

**THE REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**INSTRUMENTATION AND CONTROL OPERATOR**

**KNQF LEVEL 4**

**PROGRAMME CODE: 0714 354A**

# ACRONYMS

**PPE** - Personal Protective Equipment   
**OSHA** - Occupational Safety and Health Administration   
**IEE** - Institution of Electrical Engineers   
**SMS** - Short Message Service   
**MS** - Microsoft   
**ISCED** - International Standard Classification of Education framework)  
**SI** - Système International

# KEY TO UNIT CODE



# TABLE OF CONTENT

[ACRONYMS ii](#_Toc196816515)

[KEY TO UNIT CODE iii](#_Toc196816516)

[TABLE OF CONTENT iv](#_Toc196816517)

[OCCUPATION OVERVIEW 5](#_Toc196816518)

[Summary of Units of Competency 5](#_Toc196816519)

[UNITS OF COMPETENCY 6](#_Toc196816520)

[PERFORM ELECTRICAL INSTALLATION 7](#_Toc196816521)

[INSTALL INSTRUMENTATION AND CONTROL SYSTEM COMPONENT 12](#_Toc196816522)

[OPERATE INSTRUMENTATION AND CONTROL SYSTEM 16](#_Toc196816523)

[MAINTAIN INSTRUMENTATION AND CONTROL SYSTEMS 21](#_Toc196816524)

# OCCUPATION OVERVIEW

This occupational standard is designed to equip instrumentation and control operator with competencies required to perform electrical installation, operate instrumentation and control system, install instrumentation and control system components and maintain instrumentation and control systems.

# Summary of Units of Competency

|  |  |
| --- | --- |
| **UNITS OF COMPETENCY** | |
| 0713 351 13A | Perform electrical installation |
| 0714 351 14A | Install instrumentation and control system component |
| 0714 351 15A | Operate instrumentation and control system |
| 0714 351 16A | Maintain instrumentation and control systems |

# UNITS OF COMPETENCY

## PERFORM ELECTRICAL INSTALLATION

**UNIT CODE**: **0713 351 13A**

**UNIT DESCRIPTION**

This unit specifies the competencies required for performing electrical installation. It involves preparing a list of tools equipment and materials, performing piping, and laying of cables, installing of electrical components, terminating of electrical installation, inspecting and testing the installation and documenting an electrical installation.

**ELEMENTS AND PERFORMANCE CRITERIA**

| **ELEMENT**  These describe the key outcomes which make up workplace function. | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  *(****Bold and italicized terms are elaborated in the Range)*** |
| --- | --- |
| 1. Prepare a list of tools equipment and materials | * 1. Electrical installation tools, equipment and materials are identified, and list prepared as per established procedure   2. ***Electrical installation*** *t****ools, equipment and materials*** ***specifications*** are checked for as per their functionality   3. Electrical installation tools, equipment and materials are assembled and stored as per established procedure |
| 1. Perform piping and laying of cables | * 1. Safety procedures are observed in adherence to OSHA   2. Piping is performed as per working drawing   3. Piping is performed in line with standard operating procedure   4. Number and size of cables are laid in a conduit as per the IEE regulations   5. Cables, conduits, enclosures and support systems are installed as per the working drawing   6. Cables are drawn-in in line with standard operating procedures |
| 1. Install electrical components | * 1. Components are installed in line with the design   2. Components to be installed are identified as per installation requirements   3. Components are installed in adherence to IEE regulations |
| 1. Terminate Electrical Installation | * 1. Cable lugging is performed as per the standards operating procedure.   2. Cables are terminated as per the IEE regulations   3. Labelling of the cables is performed as per the complexity of the job. |
| 1. Inspect and test installation | * 1. Types of tests are identified according to the nature of the installation   2. Testing in conducted according to the IEE regulations   3. Test parameters are recorded in line with the workplace procedures   4. Testing instruments are identified as per the type of testing expected to be carried out |
| 1. Document an Electrical installation | * 1. Report is prepared in accordance with the industry best practices   2. Report is shared with the relevant parties as per the installation contract   3. Report is filed in adherence to the organization filing system |

**RANGE**

This section provides work environments and conditions to which the performance criteria apply. It allows for different work environments and situations that will affect performance

| **Variable** | **Range** |
| --- | --- |
| 1. Electrical installation Tools, equipment and materials Specifications may include but not limited to | * Make / model * Size * Class |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the skills and knowledge required for this unit of competency.

**Required skills**

The individual needs to demonstrate the following skills:

* Communications (verbal and written)
* Time management
* Problem solving
* Decision making
* First aid
* Planning
* Negotiation

**Required knowledge**

The individual needs to demonstrate knowledge of:

* The manufacturer's warranty requirements relating to electrical installation systems and related components.
* The legal requirements relating to electrical installations
* Kenyan legislation and workplace procedures relevant to:
  + - Health and safety
    - Environment (including waste disposal)
    - Appropriate personal protective equipment (PPE).
* Workplace procedures for:
  + - Workplace communication
    - Time management
    - Materials management
* The use of technical information including:
  + - The importance of using the correct sources of technical information.
* Interpreting circuits, drawings, specifications and instructions

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Prepared a list of tools, equipment and materials as per established procedure   2. Checked tools, equipment and materials for specifications and functionality as per the standard operating procedure   3. Laid number and size of cables in a conduit as per the IEE regulations   4. Drawn-in cables line with standard operating procedures   5. Mounted components in accordance to the working drawings   6. Terminated cables as per the IEE regulations   7. Performed labelling of the cables as per the complexity of the job.   8. Identified types of tests according to the nature of the installation   9. Conducted testing according to the IEE regulations   10. Prepared Report in accordance with the industry best practices |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   1. Observation 2. Oral questioning 3. Practical demonstration 4. Written tests |
| 1. Context of Assessment | Competency may be assessed   1. On the job 2. Off the job 3. During industrial attachment |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## INSTALL INSTRUMENTATION AND CONTROL SYSTEM COMPONENT

**UNIT CODE:** **0714 351 14A**

**UNIT DESCRIPTION**

This unit covers the competencies required to install instrumentation and control system components. It involves preparing for installation of instrumentation and control system component, assembling instrumentation and control system components and testing instrumentation and control system components.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace functions | PERFORMANCE CRITERIA  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Prepare for installation of instrumentation and control system component. | * 1. Health and safety procedures are applied as per work place procedure   2. ***Site conditions and installation*** requirements for instrumentation and control system component are assessed according to manufacturer’s specifications.   3. Instrumentation and control system component specifications are verified according to design requirements   4. Instrumentation and control system ***Tools, equipment and materials*** are selected as per job requirements.   5. Housekeeping is carried out according to workplace procedures. |
| 1. Assemble instrumentation and control system components | 1. Health and safety procedures are applied as per work place procedure 2. Instrumentation and control system component is mounted as per job requirement 3. Cable laying is performed as per IEE regulations 4. Instrumentation and control system component is terminated as per manufacturer’s specifications 5. Housekeeping is carried out according to workplace procedures. |
| 1. Test instrumentation and control system component | 1. Health and safety procedures are applied as per work place procedure 2. Electrical tests are performed as per IEE regulations 3. Instrumentation and control system is test run as per manufacturer’s specifications. 4. Instrumentation and control system documentation is carried out as per job requirements. 5. Housekeeping is carried out according to workplace procedure. |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| Variable | Range |
| 1. site conditions include but not limited to: | * + temperature   + humidity   + distance   + dust   + light intensity   + pressure |
| 1. Tools, equipment and materials include but not limited to: | * + Hand tools   + Multimeters |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the knowledge and skills required for this unit of competency.

**Required skills**

The individual needs to demonstrate the following skills:

* Electrical Installation
* Wiring system
* Troubleshooting
* Interpretation of electrical drawing
* Use of electrical & mechanical tools
* Time management
* Decision making

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Various laws in electrical engineering
* Basic control system components
* MS Word & Excel
* Safety procedures and practices
* Electrical symbols and their meanings
* Power protection
* Measurement

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied health and safety procedures as per work place procedure   2. Assessed **s*ite conditions and installation*** requirements for instrumentation and control system components according to manufacturer’s specifications.   3. Verified instrumentation and control system components specifications according to design requirements   4. Mounted instrumentation and control system components as per job requirements   5. Performed electrical tests as per IEE regulations   6. Test run instrumentation and control system as per manufacturer’s specifications. |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Project   2. Practical   3. Portfolio of evidence   4. Third party reports   5. Oral questions   6. Written test |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or simulated setting of the actual work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## OPERATE INSTRUMENTATION AND CONTROL SYSTEM

**UNIT CODE:** **0714 351 15A**

**UNIT DESCRIPTION**

This unit covers the competencies required to operate instrumentation and control system. It involves performing instrumentation and control system start up, performing instrumentation and control system changeover and running instrumentation and control systems.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| **ELEMENT**  These describe the key outcomes which make up workplace functions | **PERFORMANCE CRITERIA**  These are assessable statements which specify the required level of performance for each of the elements  ***(Bold and italicized terms are elaborated in the range)*** |
| 1. Perform instrumentation and control system start up | 1. Safety procedures are applied as per manufacturer’s manual 2. Instrumentation and control system ***inspection*** is carried out as per manufacturer’s specifications 3. Instrumentation and control system is initialized as per manufacturer’s specifications 4. Instrumentation and control system active ***alarms*** are reset as per manufacturer’s specifications 5. Instrumentation and control system dry run is carried out manufacturer’s specifications |
| 1. Perform instrumentation and control system changeover | 1. ***Instrumentation and control system dies*** are identified as per job requirement 2. Instrumentation and control system tools and equipment are assembled as per job requirements 3. Instrumentation and control system die changeover is carried out as per job requirement 4. Instrumentation and control system dies are ***tested*** as per job requirement |
| 1. Run instrumentation and control system | 1. Instrumentation and control system ***raw materials*** are loaded as per job requirement 2. Instrumentation and control system recipe is selected as per job requirements. 3. Instrumentation and control system parameters are adjusted as per job requirements. 4. Instrumentation and control system monitoring is carried out as per job requirements. 5. Instrumentation and control system ***documentation*** is carried out as per job requirements. 6. Identified ***written communication methods*** are applied based on the workplace policy. |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| **Variable** | **Range** |
| 1. Inspection include but not limited to: | * + Firmness   + Tightness   + Gauges   + Levels   + Safety interlocks |
| 1. Instrumentation and control system dies include but not limited to: | * + Moulds   + Star wheels   + Guide ways   + Worm wheels |
| 1. Raw materials include but not limited to: | * + caps   + bottles   + preforms   + labels   + product |
| 1. Documentation include but not limited to: | * + installation manuals   + maintenance manuals   + maintenance schedule   + checklist |
| 1. Written communication includes but not limited to: | * Memos * Letters * Notices * SMS |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the knowledge and skills required for this unit of competency.

**Required skills**

The individual needs to demonstrate the following skills:

* Troubleshooting
* data capture
* Interpretation of electrical drawing
* Problem solving
* Use of electrical & mechanical tools
* First aid
* Planning
* Time management
* Decision making

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Control system components
* MS Word & Excel
* Safety procedures and practices
* Electrical symbols and their meanings
* Electrical measurement
* Electrical tools and equipment

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   1. Applied safety procedures as per work requirement 2. Carried out instrumentation and control system inspection per manufacturer’s specifications 3. Reset Instrumentation and control system active alarms as per manufacturer’s specifications 4. Changed Instrumentation and control system dies as per job requirement 5. Loaded Instrumentation and control system raw materials as per job requirement 6. Selected Instrumentation and control system recipe as per job requirements. 7. Adjusted Instrumentation and control system parameters as per job requirements. 8. Carried out Instrumentation and control system monitoring as per job requirements. 9. Effected written communication based on workplace requirements |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Project   2. Practical   3. Portfolio of evidence   4. Third party reports   5. Oral questions   6. Written test |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or simulated setting of the actual work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |

## MAINTAIN INSTRUMENTATION AND CONTROL SYSTEMS

**ISCED UNIT CODE:** **0714 351 16A**

**UNIT DESCRIPTION**

This unit covers the competencies required to maintain instrumentation and control systems. It involves preparing instrumentation and control systems maintenance schedule, conducting instrumentation and control systems preventive maintenance, conducting instrumentation and control systems corrective maintenance, testing and commissioning instrumentation and control system.

**ELEMENTS AND PERFORMANCE CRITERIA**

|  |  |
| --- | --- |
| ELEMENT  These describe the key outcomes which make up workplace functions | PERFORMANCE CRITERIA  These are assessable statements which specify the required level of performance for each of the elements  Bold and italicized terms are elaborated in the range |
| 1. Prepare instrumentation and control systems maintenance schedule | * 1. Instrumentation and control systems maintenance manuals are interpreted as per manufacturer’s specifications.   2. ***Type of maintenance*** is identified as per manufacturer’s specifications   3. Instrumentation and control systems maintenance work plan is prepared as per work procedure   4. Instrumentation and control systems ***maintenance documents*** are prepared as per work procedure |
| 1. Conduct instrumentation and control systems preventive maintenance | * 1. Health and safety procedures are applied in accordance to work procedure   2. Instrumentation and control system components due for maintenance are identified as per manufacturer’s specifications.   3. Instrumentation and control system maintenance activities are performed as per maintenance manuals.   4. Instrumentation and control systems preventive maintenance is carried out as per manufacturer’s specifications. |
| 1. Conduct instrumentation and control systems corrective maintenance | 1. Health and safety procedures are applied in accordance to work procedure 2. Instrumentation and control system troubleshooting is performed as per manufacturer’s specifications. 3. Instrumentation and control system faulty components are identified as per job specifications. 4. Instrumentation and control system faulty components are rectified as per manufacturer’s specifications. |
| 1. Test and Commission instrumentation and control system | * 1. Health and safety procedures are applied in accordance to work procedure   2. Basic ***SI units*** in electrical are identified based on scope of work   3. ***Quantities*** of charge, force, work and power are identified as per Work requirement   4. Calculations involving ***electrical quantities*** are performed based on Work requirement   5. Calculations involving parallel and series circuits are performed as per Work requirement   6. Instrumentation and control systems ***Electrical tests*** are performed as per IEE regulations   7. Instrumentation and control system is test-run to ensure optimum functionality as per manufacturer’s specifications.   8. Instrumentation and control system housekeeping is carried out according to work procedure.   9. Instrumentation and control system maintenance report is prepared as per work procedure   10. End user is trained in accordance with standard operating procedure   11. Instrumentation and control system is handed over as per work procedure   12. Instrumentation and control system ***Commissioning documents*** are disseminated in accordance with work procedure |

**RANGE**

This section provides work environment and conditions to which the performance criteria apply. It allows for different work environment and situations that will affect performance.

|  |  |
| --- | --- |
| Variable | Range |
| 1. *Type of maintenance* may include but not limited to: | * + Preventive maintenance   + Predictive maintenance   + Corrective maintenance   + Condition based maintenance   + Predetermined maintenance   + reactive maintenance |
| 1. SI unit include but is not limited to: | * + Power – Watts (W)   + Current – Amperes (A)   + Resistance – Ohms(Ω)   + Voltage – Volts (V) |
| 1. Quantities include but is not limited to: | * + Charge   + Force   + Work   + Power |
| 1. *electrical tests* may include but not limited to: | * + Polarity test   + Earth loop impedance test   + Insulation resistance test   + Earth electrode resistance test |

**REQUIRED SKILLS AND KNOWLEDGE**

This section describes the knowledge and skills required for this unit of competency.

**Required skills**

The individual needs to demonstrate the following skills:

* Electrical Installation
* Wiring systems
* Troubleshooting
* Survey and data capture
* Electrical system testing
* Interpretation of maintenance manuals
* Problem solving
* Use of electrical & mechanical tools
* Analytical
* First aid
* Planning
* Communications
* Digital literacy
* Time management
* Report writing
* Decision making
* Soldering

**Required knowledge**

The individual needs to demonstrate knowledge of:

* Electrical power calculations
* Various laws in electrical engineering
* Control system components
* Safety procedures and practices
* Electrical symbols and their meanings
* Network Components and devices
* Electrical standards
* Power protection
* Measurement
* Types of maintenance

**EVIDENCE GUIDE**

This provides advice on assessment and must be read in conjunction with the performance criteria, required knowledge and understanding and range.

|  |  |
| --- | --- |
| 1. Critical Aspects of Competency | Assessment requires evidence that the candidate:   * 1. Applied health and safety procedures in accordance to work procedure   2. Prepared Instrumentation and control systems maintenance work plan as per work procedure   3. prepared Instrumentation and control systems maintenance documents as per work procedure   4. Performed Instrumentation and control system maintenance activities as per maintenance manuals.   5. Carried out Instrumentation and control systems preventive maintenance as per manufacturer’s specifications.   6. Performed Instrumentation and control system troubleshooting as per manufacturer’s specifications.   7. Rectified Instrumentation and control system faulty components as per manufacturer’s specifications   8. Performed Instrumentation and control systems Electrical tests as per IEE regulations   9. Test-run Instrumentation and control system to ensure optimum functionality as per manufacturer’s specifications.   10. Identified basic SI units in Electrical based on scope of work   11. Identified Quantities of Charge, force, work and power as per work requirement   12. Performed calculations involving parallel and series circuits as per Work requirement |
| 1. Resource Implications | The following resources should be provided:   * 1. Appropriately simulated environment where assessment can take place.   2. Access to relevant work environment   3. Resources relevant to the proposed activities or tasks |
| 1. Methods of Assessment | Competency may be assessed through:   * 1. Practical   2. Oral questioning   3. Written assessment   4. Project   5. Portfolio of evidence   6. Third-party reports |
| 1. Context of Assessment | Competency may be assessed individually in the actual workplace or simulated setting of the actual work place |
| 1. Guidance information for assessment | Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. |