TECHNICAL &
VOCATIONAL
EDUCATION &
TRAINING

National Competency Standard for ELECTRICIAN Qualification Code: CON01S07VI

[Endorsed by the MALDIVES ACCREDITATION BOARD (MAB)]

PREFACE

The ADB Loan 2028 MLD, Employment Skills Training Project's (ESTP) objective is to increase the number of Maldivians, men and women, actively participating in the labor force, employed and self employed. The Project will support the expansion of demand driven employment-oriented skills training in priority occupations and improve the capacity to develop and deliver Competency Based Skill Training (CBST). The Project aims to (i) provide youth with employment-oriented skills training; (ii) improve public perception of training and employment in locally available skills-oriented occupations; (iii) make available employment-related information to more Maldivians; and (iv) strengthen the capacity for labor administration and for labor market analysis.

The objective of the project is to deliver CBST programs to satisfy employer demand-driven needs. The National Competency Standards (NCS) provide the base for this training. Initially training will be focused on five key sectors: tourism, fisheries and agriculture, transport, construction and the social sectors. These sectors are included as priority sectors in the national development plan and play a vital role in the continued economic growth of the country.

The NCS are developed in consultation with Employment Sector Councils representing employers. They are designed using a consensus format endorsed by the Maldives Accreditation Board (MAB) to maintain uniformity of approach and the consistency of content amongst occupations. This single format also simplifies benchmarking the NCS against relevant regional and international standards.

NCS specify the standards of performance of a competent worker and the various contexts in which the work may take place. NCS also describes the knowledge, skills and attitudes required in a particular occupation. They provide explicit advice to assessors and employers regarding the knowledge, skills and attitudes to be demonstrated by the candidates seeking formal recognition for the competency acquired following training or through work experience. By sharing this information, all participants in the training process have the same understanding of the training required and the standard to be reached for certification. Certification also becomes portable and can be recognized by other employers and in other countries with similar standards.

NCS are the foundation for the implementation of the Technical and Vocational Education and Training (TVET) system in Maldives. They ensure that all skills, regardless of where or how they were developed

can be assessed and recognized. They also form the foundation for certifying skills in the Maldives National Qualification Framework (MNQF).

NCS are developed by the TVET Section of Ministry of Higher Education, Employment and Social Security. The NCS are endorsed by the Employment Sector Councils of the respective sectors and validated by the Maldives Accreditation Board.

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National Competency Standard has been Endorsed by

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Date of Endorsement: 27 December 2007	Date of revision

Key for coding
Coding Competency Standards and Related Materials

DESCRIPTION	REPRESENTED BY
Industry Sector as per ESC (Three letters)	Construction Sector **(CON)** Fisheries and Agriculture Sector **(FNA)** Transport sector **(TRN)** Tourism Sector **(TOU)** Social Sector **(SOC)** Foundation **(FOU)**
Competency Standard	**S**
Occupation with in a industry Sector	**Two digits 01-99**
Unit	**U**
Common Competency	**1**
Core Competency	**2**
Optional/ Elective Competency	**3**
Assessment Resources Materials	**A**
Learning Resources Materials	**L**
Curricula	**C**
Qualification	**Q1, Q2 etc**
MNQF level of Qualification	**L1, L2 etc**
Version Number	**V1, V2 etc**
Year of endorsement of standard, qualification	**By two digits Example- 07**

2. NATIONAL CERTIFICATE III IN ELECTRICIAN		
3. Qualification code: CON01SQ1L307		**Total Number of Credits: 60**
4. Purpose of the qualification The holders of this qualification will be competent to work in the Construction Sector as a domestic electrician. The level III qualification presented here will facilitate preparing students to the entry level workplace tasks and the competency units are mapped in such a way to fulfill the knowledge and skills requirements of the "Domestic Electrician" occupation within the local construction Industry.		
5. Regulations for the qualification		National Certificate III in the occupation of Electrician will be awarded to those who are competent in units 1+2+3
6. Schedule of Units		
Unit Title	**Unit Title**	**Code**
1	Carry out domestic single phase and **three phase** electrical wiring	CON01S2U01V1
2	Carry out inspection, testing, fault finding and repair in domestic electrical installations	CON01S2U02V1
3	Estimates Material requirement for electrical installations	CON01S2U03V1
7. Accreditation requirements	The training provider should have a workshop or similar training facility to provide the trainees the hands-on experience related to this qualification	
8. Recommended sequencing of units	As appearing under the section 06	

2. NATIONAL ADVANCED CERTIFICATE IN ELECTRICIAN	
2. Qualification code: CON01SQ2L407	**Total Number of Credits 139**
3. Purpose of the qualification The holders of the advanced certificate are expected to possess all the relevant knowledge and skills to work as Electrician in the Construction Industry.	
4. Regulations for the qualification	National Advanced Certificate in the occupation of Electrician will be awarded to those who are competent in units 1+2+3+4+5+6+7 (Unit 7 is optional)

5. Schedule of Units

Unit Title	Unit Code
Carry out domestic single phase and **three phase** electrical wiring	CON01S2U01V1
Carry out inspection, testing, fault finding and repair in domestic electrical installations	CON01S2U02V1
Estimates Material requirement for electrical installations	CON01S2U03V1
Carry out industrial electrical installations	CON01S2U04V1
Inspect, test, trace and repair faults in industrial electrical installations	CON01S2U05V1
Install service / repair or replace electrical control system and protective switchgear	CON01S2U06V1
Install service and repair programmable logic control systems	CON01S2U07V1

6. Accreditation requirements	The training provider should have a workshop or similar training facility to provide the trainees the hands-on experience related to this qualification
7. Recommended sequencing of units	As appearing under the section 06

Units Details

Unit Title	Unit Title	Code	Level	No of credits
1	Carry out domestic single phase and **three phase** electrical wiring	CON01S2U01V1	3	36
2	Carry out inspection, testing, fault finding and repair in domestic electrical installations	CON01S2U02V1	3	18
3	Estimates Material requirement for electrical installations	CON01S2U03V1	3	06
4	Carry out industrial electrical installations	CON01S2U04V1	4	24
5	Inspect, test, trace and repair faults in industrial electrical installations	CON01S2U05V1	3	12
6	Install service / repair or replace electrical control system and protective switchgear	CON01S2U06V1	4	18
7	Install service and repair programmable logic control systems	CON01S2U07V1	4	25

Packaging of National Qualifications:

National certificate III in Electrician (domestic) will be awarded to those who are competent in units 1+2+3

Qualification Code: CON01SQ1L307

National Advanced Certificate in Electrician will be awarded to those who are competent in units 1+2+3+4+5+6+7(Unit 7 is optional)

Qualification Code: CON01SQ2L407

Competency Standard for

ELECTRICIAN

Unit No	Unit Title
1.	Carry out domestic single phase and **three phase** electrical wiring
2.	Carry out inspection, testing, fault finding and repair in domestic electrical installations
3.	Estimates Material requirement for electrical installations
4.	Carry out industrial electrical installations
5.	Inspect, test, trace and repair faults in industrial electrical installations
6.	Install service / repair or replace electrical control system and protective switchgear
7.	Install service and repair programmable logic control systems

UNIT TITLE	Carry out domestic single phase and **three phase** electrical wiring				
DESCRIPTOR	This unit covers the competencies required to wire domestic electrical circuits, install and wire electrical switchgear, accessories, equipment and fittings etc, using specified tools, measuring instruments and material, in accordance with the electrical layout plans/ wiring diagrams, etc, conforming to standards and regulations, while ensuring safety of self, others and property including safety of the electrical installations				
CODE	CON01S2U01V1	LEVEL	3	CREDIT	36

ELEMENTS OF COMPETENCIES	PERFORMANCE CRITERIA
1. Prepare material for wiring	1.1. Cables required for each circuit selected considering current ratings and conforming with standards and regulations 1.2. Poly Vinyl Chloride (PVC) conduit and trunking and related accessories selected according to requirements 1.3. Electrical fittings, wiring accessories, switchgear and other required material selected as specified in the layout plan/ wiring diagram
2. Lay and fix electrical trunking and wire	2.1 Locations of the electrical points identified and marked according to layout plan 2.2 Location of PVC conduit/ trunking to be laid, marked according to the wiring diagram 2.3 Walls chipped as necessary for burying of conduit according to its sizes and number 2.4 Conduits selected and cut/bent/joined them as necessary, buried in the walls, clamped firmly, ensuring correct clearance from the wall surfaces and paying attention to the sizes and number of wires to be accommodate according to regulations and specifications 2.5 PVC trunking selected and cut as necessary, fixed firmly and neatly on the wall surfaces according to the wiring diagram, paying attention to the sizes and number of wires to be accommodated according to regulations and

	specifications 2.6 Wires and cables selected according to the wiring diagram considering current ratings, voltage drop and switch gear used 2.7 Wires and cables drawn according to the circuit requirements ensuring safety of the wires / cables, tools and equipment
3. Erect electrical accessories	3.1 Electrical accessories, fittings erected at standard heights and stipulated locations etc., according to layout plan and MEA regulations 3.2 Cables and flexible cords terminated to accessories following code of practice
4. Fix and wire consumer units and gear	4.1 Distribution board installed as per layout plan/ and MEA regulation 4.2 Main isolator, earth leakage protecting device, overload protection devices mounted in distribution board according to regulation MEA 4.3 Main supply cables, earth wires and all sub circuits terminated to corresponding devices according to the wiring diagram following code of practice and **regulation MEA**
5. Install the earth electrode of the domestic electrical installation	5.1 Earth electrode selected to suit the soil conditions and according to standard earthing practices and **regulation MEA** 5.2 Earth electrode prepared, driven / buried into the ground at the location identified to a suitable get the required earth resistance 5.3 Earth continuity wire/cable terminated at the earth electrode ensuring sound electrical bond using specified connecting/ fixing accessories 5.4 Suitable earth electrode cover pit constructed and marked for identification

Range Statement

Work may take place in residential building, where the electrician is called to perform the job.

This unit applies to the following and should be contextualized to the qualifications to which it is being applied.

Domestic electrical wiring includes:

- Lighting Circuits
- Socket outlet circuits
- Heavy current rated circuits for cooking rages etc.,
- Ventilator circuits
- Circuits for fixed appliances

Electrical switchgear and accessories include:-

Main isolator, (Electrical Control Board) ELCB, (Motor Control Board) MCBs, Switches, soaked outlets, regulators, lamp fixtures, lamp holders, door bells/ door openers etc

Tools, equipment and material used in this unit may include

- Electrician's tool kit
- Soldering lead and fluxes
- Vices
- Control and protective switchgear used in domestic electrical installations
- Wires and cables
- Electrical conduit
- Anchor bolts
- Insulation tape
- Draw-wire/ tape etc.,
- PVC conduits and trunking
- Soldering iron (40-100watts)
- Compression tools
- Measuring tape
- Electrical accessories
- Wiring accessories
- Flexible cords
- Rawl plugs
- Cable lugs
- Nails, screws

- Personal protective equipment

Electrical measuring and detected instruments includes:

- Continuity tester/ buzzer
- Clamp-on meter
- Insulation resistance testers
- Multi-meter

Work is performed to drawings sketches, specifications and instructions as appropriate and to predetermined standards of quality and safety.

Range of work expected in this unit includes:

- Selection of correct type and size of wires and cables
- Wiring according to correct phase sequence in the system
- Ensuring acceptance insulation resistance level
- Adherence to safe working practices
- Ensuring safe and proper performance of the installation
- Selection of correct types of electrical switch gear, accessories and fittings
- Wiring according to correct polarity of switches and socket outlets.
- Ensuring earthing and earth electrode resistance to acceptable level

The instructional and other reference data connected with this unit includes:

- Layout plans/wiring diagrams
- Latest standards & regulations related to the domestic electrical wiring
- Manufacturer's instruction manuals, as appropriate

Sources of information/documents include:

- Manufacturers' specifications
- Customer requirements
- Workplace codes and practice
- MEA regulations

The performance of this unit is expected to be carried out to the following standards:

- MEA Regulations

- Occupational health and safety regulations

ASSESSMENT GUIDE

Forms of assessment

Continuous assessment coupled with gathered evidence of performance is suitable for this unit.

Assessment context

This unit shall be assessed on the job or in a simulated environment demonstrated by an individual working alone or as part of a team

This unit could be assessed individually or in conjunction with other related units

Critical aspects (for assessment)

Assessment must confirm the candidate's ability to:

- Safety of self, others and property
- Wiring according to correct phase sequence in the system and to correct polarity of switches and sockets outlets
- Ensure acceptable earth insulation resistance level and earthing and earth
- Adherence to standards and latest regulations

Assessment conditions

The candidate will have access to:

- All tools, equipments, materials and documentation required

The candidates will be permitted to refer to the following documents:

- Relevant workplace procedures
- Relevant product and manufacturing specifications
- Relevant manuals, standards and reference material
- Layout plans/wiring diagrams

The candidates will be required to:

- Orally, or by other methods of communication, answer questions asked by the assessors
- Identify superiors who can be approached for the collection of competency evidence where appropriate
- Present the evidence of credit for any off-job training related to this unit

Assessors must be satisfied that the candidate can competency and consistently perform all elements of the unit as specified by the criteria, and that he/she possess the required underpinning knowledge

UNDERPINNING KNOWLEDGE AND SKILLS

Underpinning Knowledge	Underpinning Skills
• Interpretation of layout plans/wiring diagrams and manufacturers specifications, technical sketches, graphic symbols and etc • Type of domestic wiring methods and circuits and their applications • Type of electrical control and protection switchgear and accessories used in domestic electrical installations • Type of electrical wires and cables and their ratings • Types of electrical accessories used in domestic installations • Types of electrical conduits, casting and capping etc., and their applications and their cutting/joint/fixing methods • Electrical tools and measuring instruments used in domestic electrical installation work • Methods of joining terminating electric wires/ cables and type of insulation materials used in electrical installations • Earth electrodes and installation techniques • MEA Regulation	• Refers, interpret and apply technical information including statutory regulations on domestic electrical installations • Select the correct methods and type of wiring circuit, according to the wiring diagram/layout plan • Select and use of electrical control and protective switchgear, according to the wiring diagram/layout plan, rating and type • Select and use correct type and size of wires and cables, according to the rating of each circuit • Select the correct types and size of electrical conduit/casting and capping etc, cut, bend, join/fix them according to the requirements of each circuit • Use the correct type of electricians tools and measuring instruments • * Splice, join, terminate, solder and insulate joints in electrical

UNIT TITLE	Carry out inspection, testing, fault finding and repair in domestic electrical installations				
DESCRIPTOR	This unit covers the competencies required to inspect and test domestic electrical installations, locate faults in the system and rectify such faults, using specified tools, testing and measuring instruments and material. Carry out periodical tests conforming to standards and regulations for safe performance of installations, while ensuring safety of self, others and property.				
CODE	CON01S2U02V1	LEVEL	3	CREDIT	18

ELEMENTS OF COMPETENCIES	PERFORMANCE CRITERIA
1. Inspect and test electrical installations	1.1. Installation checked for conformity with the layout plan 1.2. Electrical installation visually inspected for faults / defects 1.3. Heights and location of the electrical switchgear and accessories checked as per standards and regulations 1.4. Electrical installations tested as specified in the MEA regulations 1.5. Results of the tests recorded and maintained.
2. Repair / maintain the electrical installations	2.1 The installation tested and faults located and noted down 2.2 Necessary adjustments in the control and protective switchgear attended to 2.3 List of items/ material required for replacement prepared 2.4 Defective earth electrode and faulty/ damaged earthing conductors replaced 2.5 Installations tested for safe and optimum performance according to standards and regulations

Range Statement

Work may take place in domestic and commercial building, where the electrician is called to perform the job

The following tasks are included in this unit:

- Short circuit tests between phase and neutral conductors

- Short circuit tests between conductors and earth
- Continuity tests on main circuits
- Continuity tests on sub circuits
- Continuity tests on final circuits
- Continuity tests on protective conductors
- Polarity tests
- Insulation resistance tests
- Earth electrode resistance test
- Performance of over current protective devices/ earth leakage protection
- Functional tests on control switch gear and accessories
- Overall tests on domestic electrical installations soon after completion of the installations
- Periodic inspections and testing on existing domestic electrical installation

Tools, equipment and material used in this unit may include

- Electrician's tool kit
- Soldering lead and fluxes
- Vices
- Flexible cords
- Wooden plugs
- Anchor bolts
- Insulation tape
- Personal protective equipment
- Soldering iron (40-100 watts)
- Compression tools
- Cables – (single and multi core)
- Conduit (PVC and metal)
- Raw plugs
- Cable lugs
- Draw-wire / tape

Electrical measuring and detecting instruments include:

- Multi-meter
- Field/ signal strength meter
- Clip-on-meter

Work is performed to drawing sketches, specification and instructions as appropriate to predetermined standards of quality and safety

The instructional and other reference data connected with this unit may include:

- Layout drawings/plans
- Single line & multi line representations
- Wiring diagrams
- Electrical specifications and
- Manufacturer's instructional manuals, as appropriate.

Sources of information/documents include:

- Latest MEA regulations
- Manufacturer's specifications
- Customer requirements
- Local Authority requirements
- Industry / workplace codes of practice

The performances of this unit are expected to be carried out to the following standards:

- Occupational health and safety regulations
- MEA regulations

Electrician's Operational Methods may include:

- Reading / interpreting electrical layout plans/wiring diagrams of domestic electrical installations
- Testing, dismantling, servicing, assembling, removing and replacing of electrical circuits, control & protective switchgear and accessories.
- Fault finding using smell, sound & sight assessments for damage, corrosion, wear and electrical short/broken circuits, electrical measurements and rectify faults in domestic electrical installations.

Methods should be applied under normal operating conditions.

ASSESSMENT GUIDE

Forms of assessment

Continuous assessment coupled with gathered evidence of performance is suitable for this unit

Assessment context

This unit shall be assessed on the job or in a simulated environment demonstrated by an individual working alone or as part of a team.

This unit could be assessed individually or in conjunction with other related units

Critical aspects (for assessment)

Assessment must confirm the candidate's ability to:

- Follow safety procedures and work practices
- Isolate and label all connected loads from the circuit before conducting insulation test
- Isolate electronic devices/ capacitors etc., from the circuits before conducting continuity tests
- All adjustments/ replacements of components should be done according to manufacturer's specifications.
- Component like fire fighting need to be carried by licensed body

Test and inspect in sequential order of testing according to regulations and standards, using specified test instruments.

Assessment conditions

The candidate will have access to:

- All tools, equipment, material and documentation required.

The candidate will be permitted to refer to the following documents:

- Relevant workplace procedures
- Relevant product and manufacturing specifications
- Relevant drawings, manuals, codes, standards and reference material

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessor
- Identify superiors who can be approached for the collection of competency evidence where appropriate
- Present evidence of credit for any off-job training related to this unit

Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, and that he/she possess the required underpinning knowledge

UNDERPINNING KNOWLEDGE AND SKILLS

Underpinning Knowledge	**Underpinning Skills**
• Interpretation of layout diagrams, technical sketches, graphic symbols and wiring diagrams and manufacturer's specifications etc., • Types of electrical tools used for wiring purpose • Types of electrical measuring instruments used in testing domestic electric installations • Types of electrical wiring systems for domestic purposes • Types of electrical control and protective switchgear and accessories used in domestic electrical circuits • Types and principles of operation of circuit breakers used in domestic electrical installations and their applications • Types of electrical wires and cables and their ratings • Types of electrical accessories and their applications on domestic electrical installations • Types of earthing systems used in domestic electrical installations	• Refer, interpret and apply layout plans, wiring diagrams, manufacturer's technical information/ specifications including statutory regulations on domestic electrical installations • Select and use the correct type electrical tools • Use electrical measuring and testing equipment correctly and safely, test and identify faults in wiring systems • Check for appropriateness of the wiring system according to regulations • Inspect and test electrical control and protective switchgear for their optimum performance • Check the type and rating of circuit breakers/ protective switchgear installed and determine their appropriateness according to the circuit protection requirements • Check appropriate type and size of wires/ cables in conformity with requirements. • Check for correct type of electrical accessories used, according to requirements of regulations

• Importance of testing electrical installations after completion and thereafter carrying out periodical inspections • Manual handling techniques • Safe methods of handling heavy loads • Material handling devices • Occupational health and safety regulations • First aid including methods of resuscitation • Fire fighting • Safe working methods • Record keeping and reporting	• Identify and use the appropriate type of earth electrode most suitable according to the soil conditions and test the earth electrode for recommended earth resistance • Test completed domestic electrical installations in sequential order, according to regulations • Safely handle heavy loads without endangering self, others and property • Safe handling of electric shock victims • Good housekeeping • Administering first aid • Use of fire protection equipment • Ability to select substitute components/ accessories/ devices by referring technical specifications • Safe work practices in working at heights, ladders etc., • Check the installations for adhering to laid down local authority/ enterprise policies/ electrical regulations etc., • Check for safety precautions taken in installing electrical wiring and accessories used in hazardous areas • Documentation related to inspection and testing of completed domestic electrical installations

UNIT TITLE	Estimates Material requirement for electrical installations				
DESCRIPTOR	This unit covers the competencies required to prepare estimates for domestic and industrial wiring in accordance with the layout plan / wiring diagram etc., ensuring cost effectiveness, conforming to standards and regulations.				
CODE	CON01S2U03V1	LEVEL	3	CREDIT	6

ELEMENTS OF COMPETENCIES	PERFORMANCE CRITERIA
1. Collect information for the electrical installation work	1.1. Information gathered from the customer 1.2. Material required for the installation work listed out, considering the customer's needs and referring to the layout plan / wiring diagram 1.3. Current market prices of material, goods and switch gear of appropriate quality obtained from several suppliers and compared prices 1.4. Labour requirement for the installation estimated, based on nature of work
2. Prepare Estimates for the Material	2.1 Cost of material and accessories calculated in terms of current market prices
3. Provide information to customers or management	3.1 Information provided to the customer or management regarding to the material required for the electrical installation

Range Statement

Work can take place in a residential where the electrician is called upon to prepare the estimate.

In this unit preparation of estimates are limited to the following:

- Domestic electrical new installations
- Repairs / alternations/ additions to existing domestic electrical installations, three phase, 400 volts, 60 amp

Tools, equipment and material used in this unit may include

- Measuring tape
- Stationary

- Data relevant to the particular installation
- Calculator
- Layout plans
- Manufacture's technical specifications

ASSESSMENT GUIDE

Forms of assessment

Continuous assessment coupled with gathered evidence of performance is suitable for this unit.

Assessment context

This not could be assessed on or off the job or in simulated situation

Candidate must demonstrate the competencies in this unit individually

This unit could be assessed individually or in conjunction with other related units.

Critical aspects (for assessment)

Assessment must confirm the candidates' ability to:

- Identify customer's requirements and prepare estimates referring to layout plans
- Use of current market prices of electrical switch gear, accessories and material
- Prepare the list of material

Assessment conditions

The candidate will have access to:

- Current market prices of items needed
- Information on current labour rates/ overhead costs/ taxes/ exchange rates, where applicable
- Stationary and documenting material required for preparation of estimates. Etc.,

The candidate will be permitted to refer to the following documents:

- Relevant product and manufacturing specifications
- Relevant manuals, standards and reference materials.

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessor
- Identify superiors who can be approached for the collection of competency evidence where appropriate
- Present evidence of credit for any off-job training related to this unit

Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, and that he/she possess the required underpinning knowledge

UNDERPINNING KNOWLEDGE AND SKILLS

Underpinning Knowledge	**Underpinning Skills**
• Norms in interacting and negotiating with customers / clients • Interpretation of layout plans/ wiring diagrams, service manuals and manufacture's specifications, technical sketches, graphic symbols etc • Types of electrical control and protective switchgear and accessories used in domestic electrical circuits. • Types of electrical wires and cables and their rating • Types of electrical accessories and their applications • Types of insulating materials used in electrical installations • Types of earth electrodes and their applications • MEA regulations	• Customers interaction and negotiation skills • Refer layout plans/ wiring diagrams, manufactures specification, etc, on electrical installations • Select correct type and rating of electrical control and protective switchgear, according to the wiring diagram/ layout plan • Select correct type and size or wires and cables, according to the rating of each circuit • Select correct type of electrical accessories according to the type of circuit. • Select the correct type and size of electrical conduit/ casing and capping. etc • Select the correct type of insulating materials according to the requirements • Select the most appropriate and cost-effective earth electrode for the electrical installation • Select items/material in conformity with the regulations& standards

UNIT TITLE	Carry out industrial electrical installations				
DESCRIPTOR	This unit coves the competencies required to install industrial electrical control and protective switchgear, lay conduits/ trunking/ ducts and wire single and multi phase circuits, install electrical accessories, fixtures and fitting using specified tools, equipment and material, according to electrical layout plans, conforming with standards and regulations for safety of the installation, while ensuring safety of self, others and property				
CODE	CON01S2U04V1	LEVEL	4	CREDIT	24

ELEMENTS OF COMPETENCIES	PERFORMANCE CRITERIA
1. Lay and fix electrical conduits / trunking / ducts etc.,	1.1. Locations of the electrical points identified and marked according to layout plan 1.2. Locations and directions of conduit/ trunking/ ducts etc marked according to the layout plan 1.3. Walls chipped where necessary, for the burying of conduit according to its sizes and number of runs 1.4. Steel conduits, trunking/ducts etc selected, prepared and fixed in pre-identified locations, clamped firmly, paying attention to the sizes and number of cables/wires to be accommodated according to the wiring diagrams/ regulations/ standards 1.5. Conduit accessories firmly buried/ mounted at pre-identified locations, according to layout plan, at specified depths and heights for each electrical point in conformity with regulations/ standards
2. Install and wire main electrical control and protective switchgear	2.1 Main power control switch gear fixed/ mounted at pre-identified locations, according to the layout plan / diagram 2.2 Stand by power supply equipment and change-over switchgear installed as per manufacturer's specifications 2.3 Cables from the main power control switchgear to the main power supply/ transformers laid and terminated as specified/ detailed in the layout plan/ regulations/ standards

	2.4 Earth electrodes installed and terminated at the pre-identified locations, in accordance with layout plan and conforming with regulations and standards 2.5 Installations tested for safe and optimum performance according to standards and MEA regulations
3. Wire electrical final circuits	3.1 Type and size of wires and cables selected for each final circuit referring to the wiring diagram/ standards 3.2 Wiring carried out in accordance with the wiring diagram/ layout plan and in conformity with standards and MEA regulations 3.3 Electrical accessories in the final circuits mounted and wires terminated as per wiring diagrams 3.4 Special wiring for construction sites, temporary buildings, agricultural and historical sites carried out according to regulations and standards 3.5 Electrical installations in hazardous areas carried out according to regulations and standards 3.6 Electrical appliances, equipment in final circuits fixed according to the wiring diagram/ standards
4. Install wiring for stand by power supplies	4.1 Trunking/ conduit/ ducts etc. for laying of power cables installed according to wiring diagrams 4.2 Earth electrodes for the stand by power supply installed and connected as per manufacturer's specifications/ regulations and standards 4.3 Power changeover switchgear/ control and protective switchgear required for the stand by power supply installed and cables laid and terminated as per manufacturer's specifications/ regulations/ standards 4.4 Power changing over systems checked for correct phase sequence and performance

Range Statement

Work takes place in a construction worksite or in a industrial/ commercial building where the electrician is called to perform the job

Industrial electrical wiring circuits include:

- Lighting circuits
- Circuits for fixed electrical equipment/ appliances
- Circuits for industrial socket outlets
- Circuits for special locations and hazardous areas
- Circuits for stand by power supply
- Ring and radial circuits for socket outlets
- Circuits for high current rated electrical machinery and equipment

Electrical control and protective switchgear:

- Main electrical control and protective and switchgear
- Sub circuit control and protective and switchgear
- Metering and monitoring devices
- Motor control devices
- Standby Generator power change over switchgear

The following electrical measuring instruments, tools, equipment & material are included within this unit:

- Electrician's tool kit
- Multi-meter
- Insulation Resistance tester
- Earth fault loop impedance tester
- Earth Electrode Resistance tester
- Prospective Short-Circuit Current (PSCC) Tester
- Prospective Earth Fault Current (PEFC) Tester
- Personal protective equipment
- Draw wire

Work is performed to drawings, sketches, specifications and instructions as appropriate and to predetermined standards of quality and safety.

The instructional and other reference data connected with this unit include:

- Layout drawings

- Block diagrams
- Single line & multi line representations
- Wiring diagrams
- Electrical specifications
- Manufacturer's instructional manuals, as appropriate

Sources of information/documents include:

- MEA regulations
- Manufacturer specifications
- Customer requirements
- Industry / workplace codes of practice

Occupational health & safety practices which should be abided by:

- Occupational health & safety legislations
- MEA regulations

Electrician's operational methods include:

- Reading / interpreting layout plans/wiring diagrams
- Electrical measurements & fault tracing using specified electrical test & measuring instruments
- Testing, servicing and replacement of defective control and protective switchgear and accessories
- Removal and replacement of defective cables / wires,
- Fault finding using smell, sound & sight assessments for damage, corrosion, wear and electrical short/broken circuits

Methods should be applied under normal operating conditions.

Tools, equipment and material used in this unit may include

- Electrician's tool kit
- Insulations resistance tester
- Earth Electrode Resistance tester
- Prospective Earth Fault Current (PEFC) Tester
- Personal protective equipment
- Multi-meter

- Earth fault loop impedance tester
- Prospective Short-Circuit Current (PSCC) Tester
- Draw wire

Work is performed to drawings, sketches, specifications and instructions as appropriate and to predetermined standards of quality and safety.

ASSESSMENT GUIDE

Forms of assessment

Continuous assessment coupled with gathered evidence of performance is suitable for this unit

Assessment context

This unit shall be assessed on the job or in a simulated environment demonstrated by an individual working alone or as part of a team.

This unit could be assessed individually or in conjunction with other related units

Critical aspects (for assessment)

- Assessment must confirm the candidate's ability to:
- Safety of self, others and property
- Regulations and standards

Assessment conditions

The candidate will have access to:

- All tools, equipment, material and documentation required.

The candidate will be permitted to refer to the following documents:

- Relevant workplace procedures
- Relevant product and manufacturing specifications
- Relevant drawings, manuals, codes, standards and reference material

The candidate will be required to:

Orally or by other methods of communication, answer questions asked by the assessor

- Identify superiors who can be approached for the collection of competency evidence where appropriate
- Present evidence of credit for any off-job training related to this unit

Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, and that he/she possess the required underpinning knowledge

UNDERPINNING KNOWLEDGE AND SKILLS

Underpinning Knowledge	**Underpinning Skills**
• Read and interpret Electrical layout plans/wiring diagrams • Electrical legislations and regulations related to industrial electrical wiring • Types of electrical control and protective switchgear and accessories used in industrial electrical circuits • Types of electrical wires and cables, including underground cables, their ratings and its applications • Types of electrical accessories used for industrial electrical installations and their applications. • Types of electrical conduits/ducts, casing and capping etc., and their cutting/joining/fixing methods • Knowledge of methods of cutting, drilling, filing and grinding etc., • Types of electrical wiring for industrial purpose • Types of electrical tools and measuring instruments used in industrial installation work • Types of insulation material used in electrical installations	• Refer electrical layout plans, wiring diagrams etc., carry out industrial wiring according to current electrical wiring regulations and work accordingly • Select and use correct type and rating of industrial electrical control and protective switchgear, according to the wiring diagram/ layout plan • Select and use correct type and size of wires and cables, according to the rating of each circuit • Select and use correct type of industrial type electrical accessories, according to the type of each circuit • Select the correct type and size of electrical conduit/ducts, casing and capping etc., cut/bend /join/thread and fix them according to the requirements of each circuit • Ability to cut drill, file and grind with hand tools and measuring instruments • Use portable electric drill, angle grinder etc., • Use power tools such as electric portable drill, angle grinder etc.,

• Types of earth electrodes and their applications in electrical installations • Read and interpret manufacturer's service manuals on standby supply • Manual handling techniques • Safe methods of handling heavy loads • Material handling devices. • Occupational health and safety legislations related to electrical installations • First aid treatment methods including methods of resuscitation • Fire precautions • Local authority/ enterprise policies related to industrial electrical installations • Safe working methods and personal safety procedures • Record keeping and reporting • MEA regulations	• Use correct type of electricians tools and measuring instruments • Splice, joint, terminate and solder and insulate joints in electrical wires and cables including underground cables, using specified tools • Select and use the most appropriate and cost effective earth installations, according the soil conditions • Refer manufacturer's service manuals on installing and maintenance of standby power supply • Use mechanical devices specified for lifting and transporting equipment and material safely without endangering self, other and property • Maintain good house keeping • Administer first aid to victims of electrical shock • Use fire fighting equipment in case of fire • Safe working at heights using scaffolding, ladders, platforms scaffolding etc., • Maintain records and supporting documents on testing of industrial electrical installations and periodic maintenance of standby supply

UNIT TITLE	Inspect, test, trace and repair faults in industrial electrical installations				
DESCRIPTOR	This unit covers the competencies required to inspect and test industrial electrical installations after completion of the installations. Locate faults systematically according to regulations/ standards, using specified test instruments and repair. Carry out periodical tests and maintain reports for safe and optimum performance of the electrical installation, while ensuring safety of self, others and property.				
CODE	CON01S2U05V1	LEVEL	4	CREDIT	12

ELEMENTS OF COMPETENCIES	**PERFORMANCE CRITERIA**
1. Inspect the industrial electrical installation	1.1. The installation checked for general compliance with the standards and MEA regulations and referring to layout plans 1.2. The electrical installations inspected for defects/ damages and probable deviations from the layout plans 1.3. Locations of electrical switchgear checked for standard heights 1.4. Protective devices and accessories checked for correct type and for compliance with the layout plan/ standards and regulations
2. Test the electrical installation	2.1 The following tests carried out using specified electrical test instruments in conformity with regulations and standards and observing safety precautions: a. Conductor continuity b. Polarity c. Phase sequence d. Insulation resistance e. Earth electrode resistance f. Earth fault loop impedance g. Prospective over current / short circuit current h. Voltage 2.2 The installation tested, faults located and noted down and reports prepared

3. Repair / maintain the electrical installations	3.1 Necessary adjustments in the control, protective and monitoring switchgear attended to 3.2 List of items/ material required for replacement prepared and obtained 3.3 Defective control and protective switchgear, damaged wires/cables, damaged/defective lamps/fixtures/fittings/ electrical accessories, earth electrode and faulty/ damaged earthing conductors repaired and replaced

Range Statement

Work take place in a construction worksite or building where the electrician is called ton perform the job

Inspection, testing & fault rectification in this unit includes:

- Overall tests on industrial electrical installations soon after completion of the installation
- Periodic inspection & testing on existing industrial electrical installations
- Repairs / replacements of defective components

Following safety practices and procedure, and in conformity with regulations/standards & manufacturer's specifications etc.

The following electrical measuring instruments, tools, equipment & materials are included within this unit:

- Multi-meter
- Insulation Resistance Tester
- Earth fault loop impedance tester
- Earth Electrode Resistance tester
- Prospective Short-Circuit Current (PSCC) Tester
- Prospective Earth Fault Current (PEFC) Tester
- Clip-on meter

The instructional and other reference data connected with this unit may include:

- Layout drawings
- Circuit diagrams

- Wiring diagrams
- Regulations and Standards

Manufacturer's instructional manuals/data etc.

Sources of information/documents may include:

- MEA regulations

Electrician's Operational Methods include:

- Reading / interpreting wiring diagrams
- Testing of industrial electrical installations in sequential order of testing
- Fault finding using Smell, Sound & Sight assessments for damage, corrosion, wear and electrical short/broken circuits, electrical measurements

Methods should be applied under normal operating conditions.

ASSESSMENT GUIDE

Forms of assessment

Continuous assessment coupled with gathered evidence of performance is suitable for this unit

Assessment context

This unit shall be assessed on the job or in a simulated environment demonstrated by an individual working alone or as part of a team.

This unit could be assessed individually or in conjunction with other related units

Critical aspects (for assessment)

Assessment must confirm the candidate's ability to:

- Carryout inspection, testing, installation and fault finding safely and in sequential order
- Adhere to safe work practices and use personal protective equipment
- Carryout replacements according to manufacturer's specifications

Assessment conditions

The candidate will have access to:

- All tools, equipment, material and documentation required.

The candidate will be permitted to refer to the following documents:

- Relevant workplace procedures
- Relevant product and manufacturing specifications
- Relevant drawings, manuals, codes, standards and reference material

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessor
- Identify superiors who can be approached for the collection of competency evidence where appropriate
- Present evidence of credit for any off-job training related to this unit

Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, and that he/she possess the required underpinning knowledge

UNDERPINNING KNOWLEDGE AND SKILLS

Underpinning knowledge	**Underpinning skills**
• Interpretation of circuit diagrams, service manuals, technical sketches, graphic symbols and wiring diagrams and manufacturer's specifications etc., • Types of electrical tools used for wiring purposes • Types of electrical measuring instruments used in testing electrical installations • Types of electrical wiring systems for industrial purposes • Types of electrical control and protective switchgear and accessories used in industrial electrical circuits • Principles of operation of circuit breakers and applications • Types of electrical wires and cables	• Refer, interpret and apply technical information including statutory regulations on industrial electrical installations • Select and use the correct type electrical tools • Use electrical measuring and testing equipment correctly and safely test and identify faults in wiring systems • Check for appropriateness of the wiring system according to regulations • Inspect and test electrical control and protective switchgear for their optimum performance • Check the type and rating of circuit breakers / protective switchgear installed in industrial electrical installations and determine their appropriateness

and their ratings • Types of industrial electrical accessories and their application on industrial electrical installations • Types of earth electrodes systems used in industrial electrical installations • Importance of testing electrical installations after completion, and thereafter carrying out periodical inspections • Troubleshooting and repair procedures in industrial electrical installations • Manual handling techniques • Safe methods of handling heavy loads • Material handling devices • First aid including methods of resuscitation • Fire precautions • Safe working methods • Record keeping and reporting • MEA regualtions	according to the circuit protection requirements • Use appropriate type and size of wires/cables in conformity with industrial requirements of regulations • Check for correct type of electrical accessories used, according to industrial requirements of regulations • Select substitute components, accessories, devices by referring to technical specifications • Install correct type of earth electrode and test for recommended earth electrode resistance • Test completed industrial electrical installations and periodical test in existing electrical installations in sequential order according to regulations. • Safely handle heavy loads without endangering self, others and property • Safe handling of electric shock victims • Good housekeeping • Administering first aid • Use of fire protection equipment • Safe work practices in working at heights, ladders, scaffolds etc., • Check the installation for adhering to laid down local authority/ enterprise policies/ electrical regulations etc., • Check the installation for adhering to laid down local authority/enterprise policies/electrical regulations etc., • Documentation related to inspection and testing of industrial electrical installations

UNIT TITLE	Install service / repair or replace electrical control system and protective switchgear				
DESCRIPTOR	This unit covers the competencies required to install industrial electrical control and protective switchgear. Service / repair and maintain electrical control systems and protective switchgear using specified tools and test instruments, according to manufacturer's specifications/ instruments where applicable, conforming to standards and regulations, while ensuring safety of self, others and property.				
CODE	CON01S2U06V1	LEVEL	4	CREDIT	18

ELEMENTS OF COMPETENCIES	PERFORMANCE CRITERIA
1. Prepare material for the installations of electrical control system and protective switchgear	1.1. Layout plans/ manufacturer's specifications / service manual read and interpreted 1.2. Layout plan / manufacturer's specifications checked and decided on the location of units of the system 1.3. Conduit / trunking / casing and capping etc., prepared for the laying of wires and cables according to the layout diagram 1.4. Brackets/holders/fittings etc., prepared as necessary for mounting / fixing of units / components 1.5. Different units of the control system prepared / assembled
2. Install electrical control system and protective switchgear	2.1 Conduit / trunking / casing and capping necessary to run the wires and cables for the control system installed as per layout plan 2.2 Mounting boards / brackets for the units installed, as necessary 2.3 Install components of the system as specified in the layout plan / diagram 2.4 Wires and cables laid and terminated in the control units 2.5 The control and protective switchgear system commissioned and informed the client / relevant authority on the operating procedure and periodic testing / maintenance of the system
3. Service / Repair / Replace electrical	3.1 Electrical control system and protective switchgear tested according to manufacturer's instructions and

control system and protective switchgear	specifications 3.2 Adjustments to the system made according to manufacturer's instructions and specifications 3.3 Defective parts replaced with specified items 3.4 Defective control system, components/ accessories of control systems repaired according to manufacturer's instructions and specifications 3.5 Performance of electrical control system and switchgear tested according to specifications

Range Statement

Work may take place in a construction worksite or building where the electrician is called to perform the job.

This unit applies to the following:

- Electrical control and protective switchgear in industrial electrical installations
- Electric motor control and allied protection switchgear
- Special electrical control and protection switchgear for stand by generators, emergency power supplies etc.,
- Power factory improving system

The following electrical measuring instruments, tools, equipment and material are included within this unit:

- Electrician's tool kit
- Multi-meter
- Material required for the installation
- Insulation resistance tester
- Wires and cables
- Personal protective equipment

Work is performed to drawings, sketches, specifications as appropriate and to predetermined standards of quality and safety

The instructional and other reference data connected with this unit include:

- Layout drawings
- Circuit diagrams
- Wiring diagrams
- Manufacturer's instructional manuals, as appropriate
- Block diagrams
- Single line and multi line representations
- Electrical specifications

Source of information / documents include:

- MEA regulations
- Manufacturer's specifications
- Customer's requirements

Electrician's operational methods include:

- Testing, dismantling, servicing, assembly, removal and replacement
- Faultfinding using smell, sound & sight assessments for damage, corrosion, wear and electrical short/broken circuits, electrical measurements
- Reading / interpreting wiring diagrams

Methods should be applied under normal operating conditions.

ASSESSMENT GUIDE

Forms of assessment

Continuous assessment coupled with gathered evidence of performance is suitable for this unit.

Assessment context

This unit may be assessed on job or in a simulated situation/ environment demonstrated by an individual working alone or as part of a team.

This unit could be assessed individually or in conjunction with other related units

Critical aspects (for assessment)

Assessment must confirm the candidate's ability to:

- Ensure correct functioning of the control and protective systems
- Adhere to safety procedures and practices

- Adhere to manufacturer's instructions on the use of testing instruments

Assessment conditions

The candidate will have access to:

- All tools, equipment, material and documentation required.

- The candidate will be permitted to refer to the following documents:
- Relevant workplace procedures
- Relevant product and manufacturing specifications
- Relevant drawings, manuals, codes, standards and reference material

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessor
- Identify superiors who can be approached for the collection of competency evidence where appropriate
- Present evidence of credit for any off-job training related to this unit

Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, and that he/she possess the required underpinning knowledge

UNDERPINNING KNOWLEDGE AND SKILLS

Underpinning knowledge	**Underpinning skills**
• Interpretation of circuit diagrams, service manuals, technical sketches, graphic symbols and wiring diagrams and manufacturer's specifications etc., • Types of electrical tools used for wiring purpose • Types of electrical measuring instruments used in testing electrical installations • Types of electrical wiring systems for	• Refer, interpret and apply technical information including statutory regulations on installing service and repair of electrical control systems and protective switchgear • Select and use the correct type of electrical tools • Use electrical measuring and testing equipment correctly and safely, test and identify faults in electrical control systems and protective switchgear

industrial purposes • Types of electrical control systems and protective switch gear used in industrial electrical installations • Principles of operation of circuit breakers and their applications • Types of electrical wires and their ratings • Types of industrial electrical accessories and their application on electrical control systems and protective switchgear • Importance of testing & periodical inspections on electrical control systems & protective switchgear • Troubleshooting and repair procedures in electrical control systems and protective switchgear • Common faults in industrial power control and protection switchgear • Manual handling techniques • Safe methods of handling heavy loads • Material handling devices • Occupational health and safety applied to electrical installations • First aid including methods of resuscitations • Fire precautions • Safe working methods • Electrical legislations and regulations related to electrical control system and protective switchgear • Record keeping and reporting • MEA regulations	• Install electrical control system and protective switchgear according to specified wiring system • Inspect & test electrical control systems & protective switch gear according to the requirement • Select and use correct type of electrical control system and protective switchgear according to the requirement • Use correct type and rating of circuit breakers / protective switchgear installed in electrical control system and protective switchgear and determine their appropriateness according to the circuit protection requirements • Use appropriate type and size of wires and cables in conformity with the requirements • Select and use correct type of industrial electrical accessories used, according to requirements and regulations • Test electrical control system and protective switchgear and do periodical tests in sequential order, according to regulations • Troubleshoot electrical control systems and protective switchgear in conformity with manufacturer's specifications, instructions • Handle heavy loads without endangering self, others and property • Treat electric shock victims • Good housekeeping • Administer first aid • Use fire protection equipments • Work safely at heights, ladders, scaffolds

	etc., • Documentation related to inspection and testing of electrical control systems and protective switchgear

UNIT TITLE	Install, service and repair programmable logic control systems				
DESCRIPTOR	This unit covers competencies required to install, service, repair and maintain industrial programmable logic control systems as per manufacturer's specifications and instructions, conforming to standards and regulations, while ensuring proper performance of the system and safety of self, others and property				
CODE	CON01S2U07V1	LEVEL	4	CREDIT	20

ELEMENTS OF COMPETENCIES	PERFORMANCE CRITERIA
1. Install appropriate programmable logic control systems	1.1. Manufacturer's instructional / service manual referred to, and machine functional diagram read and interpreted functions of the input/ output devices of the system identified 1.2. Input/output devices connected to the PLC system according to the functional diagram 1.3. PLC systems programmed according to the required functions 1.4. The machine run and the required performance checked
2. Maintain/ service/ repair Programmable Logic Control (PLC) systems / machines	2.1 Manufacturer's service manuals/ software referred and the machine / system tested, and the locations of faults identified 2.2 The faults in the input/ output device located and the faulty components serviced/ repaired as necessary 2.3 The defects of software in the PLC identified by downloading the programme on to personal computer, checked input/ output status/ voltages and the faults corrected 2.4 Faults in the PLC checked and corrected using manufacturer's software programmes as necessary 2.5 The software program uploaded from the personal computer to PLC
3. Maintain/ repair / or service input/ output devices	3.1 Control devices and final working elements and their functions identified 3.2 Defects in control devices and final working elements diagnosed and located

	3.3 Faulty component serviced or replaced as necessary 3.4 Functional tests on the control devices and final working elements carried out 3.5 Control devices and final working elements checked for satisfactory performance of the system or machine

Range Statement

Work may take place in a factory or industrial establishment where programmable control systems and machines are installed

This unit applies to the following:

- PLC based control systems
- Protective relays, sensors and proximity switches
- Machine process control and protection

The following electrical measuring instruments, tools, equipment and material are included within this unit:

- Electrician's tool kit
- Clip on meter
- Logic probe
- Personal computer with necessary software
- Manufacturer's software for re-programming the PLC
- Multi-meter
- Insulation resister
- Logic analyzer
- PLC based electrical control machine / device
- Input / output stations

Work is performed to drawings, sketches, specifications as appropriate and to predetermined standards of quality and safety

The instructional and other reference data connected with this unit include:

- Circuit diagrams
- Wiring diagrams

- Manufacturer's instructional manuals, as appropriate
- Block diagrams
- Single line and multi line representations
- Manufacturer's programming software on PLC etc.,

Source of information / documents include:

- Manufacturer's specifications
- Customers requirements
- Industry / workplace codes of practice

Tools, equipment and material used in this unit may include

ASSESSMENT GUIDE

Forms of assessment

Continuous assessment coupled with gathered evidence of performance is suitable for this unit.

Assessment context

This unit may be assessed on job or in a simulated situation/ environment demonstrated by an individual working alone or as part of a team.

This unit could be assessed individually or in conjunction with other related units

Critical aspects (for assessment)

Assessment must confirm the candidate's ability to:

- Use personal computer for downloading and uploading of software programs
- Troubleshoot, identify faults and ensure correct functioning of the system
- Adherence to safety procedures and practices
- Use manufacturer's specifications

Assessment conditions

The candidate will have access to:

- All tools, equipment, material and documentation required.

The candidate will be permitted to refer to the following documents:

- Relevant workplace procedures
- Relevant product and manufacturing specifications
- Relevant drawings, manuals, codes, standards and reference material

The candidate will be required to:

- Orally or by other methods of communication, answer questions asked by the assessor
- Identify superiors who can be approached for the collection of competency evidence where appropriate
- Present evidence of credit for any off-job training related to this unit

Assessors must be satisfied that the candidate can competently and consistently perform all elements of the unit as specified by the criteria, and that he/she possess the required underpinning knowledge

UNDERPINNING KNOWLEDGE AND SKILLS

Underpinning knowledge	**Underpinning skills**
• Interpretation of circuit diagrams, service manuals, technical sketches, graphic symbols and wiring diagrams and manufacturer's specifications etc., • Fundamentals of Digital Electronics • Types of PLC based machines and their applications • Trouble shooting techniques in PLC based machines • Motor control switch gear and its applications with PLC • Common faults in industrial PLC based machines • Documentation related to inspection and testing of PLC based control systems and machines • Safety procedures to be followed. • Fundamental of hydraulic and pneumatic valves/accessories • Sensors and proximity switches	• Refer, interpret and apply technical information on installing, servicing & repair of PLC based machines & its control systems • Test and identify faults in PLC based electrical control systems • Install PLC software in PLC based machines • Inspect & test PLC based control systems for their optimum performance. • Select and use correct type of PLC based electrical control systems according to the requirement • Read & understand and apply PLC based software • Trouble shoot and rectify faults in PLC based machines/ electrical control systems • Adhere to safe working procedures & practices • Record keeping and reporting • Use of personal computers