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**REPUBLIC OF KENYA**

**NATIONAL OCCUPATIONAL STANDARDS**

**FOR**

**INSTRUMENTATION AND CONTROL ARTISAN**

**LEVEL 3**



TVET CDACC

P.O. BOX 15745-00100

NAIROBI

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**FOREWORD**

The provision of quality education and training is fundamental to the Government’s overall strategy for social economic development. Quality education and training will contribute to achievement of Kenya’s development blue print and sustainable development goals.

Reforms in the education sector are necessary for the achievement of Kenya Vision 2030 and meeting the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution and this resulted in the formulation of the Policy Framework for Reforming Education and Training. A key feature of this policy is the radical change in the design and delivery of the TVET training. This policy document requires that training in TVET be competency based, Curriculum development be industry led, certification be based on demonstration of competence and mode of delivery allows for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in Curriculum development to ensure the Curriculum addresses its competence needs. It is against this background that these Occupational Standards was developed for the purpose of developing a competency-based Curriculum for Instrumentation and Control Level 3. These Occupational Standards will also be the basis for assessment of an individual for competence certification.

It is my conviction that these Occupational Standards will play a great role towards development of competent human resource for the Engineering Sector’s growth and sustainable development.

**PRINCIPAL SECRETARY, VOCATIONAL AND TECHNICAL TRAINING MINISTRY OF EDUCATION**

**PREFACE**

The TVET Curriculum Development, Assessment and Certification Council (TVET CDACC), in conjunction with Instrumentation and Control Sector Skills Advisory Committee (SSAC) have developed these Occupational Standards for an Instrumentation and Control Artisan level 4. These standards will be the basis for development of a competency-based Curriculum for Instrumentation and Control Technology level 4. These Standards will also be the basis for assessment of an individual for competence certification.

The Occupational Standards are designed and organized with clear performance criteria for each element of a unit of competency. These standards also outline the required knowledge and skills as well as evidence guide.

I am grateful to the Council Members, Council Secretariat, Instrumentation and Controls SAC, expert workers and all those who participated in the development of these Occupational Standards.

**CHAIRPERSON, TVET CDACC**

**ACKNOWLEDGMENT**

These Occupational Standards were developed through combined effort of various stakeholders from private and public organizations. I am sincerely thankful to the management of these organizations for allowing their staff to participate in this course. I wish to acknowledge the invaluable contribution of industry players who provided inputs towards the development of these Standards.

I thank TVET Curriculum Development, Assessment and Certification Council (TVET CDACC) for providing guidance on the development of these Standards. My gratitude goes to the Instrumentation and Control Sector Skills Advisory Committee (SSAC) members for their contribution to the development of these Standards. I thank all the individuals and organizations who participated in the validation of these Standards.

I acknowledge all other institutions which in one way or another contributed to the development of these Standards.

**CHAIRPERSON INSTRUMENTATION AND CONTROL SECTOR SKILLS ADVISORY COMMITTEE**

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**KEY TO UNIT CODE**

ENG/OS/IAC/BC/01/3/A

Industry or sector

Occupational Standards

Occupational area

Type of competency

Competency number

Competency level

Control Version

# OVERVIEW

Instrumentation and Control Level 3 qualification consists of the following competencies:

**Generic competencies**

1. Apply workplace health, safety, environmental and emergency practices
2. Apply workplace essential skills
3. Plan and organise work activities

**Core competencies**

1. Install and maintain basic instrumentation and control equipment
2. Install and service instrumentation and control indicating devices
3. Install and service instrumentation and control motion devices
4. Install and service instrumentation and control parameter measuring devices
5. Install and service process analyzers
6. Apply basic knowledge of instrumentation and control
7. Conduct basic electrical installation

# COMMON UNITS OF COMPETENCY

# APPLY WORKPLACE HEALTH, SAFETY, ENVIRONMENTAL AND EMERGENCY PRACTICES

**Unit Code:** ENG/OS/IAC/BC/01/3

**Unit Standard Description**

This unit standard has been developed to assist with the advancement of people who wish to gain paid employment or enter into self-employment in a variety of contexts. It specifies the competencies required to: Apply workplace health and safety practices; Perform basic firefighting techniques; Perform first aid practices; Adhere to site emergency plans; and Apply environmental integrity.

**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. Apply workplace health and safety practices | 1. Factors affecting health and safety in the workplace are identified 2. General work site and employer safety rules are applied 3. ***Personal protective equipment (PPE)*** is identified, selected and used |
| 1. Perform basic fire-fighting techniques | 1. The type of fire encountered is classified 2. Fire-fighting equipment is identified and selected according to ***class of fire*** 3. The use of different fire-fighting ***equipment*** is demonstrated 4. Fire-fighting ***report*** is completed |
| 1. Perform first aid practices | 1. Nature and context of the ***injury and/or medical emergency*** are determined 2. First aid is applied 3. Injured and/or ill person is handed over to medical personnel 4. Incident and/or accident report is completed |
| 1. Adhere to site emergency plans | 1. ***Information on site*** emergency plans is interpreted 2. Instructions are followed and/or communicated 3. Risks are assessed and course of action determined 4. Emergency equipment and supplies are operated |
| 1. Apply environmental integrity | 1. General environmental impacts are described 2. Spill prevention, control and countermeasure (SPCC) techniques are applied 3. Work site techniques to minimise environmental damage are applied 4. Housekeeping procedures are applied in accordance with environmental control and worksite requirements |

**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. Personal Protective Equipment (PPE) may include but is not limited to: | * safety boots * hard hat * safety gloves * safety glasses * high visibility vest * hearing protection * respiratory protection f * all protection |
| 1. classes of fire may include, but is not limited to: | * A * B * C * D * E. |
| 1. equipment may include but not limited to: | * fire extinguishers * fire hoses * hose reels |
| 1. Report information may include but not limited to: | * location and time of fire * people involved * accident details * safety precautions that were/were not in place * machinery or substances involved * responses of emergency services. |
| 1. Injuries and medical emergencies may include but not limited to: | * stopped heart and breathing (CPR) * stopping bleeding * splinting and binding fractures * covering and calming and dealing with epileptic fits * hyper ventilation * hypo/hyperthermia * chemical and fire burns * respiratory problems or suffocation * electrical * any other shock. |
| 1. Contexts of injuries may include but not limited to: | * inaccessible places * places of extreme temperature * high risk areas |
| 1. Information may include but is not limited to | * evacuation routes * procedures * contact protocol. |

**Knowledge and Skills**

The individual needs to demonstrate knowledge of:

* Company policies and procedures, including site emergency plans
* Manufacturers’ specifications
* Legislative requirements
* Risks and consequences of HIV and AIDS, STDs and STIs to self and others
* Personal Protective Clothing and Equipment
* Causes and classes of fire
* Range of firefighting equipment
* Basic first aid procedures and techniques
* Gender parity issues, non-discrimination of women including raping
* Environmental awareness, protection and enhancement

# APPLY WORKPLACE ESSENTIAL SKILLS

**Unit Code:** ENG/OS/IAC/BC/02/3

**Unit Standard Description**

This unit standard has been developed to assist in the advancement of people who wish to gain paid employment or enter into self-employment in a variety of contexts. It specifies the competencies required to: Follow principles of work ethics; Resolve conflict with others; Demonstrate effective speaking and listening skills; Read and interpret work document; Interact with team members; and Perform individual role in a team.

**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. **Follow principles of work ethics** | 1. Integrity work ethics and expectations are identified 2. Open mind and flexibility is kept at the time 3. Conflicts are avoided whenever necessary 4. Company policies and procedures are operated as required 5. Self-assessment from time to time is carried out |
| 1. **Resolve conflict with others** | 1. Problem at the work site is identified and analysed 2. Company policies and procedures for solving the problem are applied 3. Problem and disagreement resolution are justified with applicable legislation 4. Conflict resolution techniques are formulated 5. Effectiveness of problem or conflict resolution is evaluated |
| 1. **Demonstrate effective speaking and listening skills** | 1. Correct oral message to be communicated is identified 2. Clarity of the oral message to be communicated is determined 3. Appropriate means of oral communication is selected 4. Clear and accurate oral message is conveyed 5. Feedback on the message conveyed is obtained and interpreted 6. Corrective message communication measures are applied 7. Prepared documentation to keep record of communication is used |
| 1. **Read and interpret work document** | 1. Required work document are gathered and interpreted 2. Work document details are verified against actual work 3. Work document to correspond to actual work are reviewed |
| 1. **Interact with team members** | 1. Correct team members are identified according to task requirements 2. Capabilities of each team member are determined according to task requirements 3. Acceptable, non-offensive language and gestures are used 4. Relationships between members are maintained 5. Suitable corrective measures for deviating members are employed 6. Cross cultural diversities are accommodated |
| 1. **Perform individual role in a team** | 1. Individual roles in a team are identified and described 2. Assigned roles to the individual are conveyed and monitored |

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| --- | --- | --- | --- |
| **Unit Standard Title** | | | **Apply workplace essential skills** |
| **Unit**  **Scope/Range** | This unit standard requires the demonstration of knowledge and application of common work ethic procedures, identification of different problems as part of conflict resolution at the work site, demonstration of the application of different languages and other means of communication, interpretation of different work documents, and identification of different team members.  Performance of all elements must comply with all relevant statutory, health, safety, environment, and worksite requirements, contractual agreement and/or manufacturers’ specifications. | | |
| **Element 1** | |  | |
| **Range** | Work ethics may include, but are not limited to honesty; selflessness; consistency; moral; courage and respect. | | |
| **Performance Criteria** | | | |
| 1.1  1.2 1.3  1.1.5 | | | |
| **Element 2** | |  | |
| **Range** | Problems may include, but are not limited to interpersonal problems; organisational problems; group problems; and inter organizational problems. | | |
| **Performance Criteria** | | | |
| 2.1  2.2 2.3 | | | |

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| **Element 3** | |  |
| **Range** | Language of communication may include, but is not limited to English, Kiswahili and sign language. | |
| **Performance Criteria** | | |
|  | | |
| **Element 4** | |  |
| **Range** | Work documents may include, but are not limited to work timesheets; attendance registers; job cards site maps; plans; inspection licenses; authority approvals documents, equipment inspection check sheets, and safe systems of work documents. | |
| **Performance Criteria** | | |
| 4.1  4.2  4.3 | | |
| **Element 5** | |  |
| **Range** |  Team members may include, but are not limited to core team members and support team members. | |
| **Performance Criteria** | | |
| 5.1 5.2  5.3 5.4  5.5  5.6 | | |

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| --- | --- | --- |
| **Element 6** | |  |
| **Range** | N/A | |
| **Performance Criteria** | | |
| 6.1 | | |
| **Underpinning Knowledge** | | |
| The individual needs to demonstrate knowledge of:   * Concept of a team and team work * Multi cultural diversity * Team goals and motivation * Problem/conflict solving techniques | | |
| **Generic Skills** | | |
| The individual needs to demonstrate ability related to:   * Communication * Team Work * Problem solving * Planning and Organising * Self-management * Technology | | |

# PLAN AND ORGANISE WORK ACTIVITIES

**Unit Code:** *GEN003*

**Unit Standard Description**

This unit standard has been developed to assist with the advancement of people who wish to gain paid employment or enter into self-employment in a variety of contexts. It specifies the competencies required to: Apply time management techniques; Apply quality improvement principles; and Apply productivity improvement measures.

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| **Unit Standard Title** | | | **Plan and organise work activities** |
| **Unit Scope** | This unit standard requires the application and implementation of work scheduling rules and productivity measures. | | |
| **Element 1** | | **Apply time management techniques** | |
| **Range** | Work-scheduling rules may include, but are not limited to daily and weekly working hours; break start and finish hours; and overtime. | | |
| **Performance Criteria** | | | |
| 1.1 Prepared activity time plan is identified  1.2 Activity goals and action plan are set  1.3 Time allocated for each activity is monitored and reviewed  1.4 Activity management techniques are applied  1.5 Activity intervention strategies are applied when required | | | |
| **Element 2** | | **Apply quality improvement principles** | |
| **Range** | N/A | | |
| **Performance Criteria** | | | |
| 2.1 Principles of quality control are identified  2.2 Suitable quality control principles are selected  2.3 Relevant quality management principles are applied  2.4 Appropriate control strategies are determined  2.5 Required quality improvement principles are applied  2.6 Effects of change of quality control strategies are assessed | | | |

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| **Element 3** | | **Apply productivity improvement measures** |
| **Range** | Productivity measures may include, but are not limited to productivity data, cycles and targets. | |
| **Performance Criteria** | | |
| 3.1 Productivity cycle is identified and described  3.2 Challenges in production activities are determined  3.3 Possible solutions are formulated  3.4 Productivity measures are implemented  3.5 Productivity improvement measure is appraised | | |
| **Underpinning Knowledge** | | |
| The individual needs to demonstrate knowledge of:   * Quality requirements * Time management concepts * Team goals and motivation | | |
| **Generic Skills** | | |
| The individual needs to demonstrate ability related to:   * Communication * Team Work * Problem solving * Planning and Organising * Self-management * Technology | | |

# INSTALL AND MAINTAIN BASIC INSTRUMENTATION AND CONTROL EQUIPMENT

**Unit Code:** *IAC001*

**Unit Standard Description**

This unit standard is intended for those who carry out instrumentation and control operations. It specifies the competencies required to: Install; Calibrate and configure; Test and Maintain basic instrumentation and control equipment tools and equipment.

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| **Unit Standard Title** | | | **Install and maintain basic instrumentation and control equipment** |
| **Unit Scope** | This unit standard requires the installation, calibration and configuration of basic instrumentation and control equipment, including a range of testing and maintenance procedures.  Performance of all elements must comply with all contractual agreement and/or manufacturers’ specifications, safe use of tools and materials, use of PPE, and relevant worksite, statutory, health, safety, and environment requirements, including e-waste disposal. | | |
| **Element 1** | | **Install basic instrumentation and control equipment** | |
| **Range** | Basic instrumentation and control equipment are simple equipment with few and rudimentary parts. | | |
| **Performance Criteria** | | | |
| 1.1 Tools and equipment for installing basic instrumentation and control equipment are selected according to workplace procedures  1.2 Drawings and circuit diagrams are interpreted according to workplace procedures  1.3 Basic instrumentation and control equipment are installed according to workplace procedures  1.4 Instrumentation and control equipment are commissioned according to manufacturers’ specifications. | | | |
| **Element 2** | | **Calibrate and configure equipment** | |
| **Range** | These include and are not limited to calibration and configuration tools, equipment and software | | |
| **Performance Criteria** | | | |
| 2.1 Calibration tools and equipment are identified and inspected according to manufacturers’ specification  2.2 Calibration tools and equipment are tested according to manufacturers’ specifications  2.3 Configuration of equipment is performed according to workplace procedures  2.4 Software versions and firmware are confirmed and updated according to manufacturers’ specifications  2.5 Calibrated, tested equipment and devices are stored according to according to workplace procedures  2.6 Calibration, configuration and test documents and certificates are filled according to workplace procedures  2.7 Calibrated and configured equipment documents are stored according to workplace procedures. | | | |

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| **Element 3** | | **Test basic instrumentation and control equipment** |
| **Range** | Testing includes and is not limited to full load and no load tests. | |
| **Performance Criteria** | | |
| 3.1 Test equipment for basic instrumentation and control equipment is identified and checked according to workplace procedures.  3.2 Basic instrumentation and control equipment is tested according to workplace procedures  3.3 Essential reading and measurements are recorded. | | |
| **Element 4** | | **Maintain equipment** |
| **Range** | Maintenance includes and is not limited to cleaning, lubricating and replacing faulty or worn-out. | |
| **Performance Criteria** | | |
| 4.1 Maintenance procedures are developed and updated according to workplace procedures.  4.2 Databases of equipment configuration and software created are backed up and documented according to workplace procedures.  4.3 Calibration sheets are updated according to maintenance procedures.  4.4 Maintenance records and operation manuals are updated and documented according workplace procedures.  4.5 Assessment reports of equipment are presented to supervisors according to workplace procedures.  4.6 Forms and data sheets are used to create service reports according workplace procedures.  4.7 Regulatory documents are updated and filed according to workplace procedures.  4.8 Asset management systems are used according to workplace procedures. | | |
| **Element 5** | | **Maintain tools** |
| **Range** | Tools include and are not limited to hand, power and machine tools | |
| **Performance Criteria** | | |
| 5.1 Tools are stored in accordance to workplace procedures  5.2 Hand tools are inspected for damage according to workplace procedures  5.3 Damaged hand tool parts are replaced according to manufacturers’ specifications  5.4 Tools are cleaned after use according to manufacturers’ specifications  5.5 Hand tools are lubricated according to manufacturers’ specifications  5.6 Tool batteries and chargers are checked according to manufacturers’ specifications | | |
| 5.7 Tool batteries and chargers are replaced according to manufacturers’ specifications  5.8 Power tools are cleaned and inspected Tool batteries and chargers are checked according to manufacturers’ specifications  5.9 Defective components of power tools are repaired according to manufacturers’ specifications  5.10 Damaged power tool components are replaced according to manufacturers’ specifications. | | |
| **Underpinning Knowledge** | | |
| The individual needs to demonstrate knowledge of:   * Types of calibration and test equipment such as multimeters, pressure calibrators and handheld communicators * Types of configuration equipment such as highway addressable remote transducer (HART) communicators, computers and associated software * Calibration, configuration and test equipment operating procedures and limitations * Maintenance schedule and certification requirements of calibration, configuration and test equipment * Types of hand tools * Hand tool operating procedures and limitations * Portable and stationary power tool operating procedures and limitations * Types and functions of rigging equipment such as belts, ropes, cables and slings * Operating procedures for hoisting and lifting devices * Hoisting and lifting capacities * Material handling equipment including pallet jacks, Forklifts, stationary cranes and rigging  E-waste disposal | | |
| **Generic Skills** | | |
| The individual needs to demonstrate ability related to:   * Communication * Team Work * Problem solving * Planning and Organising * Self-management * Safety Awareness | | |

# INSTALL AND SERVICE INSTRUMENTATION AND CONTROL INDICATING DEVICES

**Unit Code:** *IAC002*

**Unit Standard Description**

This unit standard is intended for those who carry out instrumentation and control operations. It specifies the competencies required to: Install; Service; and Repair pressure, temperature, level and flow devices.

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| **Unit Standard Title** | | | **Install and service instrumentation and control indicating devices** |
| **Unit Scope** | This unit standard requires the installation and repair of instrumentation and control indicating devices, including a range of servicing procedures.  Performance of all elements must comply with all contractual agreement and/or manufacturers’ specifications, safe use of tools and materials, use of PPE, and relevant worksite, statutory, health, safety, and environment requirements, including e-waste disposal. | | |
| **Element 1** | | **Install pressure, temperature, level and flow devices** | |
| **Range** | Installations include and are not limited to site clearing, cleaning, mounting procedures and testing | | |
| **Performance Criteria** | | | |
| 1.1 Tools and equipment are selected and used according to type of device as per manufacturers’ specifications  1.2 Devices are selected according to process application, environment and engineered designs.  1.3 Mounting locations are selected according to engineered designs and manufacturers’ specifications.  1.4 Devices are selected and mounted according to engineered designs and manufacturers’ specifications.  1.5 Enclosures and panels to hold devices and indicators are modified according to workplace procedures.  1.6 Devices are connected to the process using tubing, in-line installation and thermo-well according to engineered designs.  1.7 Wiring is terminated to devices according to engineered designs and manufacturers’ specifications.  1.8 Devices are configured and calibrated according to manufacturers' instructions, process requirements and data sheets.  1.9 Device operations are verified within specified parameters by use of test equipment and procedures.  1.10 Configuration and calibration settings are performed according to manufacturing specifications  1.11 Configuration and calibration settings are backed up and documented according to workplace procedures. | | | |

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| **Element 2** | | **Service pressure, temperature, level and flow devices** |
| **Range** | Service includes and is not limited to cleaning, lubrication and replacement of worn parts | |
| **Performance Criteria** | | |
| 2.1 Inspection to detect abnormalities is performed according to the workplace procedures  2.2 Device operations and functions are checked for functionality according to manufacturers’ specifications.  2.3 Devices sensing lines and taps are cleared, isolated, equalized or blown down to ensure lines are not plugged according to workplace procedures.  2.4 Devices are cleaned according to workplace procedures.  2.5 Device calibration performed before returning to service.  2.6 Calibration of devices verified according to maintenance specifications. | | |
| **Element 3** | | **Repair pressure, temperature, level and flow devices** |
| **Range** | Repair include and is not limited to fault diagnosis, problem fixing, testing, commissioning and job documentation and recommendations | |
| **Performance Criteria** | | |
| 3.1 Diagnostic tools and equipment are selected and prepared  3.2 Fault detection and inspections are performed according to workplace procedures  3.3 Device functions are checked and faulty ones isolated according to workplace procedures  3.4 Calibration and functional checks of device are performed  3.5 Fault root causes are determined according to workplace procedures  3.6 Faulty equipment are identified according to workplace procedures  3.7 Repair tools and equipment are selected and used according to workplace procedures  3.8 Components are selected according to codes and manufacturers’ specifications  3.9 Faulty components are replaced according to workplace procedures  3.10 Plugged lines are cleared using pressurized liquids or air according to workplace procedures  3.11 Process-wetted components are inspected and cleaned  3.12 Devices are calibrated according to manufacturers’ specifications  3.13 All repaired equipment are tested and commissioned according to workplace procedures. | | |

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| **Underpinning Knowledge** |
| The individual needs to demonstrate knowledge of:   * Types of pressure and vacuum measuring devices such as pneumatic, electronic and mechanical * Types of level measuring devices such as differential pressure (DP) transmitter, ultrasonic, radar and float switches (mechanical) * Types of flow measuring devices such as vortex, thermal mass and ultrasonic * Types of temperature measuring devices such as thermocouples, RTD, filled thermal systems and pyrometers * Types of indicating devices such as chart recorders, digital display and gauges * Types of pressure scales such as absolute, differential, gauge and barometric * Temperature scales such as Kelvin, Fahrenheit and Celsius * Types of connections such as piping, tubing and wiring * Primary elements such as orifice plates, turbines and coriolis tubes * Pressure, level and flow calibration instruments such as pressure calibrators, dead weight testers and multi meters * Temperature calibration instruments such as multimeters, temperature baths, dry block calibrators and infrared thermometers * Accuracy and limitations of calibration instruments * Required calibrating parameters of measuring devices such as zero, span, range, repeatability, specific gravity and accuracy * Calibration methods as required by the measuring device * Interaction of various loops * Measuring device operation * Repair/replacement methods * Root cause diagnostics and analysis * Maintenance procedures, documentation and schedules * Use of original software * E-waste disposal |
| **Generic Skills** |
| The individual needs to demonstrate ability related to:   * Communication * Team Work * Problem solving * Planning and Organising * Self-management * Safety Awareness |

# INSTALL AND SERVICE INSTRUMENTATION AND CONTROL MOTION DEVICES

**Unit Code:** *IAC003*

**Unit Standard Description**

This unit standard is intended for those who carry out instrumentation and control operations. It specifies the competencies required to: Mount; Service; and Repair motion, speed, position and vibration devices.

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| **Unit Standard Title** | | | **Install and service instrumentation and control motion devices** |
| **Unit Scope** | This unit standard requires the mounting and repair of instrumentation and control motion devices, including a range of servicing procedures.  Performance of all elements must comply with all contractual agreement and/or manufacturers’ specifications, safe use of tools and materials, use of PPE, and relevant worksite, statutory, health, safety, and environment requirements, including e-waste disposal. | | |
| **Element 1** | | **Mount motion, speed, position and vibration devices** | |
| **Range** | Motion includes vertical, horizontal and radial movement | | |
| **Performance Criteria** | | | |
| 1.1 Tools and equipment are selected and used according to type, process application and engineered designs  1.2 Mounting location and hardware is selected according to manufacturers’ specifications and engineered designs  1.3 Electrical wiring is terminated according to manufacturers' specifications  1.4 Devices are configured and calibrated according to manufacturers' instructions  1.5 Device operation is tested and verified using test equipment and procedures  1.6 Configuration and calibration settings for future data recovery are backed up and documented | | | |
| **Element 2** | | **Service motion, speed, position and vibration devices** | |
| **Range** | Service includes and is not limited to cleaning, lubrication and tightening of loose parts | | |
| **Performance Criteria** | | | |
| 2.1 Abnormality inspections are performed according to workplace procedures  2.2 Functional checks of devices to confirm proper operation are performed according to workplace procedures  2.3 Components are checked and serviced according to manufacturers’ specifications  2.4 Calibration of devices are performed and verified according to maintenance specifications. | | | |

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| **Element 3** | | **Repair motion, speed, position and vibration devices** |
| **Range** | Repair may include and is not limited to modification or replacement of faulty parts | |
| **Performance Criteria** | | |
| 3.1 Diagnostic tools are selected and prepared according to workplace procedures.  3.2 Fault inspections are carried out according to workplace procedures  3.3 Functional checks on devices are performed according to manufacturers’ specifications  3.4 Fault locations are identified according to workplace procedures  3.5 Probable root cause of faults determined and recorded in line with workplace procedures  3.6 Required replacement components are selected according to codes and manufacturers’ specifications  3.7 Faulty components are removed and replaced according to workplace procedures  3.8 Devices are tested and calibrated according to manufacturers’ specifications  3.9 Work area is cleaned and cleared according to workplace procedures | | |
| **Underpinning Knowledge** | | |
| The individual needs to demonstrate knowledge of:   * Motion and position/displacement devices such as torque switches, proximity switches, proximity probes and analogue position sensors * Speed devices such as tachometers, strobes and proximeters * Vibration devices such as probes and proximeters * Indicating devices such as chart recorders, digital displays and gauges * Motion, speed, position and vibration calibration instruments such as strobe lights, multimeters and tachometers * Required calibrating of measuring parameters such as zero, span, range and accuracy  Interaction of various loops * Principles of operation and laws of physics such as speed and velocity * Materials such as solvents and contact cleaners * Maintenance procedures, documentation and schedules * Root cause diagnostics * Repair and replacement methods * E-waste disposal | | |

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| **Generic Skills** |
| The individual needs to demonstrate ability related to:   * Communication * Team Work * Problem solving * Planning and Organising * Self-management * Safety Awareness |

# INSTALL AND SERVICE INSTRUMENTATION AND CONTROL PARAMETER MEASURING DEVICES

**Unit Code:** *IAC004*

**Unit Standard Description**

This unit standard is intended for those who carry out instrumentation and control operations. It specifies the competencies required to: Install; Maintain; and Repair mass, density and consistency devices.

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| **Unit Standard Title** | | | **Install and service instrumentation and control parameter measuring devices** |
| **Unit Scope** | This unit standard requires the installation, maintenance and repair of instrumentation and control parameter measuring devices, including the modification or replacement of faulty parts.  Performance of all elements must comply with all contractual agreement and/or manufacturers’ specifications, safe use of tools and materials, use of PPE, and relevant worksite, statutory, health, safety, and environment requirements, including e-waste disposal. | | |
| **Element 1** | | **Install mass, density and consistency devices** | |
| **Range** | Installations include and not limited to site clearing and cleaning, mounting procedures, wiring, calibration, configuration and testing | | |
| **Performance Criteria** | | | |
| 1.1 Tools and equipment used are selected according to type of device  1.2 Device is selected according to process application, environment and engineered designs  1.3 Mounting location and devices/hardware is selected according to engineered designs and manufacturers’ specifications  1.4 Device is mounted and connected to the process using methods such as bolting, piping and tubing according to engineered designs  1.5 Wiring is terminated to devices according to manufacturers' specifications and engineered designs  1.6 Devices are configured and calibrated according to manufacturers' instructions, process requirements and data sheets  1.7 Device operation is verified within specified parameters by using test equipment and procedures  1.8 Configuration and calibration settings for future data recovery is backed up and documented. | | | |
| **Element 2** | | **Maintain mass, density and consistency devices** | |
| **Range** | Maintenance include and is not limited to making maintenance plans or charts, documents, device cleaning, lubrication, replacement of worn out parts and testing | | |
| **Performance Criteria** | | | |
| 2.1 Inspection to detect abnormalities such as leaks, loose connections and corrosion is performed according to workplace procedures.  2.2 Function check of device to confirm proper **o**peration is performed according to workplace procedures.  2.3 Devices cleaned using materials such as solvents, fine wire, abrasives and contact cleaners according to manufacturers’ specifications.  2.4 Calibration of devices is verified according to maintenance procedures. | | | |

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| 2.5 Equipment calibrated before returning to service according to workplace procedures. | | |
| **Element 3** | | **Repair mass, density and consistency devices** |
| **Range** | Repair of consistency devices includes and is not limited to modification or replacement of faulty parts | |
| **Performance Criteria** | | |
| 3.1 Diagnostic tools and equipment are selected and used  3.2 Fault inspections are carried out according to workplace procedures  3.3 Device functions are checked for fault isolation according to device specifications  3.4 Calibration check is performed according to workplace procedures  3.5 Probable root causes and faults locations are identified and determined according to workplace procedures  3.6 Tools and equipment are selected and used  3.7 Components are replaced according to workplace procedures  3.8 Components inspected and cleaned according to manufacturers’ specifications  3.9 Devices are rebuilt to replace worn components according to workplace procedures and original component specifications  3.10 Devices are calibrated according to manufacturers’ specifications. | | |

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| **Underpinning Knowledge** |
| The individual needs to demonstrate knowledge of:   * Types of mass devices such as load cells, scales and strain gauges * Types of density devices such as u-tubes, displacers, nuclear gauges and refractometers  Radiation safety practices * Types of consistency devices such as optical, rotary, blade, paddle and microwave * Types of indicating devices such as chart recorders, digital displays and gauges * Types of connections such as piping and wiring * Factors affecting system performance such as temperature, vibration and pressure * Calibration instruments such as multimeters, refractometers, radiation survey meters and calibrated standards * Accuracy of calibration equipment * Required calibrating measuring parameters such as zero, span, range, repeatability, accuracy and specific gravity * Calibration methods as required by the measuring device * Interaction of various loops * Measuring device operation * Repair/replacement methods * Root cause diagnostics * Maintenance procedures, documentation and schedules * E-waste disposal |
| **Generic Skills** |
| The individual needs to demonstrate ability related to:   * Communication * Team Work * Problem solving * Planning and Organising * Self-management * Safety Awareness |

# INSTALL AND SERVICE PROCESS ANALYZERS

**Unit Code:** *IAC005*

**Unit Standard Description**

This unit standard is intended for those who carry out instrumentation and control operations. It specifies the competencies required to: Install; Maintain and Repair process analyzers.

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| **Unit Standard Title** | | | **Install and service process analyzers** |
| **Unit Scope** | This unit standard requires the installation and repair of process analyzers, including a range of maintenance procedures.  Performance of all elements must comply with all contractual agreement and/or manufacturers’ specifications, safe use of tools and materials, use of PPE, and relevant worksite, statutory, health, safety, and environment requirements, including e-waste disposal. | | |
| **Element 1** | | **Install process analyzers** | |
| **Range** | Installations include and not limited to site clearing/cleaning, mounting procedures, wiring, calibration, configuration and testing | | |
| **Performance Criteria** | | | |
| 1.1 Installation tools and equipment are selected and used  1.2 Analyzers are selected according to process application, environmental conditions, manufacturers' specifications and engineered designs  1.3 Mounting locations and hardware are selected according to engineered designs and manufacturers’ specifications  1.4 Devices are mounted according to manufacturers' instructions and engineered designs  1.5 Wiring to devices are terminated according to manufacturers' specifications  1.6 Analyzer and indicating devices are configured and calibrated according to manufacturers' instructions, process requirements and data sheets  1.7 Sampling systems and conditioners are installed according to manufacturers’ specifications. | | | |
| **Element 2** | | **Maintain process analyzers** | |
| **Range** | Maintenance includes and is not limited to cleaning, lubricating, and tightening of loose parts and calibrations | | |
| **Performance Criteria** | | | |
| 2.1 Abnormalities checks are performed according to workplace procedures  2.2 Functional operations of analyzers and sampling systems are checked to conform with manufacturers’ specifications  2.3 Cleaning materials are selected and used  2.4 Sample lines are cleared by flushing using materials according workplace procedures  2.5 Calibrations of devices are performed according to maintenance procedures  2.6 Devices are tested before returning to service according to workplace procedures. | | | |

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| **Element 3** | | **Repair process analyzers** |
| **Range** | Repair include and not limited to fault diagnosis, problem fixing, testing, commissioning and job documentation and recommendations | |
| **Performance Criteria** | | |
| 3.1 Diagnostic tools and equipment are selected and used  3.2 Inspections to detect errors are performed according to workplace procedures  3.3 Functions of process analyzers are checked according to manufacturers’ procedures  3.4 Faulty analyzers are isolated according to manufacturers’ procedures  3.5 Calibration of “as-found” equipment is carried out and checked according to workplace procedures  3.6 Reference samples and cleaning supplies are selected and used according to workplace procedures  3.7 Sensors and optics are cleaned according to manufacturer’s specifications  3.8 Probable root cause and location of faults and required repairs are performed according to workplace procedures  3.9 Abnormality checks are performed according to manufacturers’ specifications  3.10 Functional operations of analyzers and sampling systems are checked to conform with specifications  3.11 Cleaning materials are selected and used according to workplace procedures  3.12 Sample lines are cleared by flushing using materials according workplace procedures  3.13 Calibrations of devices are performed according to maintenance procedures  3.14 Devices are tested before returning to service according to workplace procedures. | | |

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| **Underpinning Knowledge** |
| The individual needs to demonstrate knowledge of:   * Process analyzers such as pH, conductivity, turbidity and ORP * Quality control analyzers such as chromatographs, spectrometers and pulp quality analyzers * Environmental emission analyzers such as for noise, hazardous gases and greenhouse gases * Types of connections such as piping, wiring and flange-mounted * Operating parameters such as sampling time, lag time and measurement limitations * Required installation conditions such as ambient temperature and cleanliness * Sampling systems, conditioners and methods * Calibration instruments such as lab instruments, multi meters and software. * Required calibration parameters of analyzers * Calibration material such as inert gases, standard gases, water and oil * Accuracy and repeatability limitations of the analyzer * Calibration methods as required by the analyzer * Interaction of various loops * Interaction of analyzer to process * Possible contamination of analyzers * Maintenance materials * Theory of analyzer operation * Jurisdictional regulations and licensing requirements * Repair/replace methods * Root cause diagnostics * Maintenance procedures, documentation and schedules * Use of original software * E-waste disposal |
| **Generic Skills** |
| The individual needs to demonstrate ability related to:   * Communication * Team Work and problem solving * Planning and Organising  Self-management |

# APPLY BASIC KNOWLEDGE OF INSTRUMENTATION AND CONTROL

**Unit Code:** *IAC026*

**Unit Standard Description**

This unit standard describes the competences required to apply knowledge of Instrumentation and Control in a variety of contexts in paid employment or self-employment. It specifies the competencies required to: Interpret schematics, datasheets and drawings; Interpret standards and codes; Apply basic Instrumentation and Control Strategies; Measure process variables; and Carryout basic mathematical calculations.

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| **Unit Standard Title** | | | **Apply basic knowledge of instrumentation and control** |
| **Unit Scope** | Performance of all elements must comply with all contractual agreements and/or manufacturers’ specifications, safe use of tools and materials, use of PPE, and relevant worksite, statutory, health, safety, and environment requirements, including e-waste disposal. | | |
| **Element 1** | | **Interpret schematics, datasheets and drawings** | |
| **Range** | Drawings include and are not limited to schematic drawings; wiring diagrams; circuit diagrams; line diagrams; pictorial drawings; orthographic (first and third angle), oblique and isometric projection drawings; isometric circles.  The unit includes the compilation and illustration of data sheets. | | |
| **Performance Criteria** | | | |
| 1.28 The importance and functions of schematic diagrams; wiring diagrams; circuit diagrams; line diagrams; pictorial drawings; orthographic (first and third angle), oblique and isometric projection drawings; isometric circles; and other types of drawings are recognised and explained in line with engineering drawing conventions.  1.29 The different types of drawings are interpreted in accordance with the standard conventions of the different drawings.  1.30 Data sheets are compiled and illustrated in accordance with standard procedures. | | | |
| **Element 2** | | **Interpret standards and codes** | |
| **Range** | Standards and codes may include but are not limited to those of products, processes and procedures | | |
| **Performance Criteria** | | | |
| 2.23 The importance and uses of standards and codes are recognised and explained in accordance with standard conventions.  2.24 Different standards and codes are interpreted according to manufacturers’ specifications and workplace procedures. | | | |
| **Element 3** | | **Apply basic instrumentation and control strategies** | |
| **Range** | N/A | | |
| **Performance Criteria** | | | |
| 3.21 The importance and applications of instrumentation and control strategies are identified and explained.    3.22 The advantages and disadvantages of different instrumentation and control strategies are | | | |

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| identified according to workplace procedures.  3.23 Different instrumentation and control strategies are applied in accordance with workplace procedures.  3.24 Instrumentation and control strategies are applied in accordance with workplace procedures. | | |
| **Element 4** | | **Measure process variables** |
| **Range** | N/A | |
| **Performance Criteria** | | |
| 4.1 Different types of process variables, their features, operating principles, applications, advantages and disadvantages are identified and explained.  4.2 Process measuring tools and equipment are identified, safely used, handled, maintained and stored.  4.3 The principles of operation of the different tools and equipment are identified.  4.4 The advantages and disadvantages of the different processes of measuring process variables is are identified.  4.5 The measurement of different process variables is demonstrated. | | |
| **Element 5** | | **Carryout basic mathematical calculations** |
| **Range** | The basic mathematical calculations include but are not limited to the solving problems using basic equations, graphs, basic sinusoidal functions and vector diagrams. | |
| **Performance Criteria** | | |
| 5.1 Basic equations and formulae are used to solve problems.  5.2 Graphical methods are used to solve problems.  5.3 Basic sinusoidal functions are used to calculate and display electrical quantities in an AC circuit.  5.4 Basic vector diagrams are used to calculate different electrical quantities. | | |
| **Underpinning Knowledge** | | |
| The individual needs to demonstrate knowledge of:   * Engineering drawings * Instrumentation and Control Strategies * Process variables * Algebra * Ratios and proportions * Graphs | | |
| * Trigonometry * Simultaneous equations * Sinusoidal functions * Wave forms * Calculation of voltage, current and power * Vector diagrams | | |
| **Generic Skills** | | |
| The individual needs to demonstrate ability related to:   * Communication * Team Work * Problem solving * Planning and Organising * Self-management * Safety Awareness | | |

# CONDUCT BASIC ELECTRICAL INSTALLATION

**Unit Code:** *IAC027*

**Unit Standard Description**

This unit standard describes the competences required to conduct basic electrical installation in a variety of contexts in paid employment or self-employment. It specifies the competencies required to: Select electrical materials; Install cable enclosures; Carryout electrical installation.

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| **Unit Standard Title** | | | **Conduct basic electrical installation** |
| **Unit Scope** | This unit standard covers the selection of electrical materials, installation of cable enclosures and carrying out electrical installations.  Performance of all elements must comply with all contractual agreements and/or manufacturers’ specifications, safe use of tools and materials, use of PPE, and relevant worksite, statutory, health, safety, and environment requirements, including e-waste disposal. | | |
| **Element 1** | | **Select electrical materials** | |
| **Range** | Selecting electrical materials includes choosing the correct materials according type of electrical installation, ambient temperature and cost implications. | | |
| **Performance Criteria** | | | |
| 1.31 Electrical materials are identified according to their conductivity or resistance in accordance with manufacturers’ specifications and workplace procedures.  1.32 The differences of electrical materials in relation to their characteristics, resistance and conductivity are identified manufacturers’ specifications and workplace procedures.  1.33 The applications, advantages and disadvantages of the different electrical materials are identified manufacturers’ specifications. | | | |
| **Element 2** | | **Install cable enclosures** | |
| **Range** | Installation includes and is not limited to mounting, fixing and erecting. | | |
| **Performance Criteria** | | | |
| 2.25 The features and applications if different installation tools are identified according to manufacturers’ specifications and workplace procedures.  2.26 Tools and equipment used for installation are selected and used according to manufacturers’ specifications and workplace procedures.  2.27 Different types of cable enclosures and cable trays, their features characteristics, and applications are identified according to manufacturers’ specifications and workplace procedures.  2.28 Cable encloses are installed according to wiring and circuit diagrams, manufacturers’ specifications and workplace procedures. | | | |
| **Element 3** | | **Carryout electrical installation** | |
| **Range** | N/A | | |
| **Performance Criteria** | | | |
| 3.25 Tools and equipment are selected and used according to manufacturers’ specifications and | | | |
| workplace procedures.  3.26 Cables are laid according to wiring and circuit diagrams and workplace procedures.  3.27 Cables are drawn through cable enclosures according to workplace procedures.  3.28 Cables are terminated according to workplace procedures  3.29 Tests are conducted on electrical installations according to according to system specifications and workplace procedures. | | | |
| **Underpinning Knowledge** | | | |
| The individual needs to demonstrate knowledge of:   * Electrical theories and formulas such as Ohm’s Law, Kirchhoff’s Laws and Faraday’s Law * Power quality, specifications and hazards * Types of electrical equipment such as AC/DC power supplies and UPS * Energy Regulatory Commission codes * Electrical and electronic equipment operation * Hazardous locations * Required tolerances of electrical and electronic equipment such as voltage, voltage ripple, current, repeatability and accuracy * E-waste disposal | | | |
| **Generic Skills** | | | |
| The individual needs to demonstrate ability related to:   * Communication * Team Work * Problem solving * Planning and Organising * Self-management * Safety Awareness | | | |