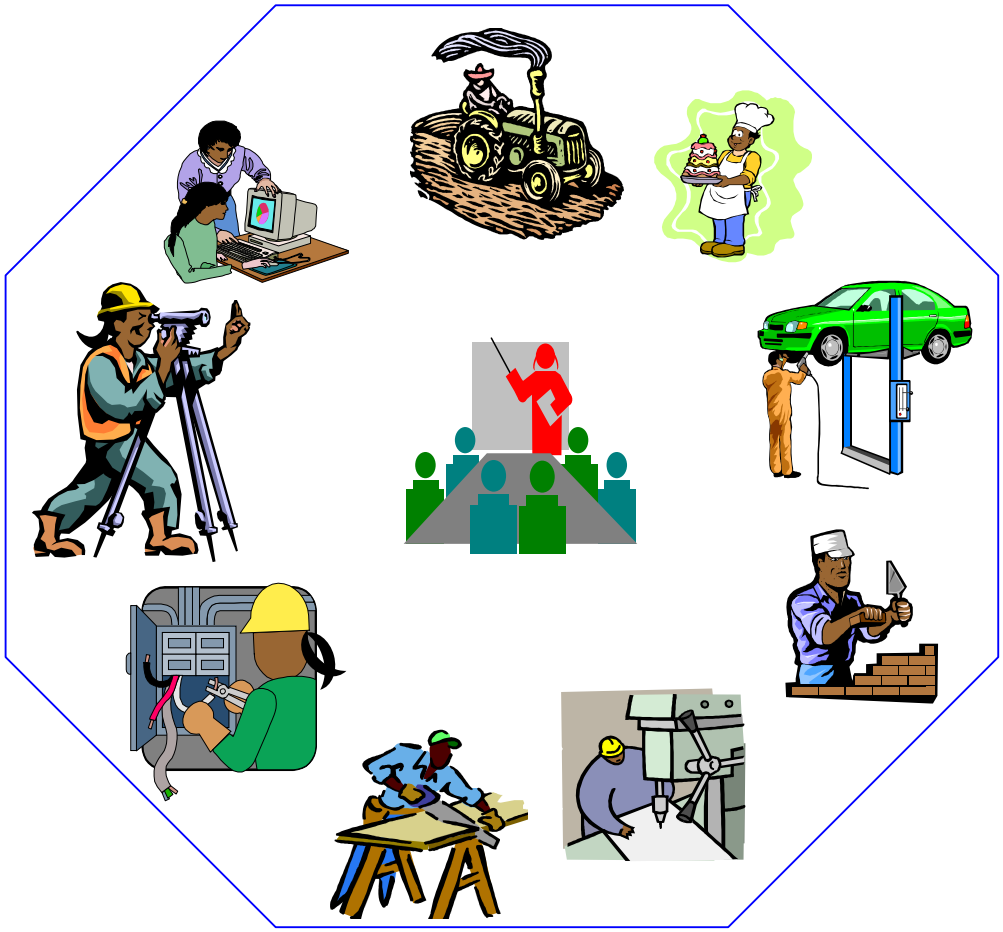
Federal Democratic Republic of Ethiopia

OCCUPATIONAL STANDARD

TRAIN ELECTRICAL/ ELECTRONICS ASSEMBLY

NTQF Level II-III



Ministry of Education
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Introduction

Ethiopia has embarked on a process of reforming its TVET-System. Within the policies and strategies of the Ethiopian Government, technology transformation – by using international standards and international best practices as the basis, and, adopting, adapting and verifying them in the Ethiopian context – is a pivotal element. TVET is given an important role with regard to technology transfer. The new paradigm in the outcome-based TVET system is the orientation at the current and anticipated future demand of the economy and the labor market.

The Ethiopian Occupational Standard (EOS) is the core element of the Ethiopian National TVET-Strategy and an important factor within the context of the National TVET-Qualification Framework (NTQF).They are national standards, which define the occupational requirements and expected outcome related to a specific occupation without taking TVET delivery into account.

This document details the mandatory format, sequencing, wording and layout for the Ethiopia Occupational Standard which comprised of Units of Competence.

A Unit of Competence describes a distinct work activity. It is documented in a standard format that comprises:

- Occupational title, NTQF level
- Unit title
- Unit code
- Unit descriptor
- Elements and Performance criteria
- Variables and Range statement
- Evidence guide

Together all the parts of a Unit of Competence guide the assessor in determining whether the candidate is competent.

The ensuing sections of this EOS document comprise a description of the occupation with all the key components of a Unit of Competence:

- chart with an overview of all Units of Competence for the level including the Unit Codes and the Unit of Competence Titles
- contents of each Unit of Competence listed in the chart
- occupational map providing the Technical and Vocational Education and Training (TVET) providers with information and important requirements to consider when designing training programs for this standards and for the individual, a career path

UNIT OF COMPETENCE CHART

Occupational Standard: Train Electrical/Electronic Assembly		
Occupational Code: IND TEA		
NTQF Level II		
IND TEA2 01 0117 Apply Basic Electrical and Electronic Wiring Systems	IND TEA2 02 0117 Check Train Electrical and Electronics Components For Assembly	IND TEA2 03 0117 Assemble and Test Train Electrical Devices
IND TEA2 04 0117 Assemble Measuring Equipment in an Electrical Train	IND TEA2 05 0117 Install Train system Single Path Electrical Circuits D.C. and A.C. Circuits	IND TEA2 06 0117 Participate in Workplace Communication
IND TEA2 07 0117 Work in Team Environment	IND TEA2 08 0117 Develop Business Practice	IND TEA2 09 0117 Standardize and Sustain 3S

NTQF Level III

IND TEA3 01 0117 Install and Assemble Auxiliary CKT in Electrical Train	IND TEA3 02 0117 Assemble and Install Reception Display and Signal Distribution Equipment	IND TEA3 03 0117 Assemble and Install Reception Display and Signal Distribution Equipment
IND TEA3 04 0117 Troubleshoot Digital Sub-systems	IND TEA3 05 0117 Read and Apply Vehicle Wiring Schematics and Drawings	IND TEA3 06 0117 Assess and Install Complex Power Supplies
IND TEA3 07 0117 Provide Basic Instruction in the Use of Electrical Train Apparatus	IND TEA3 08 0117 Arrange Circuits, Control and Protection for Main Train Electrical Installations	IND TEA3 09 0117 Solve Problems in Electromagnetic Devices and Related Circuits In Train
IND TEA3 10 0117 Inspect and Assemble Braking Systems	IND TEA3 11 0117 Install and Assemble Train Lighting, Wiring Systems and Accessories	IND TEA3 12 0117 Install and Modify Performance Data Communication Copper Cabling
IND TEA3 13 0117 Develop Electrical Control Systems and Electronic Sub Assemblies	IND TEA3 14 0117 Install Appliances, Switchgear and Associated Accessories	IND TEA3 15 0117 Rewind Single Phase and Three Phase Induction Machines Rated for Low Voltage
IND TEA3 16 0117 Monitor Implementation of Work Plan/Activities	IND TEA3 17 0117 Apply Quality Control	IND TEA3 18 0117 Lead Workplace Communication
IND TEA3 19 0117 Lead Small Teams	IND TEA3 20 0117 Improve Business Practice	IND TEA3 21 0117 Prevent and Eliminate MUDA

Occupational Standard: Train Electrical/Electronics Assembly Level II	
Unit Title	**Apply Basic Electrical and Electronic Wiring Systems**
Unit Code	**IND TEA2 01 0117**
Unit Descriptor	This unit describes the performance outcomes required to demonstrate knowledge of electrical principles that enable structured testing of basic circuits in electrical and electronic systems, components and technologies found in motor vehicles. The unit involves applying Ohm's, Watts and Kirchhoff's laws to enable basic structured problem solving to locate a range of common faults in vehicle electrical circuits and wiring systems. It involves the application of knowledge of fundamental elements of electricity and vehicle electrical circuit theory and electrical wiring systems.

Elements	Performance Criteria
1. Develop knowledge of vehicle electrical circuits and wiring systems	1.1 Relevant ***sources of information*** are located to assist with understanding of vehicle electrical circuits and wiring systems 1.2 Knowledge of the operating principles of ***electrical circuits*** and ***wiring systems*** is developed
2. Demonstrate knowledge of vehicle electrical circuits and wiring systems	2.1 Knowledge of the relationship of volts, amps and ohms in a vehicle electrical circuit is applied 2.2 Knowledge of circuit components, their function and operation in a vehicle electrical circuit is applied 2.3 Knowledge of basic principles for testing and processes for checking a vehicle's electrical circuits and wiring systems is applied
3. Demonstrate knowledge of electrical circuits as applied to vehicle fault identification	3.1 Components of a vehicle's electrical circuit and wiring system are identified 3.2 Basic electrical principles are applied to practical inspection and service activities 3.3 Knowledge of a vehicle's electrical circuit and wiring system is practically applied when identifying potential faults

Variable	Range
Sources of information	May include but not limited to: • workplace service information • electrical texts • original equipment manufacturer information • vehicle workshop manuals • service bulletins

	• Magazine technical articles.
Electrical circuits	May include but not limited to: • Voltage • current • resistance • series circuits • parallel circuits • series and parallel circuits • open circuit to power, signal or ground • short circuit to power, signal or ground • High resistance to power, signal or ground.
Wiring systems	May include but not limited to: • common multi-stand conductor • various wire gauges and insulation types • twisted pair (CAN-bus network wiring) • shielded wire (audio speaker wiring).

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • location of relevant sources of information on vehicle electrical circuits and wiring systems • operating principles of electrical circuits and wiring systems • relationship of volts, amps and ohms in a vehicle electrical circuit • relationship of current flow and necessary wire gauge • relationship of voltage dropping across a resistive load and the current flowing in the circuit • circuit components, their function and operation in a vehicle electrical circuit • testing principles and processes for checking a vehicle's electrical circuits and wiring systems.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • location of relevant sources of information on vehicle electrical circuits and wiring systems • operating principles of electrical circuits and wiring systems • relationship of volts, amps and ohms in a vehicle electrical circuit • relationship of current flow and necessary wire gauge • relationship of voltage dropping across a resistive load and the current flowing in the circuit • circuit components, their function and operation in a vehicle electrical circuit
Underpinning Skills	Demonstrate skills to:Competency is to be assessed in the workplace or a simulated workplace environment that accurately reflects performance in a real workplace setting. • Assessment is to occur:

	• using standard workplace practices and procedures • following safety requirements • Applying environmental constraints. • Assessment is to comply with relevant: • regulatory requirements • Ethiopian standards • Industry codes of practice. • The following resources must be made available for the assessment of this unit: • technical reference library with various information resources • a range of functioning vehicle electrical circuits, components and wiring systems • functioning light vehicle or vehicles
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level II	
Unit Title	**Check Train Electrical and Electronics Components For Assembly**
Unit Code	**IND TEA2 02 0117**
Unit Descriptor	This unit covers identifying and selecting train electrical and electronics components for assembly from job specifications. It encompasses working safely, interpreting job specifications, identifying components by colour code and markings and following quality procedures and work instructions.

Elements	Performance Criteria
1. Prepare to select electronic components.	1.1 OHS procedures for a given work area are identified, obtained and understood. 1.2 Established OHS risk control measures for work preparation are followed. 1.3 Work instructions are obtained and understood. 1.4 Advice is sought from the work supervisor to ensure the work is co-ordinated effectively with others. 1.5 Materials required for the work are obtained in accordance with established routines and procedures. 1.6 Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety.
2. Select electronic components.	1.1 Electronic ***components*** are selected, sorted and placed in accordance with work instructions and established routines 1.2 Prescribed solutions are used to resolve issues with supply of component. 1.3 Routine quality checks are conducted to ensure components comply with enterprise / industry standards. 1.4 Work is completed in acceptable timeframe given environment and workplace conditions
3. Complete work report.	3.1 Established OHS risk control measures for work completion are followed. 3.2 Work report forms/data sheets on components are completed accurately ***electrical & electronics circuits***

Variable	Range
Components	May include but not limited to: • printed circuit board

	• different electronic apparatus consisting of a chassis • adjustment components • select high voltage, low voltage electrical and electronics devices for job specification
Electrical & electronics circuits	May include but not limited to: • providing the range of contexts • conditions to which the performance criteria apply • interconnections in an environment designed specifically for the purpose.

Evidence Guide	
Critical Aspects of Competence	Demonstrate knowledge and skills to: • Must have a good knowledge and skills on Traction transformer, Traction converter, Traction control, Train Control and Monitoring System, Traction motor, Diesel engine generator, Auxiliary converter, Battery charger, Energy storage
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Types of components encompassing: ➢ resistors, inductors, capacitors, diodes, transistor, integrated circuits, printed circuit boards, sub-assemblies, and mounting/enclosing, connection and termination hardware.
Underpinning Skills	Demonstrate skills of: • The physical features and primary characteristic of components encompassing: ➢ features include shape, size and connections ➢ Characteristics include parameter and power ratings and polarity. ➢ Methods of identifying and marking of component ratings. ➢ Identifying and handling static sensitive components. ➢ selection of components
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level II	
Unit Title	**Assemble and Test Train Electrical Devices**
Unit Code	**IND TEA2 03 0117**
Unit Descriptor	This unit covers assembly, setting up and testing as directed in electric connection drawings. It encompasses safe working practices, checking train electrical components, assembling components to form a basic train electrical drawings, installing and testing basic operating system.

Elements	Performance Criteria
1. Assemble train electrical devices.	1.1 OHS procedures for a given work area are identified, obtained and understood through established routines and procedures. 1.2 Established OHS risk control measures and procedures in relation electrical train devices and use electric connection drawings are followed. 1.3 Advice is sought from the work supervisor to ensure the work is co-ordinated effectively with others 1.4 ***Electrical devices***, components, operating system and application electrical connection drawings are obtained in accordance with established routines and checked as meeting requirements.. 1.5 Electrical Train components are assembled and connected in accordance with Train manufacturer's instructions. 1.6 In ***test and assemble electrical devices***, Routine quality checks are carried out in accordance with work instructions. 1.7 Procedures are followed for referring non-routine events to immediate supervisor for directions
2. Install operating system	2.1 Established OHS risk control measures and procedures for carrying out the work are followed 2.2 Minimum electrical engineering and TVET levels requirements are established that are appropriate for the operating system that will be installed. 2.3 Application electric connection drawing is installed to default following measuring installation instruction. 2.4 Routine quality checks are carried out in accordance with work instructions 2.5 Procedures for referring non-routine events to immediate supervisor for directions are followed.

3. Test Train electrical devices assemble	3.1 Established OHS risk control measures and procedures for carrying out the work are followed 3.2 Faults are identified as being the result of 3.3 The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures. 3.4 Work is carried out efficiently without waste of materials or damage to apparatus, circuits, the surrounding environment or services
4. Complete work and report.	4.1 OHS risk control work completion measures and procedures are followed. 4.2 Work area is cleaned and made safe in accordance with established procedures. 4.3 Work supervisor is notified of the completion of the work in accordance with established procedures.

Variable	**Range**
Electrical devices	May include but not limited to: • Assembly train electrical devices for Primary box • Assembly train electrical devices for input box one • Assembly train electrical devices for input box two • Assembly train electrical devices for fuse box
Test and assemble electrical devices	May include but not limited to: • Installed to default following measuring:-assembly, installation instruction. • different electrical apparatus consisting of a chassis • use only assembly and circuit connection depend on drawings

Evidence Guide	
Critical Aspects of Competence	Demonstrate knowledge and skills to: • It must be assured that Minimum electrical engineering and TVET levels requirements are established that are appropriate for the operating system that will be installed • It must be aware of installing train electrical connection drawings by following measuring installation instructions
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Electrical train components are assembled and connected in accordance with Train manufacturer's instructions. • In test and assemble electrical devices, Routine quality checks are carried out in accordance with work instructions. • Procedures are followed for referring non-routine events to immediate supervisor for directions

Underpinning Skills	Demonstrate skills to:: • Assemble train electrical devices for Primary box • Assemble train electrical devices for input box one • Assemble train electrical devices for input box two • Assemble train electrical devices for fuse box
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level II	
Unit Title	**Assemble Measuring Equipment in an Electrical Train**
Unit Code	**IND TEA2 04 0117**
Unit Descriptor	This unit describes the performance Must be fitted with on board metering which measures the total energy consumed for Intercity Express Programs (IEP) unites the system shall log data on board the IEP unit.

Elements	Performance Criteria
1. Prepare to undertake measurements	1.1 Nature and scope of work requirements are identified and confirmed 1.2 Train Health and Safety (THS) requirements and appropriate precautions are identified and applied 1.3 Procedures and instructions, including Train manuals and specifications, are sourced and used to determine job operators requirements 1.4 Measuring methods appropriate to the circumstances are selected total energy and prepared according to train operators procedures 1.5 Measuring equipment is sourced and prepared 1.6 Warnings relating to working with precision tools and equipment are observed
2. Conduct measurements and analyse results	2.1 Measurement is conducted according to workplace procedures and equipment manufacturer specifications 2.2 Measurement results are compared with manufacturer specifications to indicate compliance or non-compliance 2.3 Measurements are documented and recommendations made 2.4 Reports are processed according to workplace procedures
3. Maintain measuring equipment	3.1 Information required for equipment maintenance is accessed from manufacturer specifications and interpreted 3.2 Measuring equipment is checked against manufacturer recommendations and recommended ***maintenance methods*** are confirmed to ensure safe and accurate operating condition 3.3 Measuring equipment is maintained and stored according to manufacturer specifications 3.4 Equipment checks are completed without causing damage to component or system

	3.5 ***Workplace documents*** are completed according to workplace procedures

Variable	Range
Maintenance methods	May include but not limited to: • routine maintenance to tools and equipment as per schedules • calibrating or adjusting measuring equipment • minor repairs to tools and equipment • Documenting or tagging equipment as faulty or out-of-service.
Workplace documents	May include but not limited to: • fault or defect reporting documents • out-of-service reports • job or organisation work specifications and requirements.

Evidence Guide	
Critical Aspects of Competence	Demonstrate knowledge and skills: • identify and minimize risk to operator and others • contribute to activities that implement and follow workplace procedures • problem-solving skills to: • recognize a workplace problem or a potential problem • Refer problems outside area of responsibility to appropriate person.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • WHS regulations/requirements, equipment, material and personal safety requirements • dangers of working with raised vehicles • principles of electrical brake system operating • brake bleeding methods • methods of using and applying lubricants and sealants • Methods of fitting gaskets. • types of wheel bearings and their adjustment methods
Underpinning Skills	Demonstrate skills of: • analytical skills to identify and analyse technical information • communication skills to: ➢ follow verbal and written instructions ➢ communicate information relating to the correct and safe use of equipment • literacy skills to: ➢ read and follow Original Equipment Manufacturer (OEM) maintenance information and measuring equipment use ➢ read and follow information on operating

	procedures and OEM repair guidelines ➢ numeracy skills to read and interpret metric and non-metric systems of measurement • self-management skills to: ➢ locate and identify appropriate measuring equipment ➢ recognizes limitations and seek timely advice ➢ follow basic workplace documentation, such as operating procedures • technical skills to: ➢ select measuring equipment appropriate to the task ➢ use measuring equipment safely ➢ maintain measuring equipment using appropriate techniques ➢ calibrate or adjust measuring equipment ➢ identify defects in measuring equipment and mark for repair ➢ store measuring equipment according to manufacturer and workplace procedures • technology skills to: ➢ use manual, electronic and digital measuring equipment ➢ use workplace technology to assist with work practices
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level II	
Unit Title	**Install Train system Single Path Electrical Circuits D.C. and A.C. Circuits**
Unit Code	**IND TEA2 05 0117**
Unit Descriptor	This unit covers ascertaining correct operation of single phase A.C. and D.C. circuits and solving circuit problems as they apply to servicing, fault finding, installation, and compliance work functions. It encompasses safe working practices, multiphase circuit arrangements, issues related to protection, power factor and MEN systems and solutions to circuit problems derived from calculated and measured parameters.

Elements	Performance Criteria
1. Prepare to solve low voltage A.C. circuit problems.	1.1 OHS procedures for a given work area are identified, obtained and understood. 1.2 Established OHS risk control measures and procedures in preparation for the work are followed. 1.3 Safety hazards, which have not previously been identified, are noted and established risk control measures are implemented. 1.4 The nature of the circuit(s) problem is obtained from documentation or from work supervisor to establish the scope of work to be undertaken. 1.5 Advice is sought from the work supervisor to ensure the work is coordinated effectively with others. 1.6 Sources of materials that may be required for the work are established in accordance with established procedures. 1.7 Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety.
2. Solve low voltage A.C. circuit problems.	2.1 OHS risk control measures and procedures for carrying out the work are followed. 2.2 The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures 2.3 ***Operating systems*** of Circuits/machines/plant are checked as being isolated where necessary in strict accordance OHS requirements and procedures. 2.4 ***Connection systems***/methods are used to solve circuit problems from measure and calculated values as they apply to single low voltage circuit.

	2.5 Unexpected situations are dealt with safely and with the approval of an authorised person. 2.6 Problems are solved without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practices.
3. Complete work and document problem solving activities.	3.1 OHS work completion risk control measures and procedures are followed. 3.2 Work site is cleaned and made safe in accordance with established procedures. 3.3 Justification for solutions used to solve circuit problems is documented. 3.4 Work completion is documented and an appropriate person or persons notified in accordance with established procedures.

Variable	**Range**
Operating system	May include but not limited to: • Determining the operating parameters of an existing circuit • Altering an existing circuit to comply with specified operating parameters • Developing circuits to comply with a specified function and operating parameters
Connection systems	May include but not limited to: • demonstrated in relation to single source series, parallel and series-parallel D.C. circuits as they apply to install related to installation,

Evidence Guide	
Critical Aspects of Competence	Demonstrate knowledge and skills: • use of the CRO to measure D.C. and A.C. voltage levels • sinusoidal voltage generated by a single turn coil rotated in a uniform magnetic fields terms 'period', 'maximum value', 'peak-to-peak value', 'instantaneous value', 'average value', 'Root-Mean-Square (RMS) value', in relation to a sinusoidal waveform. • Determining the voltage, current resistances from measure of given values of any tow of these qualities. • Methods used to measure single phase power factor. • using manufacturers catalogues to select power factor equipment for a particular installation
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Alternating Current Quantities encompassing: ➢ sine, cosine and tangent ratios of a right angle triangle ➢ Pythagoras Theorem to a right angle triangle.

	➢ Calculation of the instantaneous value of induced voltage of a generated sinusoidal waveform. ➢ Measurement of instantaneous, peak, peak-to-peak values and the period of a sinusoidal waveform. ➢ Calculation of Root-Mean-Square (RMS) value and frequency of a sinusoidal waveform from values of peak voltage and period.
Underpinning Skills	Demonstrate skills to: • Phaser Diagrams encompassing: ➢ purpose of phaser diagrams ➢ 'In-phase', 'out-of-phase', 'phase angle'' lead' and 'lag'. ➢ Phase angle between two or more alternating quantities from a given sinusoidal waveform diagram. ➢ Convention for representing voltage, current and the reference quantity in a phaser diagram. ➢ Drawing phaser diagrams to show the relationship between two or more A.C. alues of voltage and/or current. ➢ Determination of phase relationship between two or more sinusoidal waveforms from a given diagram and measurements. • Single Element A.C. circuits encompassing: ➢ setting up and connect a single-source resistive A.C. circuit and take voltage and current measurements to determine the resistance ➢ relationship between voltage drops and current in resistive A.C. circuit ➢ applications of resistive A.C. circuits ➢ Defining 'inductive reactance'. ➢ Calculation of inductive reactance for a given inductor and the relationship between inductive reactance and frequency. ➢ Applying Ohm's Law to determine voltage, current of inductive reactance in a purely inductive A.C. circuit given any two to these quantities. ➢ Applications of inductive A.C. circuits. ➢ calculation of capacitive reactance ➢ Applying Ohm's Law to determine voltage, current or capacitive reactance in a purely capacitive A.C. circuit given any two of the quantities. ➢ applications of capacitive A.C. circuits • RC and RL Series A.C. circuits encompassing: ➢ Impedance and impedance triangle. ➢ Determining the impedance, current and voltages for a series RC circuit given the resistance, capacitance and supply voltage.

	➢ drawing and labelling the impedance triangle for a series RC circuit ➢ drawing phaser diagrams for a series RC circuit ➢ AS/NZS 3000 requirements for the installation of capacitors. ➢ Examples of capacitive components in power circuits and systems and the effect on the phase relationship between voltage and current. ➢ Determining the impedance, current and voltages for a series RL circuit given the resistance, inductance and supply voltage. ➢ drawing and labelling the impedance triangle for a series RL circuit ➢ drawing the equivalent circuit of a practical inductor ➢ Draw phaser diagrams for a series RL circuit. ➢ examples of inductive components in power circuits and systems and describe their effect on the phase relationship between voltage and current • RLC Series A.C. circuits encompassing: ➢ Measuring component voltages in a series RLC circuit and using a phaser diagram to determine the supply voltage and phase angle between circuit voltage and circuit current. ➢ Determining the impedance, current and voltages for a series RLC circuit given resistance, inductance, capacitance and supply voltage. ➢ Drawing and labelling the impedance triangle for a series RLC circuit. ➢ Calculation of total impedance for a series RLC circuit. ➢ Calculation of voltage drop for cables using the values for reactance and A.C. resistance from AS/NZS 3008. ➢ Comparison of current limiting characteristics of inductors and resistors. ➢ practical examples of RLC series circuits • Parallel A.C. Circuits encompassing: ➢ Determining the branch currents of a parallel circuit that contain RL, RC or LC in two branches. ➢ Using a phaser diagram to determine the total circuit current and phase angle in parallel RL, RC or LC circuits. ➢ Determining the total circuit impedance of parallel RL, RC or LC circuits. ➢ Measuring the branch currents in a parallel RLC circuit and use a phaser diagram to determine the total current and phase angle between circuit voltage and circuit current. ➢ Determining the branch impedances, branch

	currents and phase angles voltages for a parallel RLC circuit given resistance, inductance, capacitance and supply voltage. ➢ Calculation of impedance for a parallel RLC circuit. ➢ Practical examples of parallel circuits. • Power in an A.C. circuit encompassing: ➢ Difference between true power, apparent power and reactive power and the units in which these quantities are measured. ➢ drawing the power triangle to show the relationships between true power, apparent power and reactive power ➢ Defining the term "power factor" and phase angle. ➢ Methods used to measure single phase power, energy and demand. • Power Factor Improvement encompassing: ➢ Effects of low power factors ➢ Requirements for power factor improvement. ➢ Methods used to improve low power factor of an installation. ➢ local supply authority and AS/NZS 3000 wiring rules requirements regarding the power factor of an installation and power factor improvement equipment. • Harmonics and Resonance Effect in A.C. Systems encompassing: ➢ Term "harmonic" in relation to the sinusoidal waveform of an A.C. power system. ➢ Sources in A.C. systems that produce harmonics. ➢ Problems that may arise in A.C. circuits as a result of harmonics and how these are overcome. ➢ methods and test equipment used to test for harmonics ➢ methods used to reduce harmonics in A.C. power system ➢ Conditions in a series A.C. circuit that produce resonance. ➢ dangers of series resonance circuits ➢ Conditions in a parallel A.C. circuit that produce resonance. • dangers of parallel resonance circuits and the local supply authority requirements concerning harmonics and resonance effect in A.C. power systems: ➢ Features of a multiphase system. ➢ Comparison of voltages generated by single and multiphase alter. ➢ Calculation of R.M.S. value of voltage generated in each phase given the maximum value. ➢ Relationship between the phase alternator and the

	conventions for identifying each. ➢ Term "phase sequence" (also, referred to as "phase rotation"). ➢ determining the phase sequence of a single phase suppl. ➢ Phase relationship between line and phase voltages and line and phase currents of a star-connected system. ➢ Determining the R.M.S. value of line and phase voltage given any one of these quantities. ➢ Determining the R.M.S. value of line and phase current given any one of these quantities. ➢ Terms "balanced load" and "unbalanced loads. ➢ Phase relationship between line and phase voltages and line and phase currents of a delta-connected system. ➢ Determining the R.M.S. value of line and phase voltage given any one of these quantities. ➢ Determining the R.M.S. value of line and phase current given any one of these quantities. ➢ limitations and uses of open delta connections ➢ effect of a reversed phase winding of a delta connected transformer ➢ Example of loads in typical power systems.
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level II	
Unit Title	**Participate in Workplace Communication**
Unit Code	**IND TEA2 06 0117**
Unit Descriptor	This unit covers the knowledge, skills and attitudes required to gather, interpret and convey information in response to workplace requirements.

Elements	Performance Criteria
1. Obtain and convey workplace information	1.1 Specific and relevant information is accessed from ***appropriate sources***. 1.2 Effective questioning, active listening and speaking skills are used to gather and convey information. 1.3 Appropriate ***medium*** is used to transfer information and ideas. 1.4 Appropriate non- verbal communication is used. 1.5 Appropriate lines of communication with supervisors and colleagues are identified and followed. 1.6 Defined workplace procedures for the location and ***storage*** of information are used. 1.7 Personal interaction is carried out clearly and concisely.
2. Participate in workplace meetings and discussions	2.1 Team meetings are attended on time. 2.2 Own opinions are clearly expressed and those of others are listened to without interruption. 2.3 Meeting inputs are made consistent with the meeting purpose and ***protocols*** established. 2.4 ***Workplace interactions*** are conducted in a courteous manner. 2.5 Questions about simple routine workplace procedures and matters concerning working conditions of employment are asked and responded. 2.6 Meetings outcomes are interpreted and implemented.
3. Complete relevant work related documents	3.1 Range of ***forms*** relating to conditions of employment is completed accurately and legibly. 3.2 Workplace data is recorded on standard workplace forms and documents. 3.3 Basic mathematical processes are used for routine calculations. 3.4 Errors in recording information on forms/ documents are identified and properly acted upon. 3.5 Reporting requirements to supervisor are completed according to organizational guidelines.

Variable	Range
Appropriate sources	May include but not limited to: • Team members • Suppliers • Trade personnel • Local government and Industry bodies
Medium	May include but not limited to: • Memorandum • Circular • Notice • Information discussion • Follow-up or verbal instructions & Face to face communication
Storage	May include manual filing and computer-based filing systems
Protocols	May include but not limited to: • Observing meeting • Compliance with meeting decisions • Obeying meeting instructions
Workplace interactions	May include but not limited to: • Face to face • Telephone • Electronic and two way radio • Written including electronic, memos, instruction and forms, non-verbal including gestures, signals, signs and diagrams
Forms	May include but not limited to personnel forms, telephone message forms, safety reports

Evidence Guide	
Critical Aspects of Competency	Demonstrates skills and knowledge to: • Prepare written communication following standard format of the organization • Access information using communication equipment • Make use of relevant terms as an aid to transfer information effectively • Convey information effectively adopting the formal or informal communication
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Effective communication • Different modes of communication • Written communication • Organizational policies • Communication procedures and systems • Technology relevant to the enterprise and the individual's work responsibilities

Underpinning Skills	Demonstrate skills to: • Follow simple spoken language • Perform routine workplace duties following simple written notices • Participate in workplace meetings and discussions • Complete work related documents • Estimate, calculate and record routine workplace measures • Do basic mathematical processes of addition, subtraction, division and multiplication • relate to people of social range in the workplace • Gather and provide information in response to workplace Requirements
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level II	
Unit Title	**Work in Team Environment**
Unit Code	**IND TEA2 07 0117**
Unit Descriptor	This unit covers the skills, knowledge and attitudes to identify role and responsibility as a member of a team.

Elements	Performance Criteria
1. Describe team role and scope	1.1 The ***role and objective of the team*** are identified from available ***sources of information***. 1.2 Team parameters, reporting relationships and responsibilities are identified from team discussions and appropriate external sources.
2. Identify own role and responsibility within team	2.1 Individual role and responsibilities within the team environment are identified. 2.2 Roles and responsibility of other team members are identified and recognized. 2.3 Reporting relationships within team and external to team are identified.
3. Work as a team member	3.1 Effective and appropriate forms of communications are used and interactions undertaken with team members who contribute to known team activities and objectives. 3.2 Effective and appropriate contributions are made to complement team activities and objectives, based on individual skills and competencies and ***workplace context***. 3.3 Protocols are observed in reporting using standard operating procedures. 3.4 Contribution is made to the development of team work plans based on an understanding of team's role and objectives and individual competencies of the members.

Variable	Range
Role and objective of team	May include but not limited to: • Work activities in a team environment with enterprise or specific sector • Limited discretion, initiative and judgment maybe demonstrated on the job, either individually or in a team environment
Sources of information	May include but not limited to: • Standard operating and/or other workplace procedures • Job procedures • Machine/equipment manufacturer's specifications and instructions

	• Organizational or external personnel • Client/supplier instructions • Quality standards • OHS and environmental standards
Workplace context	May include but not limited to: • Work procedures and practices • Conditions of work environments • Legislation and industrial agreements • Standard work practice including the storage, safe handling and disposal of chemicals • Safety, environmental, housekeeping and quality guidelines

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • Operate in a team to complete workplace activity • Work effectively with others • Convey information in written or oral form • Select and use appropriate workplace language • Follow designated work plan for the job • Report outcomes
Underpinning Knowledge and Attitude	Demonstrate knowledge of: • Communication process • Team structure • Team roles • Group planning and decision making
Underpinning Skills	Demonstrate skills to: • Communicate appropriately, consistent with the culture of the workplace
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level II	
Unit Title	**Develop Business Practice**
Unit Code	**IND TEA2 08 0117**
Unit Descriptor	This unit covers knowledge, skills and attitude required to establish a business operation from a planned concept. It includes researching the feasibility of establishing a business operation, planning the setting up of the business, implementing the plan and reviewing operations once commenced, customer handling, developing and maintaining business relationships.

Elements	Performance Criteria
1. Identify business opportunities and business skills	1.1 The concept of paradigm shift and means of divergent thinking are elaborated and strategies to look beyond the boundaries are discussed. 1.2 ***Unusual business opportunities*** are identified. 1.3 Feasibility on ***business skills and personal attributes*** is assessed and matched against those perceived as necessary for a particular business opportunity. 1.4 New behavior on how problems can be the pivotal source of business opportunity is elaborated and experience taken. 1.5 Assistance sought with feasibility study of ***specialist and relevant parties*** is discussed, as required. 1.6 Impact of emerging or changing technology, including e-commerce, on business operations is evaluated. 1.7 Practicability of business opportunity is assessed in line with perceived ***business risks***, returns sought, personal preferences and resources available. 1.8 Business plan is revised in accordance with the identified opportunities.
2. Plan for the establishment of business operation	2.1 Organizational structure and operations are determined and documented. 2.2 Procedures are developed and documented to guide operations. 2.3 Financial backing is secured for business operation. 2.4 Business legal and regulatory requirements are identified and compiled. 2.5 ***Human and physical resources*** required to commence business operation are determined. 2.6 Recruitment and procurement strategies are developed.

3. Implement Business Development Plan	3.1 Physical and human resources are obtained to implement business operation. 3.2 ***Operational unit*** is established to support and coordinate business operation. 3.3 Simulations on the development plan are well discussed and understood. 3.4 Implementation manual is discussed and understood. 3.5 Marketing the business operation is undertaken. 3.6 Monitoring process is developed and implemented for managing operation. 3.7 ***Legal documents*** are carefully maintained and relevant records kept and updated to ensure validity and accessibility. 3.8 Contractual procurement rights for goods and services including ***contracts with relevant people*** are negotiated and secured as required in accordance with the business plan. 3.9 Options for leasing/ownership of business premises are identified and contractual arrangements completed in accordance with the business plan.
4. Review implementation process and take corrective measures	4.1 Review process is developed and implemented for implementation of business operation. 4.2 Improvements in business operation and associated management process are identified. 4.3 Identified improvements are implemented and monitored for effectiveness.
5. Establish contact with customers and clarify needs of customer	5.1 Persuasion strategies are developed and discussed. 5.2 Welcoming customer environment is maintained and Customer is greeted warmly according to enterprise policies and procedures. 5.3 Information is provided to satisfy customer needs. 5.4 Information on customers and service history is gathered for analysis. 5.5 Customer data is maintained to ensure database relevance and currency. 5.6 Customer needs are accurately assessed against the products/services of the enterprise. 5.7 Customer details are documented clearly and accurately in required format. 5.8 Negotiations are conducted in a business-like and professional manner.

	5.9 Benefits for all parties are maximized in the ***negotiation through use of established techniques*** and in the context of establishing long term relationships. 5.10 The results of negotiations are communicated to appropriate colleagues and stakeholders within appropriate timeframes. 5.11 ***Opportunities to maintain regular contact*** with customers are identified and taken-up.
6. Develop and Maintain Business Relationship	6.1 Features and benefits of products/services provided by the enterprise are described/ recommended to meet customer needs. 6.2 Alternative sources of information/advice are discussed with the customer. 6.3 Information needed is pro-actively sought, reviewed and acted upon to maintain sound business relationships. 6.4 Agreements are honored within the scope of individual responsibility. 6.5 Adjustments to agreements are made in consultation with the customer and information shared with appropriate colleagues. 6.6 Relationships are nurtured through regular contact and use of effective interpersonal and communication styles.

Variable	Range
Unusual Business opportunities	May include but not limited to: • Public holidays • Ceremonies • Natural disaster • Campaigns
Business opportunities	May include but not limited to: • Expected financial viability • Skills of operator • Amount and types of finance available • Returns expected or required by owners • Likely return on investment • finance required • Lifestyle issues
Business skills and personal attributes	May include but not limited to: • Technical and/ or specialist skills • Managerial skills • Entrepreneurial skills • Taking calculated risk skills • Willingness to take calculated risks • Willingness to work under pressure

Specialist and relevant parties	May include but not limited to: • Chamber of commerce • Financial planners and financial institution representatives, business planning specialists and marketing specialists • Accountants • Lawyers and providers of legal advice • Government agencies • Industry/trade associations • Online gateways • Business brokers/business consultants
Business risks	May include but not limited to: • Occupational health and safety • Environmental risks • Relevant legislative requirements • Security of investment • Market competition • Security of premises/location • Supply and demand • Resources available
Human and physical resources	May include but not limited to: • Software and hardware • Office premises and equipment • Communications equipment • Specialist services through outsourcing, contracting and consultancy • Staff • Vehicles
Operational unit	May include but not limited to different departments, sections, teams, divisions, etc. staffed with required personnel and equipped to service and support business
Legal documents	May include but not limited to: • Partnership agreements, constitution documents, statutory books for companies (register of members, register of directors and minute books), certificate of Incorporation, franchise agreements and financial documentation, appropriate software for financial records • Occupational Health and Safety (OHS) • Recordkeeping including personnel, financial, taxation, and environmental
Contracts with relevant people	May include but not limited to: • business owners, suppliers, employees, agents, land owners, distributors, customers or any person with whom the business has, or seeks to have, a performance-based relationship
Negotiation techniques	May include but not limited to: • Identification of goals, limits • Clarification of needs of all parties

	• Listening and questioning • Non-verbal communication techniques • Appropriate language and situation • Bargaining • Developing options • Appropriate cultural behavior • Confirming agreements
Opportunities to maintain regular contact	to maintain regular contact with customers may include: • Informal social occasions • Ceremonies • Exhibitions • Industry functions • Association membership • Co-operative promotions • Program of regular telephone contact

Evidence Guide	
Critical Aspects of Competence	Demonstrates knowledge and skills in: • that a business operation has been planned and implemented from initial research of feasibility of the business and completion of the plan, through implementing the plan and commencing operations • the ability to evaluate the results of research and assess the likely viability and practicability of a business opportunity, taking into account the current business/market climate and resources available • treating customers in a courteous and professional manner • building and maintaining relationships to achieve successful business outcomes
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Paradigm shift • Unusual business opportunities • Feasibility study • Business structure • Federal and regional government legislative requirements affecting business operations, especially in regard to OHS, EEO, industrial relations and anti-discrimination • Procurement and recruitment strategy • Operational unit • Monitoring process • Business systems and operations • Relevant marketing, management, sales and financial concepts • Options for financing • Business premises and ownership • Lease • Methods for researching business opportunities

	• Methods of identifying relevant specialist services to complement the business • Advertising and promotion • Distribution and logistics • Terms and conditions in contractual agreement • Record keeping duties • Operational factors relating to the business (provision of professional services, products) • Customer need assessment • Source of information • Operational knowledge of enterprise policies and procedures in regard to: ➢ customer service ➢ dealing with difficult customers ➢ maintenance of customer databases ➢ allocated duties/responsibilities ➢ General knowledge of the range of enterprise merchandise and services, location of telephone extensions and departments/sections • Basic operational knowledge of industry/workplace codes of practice in relation to customer service • negotiation and communication techniques appropriate to negotiations that may be of significant commercial value
Underpinning Skills	Demonstrate skills of: • Hunting and exploiting unusual business opportunities • Interpreting legal requirements, company policies and procedures and immediate, day-to-day demands • Conducting feasibility study • Developing new behavior • Using technology • Marketing skills • Business planning skills • Entrepreneurial skills • Time management skills • Customer handling skills • Communication skills including questioning, clarifying, reporting, and giving and receiving constructive feedback • Technical and analytical skills to interpret business documents, reports and financial statements and projections • Ability to relate to people from a range of social, cultural and ethnic backgrounds and physical and mental abilities • Problem solving skills to develop contingency plans • Using computers and software packages to record and manage data and to produce reports • Interpreting business information, numeracy skills for data analysis to aid research • Negotiation to conduct business activities

	• Research to identify a business opportunity and to conduct a feasibility study • Analytical skills to assess personal attributes and to identify business risks • Observation skills for identifying appropriate people, resources and to monitor work • Persuasion and networking skills • Welcoming customers • Information seeking skills to collect, organize and understand information related to collating and analyzing customer information to identify needs • Establish diagnostic processes which identify and recommend improvements to customer service
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level II	
Unit Title	**Standardize and Sustain 3S**
Unit Code	**IND TEA2 09 0117**
Unit Descriptor	This unit of competence covers the knowledge, skills and attitudes required by worker to standardize and sustain 3S to his/her workplace. It covers responsibility for the day- to-day operations of the workplace and ensuring that continuous improvements of Kaizen elements are initiated and institutionalized.

Elements	Performance Criteria
1. Prepare for work.	1.1 Work instructions are used to determine job requirements, including method, material and equipment. 1.2 Job specifications are read and interpreted following working manual. 1.3 ***OHS requirements***, including dust and fume collection, breathing apparatus and eye and ear personal protection needs are observed throughout the work. 1.4 ***Safety equipment and tools*** are identified and checked for safe and effective operation. 1.5 ***Tools and equipment*** are prepared and used to implement 3S.
2. Standardize 3S.	2.1 Plan is prepared and used to standardize 3S activities. 2.2 ***Tools and techniques*** to standardize 3S are prepared and implemented based on ***relevant procedures***. 2.3 Checklists are followed for standardize activities and ***reported*** to ***relevant personnel***. 2.4 The workplace is kept to the specified standard. 2.5 Problems are avoided by standardizing activities.
3. Sustain 3S.	3.1 Plan is prepared and followed to standardize 3S activities. 3.2 ***Tools and techniques*** to sustain 3S are discussed, prepared and implemented based on relevant procedures. 3.3 Workplace is inspected regularly for compliance to specified standard and sustainability of 3S techniques. 3.4 Workplace is cleaned up after completion of job and before commencing next job or end of shift. 3.5 Situations are identified where compliance to standards is unlikely and actions specified in procedures are taken. 3.6 Improvements are recommended to lift the level of compliance in the workplace. 3.7 Checklists are followed to sustain activities and report to relevant personnel.

	3.8Problems are avoided by sustaining activities.

Variable	Range
OHS requirements	May include but not limited to: • Are to be in accordance with legislation/ regulations/codes of practice and enterprise safety policies and procedures. This may include protective clothing and equipment, use of tooling and equipment, workplace environment and safety, handling of material, use of firefighting equipment, enterprise first aid, hazard control and hazardous materials and substances. • Personal protective equipment is to include that prescribed under legislation/regulations/codes of practice and workplace policies and practices. • Safe operating procedures are to include, but are not limited to the conduct of operational risk assessment and treatments associated with workplace organization. • Emergency procedures related to this unit are to include but may not be limited to emergency shutdown and stopping of equipment, extinguishing fires, enterprise first aid requirements and site evacuation.
Safety equipment and tools	May include but not limited to: • dust masks/ goggles • glove • working cloth • first aid and safety shoes
Tools and equipment	May include but not limited to: • paint • hook • sticker • signboard • nails • shelves • chip wood • sponge • broom • pencil • shadow board/ tools board
Tools and techniques	May include but not limited to: • 5S Job Cycle Charts • Visual 5S • The Five Minute 5S • Standardization level checklist • 5S checklist • The five Whys and one How approach(5W1H) • Suspension • Incorporation and Use Elimination

Relevant procedures	May include but not limited to: • Assign 3S responsibilities • Integrate 3S duties into regular work duties • Check on 3S maintenance level • OHS measures such as signage, symbols / coding and labeling of workplace and equipment • Creating conditions to sustain your plans • Roles in implementation
Reporting	May include but not limited to: • verbal responses • data entry into enterprise database • brief written reports using enterprise report formats
Relevant personnel	May include but not limited to: • supervisors, managers and quality managers • administrative, laboratory and production personnel • internal/external contractors, customers and suppliers
Tools and techniques	May include but not limited to: • 5S slogans • 5S posters • 5S photo exhibits and storyboards • 5S newsletter • 5S maps • 5S pocket manuals • 5S department/benchmarking tours • 5S months • 5S audit • Awarding system • Big cleaning day • Patrolling system may include: ➢ Top management Patrol ➢ 5S Committee members and Promotion office Patrol ➢ Mutual patrol ➢ Self-patrol ➢ Checklist and Camera patrols

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • Discuss the relationship between Kaizen elements. • Standardize and sustain 3S activities by applying appropriate tools and techniques.
Underpinning Knowledge and Attitudes	Demonstrates knowledge of: • Elements of Kaizen • Ways to improve Kaizen elements • Benefits of improving kaizen elements • Relationship between Kaizen elements • The fourth pillar of 5S • Benefits of standardizing and sustaining 3S

	• Procedures for standardizing and sustaining 3S activities • Tools and techniques to sustain 3S • Relevant Occupational Health and Safety (OHS) and environment requirements • Plan and report • Method of communication
Underpinning Skills	Demonstrates skills of: • improving Kaizen elements by applying 5S • standardizing and sustaining procedures and techniques to avoid problems • technical drawing • procedures to standardizing 3S activities • analyzing and preparing shop layout of the workplace • standardizing and sustaining checklists • preparing and implementing tools and techniques to sustain 3S • working with others • reading and interpreting documents • observing situations • solving problems by applying 5S • communication skills • preparing labels, slogans, etc. • gathering evidence by using different means • using Kaizen board properly in accordance the procedure • reporting activities and results using report formats
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

NTQF Level III

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Install and Assemble Auxiliary CKT in Electrical Train**
Unit Code	**IND TEA3 01 0117**
Unit Descriptor	This unit describes the performance outcomes required to install auxiliary CKTs and assembly, test, charge, jump-start, and remove and replace train batteries. The unit also identifying and confirming work requirements; preparing for work; servicing, testing and charging batteries; and completing work finalisation processes, including clean-up and documentation.

Elements	Performance Criteria
1. Prepare to test and inspect battery	1.1 Nature and scope of work requirements are identified and confirmed 1.2 ***Workplace Health and Safety (WHS) requirements***, including individual state and territory regulatory requirements and ***Personal Protective Equipment (PPE)*** needs, are observed throughout the work 1.3 ***Safe operating procedures*** and information such as work procedures and specifications are sourced 1.4 ***Technical information*** is accessed from manufacturer and component supplier specifications and interpreted 1.5 ***Tools, equipment*** and ***materials*** are identified and prepared 1.6 Warnings in relation to working with batteries are observed
2. Test and service battery	2.1 ***Service and maintenance methods*** are carried out according to workplace procedures and manufacturer and component supplier specifications 2.2 Electrolyte levels are checked and topped up where appropriate according to service and maintenance methods 2.3 Batteries and terminals are cleaned according to work procedures 2.4 Battery voltage and load checks are conducted to confirm service repair action 2.5 Battery is charged, jump-started or replaced
3. Charge battery	3.1 Technical information for charging is accessed from manufacturer and component supplier specifications and is correctly interpreted 3.2 Components, tools and equipment to complete work

	are identified, selected and prepared according to work procedures 3.3 Electrolyte levels are checked and topped up according to site procedures 3.4 Batteries are charged according to work procedures and component manufacturer and supplier recommendations
4. Carry out jump-start procedures to vehicle	4.1 Technical information is accessed from manufacturer and component supplier specifications and is correctly interpreted 4.2 Battery voltage is identified and vehicle and equipment are confirmed as being appropriate to jump-start procedures 4.3 Leads are connected and disconnected in correct sequence and polarity 4.4 Work is carried out without causing damage to the train vehicle involved and equipment being used
5. Remove and replace battery	5.1 Battery is removed from vehicle according to the work procedures, and component manufacturer and supplier recommendations 5.2 Battery is replaced in line with vehicle electrical and physical specifications and measurements 5.3 Correct secure battery fitment is confirmed 5.4 Battery terminals are reconnected and tightened
6. Retest battery	6.1 Test methods are implemented according to workplace procedures and manufacturer and component supplier specifications 6.2 Test results are compared with manufacturer and component supplier specifications 6.3 Results are documented with evidence, and supporting information is recorded
7. Prepare vehicle and equipment for delivery to customer after battery is replaced	7.1 Final inspection is made to ensure work is to workplace expectations 7.2 Train vehicle is cleaned to workplace expectations and presented ready for use 7.3 Train electrical system documentation is processed according to workplace procedures.
8. Clean up work area and maintain equipment	8.1 Material that can be reused or recycled is collected and stored according to workplace sustainability practices 8.2 Waste and scrap are removed according to workplace

	practices 8.3 Tools, equipment and work area are cleaned and inspected according to workplace procedures 8.4 Tools and equipment are maintained according to workplace procedures 8.5 Faulty equipment is identified, tagged and isolated according to workplace procedures

Variable	Range
WHS requirements	May include but not limited to: • personal protective clothing and equipment • safe use of tools and equipment • handling of potentially hazardous material and substances • use of fire-fighting equipment • first aid training and response • Control of hazards and hazardous materials.
PPE	May include but not limited to: • safety glasses • protective clothing • Gloves.
Safe operating procedures	May include but not limited to: • conducting operational risk assessments • treatments associated with vehicle movement • toxic substances • electrical safety • machinery movement and operation • manual and mechanical lifting and shifting • Procedures for working in proximity to others and site visitors.
Technical information	May include but not limited to: • Battery manufacturer and component supplier recommendations.
Tools and equipment	May include but not limited to: • hand tools • load testing devices • hydrometer • multimeter • jumper leads • Booster charger.
Materials	May include but not limited to: • battery consumables • Cleaning materials.
Service and maintenance methods	May include but not limited to: • inspecting battery, terminals and leads

	• inspecting battery securing system • cleaning battery and battery compartment or storage area • topping up battery fluid • Testing battery with a hydrometer.

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • should have focus on auxiliary converters, converting power from 2 kW up to 1 MW, ranging from converters for individual loads or batteries, to full onboard power supply for a train • use workplace technology relating to inspecting, servicing and maintaining battery storage systems, including use of specialist tools, measuring equipment and communication devices • report and document results
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • WHS and environmental regulations, requirements, equipment and material, including personal safety requirements • battery testing methods • dangers of working with battery testing equipment • dangers associated with overcharging batteries • operating principles and layout of vehicle battery storage systems • battery inspection procedures • battery service and maintenance procedures • workplace quality procedures • all stand-alone auxiliary converter types, battery chargers and Head End Power (HEP) converters • Compact Converters for the traction chain with integrated auxiliary converters (and battery chargers) connected to the DC link
Underpinning Skills	Demonstrate skills of: • communication skills to: ➢ follow verbal and written instructions ➢ communicate basic information relating to battery safety ➢ clarify workplace instructions and determine job requirements ➢ gain information from appropriate persons and assistance as required • initiative and enterprise skills to: ➢ participate in self-improvement activities ➢ recognize a workplace problem or potential problem • literacy skills to:

	➢ read and follow battery inspection and maintenance information ➢ read and follow information on standard operating procedures and repair guidelines • numeracy skills to: ➢ test, measure and analyze test equipment results compared to desired system performance ➢ assess tolerances and apply accurate measurements and adjustments • planning and organising skills to: ➢ identify risk factors to minimize risk to self and others ➢ contribute to activities that implement and follow standard workplace procedures ➢ problem-solving skills to refer problems outside area of responsibility to appropriate person • self-management skills to: ➢ locate and identify appropriate tools and equipment ➢ locate technical information ➢ recognize limitations and seek timely advice ➢ follow basic workplace documentation, such as operating procedures • teamwork skills to: ➢ work with others and in a team by cooperating with team members ➢ work with diverse individuals and groups • technical skills to: ➢ understand technical information relating to recognizing and reporting unsafe situations ➢ select tools and equipment appropriate to inspecting, servicing and maintaining light and heavy vehicle batteries ➢ use battery servicing and testing tools and equipment safely ➢ maintain tools and equipment using appropriate techniques and standard operating procedures
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Assemble and Install Reception Display and Signal Distribution Equipment**
Unit Code	**IND TEA3 02 0117**
Unit Descriptor	This unit covers the installation, positioning and securing of terrestrial and satellite arrays and associated amplifiers of cables and connection of multiple access outlets and associated equipment. It encompasses safe working practices, selection of antennae and distribution components, installation techniques, use of testing devices and following written and oral instruction and procedures.

Elements	Performance Criteria
1. Prepare to install and set-up reception antennae and signal distribution systems.	1.1 OHS procedures for a given work area are identified, obtained and understood through established routines. 1.2 Established OHS risk control measures are followed in preparation for the work. 1.3 Safety hazards, which have not previously been identified, are reported and advise on risk control measures, are sought from the work supervisor. 1.4 The nature and location of ***signal distribution systems*** is obtained from work supervisor or other appropriate person to establish the scope of work to be undertaken. 1.5 Advice is sought from the work supervisor and/or other appropriate person to ensure the work is co-ordinated effectively with others. Sources of materials that may be required for the work are established in accordance with established routines. 1.6 Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety.
2. Reception antennae and signal distribution systems.	1.5 Established OHS risk control measures for carrying out the work are followed. 1.6 Circuits/components are checked as being isolated where necessary in strict accordance OHS requirements and procedures. 1.7 The optimum location for an antenna of ***install reception display*** is determined from signal tests and limitation imposed by the customer and regulation. Accessories are installed straight and square in the required locations and within acceptable tolerances. 1.8 Cables and conductors are terminated at accessories in accordance with manufacture's specifications and regulatory requirements.

	1.9 Installation is carried out efficiently without waste of materials or damage to apparatus, circuits or the surrounding environment and using sustainable energy practices. 1.10 Procedures for referring non-routine events to immediate supervisor for directions are followed.
3. Set-up reception antennae and signal distribution systems and report.	3.1 OHS work completion risk control measures and procedures are followed. 3.2 Adjustments are made to the antenna and the system to optimise reception at each outlet. 3.3 Work site is cleaned and made safe in accordance with established procedures. 3.4 Work supervisor is notified of the completion of the installation work in accordance with established routines.

Variable	**Range**
Signal distribution systems.	May include but not limited to: • Systems are to consist of multiple outlets for multiple users.
install reception display	May include but not limited to: • Demonstrates about installing, connecting and setting up a typically representative reception antennae and signal distribution systems on at least two occasions.

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Safety characteristics of electrical testing devices, • Chemical cleaning solvents, glues and joining wastes used in electronics, • Safe use of electrical testing device, and • Checks and storage methods for maintaining the safety of testing devices. • Electronic safe working practices • Risk management and assessment of risk encompassing: ➢ Principle and purpose of risk management, and ➢ Processes for conducting a risk assessment • Hazards associated with low-voltage, extra-low voltage and high-currents.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • signal reception • Inadequate / optimum / excessive signal level • Multipath transmission • Types • Operating characteristics

	• TV antenna terminology • Multiple antennas • Assembly and installation
Underpinning Skills	Demonstrate skills to: • Use transmission lines may include: ➢ Types ➢ Characteristic impedance ➢ Attenuation ➢ Bandwidth ➢ Standing waves ➢ Installation • Use antenna distribution systems may include: ➢ Identical and adjacent channel interference ➢ Masthead/distribution amplifiers ➢ Diplexers ➢ Triplexes ➢ Splitters and couplers ➢ "T" networks and existing loop wired networks ➢ practical small distribution system design ➢ Field strength meters ➢ Attenuators ➢ VCR output injection ➢ Installation • Use satellite receivers may include: ➢ Block diagram ➢ Operating characteristics and Installation • Use antenna fault-finding may include: ➢ Common faults ➢ Fault finding and repair ➢ Testing • Assemble parts of an electronic systems and equipment that operate at low-voltage and extra-low voltage, • Assemble parts of an electronic systems and equipment where high-currents are likely. • Identify risks and control measures associated with high-voltage encompassing: ➢ Parts of an electronic systems and equipment that operate at high-voltage, ➢ The terms used - 'touch voltage', 'step voltage', 'induced voltage' and 'creep age' as they relate to the hazards of high-voltage, and ➢ Control measures used for dealing with the hazards of high-voltage. • Identify risks and control measures associated with low voltage encompassing: ➢ Risks associated with installation, fault finding, maintenance and repair. ➢ Control measures before, while and after working on electronic systems or equipment

	➢ Isolation and tagging-off procedures. ➢ Risks and restrictions in working live. ➢ Control measures for working live. ➢ Safety, selection, use, maintenance and care of test equipment encompassing:
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Repair predictable faults in general electronic apparatus**
Unit Code	**IND TEA3 03 0117**
Unit Descriptor	This unit covers identifying predictable faults and repairing by replacement of subassemblies in electronic apparatus. The unit encompasses safe working practices, interpreting circuit diagrams and service manuals, applying logical fault finding procedures, conducting repairs, safety and functional testing and completing the necessary service documentation.

Elements	Performance Criteria
1. Prepare to repair electronic apparatus.	1.1 OHS procedures for a given work area are identified, obtained and understood. 1.2 OHS risk control measures and procedures are followed in preparation for the work. 1.3 The nature of the fault is obtained from documentation or from work supervisor to establish the scope of work to be undertaken. 1.4 Advice is sought from the work supervisor to ensure the work is co-ordinated effectively with others. 1.5 Sources of materials that may be required for the work are established in accordance with established procedures. 1.6 Tools, equipment, testing devices and service manual needed to carry out the work are obtained in accordance with established procedures and checked for correct operation and safety.
2. Find and repair faults.	2.1 OHS risk control measures and procedures for carrying out the work are followed. 2.2 The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures. 2.3 Apparatus is checked as being isolated where necessary in strict accordance OHS requirements and procedures 2.4 ***Predictable Fault*** finding is approached methodically drawing on knowledge of electronic apparatus and circuit using measured and calculated values of apparatus parameters and/or with reference to manufacturer's service manual. 2.5 ***General electronic apparatus*** are dismantled where

	necessary and parts stored to protect them against loss or damage. 2.6 Faulty components are rechecked and their fault status confirmed. Repairs are made in accordance with manufacturer's service guide and supervisor's instructions. 2.7 Apparatus is reassembled and tested for safety and functionality in preparation for return to the customer. 2.8 Unexpected situations are dealt with safely and with the approval of an authorised person. 2.9 Repair activities are carried out efficiently without waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3. Completion and report repair activities.	3.1 OHS work completion risk control measures and procedures are followed. 3.2 Work area is cleaned and made safe in accordance with established procedures. 3.3 Written justification is made for repairs to apparatus. 3.4 Work completion is documented and an appropriate person or persons notified in accordance with established procedures.

Variable	**Range**
Predictable faults	May include but not limited to: • Demonstrates about relation to carrying out repairs of faults in two different general electronic apparatus for a given representative range.
General electronic apparatus	May include but not limited to: • General electronic apparatus are data capture devices, security panels, fire protection panels, industrial control apparatus, instrumentation electronics and the like.

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Block diagram sub-system components (i.e. functional blocks) and their operating parameters • General electronic apparatus fault finding and repair • Using methodical fault finding techniques. • Finding faults efficiently. • Replacing components without damage. • Providing written justification for the repairs.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Technical manuals and catalogues • Typical format

	• How to read and apply information
Underpinning Skills	Demonstrate skills to: • Common faults, their symptoms and cause. • Fault location procedures and testing points • Component repair/replacement • Device adjustments - general electronic apparatus are data capture devices, security panels, fire protection panels, industrial control apparatus, instrumentation electronics and any apparatus not specifically covered under other clauses but for which there is a service manual and circuit diagrams.
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Troubleshoot Digital Sub-systems**
Unit Code	**IND TEA3 04 0117**
Unit Descriptor	This unit covers determining correct operation of digital sub-systems. It encompasses working safely, problem solving procedures, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in digital components circuits.

Elements	Performance Criteria
1. Prepare to troubleshoot digital sub-systems.	1.1 OHS procedures for a given work area are obtained and understood. 1.2 OHS risk control work preparation measures and procedures are followed. 1.3 The nature of the fault is obtained from documentation or from work supervisor to establish the scope of work to be undertaken. 1.4 Advice is sought from the work supervisor to ensure the work is co-ordinated effectively with others. 1.5 Sources of materials that may be required for the work are established in accordance with established procedures. 1.6 Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety.
2. Troubleshoot digital sub-systems.	2.1 OHS risk control work measures and procedures are followed. 2.2 The need to test or measure ***troubleshooting*** live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures. Circuits are checked as being isolated where necessary in strict accordance OHS requirements and procedures. 2.3 ***Range of faults*** finding is approached methodically drawing on knowledge of digital components using measured and calculated values of parameters. 2.4 Unexpected situations are dealt with safely and with the approval of an authorised person. 2.5 Fault finding activities are carried out efficiently without unnecessary waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.

3. Complete work and document troubleshooting activities.	3.1 OHS work completion risk control measures and procedures are followed. 3.2 Work site is cleaned and made safe in accordance with established procedures. 3.3 Justification for solutions used to troubleshooting problems is documented. 3.4 Work completion is documented and an appropriate person or persons notified in accordance with established procedures.

Variable	**Range**
Troubleshooting	May include but not limited to: • Troubleshooting may involve the alteration of an existing digital subsystem to comply with a specified function and operating parameters
Range of faults	May include but not limited to: • open/shorted signal lines, output loading, input-to-input connections and clock-related faults.

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • The binary number system • The hexadecimal number system • Binary addition and subtraction • Digital displays may include: ➢ Seven segment LED displays ➢ Drive requirements ➢ Current limiting ➢ Multiplexed displays ➢ Seven segment Decoders ➢ Liquid Crystal Displays (LCD) ➢ Emerging display technologies ➢ Verification of seven segment display circuit ➢ Interfacing with logic circuits • Digital subsystem building blocks may include: ➢ Encoders and Decoders ➢ Multiplexers and De multiplexers ➢ Timing diagrams ➢ Flip flops, Latches and registers ➢ Ripple counters ➢ MOD counters ➢ Synchronous counters Multi-vibrators ➢ Clocks ➢ Verification and operation (e.g. PLDs, ICs)
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Analogue and digital signals • Comparison between analogue and digital signals

	• Observing digital and analogue waveforms • Numbering systems - conversions • Conversion between numbering systems • Binary Coded Decimal (BCD) • Gray code • The American Standard Code for Information Interchange (ASCII) • Unicode
Underpinning Skills	Demonstrate skills of: • Combinational logic circuits • Precautions when handling electronic devices due to electrostatic discharge (ESD) • Truth tables • Basic operation and characteristics of logic gates • Logic probes • Verification of operation of logic circuits • Digital fault finding may include: ➢ General fault finding principles ➢ Common digital faults ➢ Digital test equipment ➢ Digital test equipment (e.g. Logic probes, Digital Oscilloscopes, digital trainers) • Logic families and specifications may include: ➢ Input and output voltage characteristics ➢ Comparison of logic families ➢ Unit load ➢ Noise margin ➢ Interfacing different logic families ➢ Tri-state logic devices ➢ Overview and applications of A/D converter and D/A converter
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Read and Apply Vehicle Wiring Schematics and Drawings**
Unit Code	**IND TEA3 05 0117**
Unit Descriptor	This unit describes the performance outcomes required to read and apply information from vehicle wiring schematics and drawings in an assembling , fitting and installing train systems.

Elements	Performance Criteria
1. Prepare for work	1.1 ***Workplace instructions*** are used to determine ***job requirements***
	1.2 ***Workplace Health and Safety (WHS) requirements*** are observed throughout the work
	1.3 ***Wiring schematics and drawings*** that relate to the vehicle being serviced or repaired are sourced
	1.4 Wiring schematics and drawings are checked to ensure that latest amendments and version are relevant for the vehicle being diagnosed and repaired
	1.5 Knowledge of electrical fundamentals is applied
2. Read and apply information from vehicle wiring schematics and drawings	2.1 Circuit symbols, wiring codes, legends and diagrammatic representations are correctly identified and interpreted
	2.2 Information is interpreted and drawings of vehicle wiring schematics are applied to testing and repair procedures
	2.3 Technical information located in workshop wiring schematics, circuits and drawings is applied to assist when carrying out testing and repair procedures
3. Finalise work and clean up	3.1 Vehicle wiring schematics and drawings and vehicle specifications are stored appropriately to protect from damage and ensure ready access and appropriate version control of information
	3.2 Equipment and work area are cleaned and inspected for serviceable condition according to workplace procedures
	3.3 Faulty equipment is identified, tagged and isolated according to workplace procedures
	3.4 Operator maintenance is completed according to manufacturer and component supplier specifications and site procedures
	3.5 Tools and equipment are maintained according to workplace procedures

Variable	Range
Workplace instructions	May include but not limited to: • electronic or hard copy instructions • verbal instructions • Written instructions.
Job requirements	May include but not limited to: • reading, interpreting and applying vehicle wiring schematics and drawings • Diagnosis and repair methods, processes and equipment.
WHS requirements	May include but not limited to: • personal protective clothing and equipment • safe use of tools and equipment • safe handling of material • use of fire-fighting equipment • workplace safety policies and procedures • workplace first aid equipment • Hazard control, including control of hazardous materials and toxic substances.
Wiring schematics and drawings	May include but not limited to: • verbal, written and graphical instructions • signage • work schedules, plans and specifications • work bulletins and memos • material safety data sheets • diagrams and sketches • regulatory and legislative requirements relating to automotive industry • Ethiopian Design Rules • workplace work specifications and requirements • instructions issued by authorised workplace or external persons • vehicle wiring schematics • electrical component symbols • electrical operational block schematics • vehicle zoning information tables • electrical component drawings • connector drawings, including connector end view drawings • electrical installation instructions and wiring diagrams • Vehicle service requirements and repair manuals.

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • vehicle wiring schematics, service manuals, drawings, circuits or specifications of vehicles, plant, tools, equipment and systems

	• procedures for amending and maintaining version control status of appropriate vehicle wiring schematics and drawings, particularly as applied to the vehicle being diagnosed and repaired • established communication channels and protocols
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • relevant WHS and environmental regulations, standards, codes of practice, and workplace policies and procedures needed to carry out work in a manner that ensures the safety of people equipment and the environment • select and use appropriate equipment, materials, processes and procedures • recognize limitations and seek timely advice
Underpinning Skills	Demonstrate skills of: • communication skills to: ➢ follow verbal and written instructions ➢ clarify workplace instructions and determine job requirements ➢ gain information from appropriate persons and assistance as required • initiative and enterprise skills to: ➢ apply learning when reading and applying vehicle wiring schematics and drawings ➢ recognize a workplace problem or potential problem and take action ➢ learning skills to identify sources of information, assistance and expert knowledge to expand skills, knowledge and understanding • literacy skills to: ➢ read and follow information in written job instructions, specifications, standard operating procedures, charts, lists, drawings and other applicable reference documents ➢ obtain and record measurements ➢ document required repairs and parts • planning and organising skills to: ➢ plan own work requirements and priorities actions to achieve required outcomes and ensure tasks are completed on time ➢ identify risk factors and take action to minimize them • problem-solving skills to: ➢ refer problems outside area of responsibility to appropriate person and suggest possible causes ➢ seek information and assistance as required to solve problems • self-management skills to: ➢ follow workplace documentation, such as codes of practice and operating procedures

	• technical skills to use workplace technology to assist in reading and applying vehicle wiring schematics and drawings when diagnosing and repairing vehicles, including: ➢ specialist equipment ➢ electrical measuring equipment ➢ technology skills to use tools and equipment to collect, analyse and provide information
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Assess and Install Complex Power Supplies**
Unit Code	**IND TEA3 06 0117**
Unit Descriptor	This unit covers assessment and install regulated and switch mode power supplies The unit encompasses safe working practices, interpreting circuit diagrams, applying logical fault finding procedures, conducting system installing, safety and functional testing and completing the necessary service documentation.

Elements	Performance Criteria
1. Prepare assessment and install complex power supplies.	1.1 OHS procedures for a given work area are identified, obtained and understood. 1.2 OHS risk control measures and procedures are followed in preparation for the work. 1.3 The nature of the installation is obtained from documentation or from work supervisor to establish the scope of work to be undertaken. 1.4 Advice is sought from the work supervisor to ensure the work is co-ordinated effectively with others. 1.5 Sources of materials that may be required for the work are established in accordance with established procedures. 1.6 Tools, equipment and testing devices needed to carry out the work are obtained in accordance with established procedures and checked for correct operation and safety.
2. Assessment and install.	2.1 OHS risk control measures and procedures for carrying out the work are followed. 2.2 The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures. 2.3 ***Apparatus*** is checked as being isolated where necessary in strict accordance OHS requirements and procedures. 2.4 Assessment is approached methodically drawing on knowledge of complex power supplies and circuits using measured and calculated values of power supply parameters. 2.5 Apparatus components are dismantled where necessary and parts stored to protect them against loss or damage.

	2.6 Installing components are rechecked and system installation confirmed. Materials require established procedures. 2.7 Apparatus is reassembled, finally tested and prepared for return to customer. 2.8 Unexpected situations are dealt with safely and with the approval of an authorised person. 2.9 ***Application on power supplies*** refers assessment and system installing activities are carried out efficiently without waste of materials or damage to apparatus and the surrounding environment or services and using sustainable energy practices.
3. Completion and report installing activities.	3.1 OHS work completion risk control measures and procedures are followed. 3.2 Work area is cleaned and made safe in accordance with established procedures. 3.3 Written justification is made for repairs to apparatus. 3.4 Work completion is documented and an appropriate person or persons notified in accordance with established procedures.

Variable	**Range**
Apparatus	May include but not limited to: • Circuit breakers • Fuse • Contactor and relays • Electrical wires • Chips
Application on power supplies	This unit shall be demonstrated in relation to installing and assessment in a range of system modification in a representative range of regulated power supply and a switch mode power supply.

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Switching regulator configurations: step-up, step-down, inverting and isolating • Circuit analysis of each regulator, constructed from a BJT, inductor, diode and filter capacitor • Electro-Magnetic Radiation (EMR) and noise emissions • Ferrite cores • Verification of circuit operation • Heat sink selection • Switching regulation - closed loop control of output • Generic block diagram of a switching regulator

	employing feedback to control output voltage • Circuit operation • Emerging technologies in IC regulators • Verification of load regulation
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Series regulation • Operating principles • Operation and specifications of three terminal regulators • Internal protection for three terminal regulators • Increasing the output current of a three terminal regulator • Increasing the output voltage of a three terminal regulator • The three terminal regulator as a current regulator • Heat sink selection • System installation in a series regulator
Underpinning Skills	Demonstrate skills of: • Series regulator employing closed loop control ➢ Components selection ➢ Basic discrete circuits ➢ Closed loop control of regulators ➢ Error amplification ➢ The BJT used as an error amplifier ➢ Operation of a series BJT regulator employing closed loop control ➢ Crowbar protection ➢ Current limiting ➢ Verification of circuit operation ➢ Assessing in a series BJT regulator employing closed loop control • Switching regulation - basic principles ➢ Components selection ➢ Basic principles of switching regulators ➢ Pulse Width Modulation (PWM) and frequency modulation ➢ Switching regulator configurations: step-up, step-down, inverting and isolating ➢ Circuit analysis of each regulator, constructed from a BJT, inductor, diode and filter capacitor ➢ Electro-Magnetic Radiation (EMR) and noise emissions ➢ Ferrite cores ➢ Verification of circuit operation ➢ Heat sink selection • Switching regulation - closed loop control of output ➢ Generic block diagram of a switching regulator employing feedback to control output voltage ➢ Circuit operation

	➢ Emerging technologies in IC regulators ➢ Verification of load regulation • Off-line switching regulators ➢ Isolation and safety requirements ➢ Specialised safety equipment ➢ Operation of flyback (buck) and forward (boost) converters ➢ Typical faults ➢ Verification of circuit operation ➢ OHS ➢ Safe working practices and relevant Standards, Codes and Regulations
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Provide Basic Instruction in the Use of Electrical Train Apparatus**
Unit Code	**IND TEA3 07 0117**
Unit Descriptor	This unit covers instructing customers/users in the use of train electrical systems apparatus. It encompasses appropriate customer relations, the use of apparatus manufacturer's instruction material, basic instruction methods and evaluation and completing documentation.

Elements	Performance Criteria
1. Prepare to instruct users.	1.1 OHS procedures for a given work area are obtained and understood through established routines and procedures. 1.2 Established OHS risk control measures and procedures in preparation for the work are followed. 1.3 Apparatus on which users are to be instructed is confirmed with work supervisor and/or other appropriate person(s)/***activities of instructor***. 1.4 Safety features and safe use of the apparatus are reviewed by and understood. 1.5 With the apparatus is gained by reference to manufacturer's user material and a preliminary run through to ensure the process is understood. 1.6 Materials required to instruct are obtained in accordance with established routines and procedures.
2. Instruct users	2.1 Users are informed of all the safety features and safe use of the apparatus in accordance with manufacturer's instruction and regulatory requirements. 2.2 Users are given the opportunity to show that they understand the safety aspects, set up features and operation of the apparatus. 2.3 A copy of the apparatus manufacturer's user to ***provide basic instruction*** and other related documentation is given the appropriate person(s). 2.4 Procedures for referring non-routine events to immediate supervisor for directions are followed. 2.5 Instructions are given efficiently without damage to apparatus, the surrounding environment or services and using sustainable energy practices.

Variable	Range
Activities of instructor	May include but not limited to: • Users are instructed in the set up and use of the apparatus in accordance with manufacturer's instruction.
Providing basic instructions	• This unit shall be demonstrated in relation to schematic diagrams and • To provide electrical lay out, electrical circuit, electrical apparatus symbols.SS

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Written procedures and work instructions • Methods for evaluating user need - how equipment is used efficiently and safely and identifying wear and tear and damage to the equipment that requires repairing. • Types of records for maintaining work activities in an enterprise • Methods for recording and maintaining work records • Work records required by regulation requirements
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Basic instruction methods - appropriate to the culture of the users and the equipment for which instruction is given. • Methods for evaluating user's ability use equipment correctly • Communicating with suppliers • Communicating with customers • Communicating with personnel encompassing: • Oral communications
Underpinning Skills	Demonstrate skills to: • Purpose and extent of maintaining work activities records in an enterprise encompassing: • Customer relations encompassing: ➢ Purpose ➢ Procedures for dealing with customers ➢ Dealing with customer issues
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Arrange Circuits, Control and Protection for Main Train Electrical Installations**
Unit Code	**IND TEA3 08 0117**
Unit Descriptor	This unit covers the arrangement and termination of circuits, control and protection devices and systems for electrical installations. It encompass knowledge and application of schemes for protection of persons and property, correct functioning, ensuring compatibility with the supply, arranging installation into circuits and selecting and arranging switchgear/control gear and protective devices to meet compliance requirements and documenting arrangement decisions.

Elements	Performance Criteria
1. Prepare to arrange electrical installations circuits, control and protection	1.1 The extent and nature of the electrical installation is determined from job specifications. 1.2 Safety and other regulatory requirements to which the electrical installation shall comply are identified, obtained and understood. 1.3 Load requirements for individual current-using equipment are determined from job specifications or from consultation with appropriate persons.
2. Arrange electrical installations circuits, control and protection	2.1 Circuits, control and protective devices are arranged to ensure safe and functional operation of the installation and to comply with technical standards, requirements ***job application*** and specifications. 2.2 Earthing is arranged and terminated to comply with the MEN system requirements. 2.3 Protective devices are selected to meet the required switching and tripping currents, co-ordination and discrimination for overload and short-circuit protection. 2.4 Residual current devices are selected to meet the required circuit, switching and tripping currents required. 2.5 Switchgear/control gear is selected to meet current, voltage and IP ratings and functional requirements. 2.6 Switchboards are arranged to accommodate control and protective devices, links, safety services, and other distributor equipment in accordance with requirements.
3. Document electrical installation circuits, control and protection	3.1 Evidence is obtained from manufacturers/suppliers that electrical equipment selected complies with safety requirements.

arrangements	3.2 Reasons for selections made, including calculations, are documented in accordance with established procedures. 3.3 ***Wiring Installation and drawings*** arrangement and specifications for all selected items are documented in accordance with established procedures and forwarded to appropriate person(s).

Variable	**Range**
Job application	May include but not limited to: • Demonstration in relation to arranging of circuits, control and protection for at least two general electrical installations comprising a main switchboard, supplying more than one circuit each for, lighting, socket outlets, and fixed appliances.
Wiring installation and drawings	May include but not limited to: • One of the installations shall include a distribution board separate from the main switchboard and at least one circuit supplying a three-phase load and a fire pump.

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Requirements for installation design and selection of equipment - includes compliant protection arrangements; correct functioning; compatibility with supply; estimation of maximum demands; voltage drop considerations; arrangement of circuits and the like • Circuit and control arrangements encompassing: • Protection against overload and short circuit current encompassing: ➢ Overload current or fault currents in an electrical installation. ➢ reason for dividing electrical installations into circuits ➢ Factors that shall be considered in determining the number and type of circuits required for an installation.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Safety principles to which electrical systems in building and premises shall comply. • Compliant methods for providing protection - include those for providing protection against direct and indirect contact; thermal effects; unwanted voltages; over current; fault currents; overload; overvoltage; injury from mechanical movement.
Underpinning Skills	Demonstrate skills to: • Daily and seasonal demand for lighting power, heating

	and other loads in a given installation. • Number and types of circuits required for a particular installation. • Diagrams/schedules of circuits for given installations. • application and arrangements of SELV and PELV circuits • application and arrangement of an isolated supply • Hazards and risks in an electrical installation encompassing: ➢ Effects on the human body of various levels of A.C. and D.C. current and duration of current flow for various current paths. ➢ Risk of ignition of flammable materials due the thermal effects of current or electric arcs in normal service of an electrical installation. ➢ Risk of injury from mechanical movement of electrically actuated equipment. ➢ Protection against direct contact (basic protection) ➢ acceptable methods ➢ use of extra-low voltage • Protection against indirect contact encompassing: ➢ Indirect contact with live parts of an electrical installation may occur. ➢ Methods and devices that comply with the Wiring Rules for providing protection against indirect contact. ➢ Components of the 'automatic disconnection of supply' method of protection against indirect contact. ➢ The terms ‘touch voltage’ and ‘touch current’. ➢ The current path when a short circuit fault to exposed conductive parts of an appliance occurs. ➢ Protection against indirect contact is by the use of Class II equipment and by electrical separation. ➢ additional protection by use of Residual Current Devices (RCDs) ➢ Protection against indirect contact by use of extra-low voltage and electrical separation. ➢ Protection requirements for damp situations. • Earthing encompassing: ➢ The terms: earthed, earthed situation, earth electrode, equipotential bonding, multiple earthed neutral (MEN) system, protective earth-neutral (PEN) conductor, main earthing conductor, protective earthing (PE) conductor, functional earthing, MEN link. ➢ Selection of minimum size-earthing conductor for a range of active conductor sizes and materials. ➢ Parts of an earthing system and the purpose of

	each. ➢ Typical arrangement for a MEN earthing system. ➢ Arrangements of protective earthing conductors that comply with the Wiring Rules. ➢ Requirements for equi potential bonding in a range of installation situations. ➢ Installation of a MEN earthing system for a single phase installation ➢ equivalent circuit of an earth fault-loop ➢ Level of fault current possible at a given point in an installation from the fault-loop impedance and data from the electricity distributor. ➢ methods and devices that comply with the Wiring Rules AS/NZS 3000 for providing protection against the damaging effects of overload and fault current ➢ requirements for co-ordination between protective devices and conductors ➢ Requirements for co-ordination of protection devices for discrimination and back-up protection. • Devices for automatic disconnection of supply encompassing: ➢ Operating principles of thermal/magnet circuit breakers. ➢ Operating principles of common types of fuses. ➢ Operating principles of Residual Current Devices (RCD). ➢ Time/current curves tripping characteristics of various types of circuit breakers that comply with the requirements of the Wiring Rules. ➢ Time/current curves fusing characteristics of various types of fuses that comply with the requirements of the Wiring Rules. ➢ Time/current curves tripping characteristics of various types of RCDs that comply with the requirements of the Wiring Rules. ➢ Factors in a fault loop that will affect the impedance of the circuit. ➢ Maximum impedance of an earth fault-loop to ensure operating of a protection device. ➢ Selecting a fuse for fault current limiting protection. ➢ Drawing switchboard wiring arrangements of 2-pole RCDs, 4-pole RCDs, combination RCD/MCBs. • Protection against over voltage and under voltage encompassing: ➢ Causes of over voltage and how this may affect the electrical system. ➢ Methods for protection against over voltage. ➢ Causes of under voltage and how this may affect

	the electrical system. ➢ Methods for protection against under voltage. ➢ Control of an electrical installation and circuits encompassing: ➢ Switch types, current and voltage ratings and IP rating and where these apply. ➢ Switching requirements for isolation, emergency, mechanical maintenance and functional control. ➢ Control arrangement for complete installations with and without safety services and an alternative supply. • Switchboards / distribution boards encompassing: ➢ Purpose, types and applications. ➢ Physical and circuit arrangements for whole current and CT metering. ➢ Physical and circuit arrangements of main switches, circuit protection devices, fault-current limiters and metering equipment and other distributor equipment. ➢ Compliance requirements (includes location and access, arc fault protection, identification, construction suitability, equipment marking, wiring, fire protection and arc-fault protection).
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Solve Problems in Electromagnetic Devices and Related Circuits In Train**
Unit Code	**IND TEA3 09 0117**
Unit Descriptor	This unit covers determining correct operation of electromagnetic devices and related circuits and providing solutions as they apply to electrical installations and equipment. It encompasses working safely, power circuit problems solving processes, including the use of voltage, current and resistance measuring devices, providing solutions derived from measurements and calculations to predictable problems in electromagnetic devices and related circuits.

Elements	Performance Criteria
1. Prepare to work on electromagnetic devices and circuits.	1.1 OHS procedures for a given work area are identified, obtained and understood. 1.2 OHS risk control work preparation measures and procedures are followed. 1.3 The nature of the device(s)/circuit(s) problem is obtained from documentation or from work supervisor to establish the scope of work to be undertaken. 1.4 Advice is sought from the work supervisor to ensure the work is coordinated effectively with others. 1.5 Sources of materials that may be required for the work are established in accordance with established procedures. 1.6 Tools, equipment and testing devices needed to carry out the work are obtained and checked for ***job application*** for correct operation and safety.
2. Solve electromagnetic devices/circuit problems.	2.1 OHS risk control work measures and procedures are followed. 2.2 The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures. 2.3 ***Circuit and device testing*** are checked as being isolated where necessary in strict accordance OHS requirements and procedures. 2.4 Established methods are used to solving circuit problems from measure and calculated values as they apply to ***electromagnetic devices***/circuits. Unexpected situations are dealt with safely and with the approval of an authorised person.

	2.5 ***Problems in electromagnetic device*** are ***solved*** without damage to apparatus, circuits, the surrounding environment or services and using sustainable energy
3. Complete work and document problem solving activities.	3.1 OHS work completion risk control measures and procedures are followed. 3.2 Work site is cleaned and made safe in accordance with established procedures. 3.3 Justification for solutions used to solve circuit problems is documented. Work completion is documented and an appropriate person or persons notified in accordance with established procedures.

Variable	Range
Job application	May include but not limited to: • Connecting circuits, • Using methodological problem solving techniques, • Solving electromagnetic device problems, • Demonstrate an understanding of the behaviour of current and voltage in circuits with electromagnetic devices • Calculating circuit parameters accurately and devices
Circuit and device testing	May include but not limited to: • Choose correct instruments and ranges for testing, • Connect meters to measure parameters in circuits with electromagnetic
Electromagnetic devices	May include but not limited to: • Reed switches • Solenoids • Relays • Contactors • Inductive limit switches • Bells • Lifting magnets • Core balance devices • Magnetic overloads • Motors • Generators • Magnetic brakes and circuit breakers
Solving problems in electromagnetic devices	May include but not limited to: • Determining the operating parameters of an existing circuits with electromagnetic devices • Altering an existing circuit with an electromagnetic device to comply with specified operating parameters • Developing circuit with an electromagnetic device to comply with a specified function and operating parameters

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Common magnetic and non-magnetic materials and groupings (diamagnetic, paramagnetic and ferromagnetic materials). • Principle of magnetic screening (shielding) and its applications. • Calculation of induced E.M.F. in a conductor given the conductor length, flux density and velocity of the conductor. • Direction of force between adjacent current carrying conductors. • Effect of current, length and distance apart on the force between conductors (including forces on bus bars during fault conditions). • Practical applications for the effects of self and mutual induction. • Undesirable effects of self and mutual induction.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Magnetism encompassing: ➢ Magnetic field pattern of bar and horse-shoe magnets. ➢ Magnets attraction and repulsion when brought in contact with each other. ➢ practical applications of magnets ➢ Construction, operation and applications of reed switches. • Electromagnetism encompassing: ➢ Conventions representing direction of current flow in a conductor. ➢ Magnetic field pattern around a single conductor and two adjacent conductors carrying current. ➢ Using the “right hand rule” to determine the direction of magnetic field around a current carrying conductor. ➢ Magnetic field around an electromagnet. ➢ Using the “right hand rule” to determine the direction of magnetic field around a current carrying coil. ➢ Magneto Motive Force (M.M.F.) and its relationship to the number of turns in a coil and the current flowing in the coil. ➢ Practical applications of electromagnets.
Underpinning Skills	Demonstrate skills to: • Magnetic circuits encompassing: ➢ Magnetic characteristic curve for various materials and identify the various regions. ➢ Identify the various conditions of a magnetic material from its Hysteresis loop. ➢ Factors which determine losses in magnetic material.

	➢ Methods used to reduce electrical losses in a magnetic circuit. ➢ Magnetic flux (definition, unit and symbol). ➢ Reluctance as the opposition to the establishment of magnetic flux. ➢ Permeability (definition, symbol and unit). ➢ Difference for magnetic and non-magnetic materials in regards to reluctance and permeability. ➢ Calculation of M.M.F., flux or reluctance given any two values. ➢ Flux density (definition, symbol, unit and calculation). ➢ Magnetising force (definition, symbol, unit and calculation). ➢ Common magnetic circuit types. ➢ Effect of an air gap in a magnetic circuit. ➢ Terms “magnetic leakage” and “magnetic fringing”. • Electromagnetic induction encompassing: ➢ Principle of electromagnetic induction (Faraday’s law of electromagnetic induction). ➢ Applying “Fleming’s right hand rule” to a current a carrying conductor under the influence of a magnetic field. ➢ Calculation of induced E.M.F. in a coil given the number of turns in a coil and the rate of change of flux. ➢ Calculation of force on a conductor given the flux density of the magnetic field, length of the conductor and the current being carried by the conductor. ➢ Lenz’s law ➢ applications of electromagnetic induction • Inductance encompassing: ➢ Construction of an inductor, including a bifilar winding inductor. ➢ Ethiopian Standard circuit diagram symbol for the four types of inductor. ➢ Effect of physical parameters on the inductance of an inductor. ➢ Common types of inductor cores. ➢ Applications of the different types of inductors. ➢ Definition of terms self induction, inductance and mutual inductance. ➢ Calculation of value of self induced E.M.F. in a coil. ➢ Mutual induction occurs between two coils. ➢ Graphical relationship between load voltage, current and self induced E.M.F. in a single D.C. circuit having inductance. ➢ Definition of term “time constant” and draw the characteristic curve as applied to a series circuit containing an inductor and a resistor. (LR

	circuit)Calculation of value of the time constant for an LR circuit given the values of the components. ➢ Time constants required for the current in an LR circuit to reach its final value. ➢ Determining of instantaneous values of voltage and current in an LR circuit using a universal time constant chart. • Measurement Instruments encompassing: ➢ Moving coil, moving iron, dynamometer meter movements and clamp testers. ➢ Practical applications for moving coil, moving iron and dynamometer meter movements. ➢ Calculation of resistance of shunts and multipliers to extend the range of ammeters and voltmeters. ➢ Factors to be considered in selecting meters for a particular application. ➢ Safety category of meters and their associated applications. ➢ Steps and procedures for the safe use, care and storage of electrical instruments. • Magnetic devices encompassing: ➢ Construction, operation and applications of relays. ➢ Construction, operation and applications of contactors. ➢ Magnetic methods used to extinguish the arc between opening contacts. ➢ Construction, operation and applications of Hall Effect devices. ➢ Operation and applications of magnetostriction equipment. ➢ Construction, operation and application of magnetic sensing devices. • Machine principles encompassing: ➢ Basic operating principle of a generator. ➢ Applying Fleming's right hand rule for generators. ➢ Basic operating principle of a motor. ➢ Applying Fleming's left hand rule for motors. ➢ Calculation of force and torque developed by a motor. • Rotating machine construction, testing and maintenance encompassing: ➢ Components of a D.C. machine. ➢ Difference between a generator and a motor in terms of energy conversion. ➢ Nameplate of a machine. ➢ using electrical equipment to make electrical measurements and comparison of readings with nameplate ratings. ➢ Identification of faults in a machine from electrical measurements.

	➢ care and maintenance processes for rotating machines ➢ Safety risks associated with using rotating machinery. • Generators encompassing: ➢ Basic operation of a D.C. generator. ➢ calculation of generated and terminal voltage of a D.C. shunt generator ➢ Prime movers, energy sources and energy flow used to generate electricity. ➢ Types of D.C. generators and their applications. ➢ Methods of excitation used for D.C. generators. ➢ Equivalent circuit for a D.C. generator. ➢ Importance of residual magnetism for a self excited generator. ➢ Open circuit characteristics of D.C. generators. ➢ Load characteristics of a D.C. generator. ➢ reversing the polarity of a D.C. generator ➢ Connect and test a D.C. generator on no-load and load ➢ Identify safety risks associated with using generators. • Motors encompassing: ➢ Operation of a motor and its energy flow. ➢ effect of back E.M.F. in D.C. motors ➢ torque as the product of the force on the conductors and the radius of the armature/rotor. ➢ Types of D.C. motors and their applications. ➢ Circuit diagrams for the types of D.C. motors. ➢ Equivalent circuit for the types of D.C. motors. ➢ Calculation of power output of a motor. ➢ Characteristics of the different types of D.C. motors. ➢ connection and testing a D.C. shunt motor on no-load and load ➢ Reversing the direction of rotation of a D.C. motor. ➢ Safety risks associated with using motors (include risks of series D.C. motors). • Machine efficiency encompassing: ➢ Losses that occur in a D.C. machine. ➢ Methods used to determine the losses in a D.C. machine. ➢ Calculation of losses and efficiency of a D.C. machine. ➢ Efficiency characteristic of a D.C. machine and the conditions for maximum efficiency. ➢ Application of Minimum Energy Performance standards (MEPS). ➢ methods used to maintain high efficiency.
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS

	practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Inspect and Assemble Braking Systems**
Unit Code	**IND TEA3 10 0117**
Unit Descriptor	This unit covers the competence required to inspect and service braking systems and/or associated components, including pneumatic over hydraulic, air, and hand and parking brake systems in vehicle retail, service and/or repair context.

Elements	Performance Criteria
1. Prepare to undertake braking system inspection	1.1 Nature and scope of work requirements are identified and confirmed 1.2 ***WHS*** requirements, including individual State/Territory regulatory requirements and personal protection needs are observed throughout the work 1.3 Procedures and information such as workshop manuals and specifications, and tooling required, are sourced 1.4 ***Methods*** appropriate to the circumstances are selected and prepared in accordance with standard operating procedures 1.5 Resources required for inspection of braking systems are sourced and support equipments and ***materials*** are identified and prepared 1.6 Warnings in relation to working with braking systems are observed
2. Conduct braking system wear analysis	2.1 Braking system analysis is implemented in accordance with road safety legislation, workplace procedures and manufacturer/component supplier specifications 2.2 Brake wear measurement results are compared with manufacturer/component supplier specifications to indicate compliance or non-compliance 2.3 Results are documented with evidence and supporting information and recommendation(s) made 2.4 Report is processed in accordance with workplace procedures
3. Prepare to install braking system and/or associated components	3.1 WHS requirements, including individual State/Territory regulatory requirements and personal protection needs are observed throughout the work 3.2 Procedures and ***informational/ documents*** required are identified and sourced 3.3 Resources required for installing braking systems are identified and support equipment is identified and prepared

4. Carry out system installation of braking systems components	4.1 system installation is implemented in accordance with workplace procedures and manufacturer/***system component*** supplier specifications and ***environmental requirement*** 4.2 Adjustments made during the installation are in accordance with manufacturer/component supplier specifications
5. Prepare equipment for use or storage	5.1 Servicing schedule documentation is completed 5.2 Final inspection is made to ensure protective features are in place 5.3 Final inspection is made to ensure work is to workplace expectations 5.4 ***Tooling and Equipment*** is cleaned for use or storage to workplace expectations 5.5 ***Emergency procedure*** is made to ensure work activities. 5.6 Job card is processed in accordance with workplace procedures

Variable	Range
WHS	May include but not limited to: • WHS requirements are to be in accordance with legislation/regulations/codes of practice and enterprise safety policies and procedures. This may include protective clothing and equipment, use of tooling and equipment, workplace environment and safety, handling of material, use of fire fighting equipment, enterprise first aid, hazard control and hazardous materials and substances
Methods	May include but not limited to: • visual, aural and functional assessments (including damage, corrosion, fluid leaks, wear) • measurements of pedal travel, free-play, disc run out, disc thickness, drum wear and pad/lining thickness
Materials	May include but not limited to materials may include lubricants, fluids, minor spare parts and cleaning materials
Information/documents	May include but not limited to: • verbal or written and graphical instructions, signage, work schedules/plans/specifications, work bulletins, memos, material safety data sheets, diagrams or sketches • safe work procedures related to the inspection and servicing of braking systems • regulatory/legislative requirements pertaining to the automotive industry, including Ethiopian Design Rules

	• engineer's design specifications and instructions • organisation work specifications and requirements • instructions issued by authorised enterprise or external persons • Ethiopian Standards
System components	May include but not limited to: • disc pads • master cylinders • brake shoes • brake callipers • brake hoses • brake actuators • mechanical devices • valves
Environmental requirements	May include but not limited to: • Environmental requirements are to include but are not limited to waste management, noise, dust and clean-up management
Tooling and equipment	May include but not limited to: • hand tooling, gauges (including dial, venires and micrometers), bleeding and brake testing devices, dust extraction equipment and grease guns
Emergency procedures	• related to this unit are to include, but are not limited to emergency shutdown and stopping of equipment, operating safely in the event of fires, enterprise first aid requirements and site evacuation

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Operating principles of braking systems, components and their relationship to each other • types and layout of service/repair manuals (hard copy and electronic) • analysis procedures • interact effectively with other persons both on a one-to-one basis and in groups, including understanding and responding to the needs of a customer and working effectively as a member of a team to achieve a shared goals. • establish safe and effective work processes which anticipate and/or resolve problems and downtime, to systematically develop solutions to avoid or minimise reworking and avoid wastage • use mathematical ideas and techniques to correctly calculate time, assess tolerances, apply accurate measurements, calculate material requirements and establish quality checks

Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • WHS and environmental regulations/requirements, equipment, material and personal safety requirements • dangers of working with braking systems • operating principles of braking systems, components and their relationship to each other • types and layout of service/repair manuals (hard copy and electronic) • analysis procedures • servicing procedures
Underpinning Skills	Demonstrate skills to: • apply research and interpretive skills sufficient to locate, interpret and apply manufacturer/component supplier procedures, workplace policies and procedures • apply analytical skills required for identification and analysis of technical information • apply plain English literacy and communication skills in relation to dealing with customers and team members • apply questioning and active listening skills for example when obtaining information from customers • apply oral communication skills sufficient to convey information and concepts to customers • apply planning and organising skills to own work activities, including making good use of time and resources, sorting out priorities and monitoring one's own performance • interact effectively with other persons both on a one-to-one basis and in groups, including understanding and responding to the needs of a customer and working effectively as a member of a team to achieve a shared goal • use workplace technology related to the inspection and servicing of braking systems, including the use of servicing tooling and equipment, measuring equipment, computerised technology and communication devices and the reporting/ documenting of results
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Install and Assemble Train Lighting, Wiring Systems and Accessories**
Unit Code	**IND TEA3 11 0117**
Unit Descriptor	This unit describes the performance outcomes required to carry out installation and testing Low Voltage (LV) vehicle lighting and wiring systems and components. The unit involves identifying and confirming work requirements; preparing for work; installing and testing LV lighting systems and components; and completing work finalisation processes, including clean-up and documentation.

Elements	Performance Criteria
1. Prepare for work	1.1 ***Workplace instructions*** are used to determine ***job requirements*** 1.2 ***Workplace Health and Safety (WHS) requirements*** are observed throughout the work 1.3 ***Procedures and information*** are sourced and interpreted 1.4 Installation options are analysed and those most appropriate to the circumstances are selected and prepared 1.5 ***Tools and equipment*** are identified for effective installation and testing procedures
2. Install and test lighting and wiring systems	2.1 ***Low voltage lighting and wiring systems*** are installed according to manufacturer and component supplier specifications without causing damage to components or systems as a result of ***inappropriate testing procedures*** 2.2 Tests are carried out to determine ***faults in train manufacturing*** using tools and diagnostic techniques 2.3 ***Post-installing testing*** is carried out according to workplace procedures
3. Prepare vehicle and equipment for delivery to customer	3.1 Final inspection is made to ensure work is to workplace expectations 3.2 Vehicle is cleaned to workplace expectations and presented ready for use 3.3 Workplace documentation is processed according to workplace procedures
4. Clean up work area and maintain equipment	4.1 Material that can be reused is collected and stored 4.2 Waste and scrap are removed following workplace procedures

	4.3 Equipment and work area are cleaned and inspected for manufacturing condition according to workplace procedures 4.4 Faulty equipment is identified, tagged and isolated according to workplace procedures 4.5 Operator maintenance is completed according to manufacturer and component supplier specifications and site procedures 4.6 Tools and equipment are maintained according to workplace procedures

Variable	Range
Workplace instructions	May include but not limited to: • electronic or hard copy instructions • verbal instructions • Written instructions.
Job requirements	May include but not limited to: • Diagnosis and repair methods, processes and equipment.
WHS requirements	May include but not limited to: • personal protective clothing and equipment • hazards associated with high voltage ignition systems • safe use of tools and equipment • safe handling of material • use of fire-fighting equipment • workplace safety policies and procedures • workplace first aid • Hazard control, including control of hazardous materials and toxic substances.
Procedures and information	May include but not limited to: • verbal, written and graphical instructions • signage • work schedules, plans and specifications • work bulletins and memos • material safety data sheets • diagrams and sketches • regulatory and legislative requirements relating to automotive industry • Ethiopian Design Rules • engineer's design specifications and instructions • workplace work specifications and requirements • instructions issued by authorised workplace or external persons • Ethiopian standards • vehicle service requirements and repair manuals.

Tools and equipment	May include but not limited to: • hand tools • testing equipment, including multimeters and ohmmeters • insulation testers • crimping tools • soldering iron • heat-gun or blower • wire and cabling of various colours and sizes • heat shrink sleeving and flexible conduit • terminals and connectors • Electrical tape.
Low voltage lighting and wiring systems	basic single wiring: • tailor wiring harness • driving lights wiring harness • side clearance lamps • high-mount rear brake lamps • ascent strip LED lamps • Filament lamp to LED lamp replacement.
Inappropriate testing procedures	May include but not limited to: • intrusive testing (which must not be performed as it is not a recommended test and repair method), which includes: ➢ back probing terminals and connectors and fuse holders with inappropriate test probes ➢ probing terminal and connectors with inappropriate test probes ➢ Pushing sharp probes and objects into wiring insulation.
Faults in train manufacturing	May include but not limited to: • open circuits • high resistance circuits • short circuits • damaged insulation • frayed wires • burnt wiring • water and moisture ingress • connector damage • terminal damage • Diagnosis Trouble Codes (DTC) being set as a result of LED lamp resistance being lower than original resistive filament lamp load.
Post-install testing	May include but not limited to: • validating effectiveness of the installing action • confirming that reported fault has been rectified • Confirming that no other faults are present as a result of the installing action.

	• pre- and post-install testing • identifying and testing components • diagnosing and determining faults

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • teamwork skills to apply knowledge of own role to complete activities efficiently to support team activities and tasks • technical skills to use workplace technology and tools relating to installing and testing vehicle LV lighting and wiring systems and components, including: ➢ specialist tools and equipment ➢ electrical measuring equipment • component install procedures, including: ➢ removal, replacement and adjustment procedures ➢ dismantle, install, reassembly and adjustment procedures ➢ electrical measurements ➢ Visual and functional assessments, including for damage and wear
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • WHS regulations, requirements, equipment, material and personal safety requirements, including: ➢ codes of practice ➢ personal protection needs ➢ wiring harness and loom fabrication techniques ➢ procedures for removing and replacing wiring harnesses and looms ➢ soldering procedures and techniques ➢ cable types and sizes and current carrying capacity • various types of wiring systems found in vehicles, including: ➢ basic wiring ➢ twisted pair ➢ shielded wiring ➢ computer area network data bus (CAN-bus) networks ➢ techniques for reading and interpreting technical information, wiring diagrams and graphic symbols • diagnostic and testing procedures, including: ➢ testing procedures for LV lighting and wiring installations, including: ➢ following manufacturer and component suppliers' test procedures ➢ following Original Equipment Manufacturer (OEM) service information ➢ analysis of system operation using basic electrical test equipment and other industry-relevant test

	equipment • visual, aural and functional assessments, including: ➢ component damage and wear ➢ component corrosion ➢ water and moisture ingress
Underpinning Skills	Demonstrate skills of: • communication skills to: ➢ follow verbal and written instructions ➢ clarify workplace instructions and determine job requirements ➢ gain information from appropriate persons and assistance as required • literacy skills to: ➢ read and follow information in written job instructions, specifications, standard operating procedures, charts, lists, drawings and other applicable reference documents ➢ obtain and record measurements ➢ document required repairs and parts • numeracy skills to: ➢ test, measure and analyze test equipment results compared to desired system performance • planning and organising skills to: ➢ plan own work requirements and priorities actions to achieve required outcomes and ensure tasks are completed on time ➢ identify risk factors and take action to minimize them • problem-solving skills to: ➢ recognize a workplace problem or potential problem and take action ➢ refer problems outside area of responsibility to appropriate person and suggest possible causes ➢ seek information and assistance as required to solve problems • self-management skills to: ➢ select and use appropriate equipment, materials, processes and procedures ➢ recognize limitations and seek timely advice ➢ follow workplace documentation, such as codes of practice and operating procedures • technology skills to: ➢ operate a range of electrical diagnostic test equipment ➢ use technology to collect, analyse and provide information
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS

	practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Install and Modify Performance Data Communication Copper Cabling**
Unit Code	**IND TEA3 12 0117**
Unit Descriptor	backbones using structured twisted pair cabling, terminating at distributors, termination modules and in socket outlets, testing and compliance checks and completing cabling documentation. This unit covers the installation and termination of high performance data copper cabling in buildings and premises and intended for connection a telecommunications network.

Elements	Performance Criteria
1. Prepare to install and/or modify copper cabling.	1.1 OHS procedures for a given work area are identified, obtained and understood. 1.2 Health and safety risks are identified and established risk control measures and procedures are followed in preparation for the work. 1.3 Safety hazards that have not previously been identified are noted and established risk control measures are implemented. 1.4 Installation or modification of wiring is prepared in consultation with others affected by the work and sequenced appropriately. The nature and location of the work is determined from documentation or in discussion with appropriate person(s) to establish the scope of work to be undertaken. 1.5 Material needed for the installation work is obtained in accordance with established procedures and checked against job requirements. 1.6 Tools, equipment and testing devices needed to for the installation work are obtained in accordance with established procedures and checked for correct operation and safety. 1.7 Preparatory work is checked to ensure no damage has occurred and that it complies with requirements.
2. Install copper cables or modify.	2.1 OHS risk control measures and procedures for carrying out the work are followed. 2.2 ***Cable routs*** are installed or modification to comply with manufacturer specifications, technical standards and job requirements with sufficient excess to affect terminations of ***job application*** 2.3 Established methods for dealing with unexpected situations are discussed with appropriate person(s) and documented. Unexpected situations are dealt with safely

	and with the approval of an authorised person. 2.4 Ongoing checks of the quality of installed or modified wiring are undertaken in accordance with established procedures. 2.5 Cable installation/modification is carried out efficiently without waste of materials or damage to apparatus, circuits or the surrounding environment and using sustainable energy practices.

Variable	**Range**
Cable routs	May include but not limited to: • Plane within the constraints of the building structure, fire walls, cultural/heritage requirements and regulations. Advice is sought from appropriate persons to ensure the work is coordinated effectively with others.
Job application	May include but not limited to: • Demonstration in relation to installing and modifying performance structured metallic cables each on at least two occasions

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Cable identification • plans and drawing • labelling • documentation • Cable installation • Hazards • Cable damage prevention • Cable dispensers • Selecting cable and cabling hardware • cable characteristics • higher performance cable types • requirements of Ethiopian Standards
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Telecommunication cable types • construction • characteristics and • applications
Underpinning Skills	Demonstrate skills of: • Building construction may include: ➢ Domestic buildings ➢ Commercial buildings • Fixing devices may include: ➢ Bracketed assemblies ➢ Hard wall fixing devices ➢ Soft wall fixing devices and Ties

	• Cable enclosures may include: ➢ Types ➢ Fixing ➢ Regulations • Distribution boxes and back mounts may include: ➢ Systems ➢ Termination Boundaries and devices • Electrical connections may include: ➢ Hazards ➢ Regulations • Cable preparation and terminations and hauling mechanisms may include: ➢ Indoor Methods ➢ Outdoor Methods • structured cabling may include: ➢ design principles • structured cabling performance requirements may include: ➢ approved practices ➢ safety requirements ➢ connectors ➢ terminating tools ➢ continuity tests ➢ fault diagnosis ➢ recording results • Testing cabling may include: ➢ Local area network cabling systems ➢ Coaxial cables ➢ Coaxial cables ➢ Coaxial cable installation systems ➢ Twisted pair cable installation systems
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Develop Electrical Control Systems and Electronic Sub Assemblies**
Unit Code	**IND TEA3 13 0117**
Unit Descriptor	This unit covers developing, connecting and functionally testing electrical power and control circuits that perform specific control functions. It encompasses working safely; developing schematic/ladder diagrams and converting them to wiring diagrams; selecting and connecting contactors and control devices to perform a specific function.

Elements	Performance Criteria
1. Develop and connect electrical control circuits.	1.1 Safety hazards, which have not previously been identified, are noted and established risk control measures are implemented. 1.2 Control scenarios are determined from discussions with appropriate person(s) and documented in accordance with established procedures. 1.3 Agreement for the control scenarios is sought from appropriate person(s) and documented in accordance with established procedures. 1.4 Schematic arrangement of control circuits that complies with agreed scenarios is documented in accordance with established procedures. 1.5 Materials needed to connect control circuits are obtained in accordance with established procedures and checked against job requirements. 1.6 Tools, equipment and testing devices needed to connect control circuits are obtained in accordance with established procedures and checked for correct operation and safety in ***job applications*** 1.7 Preparatory work is checked to ensure no damage has occurred and complies with requirements.
2. Connect and test electrical control circuits.	2.1 OHS risk control measures and procedures for carrying out the work are followed. 2.2 The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures. 2.3 Circuits/machines/plant is checked as being isolated where necessary in strict accordance OHS requirements and procedures. 2.4 ***Electrical control circuit*** components are connected

	to comply with the agreed control scenario. 2.5 ***Electrical and electronics control devices*** operation is tested for agreed functionality and in strict accordance with OHS requirements and established safety procedures. Non-compliant control functions are rectified to comply with the agreed control scenario. 2.6 Unexpected situations are dealt with safely and with the approval of an authorised person. 2.7 Control circuits are connected and tested efficiently without unnecessary waste of materials or damage to apparatus, circuits, the surrounding environment or services and using sustainable energy practice. 2.8 ***Transducers/sensors*** are tested in electrical and electronic circuits.
3. Completion and document circuit development activities	3.1 OHS work completion risk control measures and procedures are followed. 3.2 Work site is cleaned and made safe in accordance with established procedures. 3.3 'As-connected' control circuits are documented using standard drawing conventions and an appropriate person or persons notified in accordance with established procedures.

Variable	**Range**
Job application	Demonstration in relation to developing, connecting and safety and functional testing on more than one occasion of at least four of the following control circuits:
Electrical control circuits	May include but not limited to: • Multiple light switching circuit • Master control circuit • Single stop-start circuit • Multiple stop-start circuit • Time controlled circuit • Machine interlocked circuit • Motor jogging circuit • Machine safety circuit
Electrical and electronics control devices	May include but not limited to: • Multi-way switches • Switches with more than two positions and Off • Push buttons • Electromechanical relays • Programmable relays • Contactors • Reversing contactors • Three phase starters

	• Reduced voltage starters
Transducers/sensors	May include but not limited to: • Timers • Limit switches • Proximity switches • Photoelectric cells • Pressure switches • Float switches • Light sensors • Temperature sensors

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Remote STOP-START control and electrical interlocking encompassing: ➢ operation of local and remote start-stop control of relays ➢ operation of an electrically interlocked relay circuit ➢ Development of a relay circuit incorporating local and remote start and stop buttons and electrical interlocking. ➢ Connecting electrical circuits with local and remote start-stop control and with electrical interlocking. ➢ Applying circuit checking and testing techniques to an electrical control circuit. ➢ installation of programmable control relays ➢ common faults and their symptoms
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Basic relay circuits encompassing: ➢ labelling wires and terminal (numbering systems) ➢ control relay - operating principles, basic contact configurations and identification and common applications ➢ push button - switching configurations and common applications ➢ selecting pushbuttons/pilot lamps from manufacturer's catalogues for specific applications ➢ Developments of simple stop-start relay circuit that incorporates pilot lights and latching circuit. ➢ connection and testing of control circuits • Three phase induction motor reversal and braking encompassing: ➢ reversing operating principles and control circuits ➢ plug braking operating principles and circuits ➢ dynamic braking operating principles and circuits ➢ regenerative braking operating principles and circuits ➢ eddy current brakes operating principles and circuits ➢ mechanical brakes operating principles and circuits

	➢ Comparison of the difference braking methods used. ➢ Typical applications for each braking method. ➢ Connecting a circuit with a braking feature to operate a three-phase motor. ➢ installation of motor braking control circuits • Three-phase induction motor speed control encompassing: ➢ pole changing operating principles and circuits ➢ variable frequency drives operating principles and circuits ➢ slip-ring motors operating principles and circuits ➢ Installation of motor speed controllers.
Underpinning Skills	Demonstrate skills of: • Relay circuits and drawing conventions encompassing: ➢ circuit diagram drawing conventions ➢ selecting relays from manufacturers' catalogue for specified applications ➢ circuit development of electrical control circuit in accordance with a written description (specification) and list the sequence of operation of the circuit ➢ connecting simple electrical control circuit from circuit diagrams ➢ applying safe working practices when testing an electrical control circuit • Time delay relays encompassing: ➢ timers - operating principles, basic contact configurations and identification and common applications ➢ selecting timers for specified functions from manufactures' catalogues ➢ development of timer controlled circuits from a written description and list the sequence of circuit operation ➢ Connecting a timer controlled circuit using a circuit diagram as a guide. ➢ Timer circuit checking and testing procedures. • Circuits using contactors encompassing: ➢ contactors - operating principles, basic contact configurations and identification and common applications ➢ thermal overloads - operating principles, basic contact configurations and identification and common applications ➢ circuit diagram symbols ➢ circuit development using a contactor ➢ Using contactors for motor control. ➢ Compliance requirements for devices for isolating circuits.

	• Jogging and interlocking encompassing: ➢ purpose and application of jogging control of motors ➢ operation of motor control using start, stop and jog buttons ➢ purpose and application of electrical/mechanical interlocking ➢ Developing a multiple motor starting circuit from a description of the circuit operation including jog and interlock functions. ➢ selecting circuit components using manufacturers' catalogues for appropriate duty ratings ➢ Connecting and testing a multiple motor starting circuit which incorporates start, stop and jog control. • Control devices encompassing: ➢ common control devices used in automatic control circuits: limit switches, proximity switches, photoelectric cells, pressure switches, float switches, light sensors and temperature sensors ➢ basic operating principles of common control devices ➢ advantages and disadvantages of common control devices ➢ applications for common control devices ➢ selecting control devices using manufacturers' catalogues for specified applications ➢ connection of control devices into control circuits • Programmable relays encompassing: ➢ Programmable relays - advantages over electromagnetic relay circuit control. ➢ Typical applications of programmable relays. ➢ block diagram representation and basic operating principles ➢ Input and output parameters, listing, connections and output types. ➢ connecting input and output devices to a programmable relay using a diagram ➢ basic programming of ladder circuits consisting of inputs, outputs i.e. stop-start circuit ➢ Using the monitoring facility of the programmable relay to verify each ladder circuit operation. ➢ programming timers and using the monitoring facility of the programmable relay to check the values of the timer ➢ external devices ➢ implications of programming normally closed field devices ➢ conversion of control circuits • Three-phase induction motor starters encompassing: ➢ Reasons for limiting the starting current of large

	motors. ➢ Requirements of the wiring rules (AS/NZS 3000) and the local supply authority service rules, with regard to starting and control of induction motors. ➢ DOL starter operating principles, applications and circuits ➢ electronic (soft) starter operating principles, applications and circuits ➢ connecting a DOL motor starter and testing the operation of the power and control circuits ➢ installation of DOL and soft starters • Three-phase induction motor starters- reduced voltage encompassing: ➢ star-delta starter operating principles and circuits ➢ primary resistance starter operating principles and circuits ➢ auto-transformer starter operating principles and circuits ➢ secondary resistance starter operating principles and circuits ➢ common applications for each starter type ➢ comparison of motor starters basic characteristics ➢ selecting the most suitable motor starter for a given situation ➢ connecting motor starter power and control circuits for correct operation ➢ measuring starting current and torque of selected motor starters ➢ installation of reduced voltage starters
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Install Appliances, Switchgear and Associated Accessories**
Unit Code	**IND TEA3 14 0117**
Unit Descriptor	This unit covers the installation of appliances protection devices, switchgear, control gear, switchboards, and accessories designed. It encompasses working safely and to installation standards, matching appliances and accessories with that specified, making required circuit connections and completing the necessary installation documentation.

Elements	Performance Criteria
1. Prepare to install appliances, switchgear and associated accessories.	1.1 OHS procedures for a given work area are identified, obtained and understood. 1.2 Health and safety risks are identified and established risk control measures and procedures in preparation for the work are followed. Safety hazards that have not previously been identified are noted and established risk control measures are implemented. 1.3 Installation is prepared in consultation with others affected by the work and sequenced appropriately. 1.4 The nature and location of the work is determined from documentation or appropriate person to establish the scope of work to be undertaken. 1.5 Locations of appliances, ***Application of switch boards***, switchgear and accessories are planned within the constraints of the building structure, significants and requirements. 1.6 Material needed for the installation work is obtained in accordance with established procedures and checked against job requirements. 1.7 Tools, equipment and testing devices needed to for the installation work are obtained in accordance with established procedures and checked for correct operation and safety. 1.8 Preparatory work is checked to ensure no damage has occurred and complies with requirements.
2. Install appliances, switchgear and associated accessories.	2.1 OHS risk control measures and procedures for carrying out the work are followed. 2.2 The need to test or measure live is determined in strict accordance with OHS requirements and when necessary conducted within established safety procedures

	2.3 Circuits/machines/plant is checked as being isolated where necessary in strict accordance OHS requirements and procedures. 2.4 Appliances, switchgear and accessories are installed to comply with technical standards and job specifications and requirements with sufficient access to affect terminations, adjustment and maintenance. 2.5 Accessories are installed straight and square in the required locations and within acceptable tolerances. 2.6 Wiring is terminated at appliances, switchgear and accessories in accordance with manufacture's specifications and functional and regulatory requirements. 2.7 ***Job application*** on ongoing compliance and safety inspections of the installed appliances, switchgear and accessories are undertaken. 2.8 Defects revealed through on-going compliance and safety inspection are rectified. 2.9 Installation is carried out efficiently without unnecessary waste of materials or damage to apparatus, circuits, the surrounding environment or services and using sustainable energy principles. 2.10 Unexpected situations are dealt with safely and with the approval of an authorised person. 2.11 ***Devices used in low voltage installation*** should be protected and demonstrated
3. Completion and report installation activities	3.1 OHS work completion risk control measures and procedures are followed. 3.2 Work site is cleaned and made safe in accordance with established procedures. 3.3 'As-installed' appliances, switchgear and accessories is documented and an appropriate person or persons notified in accordance with established procedures.

Variable	Range
Application of switchboards	May include but not limited to: Installing and connecting main switches, protective devices and links on a main switchboard and preparing the switchboard for the installation of metering Installing and connecting a custom switchboard; Socket-outlets; Lighting equipment and accessories; Luminaries

Job application	May include but not limited to: Demonstration in relation to installation and connection of appliances, switchgear and associated accessories as follows:
Devices used in low voltage installation	May include but not limited to: Cooking appliances Smoke and fire detectors Water heaters and controls Three phase motor starter and control switches Fixed electric heating system (room heaters) Transformers Appliances producing hot water or steam Electric heating cables for floors and ceilings Trace heating Duct heaters Electricity converters Capacitors. Batteries.

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: Required and permitted locations current-using equipment and accessories maintenance of fire protection integrity, requirements for emergency services (safety services) and the like Issues affecting electrical installations limitation on types and colour of exposed accessories.
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: equipment) and accessories to an extent indicated by the following aspects: ➢ Installation standards, codes and requirements applicable to installing electrical equipment encompassing. Protection against thermal effects Connection of electrical equipment (appliances, switchgear and accessories include switchgear and control gear, switchboards, socket-outlets, lighting equipment and accessories, lamps and luminaries, smoke and fire detectors, cooking appliances, appliances producing hot water or steam, room heaters, electric heating cables for floors and ceilings, space heating, duct heaters, electricity converters, motors, transformers, capacitors, and batteries).
Underpinning Skills	Demonstrate skills to: Control, switching and over current and RCD protection Terminal configuration for connection of phase, neutral and protective earthing conductors for each type of equipment.

	Building codes affecting the installation of current-using equipment and accessories in buildings, structures and premises encompassing: ➢ Protection of fire protection integrity, requirements for emergency services (safety services) and the like. Issues affecting electrical installations in heritage buildings and premises encompassing: ➢ Limitation on types and colour of exposed accessories.
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: Interview / Written Test Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Rewind Single Phase and Three Phase Induction Machines Rated for Low Voltage**
Unit Code	**IND TEA3 15 0117**
Unit Descriptor	This unit covers preparing, placing and connecting coils and insulating three phase stators and rotors. It encompasses working safely, using hand and powered tools, measuring, applying knowledge of electrical circuits and stator windings, using testing devices, applying technical and quality standards and keeping winding records.

Elements	Performance Criteria
1. Prepare to rewind three phase induction machines.	1.1 OHS procedures for a given work area are identified, obtained and understood. 1.2 Established OHS risk control measures for work preparation are followed. 1.3 The extent of the work is determined from its ***job application*** job sheets, specifications and regulatory requirements. 1.4 Advice is sought from the work supervisor to ensure the work is coordinated effectively with others. 1.5 Induction machine is disassembled and parts tagged and stored to prevent loss or damage. 1.6 ***Winding*** data is obtained from winding data records or directly from measurements of stator and recorded in accordance with established procedures. 1.7 Winding is stripped from stator in accordance with established procedures. Materials required for the work are obtained in accordance with established procedures and procedures. 1.8 Tools, equipment and testing devices needed to carry out the work are obtained and checked for correct operation and safety. 1.9 ***Application of rewinding three phase machines*** should be carry out when necessary.
2. Complete work report.	2.1 OHS measures work completion risk control is followed. 2.2 Work report forms/data sheets are completed accurately in accordance with established procedures.

Variable	Range
Job application	May include but not limited to: • Demonstration in relation to disassemble and winding stators for at least three different three-phase induction

	machines in an environment designed specifically for the purpose.
Winding	May include but not limited to: • It is stripped from stator in accordance with established procedures.
Application of rewinding three phase machines	May include but not limited to: • Prescribed solutions are used to resolve work completion issues. Routine quality checks are conducted to ensure coils are correctly wound with correct wire, number of turns and shape

Evidence Guide	
Critical Aspects of Competence	Must demonstrate knowledge and skills competence to: • Testing techniques encompassing: ➢ Continuity ➢ Insulation testing ➢ Use of 'growler' ➢ Magnetic field testing
Underpinning Knowledge and Attitudes	Demonstrate knowledge of: • Alternator windings encompassing: ➢ Elementary single-phase stator winding ➢ Elementary three-phase stator winding ➢ Half-coil and whole-coil windings ➢ Concentrated and distributed windings ➢ Chain, lap and wave windings ➢ Pole-pitch and coil-span ➢ Half-coil winding for a three-phase alternator ➢ Whole-coil stator winding for a three-phase alternator • Alternator windings encompassing: ➢ Elementary single-phase stator winding ➢ Elementary three-phase stator winding ➢ Half-coil and whole-coil windings ➢ Concentrated and distributed windings ➢ Chain, lap and wave windings ➢ Pole-pitch and coil-span ➢ Half-coil winding for a three-phase alternator ➢ Whole-coil stator winding for a three-phase alternato
Underpinning Skills	Demonstrate skills in: • Rating, cooling and regulation encompassing: ➢ Rating of alternators ➢ Cooling of alternators ➢ The voltage regulator • using techniques of winding three phase motors. • Performing electrical machine insulation types and applications • Using coil placement techniques • Using coil connection arrangements and terminations • Winding insulation methods

Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Monitor Implementation of Work Plan/Activities**
Unit Code	**IND TEA3 16 0117**
Unit Descriptor	This unit covers competence required to oversee and monitor the quality of work operations within an enterprise. This unit may be carried out by team leaders or supervisors.

Elements	Performance Criteria
1. Monitor and improve workplace operations	1.1 Efficiency and service levels are monitored on an ongoing basis. 1.2 Operations in the workplace have been supported overall enterprise goals and quality assurance initiatives. 1.3 Quality ***problems*** and issues are promptly identified and adjustments made accordingly. 1.4 Procedures and systems are changed in consultation with colleagues to improve efficiency and effectiveness. 1.5 Colleagues are consulted about ways to improve efficiency and service levels.
2. Plan and organise workflow	2.1 Current workload of colleagues is accurately assessed. 2.2 Work is scheduled in a manner which enhances efficiency and customer service quality. 2.3 Work is delegated to appropriate people in accordance with principles of delegation. 2.4 Workflow is assessed against agreed objectives and timelines and colleagues are assisted in prioritisation of workload. 2.5 Input regarding staffing needs is provided to appropriate management.
3. Maintain workplace records	3.1 ***Workplace records*** are accurately completed and submitted within required timeframes. 3.2 Where appropriate, completion of records is delegated and monitored prior to submission.
4. Solve problems and make decisions	4.1 Workplace problems are promptly identified and considered from an operational and customer service perspective. 4.2 Short term action is initiated to resolve the immediate problem where appropriate. 4.3 Problems are analysed for any long term impact and potential solutions assessed and actioned in consultation with relevant colleagues. 4.4 Where problem is raised by a team member, they are encouraged to participate in solving the problem. 4.5 Follow up action is taken to monitor the effectiveness of solutions in the workplace.

Variables	Range
Problems	May include but not limited to: • difficult customer service situations • equipment breakdown/technical failure • delays and time difficulties • competence
Workplace records	May include but is not limited to: • staff records and regular performance reports

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge in: • ability to effectively monitor and respond to a range of common operational and service issues in the workplace • the role of staff involved in workplace monitoring • quality assurance, principles of workflow planning, delegation and problem solving
Underpinning Knowledge and Attitude	Demonstrate knowledge of: • roles and responsibilities in monitoring work operations • overview of leadership and management responsibilities • principles of work planning and principles of delegation • typical work organization methods appropriate to the sector • quality assurance principles and time management • problem solving and decision making processes • industrial and/or legislative issues which affect short term work organization as appropriate to industry sector
Underpinning Skills	Demonstrate skills to: • monitor and improve workplace operations • plan and organize workflow • maintain workplace records
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Apply Quality Control**
Unit Code	**IND TEA3 17 0117**
Unit Descriptor	This unit covers the knowledge, attitudes and skills required in applying quality control in the workplace.

Elements	Performance Criteria
1. Implement quality standards	1.1 Agreed quality standard and procedures are acquired and confirmed. 1.2 Standard procedures are introduced to organizational staff/personnel. 1.3 Quality standard and procedures documents are provided to employees in accordance with the organization policy. 1.4 Standard procedures are revised / updated when necessary.
2. Assess quality of service delivered	2.1 Services delivered are ***quality checked*** against organization ***quality standards*** and specifications. 2.2 Service delivered are evaluated using the appropriate evaluation ***quality parameters*** and in accordance with organization standards. 2.3 Causes of any identified faults are identified and corrective actions taken in accordance with organization policies and procedures.
3. Record information	3.1 Basic information on the quality performance is recorded in accordance with organization procedures. 3.2 Records of work quality are maintained according to the requirements of the organization.
4. Study causes of quality deviations	4.1 Causes of deviations from final outputs or services are investigated and reported in accordance with organization procedures. 4.2 Suitable preventive action is recommended based on organization quality standards and identified causes of deviation from specified quality standards of final service or output.
5. Complete documentation	5.1 Information on quality and other indicators of service performance is recorded. 5.2 All service processes and outcomes are recorded.

Variable	Range
Quality check	May include but not limited to: • Check against design / specifications • Visual and Physical inspection

Quality standards	May include but not limited to: • Materials • Components • Process • Procedures
Quality parameters	May include but not limited to: • Standard Design / Specifications • Material Specification

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • Check completed work continuously against organization standard • Identify and isolate faulty or poor service • Check service delivered against organization standards • Identify and apply corrective actions on the causes of identified faults or error • Record basic information regarding quality performance • Investigate causes of deviations of services against standard • Recommend suitable preventive actions
Underpinning Knowledge and Attitude	Demonstrates knowledge of: • Relevant quality standards, policies and procedures • Characteristics of services • Safety environment aspects of service processes • Evaluation techniques and quality checking procedures • Workplace procedures and reporting procedures
Underpinning Skills	Demonstrates skills to: • interpret work instructions, specifications and standards appropriate to the required work or service • carry out relevant performance evaluation • maintain accurate work records • meet work specifications and requirements • communicate effectively within defined workplace procedures
Resource Implications	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Lead Workplace Communication**
Unit Code	**IND TEA3 18 0117**
Unit Descriptor	This unit covers the knowledge, attitudes and skills needed to lead in the dissemination and discussion of information and issues in the workplace.

Elements	Performance Criteria
1. Communicate information about workplace processes	1.1 Appropriate ***communication method*** is selected. 1.2 Multiple operations involving several topics areas are communicated accordingly. 1.3 Questions are used to gain extra information. 1.4 Correct sources of information are identified. 1.5 Information is selected and organized correctly. 1.6 Verbal and written reporting is undertaken when required. 1.7 Communication skills are maintained in all situations.
2. Lead workplace discussion	2.1 Response to workplace issues is sought. 2.2 Response to workplace issues are provided immediately. 2.3 Constructive contributions are made to workplace discussions on such issues as production, quality and safety. 2.4 Goals/objectives and action plan undertaken in the workplace are communicated.
3. Identify and communicate issues arising in the workplace	3.1 Issues and problems are identified as they arise. 3.2 Information regarding problems and issues are organized coherently to ensure clear and effective communication. 3.3 Dialogue is initiated with appropriate staff/personnel. 3.4 Communication problems and issues are raised as they arise.

Variable	Range
Methods of communication	May include but not limited to: • Non-verbal gestures • Verbal • Face to face • Two-way radio • Speaking to groups • Using telephone • Written

	• Using Internet • Cell phone

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • Deal with a range of communication/information at one time • Make constructive contributions in workplace issues • Seek workplace issues effectively • Respond to workplace issues promptly • Present information clearly and effectively written form • Use appropriate sources of information • Ask appropriate questions • Provide accurate information
Underpinning Knowledge and Attitude	Demonstrates knowledge of: • Organization requirements for written and electronic communication methods • Effective verbal communication methods
Underpinning Skills	Demonstrates skills to: • Organize information • Understand and convey intended meaning • Participate in variety of workplace discussions • Comply with organization requirements for the use of written and electronic communication methods
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Lead Small Teams**
Unit Code	**IND TEA3 19 0117**
Unit Descriptor	This unit covers the skills, knowledge and attitudes required to determine individual and team development needs and facilitate the development of the work group.

Elements	Performance Criteria
1. Provide team leadership	1.1 ***Learning and development needs*** are systematically identified and implemented in line with ***organizational requirements***. 1.2 Learning plan is collaboratively developed and implemented to meet individual and group training and developmental needs. 1.3 Individuals are encouraged to self-evaluate performance and areas identified for improvement. 1.4 ***Feedback on performance*** of team members is collected from relevant sources and compared with established team learning process.
2. Foster individual and organizational growth	2.1 Learning and development program goals and objectives are identified to match the specific knowledge and skills requirements of competence standards. 2.2 ***Learning delivery methods*** are made appropriate to the learning goals, the learning style of participants and availability of equipment and resources. 2.3 Workplace learning opportunities and coaching/ mentoring assistance are provided to facilitate individual and team achievement of competencies. 2.4 Resources and timelines required for learning activities are identified and approved in accordance with organizational requirements.
3. Monitor and evaluate workplace learning	3.1 Feedback from individuals or teams is used to identify and implement improvements in future learning arrangements. 3.2 Outcomes and performance of individuals/teams are assessed and recorded to determine the effectiveness of development programs and the extent of additional support. 3.3 Modifications to learning plans are negotiated to improve the efficiency and effectiveness of learning. 3.4 Records and reports of competence are maintained within organizational requirement.

4. Develop team commitment and cooperation	4.1 Open communication processes are used by team to obtain and share information. 4.2 Decisions are reached by the team in accordance with its agreed roles and responsibilities. 4.3 Mutual concern and camaraderie are developed in the team.
5. Facilitate accomplishment of organizational goals	5.1 Team members are made actively participatory in team activities and communication processes. 5.2 Individual and joint responsibility has been developed teams members for their actions. 5.3 Collaborative efforts are sustained to attain organizational goals.

Variable	**Range**
Learning and development needs	May include but not limited to: • Coaching, mentoring and/or supervision • Formal/informal learning program • Internal/external training provision • Work experience/exchange/opportunities • Personal study • Career planning/development • Performance appraisals • Workplace skills assessment & Recognition of prior learning
Organizational requirements	May include but not limited to: • Quality assurance and/or procedures manuals • Goals, objectives, plans, systems and processes • Legal and organizational policy/guidelines and requirements • Safety policies, procedures and programs • Confidentiality and security requirements • Business and performance plans • Ethical standards • Quality and continuous improvement processes and standards
Feedback on performance	May include but not limited to: • Formal/informal performance appraisals • Obtaining feedback from supervisors and colleagues • Obtaining feedback from clients • Personal and reflective behavior strategies • Routine and organizational methods for monitoring service delivery
Learning delivery methods may include but not limited to:	• On the job coaching or mentoring • Problem solving • Presentation/demonstration

	• Formal course participation • Work experience and Involvement in professional networks • Conference/seminar attendance and induction

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • identify and implement learning opportunities for others • give and receive feedback constructively • facilitate participation of individuals in the work of the team • negotiate learning plans to improve the effectiveness of learning • prepare learning plans to match skill needs • access and designate learning opportunities
Underpinning Knowledge and Attitude and Attitude	Demonstrates knowledge of: • coaching and mentoring principles • how to work effectively with team members who have diverse work styles, aspirations, cultures and perspective • how to facilitate team development and improvement • methods and techniques for eliciting and interpreting feedback • methods for identifying and prioritizing personal development opportunities and options • career paths and competence standards in the industry
Underpinning Skills	Demonstrates skills to: • read and understand a variety of texts, prepare general information and documents according to target audience; spell with accuracy; use grammar and punctuation effective relationships and conflict management • receive feedback and report, maintain effective relationships and conflict management • organize required resources and equipment to meet learning needs • provide support to colleagues • organize information; assess information for relevance and accuracy; identify and elaborate on learning outcomes • facilitation skills to conduct small group training sessions • relate to people from a range of social, cultural, physical and mental backgrounds
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written exam • Observation / Demonstration with Oral Questioning

Context of Assessment	Competence may be assessed in the workplace or in a simulated workplace setting

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Improve Business Practice**
Unit Code	**IND TEA3 20 0117**
Unit Descriptor	This unit covers the knowledge, skills and attitudes required in promoting, improving and growing business operations.

Elements	Performance Criteria
1. Diagnose the business	1.1 ***Sources data*** is identified; ***data required*** for diagnosis is determined and acquired based on the business diagnosis toolkit. 1.2 Value chain analysis is conducted. 1.3 ***SWOT analysis*** of the data is undertaken. 1.4 ***Competitive advantage*** of the business is determined from the data.
2. Benchmark the business	2.1 Product or service to be benchmarked is identified and selected. 2.2 Sources of relevant benchmarking data are identified. 2.3 ***Key indicators*** are selected for benchmarking in consultation with key stakeholders. 2.4 Key indicators of own practice are compared with benchmark indicators. 2.5 Areas of improvements are identified.
3. Develop plans to improve business performance	3.1 A consolidated list of required improvements is developed. 3.2 Cost-benefit analysis is determined for required improvements. 3.3 Work flow changes resulting from proposed improvements are determined. 3.4 Proposed improvements are ranked according to agreed criteria. 3.5 An action plan is developed and agreed to implement the top ranked improvements. 3.6 ***Organizational structures*** are checked to ensure they are suitable.
4. Develop marketing plans	4.1 The practice vision statement is reviewed. 4.2 Practice ***objectives*** are developed/ reviewed. 4.3 Market research is conducted and result is obtained. 4.4 Target markets are identified/ refined. 4.5 ***Market position*** is developed/ reviewed. 4.6 ***Practice brand*** is developed.

	4.7 ***Benefits*** of products or services are identified. 4.8 ***Promotion tools*** are selected and developed.
5. Develop business growth plans	5.1 Plans are developed to increase profitability 5.2 Proposed plans are ***ranked*** according to agreed criteria. 5.3 An action plan is developed and agreed to implement the top ranked plans. 5.4 Business work practices are reviewed to ensure they support growth plans.
6. Implement and monitor plans	6.1 Implementation plan is developed in consultation with all ***relevant stakeholders***. 6.2 Success indicators of the plan are agreed. 6.3 Implementation is monitored against agreed indicators. 6.4 Implementation is adjusted as required.

Variable	**Range**
Data sources	May include primary data and secondary sources
Data required	May include but not limited to: • Organization capability • Appropriate business structure • Level of client service which can be provided • Internal policies, procedures and practices • Staff levels, capabilities and structure • Market and market definition • Market changes/market segmentation • Market consolidation/fragmentation • Revenue • Level of commercial activity • Expected revenue levels, short and long term • Revenue growth rate • Break even data • Pricing policy • Revenue assumptions • Business environment • Economic conditions • Social factors • Demographic factors • Technological impacts • Political/legislative/regulative impacts • Competitors, competitor pricing and response to pricing • Competitor marketing/branding • Competitor products
SWOT analysis	May include but not limited to:

	• Internal strengths such as staff capability, recognized quality • Internal weaknesses such as poor morale, under-capitalization, poor technology • External opportunities such as changing market and economic conditions • External threats such as industry fee structures, strategic alliances, competitor marketing
Competitive advantage	May include but not limited to: • Quality • Pricing • Cost • Location • Technology • Delivery • Timeframe • Promotion • Niche marketing • Support from government
Key indicators	May include but not limited to: • Staffing • Cost and expenses • Personnel productivity (particularly of principals) • Goodwill • Profitability • Price structure • Customers base • Productivity • Quality • System
Organizational structures	May include but not limited to: • Lines of authority and reporting relationship
Objectives	May include but not limited to: • Market share growth • Revenue growth • Profitability • Productivity • Innovation
Market position	May include but not limited to: • The goods or service provided • Product mix • The core product - what is bought • The tangible product - what is perceived • The augmented product - total package of consumer • Features/benefits • Product differentiation from competitive products • New/changed products

	• Price and pricing strategies (cost plus, supply/demand, ability to pay, etc.) • Pricing objectives (profit, market penetration, etc.) • Cost components • Market position • Distribution strategies • Marketing channels • Promotion • Target audience • Communication
Practice brand	May include but not limited to: • Practice image • Practice logo/letterhead/signage • Phone answering protocol • Facility decor • Slogans • Templates for communication/invoicing • Style guide • Writing style • AIDA (Attention, Interest, Desire and Action)
Benefits	May include but not limited to: • Features as perceived by the client • Benefits as perceived by the client
Promotion tools	May include but not limited to: • Networking and referrals • Seminars • Sales promotion • Advertising • Personal selling • Press releases • Publicity and sponsorship • Brochures • Newsletters (print and/or electronic) • Websites • Direct mail • Telemarketing/cold calling
Ranking	May include but not limited to: • Importance • Urgency • Technology • Resource availability
Relevant stockholders	May include but not limited to: • Micro and Small Enterprises development • Non-Government Organizations (NGOs) • Finance institutions • Capital goods leasing enterprise

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge of: • Identifying the key indicators of business performance • Identifying the key market data for the business • A wide range of available information sources • Acquiring information not readily available within a business • Analyzing data and determine areas of improvement • Negotiating required improvements to ensure implementation • Evaluating systems against practice requirements • Forming recommendations and/or make recommendations • Assessing the accuracy and relevance of information
Underpinning Knowledge and Attitude	Demonstrates knowledge of: • Data gathering and analysis • Value chain analysis • SWOT analysis • Competitive advantage • Cost benefit analysis • Target market • Marketing principles • Organizational structure • Marketing mix • Promotion mix • Market position • Branding Profitability demonstrates knowledge of: • Data gathering and analysis • Value chain analysis • SWOT analysis • Competitive advantage • Cost benefit analysis • Target market • Marketing principles • Organizational structure • Marketing mix • Promotion mix • Market position • Branding • Profitability
Underpinning Skills	Demonstrates skill in: • Benchmarking skills • Communication skills • Computers kills to manipulate data and present information • Negotiation skills

	• Preparing action plan • Conducting market research • Identifying target market • Identifying suitable marketing mix • Preparing promotional tools • Problem solving • Planning skills • Monitoring and evaluation • Ability to acquire and interpret relevant data • Use of market intelligence • Development and implementation strategies of promotion and growth plans • Ability to acquire and interpret required data, current practice systems and structures and sources of relevant benchmarking data • Applying methods of selecting relevant key benchmarking indicators • Communication skills • Working and consulting with others when developing plans for the business • Negotiation skills • Using computers to manipulate, present and distribute information
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

Occupational Standard: Train Electrical/Electronics Assembly Level III	
Unit Title	**Prevent and Eliminate MUDA**
Unit Code	**IND TEA3 21 0117**
Unit Descriptor	This unit of competence covers the knowledge, skills and attitude required by a worker to prevent and eliminate MUDA/wastes in his/her their workplace. It covers responsibility for the day-to-day operation of the work and ensures Kaizen elements are continuously improved and institutionalized.

Elements	Performance Criteria
1. Prepare for work.	1.1 Work instructions are used to determine job requirements, including method, material and equipment. 1.2 Job specifications are read and interpreted following working manual. 1.3 ***OHS requirements***, including dust and fume collection, breathing apparatus and eye and ear personal protection needs are observed throughout the work. 1.4 Appropriate material is selected for work. 1.5 ***Safety equipment and tools*** are identified and checked for safe and effective operation.
2. Identify MUDA.	2.1 Plan of MUDA identification is prepared and implemented. 2.2 Causes and effects of MUDA are discussed. 2.3 ***Tools and techniques*** are used to draw and analyze current situation of the work place. 2.4 Wastes/MUDA are identified and measured based on ***relevant procedures***. 2.5 Identified and measured wastes are reported to relevant personnel.
3. Eliminate wastes/MUDA.	3. 1. Plan of MUDA elimination is prepared and implemented. 3. 2. Necessary attitude and ***the ten basic principles for improvement*** are adopted to eliminate waste/MUDA. 3. 3. Tools and techniques are used to eliminate wastes/MUDA based on the procedures and OHS. 3. 4. Wastes/MUDA are reduced and eliminated in accordance with OHS and organizational requirements. 3. 5. Improvements gained by elimination of waste/MUDA are reported to relevant bodies.
4. Prevent occurrence of wastes/MUDA.	4.1 Plan of MUDA prevention is prepared and implemented. 4.2 Standards required for machines, operations, defining

	normal and abnormal conditions, clerical procedures and procurement are discussed and prepared. 4.3 Occurrences of wastes/MUDA are prevented by using ***visual and auditory control methods***. 4.4 Waste-free workplace is created using ***5W and 1H***sheet. 4.5 The completion of required operation is done in accordance with standard procedures and practices. 4.6 The updating of standard procedures and practices is facilitated. 4.7 The capability of the work team that aligns with the requirements of the procedure is ensured.

Variable	**Range**
OHS requirements	May include but not limited to: • Are to be in accordance with legislation/ regulations/codes of practice and enterprise safety policies and procedures. This may include protective clothing and equipment, use of tooling and equipment, workplace environment and safety, handling of material, use of firefighting equipment, enterprise first aid, hazard control and hazardous materials and substances. • Personal protective equipment is to include that prescribed under legislation/regulations/codes of practice and workplace policies and practices. • Safe operating procedures are to include, but are not limited to the conduct of operational risk assessment and treatments associated with workplace organization. • Emergency procedures related to this unit are to include but may not be limited to emergency shutdown and stopping of equipment, extinguishing fires, enterprise first aid requirements and site evacuation.
Safety equipment and tools	May include but not limited to: • dust masks / goggles • glove • working cloth • first aid and safety shoes
Tools and techniques	May include but not limited to: • Plant Layout • Process flow • Other Analysis tools • Do time study by work element • Measure Travel distance • Take a photo of workplace • Measure Total steps • Make list of items/products, who produces them and who uses them & those in warehouses, storages etc.

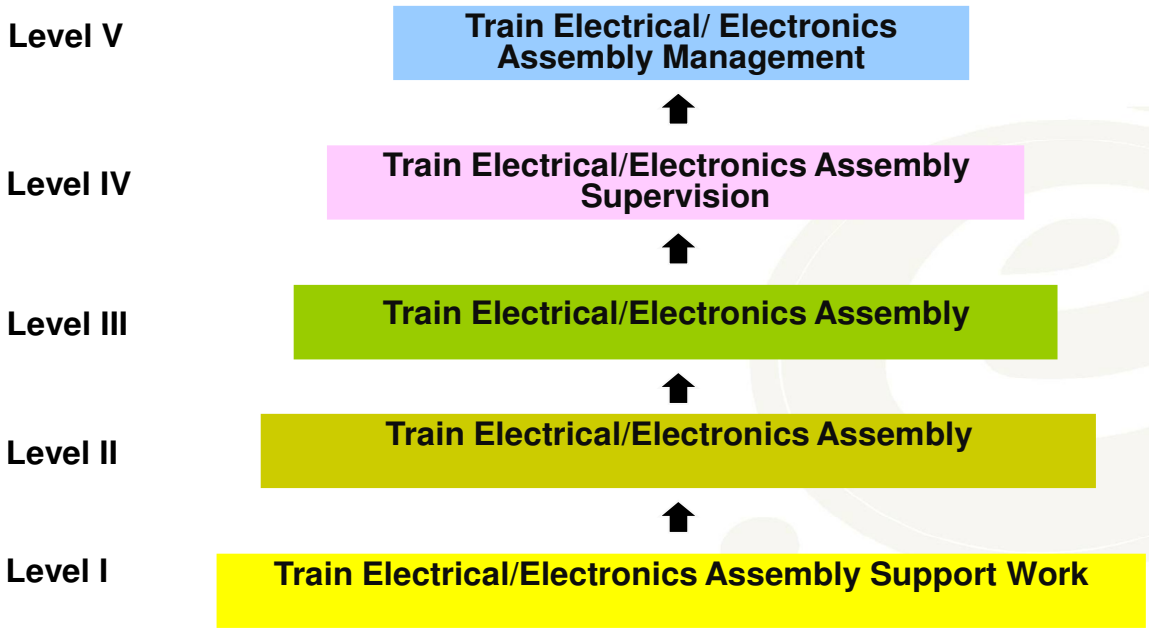
	• Focal points to Check and find out existing problems • 5S • Layout improvement • Brainstorming • Andon • U-line • In-lining • Unification • Multi-process handling & Multi-skilled operators • A.B. control (Two point control) • Cell production line • TPM (Total Productive Maintenance)
Relevant procedures	May include but not limited to: • Make waste visible • Be conscious of the waste • Be accountable for the waste. • Measure the waste.
The ten basic principles for improvement	May include but not limited to: • Throw out all of your fixed ideas about how to do things. • Think of how the new method will work- not how it won. • Don't accept excuses. Totally deny the status quo. • Don't seek perfection. A 5o percent implementation rate is fine as long as it's done on the spot. • Correct mistakes the moment they are found. • Don't spend a lot of money on improvements. • Problems give you a chance to use your brain. • Ask "why?" At least five times until you find the ultimate cause. • Ten people's ideas are better than one person's. • Improvement knows no limits.
Visual and auditory control methods	May include but not limited to: • Red Tagging • Sign boards • Outlining • Andons • Kanban, etc.
5W and 1H	May include but not limited to: • Who • What • Where • When • Why • How

Evidence Guide	
Critical Aspects of Competence	Demonstrates skills and knowledge to: • discuss why wastes occur in the workplace

	• discuss causes and effects of wastes/MUDA in the workplace • analyze the current situation of the workplace by using appropriate tools and techniques • identify, measure, eliminate and prevent occurrence of wastes by using appropriate tools and techniques • use 5W and 1H sheet to prevent
Underpinning Knowledge and Attitude	Demonstrates knowledge of: • Targets of customers and manufacturer/service provider • Traditional and kaizen thinking of price setting • Kaizen thinking in relation to targets of manufacturer/service provider and customer • value • The three categories of operations • the 3“MU” • waste/MUDA • wastes occur in the workplace • The 7 types of MUDA • The Benefits of identifying and eliminating waste • Causes and effects of 7 MUDA • Procedures to identify MUDA • Necessary attitude and the ten basic principles for improvement • Procedures to eliminate MUDA • Prevention of wastes • Methods of waste prevention • Definition and purpose of standardization • Standards required for machines, operations, defining normal and abnormal conditions, clerical procedures and procurement • Methods of visual and auditory control • TPM concept and its pillars. • Relevant OHS and environment requirements • Plan and report • Method of communication
Underpinning Skills	Demonstrates skills to: • draw & analyze current situation of the work place • use measurement apparatus (stop watch, tape, etc.) • calculate volume and area • use and follow checklists to identify, measure and eliminate wastes/MUDA • identify and measure wastes/MUDA in accordance with OHS and procedures • use tools and techniques to eliminate wastes/MUDA in accordance with OHS procedure • apply 5W and 1H sheet • update and use standard procedures for completion of

	required operation • work with others • read and interpret documents • observe situations • solve problems • communicate • gather evidence by using different means • report activities and results using report formats
Resources Implication	Access is required to real or appropriately simulated situations, including work areas, materials and equipment, and to information on workplace practices and OHS practices.
Methods of Assessment	Competence may be assessed through: • Interview / Written Test • Observation / Demonstration with Oral Questioning
Context of Assessment	Competence may be assessed in the work place or in a simulated work place setting.

ELECTRICAL/ELECTRONICS ASSEMBLY



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