Secondary resistance
  - Electronic types
- Connection requirements (safe practice)
- Test motor - CEC rules
- Check operation against design
- Types
  - Single-phase
  - Three-phase
- Making electrical connections
  - Cabling
  - Glands
  - Terminations
  - Accessories
- Install control and protection equipment
- Testing
  - CEC requirements met
  - Determining if it is safe to connect machine and control equipment
- Control equipment
  - Switch gear
  - Metering
  - Over-temperature
  - Open-circuit
  - Short-circuit
  - Overload protection
- Adjustments
  - Phase rotation
  - Polarity
- Confirm off-load and on-load operation of machine in accordance with specifications
  - Direction of rotation
  - Vibration
  - Temperature rise
  - Current draw





### LEARNING TASKS

8. Compare characteristics of motor starters
9. Describe wound-rotor motors and controllers
10. Describe synchronous motor starters
11. Describe types of motor deceleration methods

### 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
- Methods of automatic acceleration
- Basic maintenance and troubleshooting
- Connect and test wound motor controllers
- Operation of synchronous motor starters
- Basic maintenance and troubleshooting
- 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

8. Describe the construction and operating parameters of synchronous AC motors
9. Describe synchronous AC motor maintenance
10. Describe the operation of wound rotor AC motors
11. Describe the construction and operating parameters of wound rotor AC motors
12. Describe wound rotor AC motor maintenance
13. Describe the operation of three-phase AC alternators
13. Describe the operation of common AC servo motors

## CONTENT

- Manuals and specifications
- Rotation change
- Starting methods
- Self excitation
- Excited DC motors
- Starting and running
- Starting and running circuits
- Bearing and lube replacement
- Motor cooling
- Common failures and prevention
- Slip rings and brushes
- Types of wound rotor mounts
- Rotating magnetic field characteristics
- Large load inertia
- Uses of this type of motor
- Manuals and specifications
- Rotation change
- Starting methods
- Starting and running circuits
- Rotor circuit external resistances
- Resistance calculation
- Current ratings
- Heat dissipation ratings
- Bearing and lube replacement
- Motor cooling
- Common failures and prevention
- Speed and torque controls
- Constructional features
- Operating principles
- Identifying common connections
- Conditions for paralleling and synchronizing
- 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Connect and test three-phase, squirrel-cage induction motors</li> <li>• Connect and test single-phase motors</li> <li>• Connect and test three-phase alternators</li> </ul>
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:** L2 Demonstrate knowledge of DC machines [IE192-3TC]

## Objectives

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

- Demonstrate knowledge of the operation and construction of DC machines and DC servo motors.

## LEARNING TASKS

1. Describe the constructional features of DC machines
2. Describe the theory of operation of DC generators
3. Describe the characteristics of the types of DC generators

## CONTENT

- Generators
- Motors
- Armature
- Commutator
- Brushes
- Field poles
- Bearings
- Permanent-magnet field poles
- Electromagnetic field poles
  - Series and shunt field windings
  - Separately excited fields
  - 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
  - Rotational losses
  - Core losses
  - Copper losses
- Efficiency calculation
- Shunt generator
- Series generator
- Compound generator
- Cumulative compound
  - Flat-compound
  - Over-compound
  - Under-compound
- Differential compound



## 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
- Bearing 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



### LEARNING TASKS

13. Describe the theory of operation of DC servo motors
14. Describe construction and operating parameters of DC servo motors
15. Describe maintenance of DC servo motors
16. Describe correct installation and operation of DC motors to applicable CEC rules and manufacturer requirements

### CONTENT

- Types of servo motors
- Rotating magnetic field characteristics
- Robotic applications
- Pulse coded modulation
- Feedback principles in electronics
- Manuals and specifications
- Rotation change
- Potentiometers and modulation
- Starting and running circuits
- Proportional speed control
- Potentiometers and modulation
- Servo shaft angle
- Common failures and prevention
- Vendor systems and compatibility
- Control system types
- Types of motors and their applications
- Access and interpret operation and specification manuals

### 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.



<b>LINE (GAC):</b>	<b>M</b>	<b>PROGRAMMABLE LOGIC CONTROLLERS</b>
<b>Competency:</b>	<b>M1</b>	<b>Demonstrate and apply knowledge of PLC operation, installation and maintenance [IE134-3TC]</b>

### 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

1. Demonstrate knowledge of the design philosophies and uses of PLCs
2. Describe PLC hardware components
3. Compare the types of PLC and interoperability between vendor components
4. Describe the theory of operation of integrated control systems
5. Demonstrate and apply knowledge of installing and setting up integrated control systems to CEC rules and manufacturer installation and operation guidelines

### 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



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

### 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

1. Describe communication buses
2. Demonstrate knowledge of the installation of communication buses for common applications and CEC rules
3. Demonstrate knowledge of communications protocols used by PLCs
4. Describe communications devices including settings and tests
5. Describe and compare different network types and the way each operates, to CEC rules and manufacturer specifications

### CONTENT

- Communications standards
- Limitations
- Controllers
- Uses and optimization
- Wiring types
- Signal strength
- Terminations
- Routers and modems
- PLC networks
- IEEE and ISO international protocols and standards
- Vendor proprietary protocols
- Software and hardware settings
- Principles and theory of data communication
- Cards
- Communications ports
- Hardware settings
- Software settings
- Setting readings
- Testing procedures
- Communication protocols
- Hardware settings
- Modem types and settings
- IEEE and ISO standards
- Remote I/O racks
- Communication software
- Communication cards
- Configuration and addressing



### **Achievement Criteria**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Use a programming terminal</li> <li>• Monitor/test programs on-line</li> <li>• Use PLC software</li> </ul>
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.



<b>LINE (GAC):</b>	<b>M</b>	<b>PROGRAMMABLE LOGIC CONTROLLERS</b>
<b>Competency:</b>	<b>M3</b>	<b>Demonstrate knowledge of programming language and of installing and maintaining PLC software [IE138-3TC]</b>

### 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
  
2. Demonstrate knowledge of the requirements for the loading and running of programs
  
3. Describe the considerations for the maintenance of PLC software
  
4. Describe different programming languages

### CONTENT

- Software types
- Languages
- Hardware compatibility
- Operating system requirements
  
- PC interface
- Configuration
- Advantages and disadvantages of different configurations
- Network communication requirements
- 'Online', 'offline' and 'equal' states
- Awareness of company conventions
  
- Programming terminals
- Hand held programmers
- Communication software
- PLC programs and diagnostics
  
- Vendor types and proprietary standards
- Manufacturer manuals and programming specifications and guides



### **LEARNING TASKS**

5. Read and write programming language
  
  
  
  
  
  
  
  
  
  
6. Demonstrate knowledge of requirements to document and secure programs

### **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
  
- Uploading and back-up
- Programming notes
- Logic diagrams
- Test and debug programs safely
- Create reports and produce hard copy of programming



<b>LINE (GAC):</b>	<b>N</b>	<b>POWER DISTRIBUTION SYSTEMS</b>
<b>Competency:</b>	<b>N1</b>	<b>Demonstrate knowledge of installation and maintenance of transformers [IE143-3TC]</b>

### Objectives

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

- Demonstrate knowledge of connecting, grounding, installing and maintaining transformers.

### LEARNING TASKS

### CONTENT

1. Describe the construction and features of three-phase transformers	<ul style="list-style-type: none"> <li>• Construction</li> <li>• Three-phase transformer connections</li> <li>• Advantages of a single, three-phase transformer</li> <li>• Advantages of a bank of three, single - phase transformers</li> </ul>
2. Describe the connections of three-phase transformer banks	<ul style="list-style-type: none"> <li>• Wye-to-wye</li> <li>• Delta-to-delta</li> <li>• Wye-to-delta</li> <li>• Delta-to-wye</li> <li>• Four-wire delta</li> <li>• Open-delta</li> </ul>
3. Calculate voltage, current and kVA values for three-phase transformer banks	<ul style="list-style-type: none"> <li>• Wye-to-wye</li> <li>• Delta-to-delta</li> <li>• Wye-to-delta</li> <li>• Delta-to-wye</li> <li>• Four-wire delta</li> <li>• Open-delta</li> </ul>
4. Describe the common connection for autotransformers in three-phase circuits	<ul style="list-style-type: none"> <li>• Wye connection</li> <li>• Delta connection</li> <li>• Open-delta connection</li> <li>• Extended-delta connection</li> <li>• Zig-zag transformer connection                             <ul style="list-style-type: none"> <li>○ Unbalanced load</li> <li>○ Harmonic currents</li> </ul> </li> </ul>
5. Calculate voltage, current and kVA values for three-phase autotransformer circuits	<ul style="list-style-type: none"> <li>• Wye connection</li> <li>• Open-delta connection</li> <li>• Buck-boost</li> </ul>



### 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Connect and test three-phase transformer banks</li> <li>• Connect and test three-phase auto-transformers</li> <li>• Connect and test three-phase instrument transformers</li> </ul>
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:**       **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.

### LEARNING TASKS

1. Calculate power and power factor in balanced three-phase systems

### CONTENT

- Power factor
- True power (P, Watts)
- Reactive power (Q, volt-amps reactive or VAR)
- Apparent power (S, volt-amps or VA)
- Wye-connected system
- Delta-connected system
- Power measurement using wattmeters
  - Three-wattmeter method
  - Two-wattmeter method
  - Analysis of wattmeter's voltage and current values
  - Leading
  - Lagging
  - Unity
  - Single-wattmeter method
- Power factor improvement
- Low lagging power factor
  - Low useful power
  - Increased current for a given power
  - Requirements for increased capacity of supply equipment





## 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

3. Calculate the ratings of capacitors for three-phase PF correction

### Achievement Criteria

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



- |  |   |
|--|---|
| <p>4. Describe common circuit applications for the operational amplifier</p> | <ul style="list-style-type: none"> <li>• Voltage follower (unity gain)</li> <li>• Inverting amplifier</li> <li>• Non-inverting amplifier</li> <li>• Summing amplifier</li> <li>• Op-amp integrator</li> <li>• Digital-to-analogue converter (DAC)</li> <li>• Analogue-to-digital converter (ADC)</li> </ul> |
|--|---|

### **Achievement Criteria**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Test digital gates and interpret results</li> <li>• Test op-amps and interpret results                             <ul style="list-style-type: none"> <li>○ Measure voltage and current values using an oscilloscope and compare with expected values in terms of wave shape and magnitude</li> </ul> </li> </ul>
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:        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)
  
2. Describe the basic action of the SCR
  
3. Describe SCR triggering circuits for AC phase control
  
4. Describe the features of the Triac

**CONTENT**

- SCR symbol and leads
- Typical ratings
- Common case styles
- 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
- Resistor (R) triggering
- Resistor-capacitor (RC) triggering
- Paralleling SCRs for full AC load control
- 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
  
  
  
  
  
  
  
  
  
  
6. Describe the application of thyristors
  
  
  
  
  
  
  
  
  
  
7. Describe the operation of three-phase rectifier circuits
  
  
  
  
  
  
  
  
  
  
8. Determine values for rectified power supplies

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



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

### 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
2. Use a vibration meter to accurately calculate dynamic forces

### CONTENT

- Calculating polarity index using polarization index meter
- Interpreting results
- Safety procedures for vibration measurement
- Interpretation of results

### Achievement Criteria

Performance	The individual will be able to: <ul style="list-style-type: none"> <li>• Calculate and interpret polarity index readings</li> <li>• Perform vibration analysis of a motor</li> </ul>
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.





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

### 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
2. Demonstrate knowledge of installation and termination of fibre optic cable and CEC rules
3. Demonstrate knowledge of diagnosing and fixing faults in cable and interfacing

### CONTENT

- Cable routing
- Optical/electrical interface
- Manufacturer and other specifications
- Environmental concerns
- Protection
- Splicing
- Optical/electrical interface
- Signal controls
- Test equipment
- Field splicing



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

### 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

<b>Performance</b>	The individual will be able to connect and test low and mid efficiency gas furnaces.
<b>Conditions</b>	In a lab setting as part of a practical project, given the required tools and equipment.
<b>Criteria</b>	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



<b>LINE (GAC):</b>	<b>I</b>	<b>ELECTRICAL EQUIPMENT</b>
<b>Competency:</b>	<b>I5</b>	<b>Demonstrate knowledge of the installation and maintenance of Robotic Control Systems [IE176-4TC]</b>

### 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



<b>LINE (GAC):</b>	<b>J</b>	<b>CONTROL CIRCUITS</b>
<b>Competency:</b>	<b>J4</b>	<b>Demonstrate knowledge of variable speed drive (VSD) and starting systems [IE178-4TC]</b>

### 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
2. Describe the operation of power converters
3. Describe the operation of DC motors used with adjustable-speed drives

### CONTENT

- DC motor
- Control panel
  - Acceleration and deceleration
  - Stability and gain
  - Current limit
  - Maximum speed or armature voltage
- Operator's control station
- Sizes and ratings
- Mounting and wiring
- External cabling and wiring
- 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
  - Dynamic braking
  - Regenerative braking
  - Reversing
- Protection
- Start-up and adjustments
  - Before applying power
  - Control circuit operational tests
  - Initial operation of the motor
- Troubleshooting



### LEARNING TASKS

4. Describe the features of variable frequency AC drives
  
  
  
  
  
  
  
  
  
  
5. Describe the operation of frequency converters (inverters)
  
  
  
  
  
  
  
  
  
  
6. Describe the operation of AC motors used with variable frequency 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
  - Electro-magnetic interference (EMI)
  - Motor insulation voltage stress
  - Increased iron losses
- 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
- 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



### **Achievement Criteria**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Connect and test adjustable-speed DC drives</li> <li>• Connect and test variable frequency AC drives</li> </ul>
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.



<b>LINE (GAC):</b>	<b>K</b>	<b>COMPUTER SYSTEMS</b>
<b>Competency:</b>	<b>K2</b>	<b>Demonstrate and apply knowledge of network diagnostic tools [IE147-4TC]</b>

### 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
2. Install network circuits and components
3. Apply network troubleshooting techniques

### CONTENT

- Cat 5 tester
- Time domain reflectometer
- Software testing tools  
example: PING, trace commands, etc.
- Cabling
- Creating network cables
- Installing local area network
- Select proper test device
- Network test locations
- Interpretation of test results
- Safe working procedures

### Achievement Criteria

Performance	The individual will be able to: <ul style="list-style-type: none"> <li>• Install network circuits and components</li> <li>• Test and troubleshoot a network</li> </ul>
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.





<b>LINE (GAC):</b>	<b>K</b>	<b>COMPUTER SYSTEMS</b>
<b>Competency:</b>	<b>K3</b>	<b>Demonstrate and apply knowledge of communications protocols [IE148-4TC]</b>

### 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
2. Use network server commands and protocols to set up and maintain a simple computer network
3. Use TCP/IP communications protocol to set up and maintain a simple computer network

### CONTENT

- Ethernet
- Intranet
- Internet
- Awareness of other communications protocols
- Windows
- UNIX
- LINUX
- Network addressing
- Device addressing
- Security
- Reliability considerations

### Achievement Criteria

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Set up and maintain a simple computer network through use of TCP/IP commands</li> <li>• Demonstrate knowledge of hardware and wiring components of a networked computer system</li> </ul>
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.



<b>LINE (GAC):</b>	<b>L</b>	<b>ELECTRIC MOTORS</b>
<b>Competency:</b>	<b>L3</b>	<b>Design and demonstrate knowledge of motor controls and motor control programs [IE226-4TC]</b>

### 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
2. Demonstrate knowledge of the principles of software based programmable motor controls
3. Compare PLCs with hard-wired logic and explain the advantages and disadvantages of each

### CONTENT

- Circuit diagrams
- Circuit board assembly
- Hard-wire devices
- Regulations and standards
- Equipment manufacturer manuals
- Operating specifications
- Component selection criteria
- Control devices
- Overloads
- Magnetism and contacts
- Equipment manufacturer manuals
- Advanced digital logic circuits
- 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
- Auxiliary contacts and relays
- Variety of control tasks
- Ease of alteration and duplication
- Time and cost savings
- On-line documentation



### LEARNING TASKS

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

### CONTENT

- Programming language rules and logic scan direction
- Symbols and logic
  - Inputs
  - Outputs
  - Timers
  - Counters
  - Internal relays or flags
- Enter program in accordance with manufacturer instructions and industry practice
- Verify program operation against the specifications
- Switch gear and field wiring
- Instrumentation to observe and load programming
- Electrical interlocks
- Test and commission

### Achievement Criteria

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Design an efficient motor control program using hard wiring and software based control protocols</li> <li>• Install motor control program and document according to industry practice</li> </ul>
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.



<b>LINE (GAC):</b>	<b>N</b>	<b>POWER DISTRIBUTION SYSTEMS</b>
<b>Competency:</b>	<b>N3</b>	<b>Demonstrate knowledge of the installation and maintenance of high voltage circuits [IE152-4TC]</b>

### 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

1. Demonstrate knowledge of high voltage circuit diagrams and drawings
2. Describe standards that dictate the method and standard of installation
3. Describe the considerations for the installation and maintenance of high voltage circuits to meet CEC rules
4. Explain the requirement of power distribution equipment types and power distribution standards

### CONTENT

- Symbol sets
- Standards
- Schematics and construction blueprints
- Drawing updates and standards
- Appropriate safety standards
- CEC
- ULC
- ISO
- CSA
- Wiring standards
- Load and resistance calculations
- Safe high voltage working procedure
- Grounding
- Testing equipment
- Termination
- Layout and secure
- Running wire
- Operator Field Interface (OFI)
- Distribution equipment and connectors
- Environmental specifications
- PT
- CT
- Types of equipment
- CEC
- CSA
- ULC
- ISO
- Load ratings
- Load protection



## LEARNING TASKS

5. Describe the considerations for the installation of power distribution equipment to CEC rules
  
6. Describe the considerations for the maintenance of power distribution equipment to CEC rules
  
7. Describe types of protective relays and their principles of operation in terms of appropriate safety standards
  
8. Demonstrate and apply knowledge of insulation and circuit integrity on high voltage equipment using a hi-pot tester

## CONTENT

- Environmental factors
- Wiring, shielding and bonding
- Access manufacturer specifications and manuals
- Commission
- Secure and restrain
- PT
- CT
  
- Test and troubleshoot
- Protect and clean components
- Safety procedures for component replacement
- Grounding
- Manufacturer specifications
- Preventative maintenance routines
  
- Types of 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
  
- 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 dole tester and or thumper
11. Use a dole 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Test the integrity of insulation on high voltage circuits and identify faults and failures</li> <li>• Use a dole tester and or a thumper to check high voltage insulation integrity observing all safety requirements</li> </ul>
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.



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

### 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
2. Demonstrate knowledge of the installation of backup power equipment
3. Describe the considerations for the maintenance of backup power equipment
4. Identify different types of UPS in common use
5. Describe the considerations for the installation and maintenance of a UPS system and CEC rules
6. Describe and compare the common types of battery chemistry

### CONTENT

- Equipment types and uses
- Advantages and disadvantages of different equipment types
- Load specifications
- Transfer switch function
- Interpret drawings and diagram
- Voltage
- Frequency
- Alarms
- Transfer switch parameters
- CEC rules
- Preventative maintenance procedures
- Test transfer switch
- Verify component viability
- Types of UPS
- Manufacturer manuals and specifications
- Uses and advantages of common types
- 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
- 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



<b>LINE (GAC):</b>	<b>P</b>	<b>POWER GENERATION EQUIPMENT</b>
<b>Competency:</b>	<b>P1</b>	<b>Demonstrate knowledge of power generation controls and standby power generating systems [IE160-4TC]</b>

### 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

1. 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
2. Describe the operating characteristics and installation requirements of common types of prime movers in accordance with CEC rules
3. Describe problems that can occur with the different types of prime mover
4. Describe different types of power control
5. Describe maintenance procedures, CEC rules and power authority requirements for different types of power control

### 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
2. Describe portable electric welding equipment

## CONTENT

- Applications in an industrial setting
- Basic theory of its design and operation
  - Prime mover – internal combustion engines
  - Generating theory
  - Load limits
  - Capacities
  - CEC rules
- Types of portable welding equipment and their applications
  - TIG
  - MIG
  - Electric arc
- Basic theory of its design and operation
  - Prime mover – internal combustion engine or main supply
  - AC and DC power supply
  - Transformer
  - 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
2. Demonstrate knowledge of encoders on machinery and equipment in terms of CEC rules and manufacturer specifications

## CONTENT

- Types and operating principles of servo and proportional valve control loops
  - Position transducers
  - RVDTs
  - LVDTs
  - Synchro resolvers
  - Signal conditioning
  - Hydraulic valves
  - Pneumatic valves
  - Controllers and reference signals
  - Input signal and output position
- Installation
- Maintenance
- Documentation requirements
  - Installation
  - Maintenance
- Encoder types and operating characteristics
  - Belt driven
  - Gear driven
  - Direct drive
  - Output
  - BCD
  - Pulse
  - Gray code
  - Absolute positioning
  - Incremental positioning
  - Multi-turn
- Installation
- Maintenance
  - SCADA
  - DDC
  - DCS monitoring systems
- Documentation requirements
  - Installation
  - Maintenance



### LEARNING TASKS

3. Demonstrate knowledge of numeric controllers including programming controllers for different purposes
  
4. Demonstrate knowledge of process control sensors, hardware and controllers in terms of equipment manufacturer specifications
  
5. Demonstrate knowledge of SCADA, DDC, and DCS monitoring systems
  
6. Demonstrate knowledge of hydraulic and pneumatic circuit controls and pumps and compressors associated with the control circuit

### CONTENT

- Principle of operation of numeric controllers
  - Numeric controller types
  - Program languages
  - Electro-mechanical interfaces
  - XY grid coordination
- Installation
- Maintenance
- Documentation requirements
  
- Process control principles
  - Feedback
  - Pneumatic
  - Hydraulic
  - Electronic
  - Open loop/closed loop
  - Operational amplifiers and PID control
- Installation
- Maintenance
- Documentation requirements
  
- 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
  
- 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

### CONTENT

- |   |  |
|---|--|
| <p>1. Describe the basic the basic features of security systems</p> | <ul style="list-style-type: none"> <li>• Purposes of security systems</li> <li>• Alarm systems               <ul style="list-style-type: none"> <li>○ Deterrence</li> <li>○ Detection of intruders</li> <li>○ Response</li> </ul> </li> <li>• Perimeter protection</li> <li>• Space protection</li> <li>• Spot protection</li> <li>• Basic alarm system security               <ul style="list-style-type: none"> <li>○ Detection circuit</li> <li>○ Control circuit</li> <li>○ Output circuit</li> </ul> </li> <li>• Closed-loop circuits               <ul style="list-style-type: none"> <li>○ Two-wire</li> <li>○ Two-wire with end-of-line resistor</li> <li>○ Four-wire</li> <li>○ Four-wire ULC</li> </ul> </li> <li>• Common detection and alarm devices               <ul style="list-style-type: none"> <li>○ Magnetic contacts</li> <li>○ Passive infrared (PIR) detectors</li> <li>○ Microwave and ultrasonic motion detectors</li> <li>○ Dual-technology detectors</li> <li>○ Photoelectric beam detectors</li> <li>○ Gas break detectors</li> <li>○ Audio detectors</li> <li>○ Shock sensors</li> </ul> </li> <li>• Control panel functions</li> </ul> |
| <p>2. Describe the basic features of fire alarm systems</p>         | <ul style="list-style-type: none"> <li>• Initiating devices</li> <li>• Signal devices</li> </ul>   |





## 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Test and operate conventional fire alarm systems and addressable fire alarm systems</li> <li>• Test and operate Class A and Class B wiring</li> <li>• Recognize control panel indicating lights for proper operation, ground fault and trouble and describe appropriate corrective measures</li> </ul>
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	<p>Completion of standard IE102-1WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
  
2. Communicate risks and risk situations to others
  
3. Apply Workplace Hazardous Materials Information System (WHMIS) and use proper procedures for personal protection from hazardous materials
  
4. Follow evacuation and fire emergency response procedures in accordance with organizational practice

### CONTENT

- Environmental risks
- Slips
- Trips and falls
- Injury to others
- Injury from moving machinery
  
- Signage
- Tagging
- Verbal and written communications
- Safe work cards
- Risk hazard assessment procedures
- Accident reporting
  
- Material Safety Data Sheets (MSDS)
- Labelling
- Spill containment
- Personal exposure to hazardous materials
- Protective equipment for hazardous materials
  - Breathing protection
  - Eye protection
  - Spill protection
  
- Sound alarm
- Isolate power
- Use of elevators and stairs
- Use of firefighting equipment
- CO<sub>2</sub> systems
- Halon
- Emergency shutdown



**Achievement Criteria – Workplace Assessment [IE103-1WC and IE106-1WC]**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>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</li> <li>Apply workplace hazardous materials information system (WHMIS) and use proper procedures for personal protection from hazardous materials</li> <li>Respond to fire emergencies in accordance with organizational requirements</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE103-1WC and 106-1WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li><i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li><i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li><i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li><i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate proper use of non-powered hand tools</li> <li>• Demonstrate proper use, application and handling of portable power tools</li> <li>• Demonstrate proper use, application and handling of machine tools</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p>
Criteria	<p>Completion of standard IE114-1WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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

## CONTENT

- 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
- Hydraulic safety
- Safe working conditions
- Personal protective equipment
- Components and attachments
  - Guards
  - Blades
  - Punches
  - Shoes
- Maintenance

2. Select, use and maintain hydraulic tools and attachments





### **Achievement Criteria – Workplace Assessment [IE115-1WC]**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate proper use, application and handling of pneumatic tools used by electricians</li> <li>• Demonstrate proper use, application and handling of hydraulic tools used by electricians</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE115-1WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Use protective equipment to ensure personal safety, the safety of others and the safety of equipment
3. Demonstrate safe use of test equipment
4. Install grounding equipment
5. De-energize and test equipment
6. Test and re-energize equipment

### CONTENT

- 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
- Best practices
  - Arc flash assessment requirements
  - Company requirements
- Gloves
- Safety glasses
- Correct usage
- Verifying safe function
- Portable grounding
- Ground cable
- Ground chains
- Lockout and tag locations
- Communication with personnel
- Ensuring that it is safe to re-energize
- Communication with personnel
- Removal of tags and lockouts



### **Achievement Criteria – Workplace Assessment [IE108-1WC]**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>Follow safe procedures for de-energizing, tagging, locking out, removing tags and lockouts, testing, and re-energizing equipment</li> <li>Reference procedures and codes outlined in CEC, Mines Act BC, Use of Electricity in Mines (CSA) and WorkSafeBC OHS regulations</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE108-1WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li><i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li><i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li><i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li><i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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**

1. Install distribution panels to which are easily serviced and meet design specifications
  
2. Install equipment for use in hazardous locations
  
3. Install conduit and cable tray to safely route cable

**CONTENT**

- CEC rules and design specifications
- Fittings
- Termination of conductors
- Overcurrent protections
- Fault current calculations
- Fuse sequencing and selection
- Documentation
  
- CEC rules and design specifications
- Hazardous locations
- Explosion-proof equipment
- Installation of equipment
  - Terminations
  - Enclosures
  - Pressure venting
  
- 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	<p>Completion of standard IE132-2WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Install lighting equipment and controls

## CONTENT

- Emergency lighting
- Code requirements
- ULC and CSA applicable codes
- Light color required
- Ambient temperature
- Environmental requirements
- Size of illuminated space
- Wall light refraction
- Hang lighting fixtures
- Wire
- Shield and ballast
- Bulbs and bulb handling considerations
- Starters and breakers
- Access equipment catalogues and parts orders
- Low voltage control
- May include
  - Photocells and timers
  - 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.
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Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
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Criteria	<p>Completion of standard IE146-2WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>
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# **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**

**CONTENT**

- |   |  |
|---|--|
| 1. Apply troubleshooting techniques   | <ul style="list-style-type: none"> <li>• Break down systems into units of function</li> <li>• Isolate problems areas</li> </ul>  |
| 2. Use available resources to determine equipment specifications and operating parameters     | <ul style="list-style-type: none"> <li>• Manuals</li> <li>• Schematics</li> <li>• Internet resources</li> </ul>  |
| 3. Use charts and systems information interfaces to identify problems and determine solutions | <ul style="list-style-type: none"> <li>• Flow charts</li> <li>• Logic charts</li> <li>• Process charts</li> <li>• Blueprints</li> <li>• Programmable logic controllers/digital control systems interfaces</li> </ul> |

**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: <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul> |



<b>LINE (GAC):</b>	<b>A</b>	<b>ESSENTIAL SKILLS</b>
<b>Competency:</b>	<b>A8</b>	<b>Lead teams and manage electrical installation and maintenance projects [IE125-3WC]</b>

### 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
2. Use industry supervisory and reporting practice
3. Demonstrate effective leadership
4. Use methods for describing and managing complex procedures so that the work is carried out safely
5. Demonstrate planning skills in mapping out tasks

### CONTENT

- Active communication
- Planning according to the resources of team members
- Motivation
- Mentorship
- Goal setting
- Achieving objectives under pressure
- Industry standard
- Leadership skills
- Task and step breakdown
- Feedback loop
- Contingency plan
- Non-verbal signalling
- Make instructions relevant to the audience's level of technical understanding
- Plan ahead of task

### Achievement Criteria – Workplace Assessment [IE125-3WC]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Use principles of effective communication working with, planning the work of and leading a team to accomplish assigned goals safely and efficiently</li> <li>• Use techniques to ensure the safe execution of maintenance and installation procedures with a variety of personnel and in a variety of industrial setting</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE125-3WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Use gas testing equipment to measure the state of the atmosphere

**CONTENT**

- Safety equipment
- Air movers
- Emergency response plan
- 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	<p>Completion of standard IE105-3WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**LINE (GAC): C TOOLS AND EQUIPMENT**  
**Competency: C6 Use safe rigging techniques [IE104-3WC]**

### Objectives

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

- Practice safe techniques for lifting and rigging heavy objects.

### LEARNING TASKS

### CONTENT

- |  |  |
|--|--|
| 1. Use slings following safe industry practice                             | <ul style="list-style-type: none"> <li>• Sling type</li> <li>• Load ratings</li> <li>• Secure load</li> </ul>  |
| 2. Use standard hand signals for crane operation to international practice | <ul style="list-style-type: none"> <li>• Hand signals</li> </ul>   |
| 3. Inspect lifting devices to ensure they meet design specifications       | <ul style="list-style-type: none"> <li>• Logical equipment inspection techniques</li> <li>• Label data</li> <li>• Signs of wear and fatigue</li> </ul> |

### 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: <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul> |



**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
2. Use the phase rotation meter to troubleshoot and test three-phase circuits

### CONTENT

- Proper maintenance
- Safety considerations
- Compliance with current regulations and accepted practices
- Measure circuit (may include voltage)
- Safety considerations
- Missing phases
- Proof testing
- Direction of rotation
- May include
  - 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    | <p>Completion of standard IE130-3WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul> |



**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

## CONTENT

- 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
- Wiring
- Shielding, bonding and grounding
- Access manufacturer specifications and manuals

5. Install low voltage equipment

- Wiring
- Shielding, bonding and grounding
- Access manufacturer specification 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install and maintain low voltage circuits to equipment specifications and safety standards</li> <li>• Install and maintain low voltage distribution equipment to applicable safety standards and manufacturer specifications</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE142-3WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



<b>LINE (GAC):</b>	<b>K</b>	<b>COMPUTER SYSTEMS</b>
<b>Competency:</b>	<b>K1</b>	<b>Use computerized maintenance management systems and electronic logbooks [IE196-3WC]</b>

### 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
2. Use a computerized maintenance management system to identify and record maintenance work
3. Use a computerized maintenance management system to schedule works and order materials
4. Use a computerized maintenance management system to examine equipment history and maintenance work

### CONTENT

- Maintenance schedules
- Repair schedules
- Inventory principles
- Work planning
- Parts and equipment requisition and ordering
- Life cycle maintenance
- Vendors' maintenance requirements
- Warranty and service details
- Costing
- Scheduling
- Planning
- Time entry
- 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	<p>Completion of standard IE196-3WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>





**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
  
5. Maintain AC motors
  
6. Document maintenance

### CONTENT

- Access and interpret operation and specification manuals
- Maintenance records
- Safety procedures
- Troubleshooting techniques
- Preventative maintenance
- Lubrication/ lubrication schedule
- Vibration analysis
- Clean
- Current check
- Insulation test
- Listen to pump/motor
- Assessment note
- Company standards

### Achievement Criteria – Workplace Assessment [IE151-3WC]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• 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</li> <li>• Maintain and troubleshoot single-phase induction and three-phase induction AC applicable CEC rules and manufacturer specifications</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement
Criteria	<p>Completion of standard IE151-3WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Install PLC hardware components to manufacturer specifications
3. Document installation
4. Diagnose faults using logical troubleshooting techniques and apply appropriate solutions
5. Document maintenance

## CONTENT

- 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
- Wiring and terminations
- Grounding and shielding
- Software installation and diagnostics
- Fusing and overload protection
- Blueprints and drawings
- Company standards
- 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
- Company standards



### **Achievement Criteria – Workplace Assessment [IE136-3WC]**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install common PLC hardware in accordance with CEC rules and manufacturer specifications</li> <li>• Maintain PLC hardware components to acceptable operational standard</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE136-3WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
  
2. Install and connect PLC networks
  
3. Document installation
4. Maintain PLC network installations
  
5. Document maintenance

**CONTENT**

- Access system specifications and manufacturer installation parameters
- Electrical drawings
- Suitability of installation for operating environment
- Cable types and environmental considerations
- Network installations
  - Set-up and install switching racks
  - Install and set-up routers
  - Modems and converters
  - Optimize system speed
- Terminating conductors
- Company standards
- 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
- Company standards



### **Achievement Criteria – Workplace Assessment [IE137-3WC]**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install PLC communication networks that allow PLC devices to communicate to operational standards</li> <li>• Maintain PLC networks to allow PLC devices to communicate</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE137-3WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



<b>LINE (GAC):</b>	<b>M</b>	<b>PROGRAMMABLE LOGIC CONTROLLERS</b>
<b>Competency:</b>	<b>M6</b>	<b>Read and write programming language and install and maintain PLC software [IE139-3WC]</b>

### 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
2. Maintain PLC software
3. Select appropriate software programs for the situation
4. Read and write programming language
5. Document and secure programs to company standards

### CONTENT

- PC interface
- Configuration
- Advantages and disadvantages of different configurations
- Network communication requirements
- 'Online', 'offline' and 'equal' states
- Programming terminals
- Hand held programmers
- Communication software
- Back ups
- PLC programs
- Diagnostics
- Vendor types and proprietary standards
- Manufacturer manuals
- Programming specifications and guides
- 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
- 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install and maintain PLC software to manufacturer specifications, adjust as required to fit operating parameters and to allow error free communication between devices</li> <li>• 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</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE139-3WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>





# 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Plan a new electrical installation or a revision to an existing installation (may include new or revised drawings)</li> <li>• Design electrical circuits and installation layouts</li> <li>• Interpret existing and create new documents and drawing specifications according to organizational technical data management practice</li> <li>• Update drawings to 'as-built' status using common symbol sets and numbering standards, and file correctly to comply with organizational technical data management practice</li> <li>• Create electrotechnology drawings using computer aided design technology</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE119-4WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Document installation
3. Maintain heating and cooling equipment
4. Document maintenance

### CONTENT

- Fans and air movement
- Compressors
- Heat exchange circuits
- Control circuits and relays
- Dampers
- Thermostats
- Solenoids
- Company standards
- Safety principles
- Common faults and troubleshooting techniques
- Diagnosis tools and gauges
- Specification manuals and construction prints
- Cleaning
- Company standards

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

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install heating and cooling equipment in HVAC and production processes to meet CEC rules and manufacturer specifications</li> <li>• Maintain heating and cooling equipment in HVAC and production processes to meet CEC rules and manufacturer specifications</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p>
Criteria	<p>Completion of standard IE-157-4WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Maintain MCC and equipment to CEC and company standards

## CONTENT

- Manufacturer specifications
- Installation specifications
- Location and optimization
- Seismic considerations
- Safety standards
- CEC
- ULC
- 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
  - Vacuum contactors
  - 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
  
- 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 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: <ul style="list-style-type: none"><li>• Install and maintain motor control centres (MCC) to CEC rules and manufacturer specifications</li><li>• Install and maintain voltage control centres (VCC) to CEC rules</li><li>• Install and maintain power distribution centres (PDC) to CEC rules</li><li>• Select, install and maintain protective relays on power distribution equipment, to all applicable safety standards and manufacturer guidelines</li></ul>
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: <ul style="list-style-type: none"><li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li><li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li><li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li><li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li></ul>





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

### 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
2. Properly install and set up drive systems
3. Document installation
4. Properly maintain drive systems
5. Document maintenance

### CONTENT

- Access and interpret operation and specification manuals
- Control parameters
- Frequency and motor speed
- Ramping speed vs. time
- Soft start
- VFD self tune
- Controller/PC interface
- Company standards
- Diagnostic tools
- PC interface and analysis
- Access and interpret operation and specification manuals
- Company standards

### Achievement Criteria – Workplace Assessment [IE179-4WC]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install VFD drive systems and related controls to CEC rules and manufacturer specifications</li> <li>• Maintain VFD drive systems and related controls to CEC rules and manufacturer specifications</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE179-4WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Install a UPS system in accordance with industry practice
3. Document installation
4. Maintain a UPS system in accordance with industry practice
5. Document maintenance

### CONTENT

- Installation and security
- Interpret and drawings and schematics
- Manufacturer specifications
- 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
- Company standards
- Update drawings and schematics
- Security
- Wiring, bonding and shielding
- Check transfer switch
- Check alarms
- Check operating parameters with reference to distribution circuit standards
- Electronic components of a UPS
- Company standards



### **Achievement Criteria – Workplace Assessment [IE183-4WC]**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install a UPS system in a common application wired to CEC rules in accordance with equipment manufacturer specifications</li> <li>• Maintain a UPS system in a common application wired to CEC rules in accordance with equipment manufacturer specifications</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE183-4WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Document installation
3. Prepare and document a battery maintenance plan
4. Maintain batteries in accordance with industry practice
5. Document maintenance

### CONTENT

- Off gassing hazards
- Charge holding characteristics
- Load and recharge rate
- Wiring and grounding
- CEC rules for mounting and connection of batteries
- Program charge regime
- Company standards
- Electrolyte and specific gravity testing
- Voltage testing
- Electrolyte and specific gravity
- Equalization
- Float charging
- Testing voltages and characteristics of battery types
- Replace batteries and cells
- Maintenance schedule
- Company standards

### Achievement Criteria – Workplace Assessment [IE184-4WC]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Select and install batteries according to CEC rules and manufacturer specifications</li> <li>• Maintain batteries in accordance with CEC rules and manufacturer specifications</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p>
Criteria	<p>Completion of standard IE184-4WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Install power generation controls in accordance with industry practice
3. Document installation
4. Maintain power generation controls in accordance with industry practice
5. Document maintenance

### CONTENT

- Safety codes and procedures
- Access and interpret operation and specification manuals
- Power loading characteristics and capacities
- Control parameters
- Wire, shield and ground controls
- Emergency shutdown procedure
- Meets company standards
- 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

### 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 3<sup>rd</sup> 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
2. Properly install protective relays for primary power supplies in accordance with industry practice
3. Document installation
4. Maintain protective relays in accordance with industry practice
5. Document maintenance

### CONTENT

- Specifications and schematics
- Set up electronic load sharing controls
- Set up speed controls
- Voltage regulator static set up
- Program equipment parameters
- Reverse power relay settings
- Meets company standards
- Error codes and messages
- Bench test synchronizers
- Synchronizer dynamic adjustments
- Voltage regulator adjustment
- Ramp time
- Current transformer phasing
- Load gain adjustment
- Meets company standards

### 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 3<sup>rd</sup> party confirming tasks were completed to appropriate standard



**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
2. Install process control sensors and controllers in accordance with industry practice
3. Document installation
4. Maintain process controls
5. Document maintenance

### CONTENT

- Electronics power supplies
- Voltage and current calibration
- Controller tuning parameters, such as proportional band, gain, reset, derivative, etc.
- Quarter decay
- Installation specifications
- Sensor types
- Location
- Control logic
- PLC routines
- Load change during tuning
- Optimum control/minimum oscillation
- Testing
- May include
  - Install and maintain process control hardware and software on a pressurized pneumatic plywood machine
  - Adjust for best function and document a preventative maintenance schedule for the controllers
- Meets company standards
- Analyze faults using software
- Adjust control parameters
- Logic tests
- Access manufacturer specifications and service manuals
- Maintenance schedules
- Document maintenance to company standards
- Meets company standards



### **Achievement Criteria – Workplace Assessment [IE172-4WC]**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install process control sensors, hardware and controllers to CEC rules and equipment manufacturer specifications</li> <li>• Maintain process control sensors, hardware and controllers to equipment manufacturer specifications and company standards</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE172-4WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>





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

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

<b>Objectives</b>	<b>IE185-4WC: Demonstrate knowledge of safety and security systems (credit 3)</b>
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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

## 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

2. Describe alarm system installation and related CEC rules



**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	<p>Completion of standard IE185-4WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Program the alarm parameters to perform to specification in accordance with industry practice
3. Test and verify installation
4. Document installation
5. Establish a preventative maintenance regime for the alarm circuit and sensors

### **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
- Programming alarm parameters
- Meets CEC rules and specifications
- Meets company standards
- Electric circuits
- Sensors



- |  |  |
|--|--|
| 6. Maintain detection and alarm circuits to meet CEC rules and industry practice | <ul style="list-style-type: none"> <li>• Alarm circuitry characteristics</li> <li>• Supervisory currents</li> <li>• Horns</li> <li>• Strobes</li> <li>• Printers</li> <li>• Diallers and lights</li> <li>• End of line resistors</li> <li>• Fail safe logic</li> <li>• Calibration and verification techniques for correct detection target</li> <li>• Correct placement of sensors/ monitors</li> <li>• Test alarm points through to final annunciation</li> <li>• Maintenance schedules</li> </ul> |
| 7. Document maintenance  | <ul style="list-style-type: none"> <li>• Meets company standards</li> </ul>  |

#### **Achievement Criteria – Workplace Assessment [IE186-4WC]**

- |             |  |
|-------------|--|
| Performance | <p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install an alarm system in accordance with industry practice and CEC rules</li> <li>• Maintain detection and alarm circuits in accordance with industry practice</li> </ul>  |
| Conditions  | <p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement</p>   |
| Criteria    | <p>Completion of standard IE186-4WC in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul> |



# 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	<p>Completion of standard IE109-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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     | <ul style="list-style-type: none"> <li>• Manufacturer procedures for the tool in use</li> <li>• Assembly and maintenance</li> <li>• Personal protective equipment required</li> </ul> |
| 2. Explain load and fastener selection and combinations for three different situations | <ul style="list-style-type: none"> <li>• Selection</li> <li>• Combinations</li> </ul>   |
| 3. Demonstrate load and fastener selection for powder actuated tools                   | <ul style="list-style-type: none"> <li>• Load selection</li> <li>• Fastener selection</li> </ul>  |
| 4. Explain and demonstrate safe handling and storage of powder actuated tools          | <ul style="list-style-type: none"> <li>• Safe handling</li> <li>• Storage</li> </ul>  |

### Achievement Criteria – Workplace Assessment [IE197-9WE]

- |             |  |
|-------------|--|
| Performance | <p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Select load and fasteners for powder actuated tools</li> <li>• Demonstrate safe and proper use of powder actuated tools</li> </ul>   |
| Conditions  | <p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p>  |
| Criteria    | <p>Completion of standard IE197-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul> |



**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
2. Maintain liquid-fuel powered tools

### CONTENT

- Safe working conditions
- Personal protection equipment
- Blades
- Guards
- Safe mixing, handling, and storage of liquid fuel
- 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 3<sup>rd</sup> party confirming tasks were completed to appropriate standard





**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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>Describe and demonstrate proper and safe procedures for use of a boom truck personnel lifting device according to manufacturer specifications and company standards</li> <li>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)</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE198-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li><i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li><i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li><i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li><i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Comply with content of the Mines Act
3. Describe the CSA – and the sections and content pertinent to the use of electricity in mines
4. Comply with content of the CSA

### CONTENT

- Purpose
- Layout
- Legal force
- Organization
- Indexing
- Section organization
- Media – print, CD, online
- Information pertinent to electrical installations on mine sites
- Purpose
- Layout
- Legal force
- Organization
- Indexing
- Section organization
- Media – print, CD, online
- Use of electricity in mines

### Achievement Criteria – Workplace Assessment [IE211-9WE]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate and apply knowledge of the Mines Act</li> <li>• Demonstrate and apply knowledge of the CSA – Use of electricity in mines</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE211-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



<b>LINE (GAC):</b>	<b>G</b>	<b>CEC, REGULATIONS AND STANDARDS</b>
<b>Competency:</b>	<b>G5</b>	<b>Demonstrate and apply knowledge of onshore pipeline regulations [IE218-9WE]</b>

**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

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

### CONTENT

- 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, on line)
- Hydrocarbon service
- 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	<p>Completion of standard IE218-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Document installation
3. Maintain pumps to CEC rules
4. Document maintenance

### CONTENT

- Power supplies
- Grounding
- Insulation
- Confined space procedures
- BC plumbing code standards
- Line up
- Company standards
- Sealed motors
- Controllers
- Pressure and control circuits
- Cavitation
- Confined space procedures
- 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 3<sup>rd</sup> 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
2. Document maintenance
3. Operate electronic precipitators in accordance with company standards and manufacturer specifications

### CONTENT

- Electrodes
- Flushing
- Power controls
- Clearances
- Operation of safety lockouts
- Meets company standards
- Control parameter adjustments
- Flushing

### Achievement Criteria – Workplace Assessment [IE195-9WE]

Performance	<p>The individual will be able to</p> <ul style="list-style-type: none"> <li>• Maintain and operate electronic precipitators in accordance with CEC rules and manufacturer specifications</li> <li>• Operate electronic precipitators in accordance with company standards and manufacturer specifications</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p>
Criteria	<p>Completion of standard IE195-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Install RCS to meet design requirements
3. Document installation
4. Maintain robotic and remote control systems
5. Document maintenance

### CONTENT

- Location
- Power supply
- Control features
- Program controller
- Meets company standards
- Troubleshooting techniques
- Preventative maintenance for micro-electronic controllers
- Safety control systems
- 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 3<sup>rd</sup> 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
2. Properly install and set-up DC drives
3. Document installation
4. Properly maintain DC drives
5. Document maintenance

### CONTENT

- Access and interpret operation and specification manuals
- Environmental operating conditions
- 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
- Meets company standards
- Troubleshooting techniques
- Safety procedures
- Preventative maintenance procedures
- Access and interpret operation and specification manuals
- Meets company standards

### Achievement Criteria – Workplace Assessment [IE180-9WE]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install digital DC drives and associated motor controls to CEC rules (may also include analogue DC drives)</li> <li>• Maintain digital DC drives and associated motor controls to CEC rules (may also include analogue DC drives)</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE180-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>





**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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate knowledge of the operation of a wound rotor drive to CEC rules and manufacturer specifications</li> <li>• Install a wound rotor drive to CEC rules and manufacturer specifications</li> <li>• Maintain/troubleshoot wound rotor drives to ensure reliability and longevity of the drive</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE200-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
  
2. Place and wire network components and workstations
  
3. Install wireless networks and describe basic features of operation

### CONTENT

- Workstation
- Workgroup
- Servers
- Switches
- Firewalls
  
- Cat 5e cabling
- Conventions and terminations
- Network design and security.
- May include
  - Fibre optics
  - Co-axial
  - Teck cable
  - Cat 6
  
- 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    | <p>Completion of standard IE149-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul> |



**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

## CONTENT

- Pre-installation communication
- Hand-off procedures
- Access and interpret operation and specification manuals
- Blueprints
- Name plate data
- 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
- Meets company standards
- Access and interpret operation and specification manuals
- Maintenance records

- ## 2. Install and set up DC motors to CEC rules

- ### 3. Document installation

4. Prepare for maintenance of DC motors



## LEARNING TASKS

5. Properly maintain DC motors to manufacturer specifications

## CONTENT

- Safety procedures
- Troubleshooting techniques
- Preventative maintenance procedures
- Commutator maintenance
- Brush maintenance
- Lubrication schedule
- Cleaning
- May include
  - Neutral plane analysis
  - Vibration analysis
  - Cooling fins, fans and filters
- Meets company standards

- ## 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.
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Criteria	Completion of standard IE193-9WE in the Industrial Electrician logbook:
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- *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 3<sup>rd</sup> 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

1. Describe wheel motors and wheel motor operation
2. Outline wheel motor applications
3. Install wheel motors in accordance with industry practice and regulatory codes
4. Maintain wheel motors in accordance with industry practice and regulatory codes
5. Document maintenance

### CONTENT

- AC motors
- DC motors
- Variable speed control systems
- Electrical components
- Mechanical components
- Safety features
- AC motors
- DC motors
- Variable speed control systems
- Installation records database
- Speed sensors
- Resistance temperature device (RTD)
- Access manufacturer service manual
- Installation specifications
- Brush spring tension
- Torque connection
- Shunts
- Lugs
- Analyze brush wear patterns and commutator marking
- Cables and shielding
- Maintenance records database
- Access to manufacturer maintenance records
- Maintenance schedules
- Manufacturer service standards and specifications
- Safety
- Meets company standards



### Achievement Criteria – Workplace Assessment [IE204-9WE]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate knowledge of wheel motors and wheel motor operation</li> <li>• Install wheel motors in the field to manufacturer service standards and specifications</li> <li>• Maintain wheel motors in the field to manufacturer service standards and specifications</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p>
Criteria	<p>Completion of standard IE204-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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 3<sup>rd</sup> 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
  
2. Explain portable switch house operation and applications
  
3. Maintain portable switch house houses in accordance with regulatory codes and industry practice
  
4. Describe and amend PM routine

### CONTENT

- High voltage systems
- Main power/load power
- Transformers
- OCBs
- Breakers and cables
- Bus
- Pilot circuits
  
- Purpose
  
- 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



### Achievement Criteria – Workplace Assessment [IE202-9WE]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate knowledge of portable switch houses</li> <li>• Maintain portable switch houses so that they are ready for use and reliable in the field</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p>
Criteria	<p>Completion of standard IE202-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



<b>LINE (GAC):</b>	<b>N</b>	<b>POWER DISTRIBUTION SYSTEMS</b>
<b>Competency:</b>	<b>N6</b>	<b>Demonstrate knowledge of line installation, maintenance, and repair procedures [IE203-9WE]</b>

**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



### Achievement Criteria – Workplace Assessment [IE203-9WE]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate knowledge of safe line installation procedures including applicable installation codes and safety standards</li> <li>• Demonstrate knowledge of safe line maintenance and repair procedures including applicable installation codes and safety standards</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE203-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



<b>LINE (GAC):</b>	<b>N</b>	<b>POWER DISTRIBUTION SYSTEMS</b>
<b>Competency:</b>	<b>N7</b>	<b>Make-up and repair trailing cable (4160-13.8kV) (2300-600V) [IE205-9WE]</b>

**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 cable 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Demonstrate knowledge of trailing power cables</li> <li>• Make-up trailing power cable to meet regulatory codes and the rigours of field use in accordance with industry practice</li> <li>• Repair trailing power cable to meet regulatory codes and the rigours of field use in accordance with industry practice</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE205-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Install and commission power regulation equipment in accordance with specification and industry practice
3. Document installation
4. Maintain power regulation equipment in accordance with manufacturer specifications and industry standards
5. Document maintenance

### CONTENT

- Equipment types and uses
- Load specifications
- Transfer switch function
- Interpret drawings and diagram symbols
- Voltage
- Frequency
- Alarms
- Set transfer switch parameter
- Company standards
- Preventative maintenance procedures
- Test transfer switch
- Verify component viability
- Maintenance schedules
- 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 3<sup>rd</sup> party confirming tasks were completed to appropriate standard





<b>LINE (GAC):</b>	<b>O</b>	<b>POWER SUPPLIES</b>
<b>Competency:</b>	<b>O5</b>	<b>Demonstrate knowledge of electrolytic cell technology and safety considerations [IE210-9WE]</b>

**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

### CONTENT

1. Describe electrolytic cell construction and operation	<ul style="list-style-type: none"> <li>• Power unit for lead</li> <li>• Silver refinery cell house/pot house production</li> <li>• Low voltage</li> <li>• High current circuits</li> <li>• Large capacity bus connections</li> </ul>
2. Describe electrolytic cell installation requirements and considerations	<ul style="list-style-type: none"> <li>• Isolation and installation</li> <li>• Electronic controllers</li> <li>• Cooling water and air ventilation units</li> <li>• Rectifier room</li> </ul>
3. Describe electrolytic cell control, protection, and safety requirements and regulatory codes	<ul style="list-style-type: none"> <li>• Control board environmental considerations</li> <li>• Heat sink and bus-bar weld joints</li> <li>• Electrolyte</li> </ul>

### 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	<p>Completion of standard IE210-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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

- 
2. Maintain prime movers in accordance with industry practice

- ### 3. Document maintenance

## CONTENT

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



**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	<p>Completion of standard IE161-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Document maintenance carried out on portable generator sets

### CONTENT

- 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

### 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	<p>Completion of standard IE166-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Document maintenance carried out on portable welding equipment

### 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
- 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 3<sup>rd</sup> 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install servo and proportional valve control loops to CEC rules and equipment manufacturer specifications (may include hydraulic / pneumatic)</li> <li>• Maintain servo and proportional valve control loops to CEC rules and equipment manufacturer specifications (may include hydraulic / pneumatic)</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE169-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install hydraulic or pneumatic circuit controls on machinery and equipment to CEC rules and manufacturer specifications</li> <li>• Maintain hydraulic or pneumatic circuit controls on machinery and equipment to CEC rules and manufacturer specifications</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE174-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
  
2. Install analyzers, in compliance with regulatory code requirements and complete documentation requirements to meet industry best practice
  
3. Maintain analyzers, in compliance with regulatory code requirements and complete documentation requirements to meet industry best practice

### CONTENT

- Hazards of mediums measured (corrosive, poisonous gas, etc.)
- Analyzers
- Laboratory standards of precision
- Conductivity
- PH
- H<sub>2</sub>S
- Flue gas
- Calibration
  
- 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
  
- 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	<p>Completion of standard IE217-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Properly install encoders in accordance with industry practice
3. Document installation
4. Maintain encoders in accordance with industry practice
5. Document maintenance

### CONTENT

- Safety procedure
- Access manufacturer operating specifications
- CEC rules
- Safety procedure
- Machinery lock out
- Set up with PLC programming software
- Set up adjustments
- Test equipment
- Meets company standards
- 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
- Meets company standards

### Achievement Criteria – Workplace Assessment [IE170-9WE]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install an encoder on machinery, set up, and test in accordance with CEC rules and manufacturer specifications</li> <li>• Maintain encoders on machinery to CEC rules and equipment manufacturer specifications</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p>
Criteria	<p>Completion of standard IE170-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Load programs and adjust programming
3. Document installation
4. Maintain numeric controllers by reading and writing controller software
5. Document maintenance

### 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
- Load programming
- Adjust using PC
- Meets company standards
- Troubleshoot programming
- Read and write part programs
- Access part programs and equipment specifications
- Adjust programming to repurpose machinery
- Convert CAD drawings to controller language and install
- 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 3<sup>rd</sup> 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
2. Carry out procedures to check the operation of crane controls
3. Test and if necessary repair limitation devices
4. Complete log book and record keeping procedures

### CONTENT

- Manufacturer service recommendations
- Crane control systems
  - Electric cables and pendants
  - VFDs and motors
  - Contactor contacts
- Contactors
- Timers
- Limit switches
- Wound rotor motors
- Soft starters
- Brakes
- Test limitation devices
- Repair limitation devices
- 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 3<sup>rd</sup> 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	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install boiler and furnace monitors and controls in accordance with CEC rules and industry practice</li> <li>• Maintain boiler and furnace controls (Must include: maintenance schedule manufacturer maintenance instructions, test schedule, test points, safety procedures)</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p> <p><i>Assessment note: re-installing may be used to assess competency on installing as long as all required installation aspects are demonstrated</i></p>
Criteria	<p>Completion of standard IE191-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>





**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
2. Document installation
3. Maintain wireless controllers in accordance with manufacturer service specifications and spectrum management guidelines
4. Document maintenance

### CONTENT

- Set-up and reception verification
- Shielding and interference
- Wiring and bonding
- Meets company standards
- Reception verification
- Shielding and interference
- Wiring and bonding
- Maintenance schedules
- Meets company standards

### Achievement Criteria – Workplace Assessment [IE201-9WE]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install wireless controller systems in accordance with regulations and manufacturer specifications</li> <li>• Maintain wireless controller systems in accordance with regulations and manufacturer specifications</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p>
Criteria	<p>Completion of standard IE201-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Describe industrial GPS applications
3. Explain installation considerations, requirements, and procedure for GPS systems
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

**CONTENT**

- 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
- GPS applications
- Satellite visibility
- Standards of accuracy
- Data transmission
- Ground based error correction
- WAAS and DGPS
- Codes
- 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



## 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 3<sup>rd</sup> 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 H<sub>2</sub>S, methane LEL, O<sub>2</sub> deficiency, SO<sub>2</sub>, CO<sub>2</sub>.

### 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
- O<sub>2</sub> deficiency
- %LEL and H<sub>2</sub>S detection
- Alarm circuits
- Failsafe power supplies
- Control bus
- Shutdown circuits
- Detection and alarm parameters
- May include: SO<sub>2</sub> and CO
- Legal requirements
- Company standards
- %LEL and H<sub>2</sub>S detection
- Control bus
- Alarm circuits
- Failsafe power supplies
- Detection and alarm parameters
- May include: SO<sub>2</sub> and CO
- Legal requirements
- Company standards



### Achievement Criteria – Workplace Assessment [IE212-9WE]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install gas detection systems</li> <li>• Maintain gas detection systems</li> </ul>
Conditions	<p>To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.</p> <p><i>Assessment note: re-installing may be used to assess competency on installing as long as all required installation aspects are demonstrated</i></p>
Criteria	<p>Completion of standard IE212-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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 3<sup>rd</sup> 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	<p>Completion of standard IE215-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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

### CONTENT

- C++
- Visual Basic
- Block diagrams
- Ladder logic
- May include system integration in plant wide operations

2.    Build and program GUI on HMI

- Build
- Program

3.    Test and adjust GUI on HMI and feedback loops

- GUI on HMI
- Feedback loops

4.    Apply signal conditioning and scaling to blocks

- Signal conditioning
- Scaling

5.    Document installation

- Meets company standards

6.    Test and adjust programming for optimal process control

- Test
- Adjust

7.    Verify operation

- Loop checks

8.    Document maintenance

- Meets company standards

### 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 3<sup>rd</sup> party confirming tasks were completed to appropriate standard



**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
2.    Properly install audio and video monitoring systems
3.    Document installation
4.    Maintain audio and video monitoring systems
5.    Document maintenance

### CONTENT

- Access manufacturer installation specifications
- Test manuals
- 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
- Meets company standards
- 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



### **Achievement Criteria – Workplace Assessment [IE187-9WE]**

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>• Install audio and video monitoring systems to display the important functions of machinery to an operator in a control booth</li> <li>• Maintain audio and video monitoring systems</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE187-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Maintain electric arc furnaces in accordance with industry practice and regulatory codes
3. Complete maintenance documentation

### CONTENT

- 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
- 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



### 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	<p>Completion of standard IE208-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Maintain induction arc furnaces in accordance with industry practice and regulatory codes
3. Complete maintenance documentation

### CONTENT

- Inductors
- SCRs
- Capacitors
- Auto transformers
- Live bus water cooling
- Breaker control circuits and settings
- Integration into plant processes
- Basic control circuits and metering
- 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



**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	<p>Completion of standard IE209-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>





**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]

Performance	<p>The individual will be able to:</p> <ul style="list-style-type: none"> <li>Describe recovery boiler operation and principles of control</li> <li>Maintain recovery boiler control systems in accordance with safety regulations and plant operational requirements</li> </ul>
Conditions	To be assessed in the workplace by an ITA registered assessor or certified Industrial Electrician with Red Seal endorsement.
Criteria	<p>Completion of standard IE220-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li><i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li><i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li><i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li><i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



**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
2. Maintain and calibrate scanning and optimization equipment
3. Document maintenance

### CONTENT

- 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
- Maintenance procedures
- Maintenance schedules
- Calibration
- Meets company standards

### 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	<p>Completion of standard IE223-9WE in the Industrial Electrician logbook:</p> <ul style="list-style-type: none"> <li>• <i>Apprentice Diary</i> includes dates and details of work performed covering tasks listed</li> <li>• <i>Assessor or certified Industrial Electrician Observation</i> of completion of relevant tasks</li> <li>• <i>Additional Supporting Evidence</i> is sufficient and is signed-off by the assessor or certified Industrial Electrician with Red Seal endorsement</li> <li>• <i>Verification</i> by a 3<sup>rd</sup> party confirming tasks were completed to appropriate standard</li> </ul>



# **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.

- 8 Power supply stations (with fixed and variable AC and DC outputs and metering)
- 8 Sets of resistors, capacitor and inductors for circuit analysis labs
- 8 3-phase transformer stations
- 8 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)
- 8 3-phase Squirrel-cage motors (assorted 6-lead, 9-lead and 12-lead)
- 4 3-phase wound-rotor motors and controllers
- 2 Multi-speed motors and controllers
- 4 3-phase synchronous motor and controller
- 2 Power factor correction capacitors, 3-phase
- 8 Single-phase, capacitor-start, dual-voltage motors
- 1 Single-phase, shaded-pole motor
- 1 Single-phase, universal motor
- 8 Single-phase magnetic starters
- 4 Reversing drum switches
- 2 3-phase alternator Synchronizing panel with metering and controls
- 2 3-phase alternators with prime movers
- 8 DC motor control stations (with assorted magnetic and/or electronic starters)
- 8 DC motors, compound type
- 8 Oscilloscopes, dual-trace
- 8 Analogue multimeters
- 8 Digital multimeters
- 8 Wattmeters
- 8 Clamp-on ammeters
- 4 Phase-sequence indicators
- 4 Meggers
- 4 Hand-held tachometers
- 2 Motor rotation indicators
- 2 Watt-hour meters
- \* Misc. conductors and raceways for demo purposes
- 8 Electronic trainers for discrete components
- 8 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

By Richard A. Cox and Terry Borden, Thomson Delmar Learning .....ISBN13: 978-1401890070

### 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, 3<sup>rd</sup> EDITION

by Robert Rosenburg and August Hand, Delmar Publishers.....ISBN 0-0305-9584-3

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

<b>Be A Survivor</b>	<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>  This guide offers young workers solid safety information about the basics for looking out for yourself and staying safe on the job. (PDF 1mb)
<b><u>Electrical Hazards Analysis</u></b> 7/13/2006	<b>Free publication</b> online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a>  As the awareness of electrical hazards increase many are puzzled by phrases like "Limited", "Restricted", and "Prohibited Approach Boundary". and "Flash Protection Boundary". This article will address the requirements to perform the "Shock Hazard Analysis" and the "Flash Hazard Analysis" required by the NFPA 70E-2004, Section 110.8(B)(1), "Electrical Hazard Analysis" as well as the "Blast Hazard Analysis" and personal protective equipment requirements.
<b>Electricity and Magnetism</b>	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>
<b>Electricity and Magnetism</b>	Electricity and Magnetism, Benjamin Crowell 1998-2005  Free download from <a href="http://www.lightandmatter.com/area1book4.html">http://www.lightandmatter.com/area1book4.html</a>
<b><u>Electrical Safety and Maintenance Training</u></b> 4/1/2006	<b>Free publication</b> online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a>  There is nothing more important to an electrical safety program than to have a staff of technicians who have been properly trained and who are qualified to do their jobs efficiently and safely.
<b><u>Electrical Safety in Battery Maintenance and Testing</u></b> 10/20/2004	<b>Free publication</b> online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a>  There are specific hazards associated with working on or near batteries and associated equipment. This article addresses the most common issues associated with performing maintenance and testing on various types of batteries, battery rooms and service areas.
<b><u>Electrical Safety in Motor Maintenance and Testing</u></b> 6/2/2005	<b>Free publication</b> online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a>  Electrical safety in motor maintenance and testing carries the same requirements as any other work that involves working on or near exposed energized and de-energized parts of electrical equipment operating at 50 volts or more. Learn what they are and how they affect motor maintenance and testing.
<b><u>Electrical Safety in the Mining Industry</u></b> 5/11/2006	<b>Free publication</b> online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a>  In resolving the issues in electrical safety in the mining industry, a path must be followed that will lead to a comprehensive analysis of the problems and hazards that exist or may exist and provide a quantified value to ensure the selection of appropriate personal protective equipment and clothing as well as safe work practices and procedures. Analysis of all three hazards, electrical shock, electrical arc flash, and electrical arc blast must be completed and steps taken to prevent injuries and fatalities.
<b><u>Electricity - The Silent Killer</u></b> 11/15/2003	<b>Free publication</b> online or download in PDF format. <a href="http://www.electricaltrainingservices.com/free-publications.php">http://www.electricaltrainingservices.com/free-publications.php</a>  Electricity is often referred to as a "silent killer" because it cannot be tasted, seen, heard, or smelled. It is essentially invisible. Electricity has long been recognized as a serious workplace hazard, exposing employees to electrical shock.



## Establishing an Electrical Safety Program

3/2/2006

**Free publication** online or download in PDF format.

<http://www.electricaltrainingservices.com/free-publications.php>

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.

## How to Develop an Effective Training Program

6/1/2006

**Free publication** online or download in PDF format.

<http://www.electricaltrainingservices.com/free-publications.php>

The typical method utilized for developing an effective training program is the "Systematic Approach to Training" or SAT, which utilizes the "Instructional Design System" 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.

## The Hazards of Electricity - Do You Know What They Are?

2/15/2006

**Free publication** online or download in PDF format.

<http://www.electricaltrainingservices.com/free-publications.php>

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!

## **Lockout**

PDF 2.4mb , WorkSafeBC, Order #: BK21

[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)

This booklet defines lockout, explains lockout policy and procedures, and provides guidance on compliance with Regulation requirements.

## **Safety Considerations in Power Supply Design**

Research Paper, PDF available from <http://focus.ti.com/lit/ml/slup227/slup227.pdf>

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.

## **Working Safely Around Electricity**

(PDF 1.8mb) WorkSafeBC Order #: BK19

[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)

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.



## Other Reference Material

<b>The BC Safety Standards Act</b>	<p>(B.C. Reg. 100/2004) is available online at <a href="http://www.qp.gov.bc.ca/statreg/stat/S/03039_01.htm">http://www.qp.gov.bc.ca/statreg/stat/S/03039_01.htm</a> it includes the</p> <p>Electrical Safety Regulations at <a href="http://www.qp.gov.bc.ca/statreg/reg/S/100_2004.htm">http://www.qp.gov.bc.ca/statreg/reg/S/100_2004.htm</a></p>
<b>Blueprint Interpretation Manual</b>	<p>594-000 <b>Blueprint Interpretation Manual</b> US\$34.00</p> <p>Publisher: DAC Industrial Training Products</p> <p>Link: <a href="http://www.dac-3d.com">www.dac-3d.com</a></p> <p>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 will be an indispensable resource.</p>
<b>Canadian Electrical Code and Standards</b>	<p>Available from the CSA Online Store - prices range from \$50 per unit to over \$500.</p> <p>Link: <a href="http://www.csa-intl.org/onlinestore/GetCatalogDrillDown.asp?Parent=428">http://www.csa-intl.org/onlinestore/GetCatalogDrillDown.asp?Parent=428</a></p> <p>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.</p>
<b>Electrical Trades Training Manual</b>  <b>Electrical Trades Handbook</b>	<p>560-000 <b>Electrical Trades Training Manual (Electrical)</b> US\$34.00 560-001 <b>Electrical Trades Handbook</b> US\$20.00</p> <p>Publisher: DAC Industrial Training Products</p> <p>Link: <a href="http://www.dac-3d.com">www.dac-3d.com</a></p> <p>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.</p>
<b>Electrical Generation Fundamentals</b>	<p>Publisher: DAC Industrial Training Products</p> <p>Link: <a href="http://www.dac-3d.com">www.dac-3d.com</a></p> <p>Training rig with supporting course.</p>
<b>Pump Maintenance Trainer</b>	<p>Product #275 - Publisher: DAC Industrial Training Products</p> <p>Link: <a href="http://www.dac-3d.com">www.dac-3d.com</a> <a href="http://www.dac3d.com/DACTRNG/PRODMECH/275INFO.HTM">http://www.dac3d.com/DACTRNG/PRODMECH/275INFO.HTM</a></p> <p>Training rig with supporting training modules.</p>



## 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.

Competency Standard	Assessor Criteria
IE102-1WC Care safe and proper use of pneumatic and hydraulic tools	Be endorsed occupationally competent by the employer
IE116-1WC Demonstrate and apply knowledge of PC hardware and software	Be competent in the topic
IE122-2WC Communicate technical information clearly and check for understanding	
IE104-3WC Use safe lifting and rigging techniques	Be competent in the Code of Practice in The Hoisting and Rigging Safety Manual
IE105-3WC Follow safe procedures for working in confined spaces	Demonstrate proof of training in working in confined spaces in accordance with WorkSafeBC Occupational Health and Safety regulations
IE197-9WE Use powder actuated tools	Demonstrate proof of training in powder-actuated tools in accordance with WorkSafeBC Occupational Health and Safety regulations
IE198-9WE Operate personnel lifting devices	Hold Class 3 Boom Truck Operator Certification in accordance with WorkSafeBC Occupational Health and Safety regulations
IE199-9WE Use liquid-fuel powered tools	Demonstrate proof of training in liquid-fuel powered tools in accordance with WorkSafeBC Occupational Health and Safety regulations