

REPUBLIC OF KENYA

COMPETENCY BASED CURRICULUM

FOR

INSTRUMENTATION AND CONTROL

LEVEL 3



TVET CDACC

P.O. BOX 15745-00100

NAIROBI

CONTENTS

[COURSE OVERVIEW 3](#_Toc521676960)

[WORKPLACE HEALTH, SAFETY, ENVIRONMENTAL AND EMERGENCY PRACTICES 5](#_Toc521676961)

[WORKPLACE ESSENTIAL SKILLS 15](#_Toc521676962)

[PLANNING AND ORGANISING WORK ACTIVITIES 23](#_Toc521676963)

[INSTALLING AND MAINTAINING BASIC INSTRUMENTATION AND CONTROL EQUIPMENT 28](#_Toc521676964)

[INSTALL AND SERVICE INSTRUMENTATION AND CONTROL INDICATING DEVICES 35](#_Toc521676965)

[INSTALLING AND SERVICING INSTRUMENTATION AND CONTROL MOTION DEVICES 40](#_Toc521676966)

[INSTALLING AND SERVICING INSTRUMENTATION AND CONTROL PARAMETER MEASURING DEVICES 45](#_Toc521676967)

[INSTALLING AND SERVICING PROCESS ANALYZERS 51](#_Toc521676968)

[BASIC KNOWLEDGE OF INSTRUMENTATION AND CONTROL 56](#_Toc521676969)

[BASIC ELECTRICAL INSTALLATION 63](#_Toc521676970)

# COURSE OVERVIEW

**Units of Learning**

This course consists of basic and core units of learning as indicated below:

**Basic Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code**  | **Unit of Learning Title**  | **Duration Hours**  | **in**  |
| CGEN001 | Apply workplace health, safety, environmental and emergency practices | 60 |  |
| CGEN002 | Apply workplace essential skills | 60 |  |
| CGEN003 | Plan and organise work activities | 60 |  |
| **Total**  |  | 180 |  |

**Core** **Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **Unit of Learning Code**  | **Unit of Learning Title**  | **Duration Hours**  | **in**  |
| CIAC001 | Install and maintain basic instrumentation and control equipment | 60 |  |
| CIAC002 | Install and service instrumentation and control indicating devices | 50 |  |
| CIAC003 | Install and service instrumentation and control motion devices | 50 |
| CIAC004 | Install and service instrumentation and control parameter measuring devices | 60 |
| CIAC005 | Install and service process analyzers | 80 |
| CIAC026 | Apply basic knowledge of instrumentation and control | 80 |
| CIAC027 | Conduct basic electrical installation | 60 |
| **Total**  |  | 330 |

The total duration of the course is 510 hours.

**Entry Requirements**

An individual entering this course should have any of the following minimum requirements:

1. Kenya Certificate of Secondary Education (KCSE)

**Or**

1. Any equivalent qualifications as determined by Kenya National Qualifications Authority (KNQA)

**Assessment**

The course will be assessed at two levels: internally and externally. Internal assessment is continuous and is conducted by the trainer who is monitored by an accredited internal verifier while external assessment is the responsibility of TVET CDACC.

**Certification**

A candidate will be issued with a Certificate of Competency for each unit of competency. To attain the qualification National Certificate Level 3 in Instrumentation and Control, the candidate must demonstrate competence in all the units of competency as given in qualification pack. These certificates will be issued by TVET CDACC in conjunction with training provider.

# WORKPLACE HEALTH, SAFETY, ENVIRONMENTAL AND EMERGENCY PRACTICES

**Unit Code:** CGEN001(Internal code)

**Unit Title:** Apply workplace health, safety, environmental and emergency practices

**Relationship to Occupational Standards**

This unit addresses the unit standard: GEN001-Apply workplace health, safety, environmental and emergency practices and control equipment

**Duration of Unit:** 60 hours

**Unit Description**

This module describes the skills, knowledge and attitudes required by people who wish to gain paid employment in a variety of contexts. It includes general workplace health and safety practices, basic firefighting and first aid skills, awareness of and compliance with site emergency plans, and general environmental awareness.

**Summary of Learning Outcomes**

1. Apply workplace health and safety practices
2. Perform basic fire fighting
3. Perform basic first aid
4. Comply with site emergency plans
5. Maintain environmental awareness

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |
| --- | --- |
| **Learning Outcome 1:**Apply workplace health, safety and environmental practices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 1.1 Describe factors affecting health and safety in the workplace | * General safety knowledge  safety is a core value  responsible for personal safety and the safety of others

STDs, HIV and AIDS* Main categories of hazards  chemical  sensory  environmental  physical
* Common injuries and hazards  use of damaged

equipmentslips, trips and falls  hearing loss  crushing/impact  loss of control of heavy liftsequipment and motor vehicle accidentsburnsbatteries, tires, pressurised hydraulic and fuel systemsconfined space  inexperience and lack of trainingcomplacency, boredom,inattention, lack of focus on safety | Written and/or oral evidence |

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | drugs and alcohol  fatigue |  |
| 1.2 Interpret and apply general work site, legislative and employer safety rules |  | Employer safety rules and policies  developed to govern the work of all employeesbased on company philosophy, experience, safety recordoften tied to discipline policiesoften go beyond OHS&E regulationstraining and supervisionMotivation underlying safety programmes  motivated by regulations  motivated by ethics, legitimate concernsmotivated by cost of lost time and injury claims  motivated by liability | Performance evidence of demonstrating safe working practices in a simulated environment |
| 1.3 Use Personal ProtectiveEquipment (PPE) |  | PPE types and function  head protection  respiratory protection  eye protection  hearing protection  hand protection  foot protection  high visibility vest  fall protection  body protection  otherProcedures for using PPE | Written and/or oral evidence on types and function of PPEPerformance evidence of using PPE |
| **Learning Outcome 2:**Perform basic fire fighting |  |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 2.1 Demonstrate fire prevention techniques | * Causes of fire
* Classes of fire

A, B, C, D, and E* Fire prevention techniques and general housekeeping
* Procedures for fire prevention
 | Written and/or oral evidencePerformance evidence of fire prevention |
| 2.2 Operate basic fire fighting equipment | * Types and function of basic fire fighting equipment
* Safety signs/symbols on fire equipment
* Procedures for operating basic fire fighting equipment
 | Written evidence of operating basic fire fighting equipmentPerformance evidence of operating basic fire fighting equipment (simulation) |
| 2.3 Demonstrate basic fire fighting procedures | * Precautions to be taken when

fighting fires* Steps to be taken when containing fires
* Fire fighting techniques
* Fire fighting report
* Procedures for basic fire fighting
 | Written and/or oral evidencePerformance evidence of simulated basic fire fighting |

|  |
| --- |
| **Learning Outcome 3:**Perform occupational first aid |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 3.1 Determine the nature and context of the injury/medical emergency | * Applicable Occupational

Health, Safety andEnvironmental legislation and regulations* Applicable company policies and standards
* Nature of injuries/medical emergency
* Appropriate treatment and equipment
* Context of the injury/medical emergency
 | Written and/or oral evidence of nature and context of an |
|  |  |
| 3.2 Demonstrate occupational first aid procedures | * Occupational first aid concept
* Identification and function of occupational first aid equipment
* Appropriate treatments
* Factors to consider when monitoring the condition of an injured person
* Prioritising injuries
* Implications of the context of an injury on basic first aid treatment
* Implications of **NOT**

prioritising injuries if there are more than one* Procedures for demonstrating

first aid* Procedures for monitoring the condition of an injured person
* Procedures for handing over injured person to medical personnel
 | injury/medical emergencyPerformance evidence of demonstrating first aid proceduresPerformance evidence of monitoring the condition of an injured personPerformance evidence of handing over injured person to medical personnelPerformance evidence of completing first aid report |
| 3.3 Complete incident report | * Condition of the injured person
* Incident reporting
* Appropriate personnel
* Procedures for completing incident report
 |  |
| **Learning Outcome 4:**Comply with site emergency plans |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 4.1 Prepare for emergencies | * Company policies and procedures
* Site emergency response plans  evacuation routes  procedures  contact protocol
* Types of fire, i.e. class A, B, C, and D
* Types of fire extinguishers
* Identification and assessment of potential hazards and risks on work site
* Location of emergency response equipment, such as fire extinguishers and first aid

kits/stations and how to use them* Inspection requirements for safety equipment and supplies
 | Written and/or oral evidence |
| 4.2 Respond to emergencies | Performance evidence of responding to simulated emergencies |

|  |
| --- |
| **Learning Outcome 5:**Maintain environmental awareness |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 5.1 Describe general environmental values | * Habitat and ecological values
* Impacts and potential hazards to humans
* Endangered species
 | Written and/or oral evidence |
| 5.2 Describe general environmental impacts | * Global warming, carbon emissions
* Pollution
* Sedimentation
* Dust
* Habitat reduction
* Habitat degradation
 | Written and/or oral evidence |
| 5.3 Describe and demonstrate spill control techniques |  Potential sources of spills:broken lines/mechanical failureso fuel o lubricants o otherRefuelling o fuel storage o storage of other products | Written and/or oral evidence |
|  |  | SewageConcrete operationsWater system chlorination and flushingMeasures to reduce risk of spills  safe storage facilities  designated fuelling areas  high priority given to repair of machinery leakscompany policiesSpill control techniques  protect area of incident  use of appropriate protective equipmentcontrol source  control spread/movement of spill and counter measureotherProcedures for spill control techniques | Performance evidence of demonstrating spill controltechniques |
| 5.4 Describe work site techniques to minimise environmental damage |  | Minimise erosionSediment control techniques | Written and/or oral evidence |

**Suggested Delivery Methods**

* + Instructor led facilitation of theory
	+ Group and individual activities
	+ Practical demonstration of task
	+ Guided practice by learners
	+ Self-paced learning

**List of Recommended Resources**

* 1. **Text books, websites, manuals**
	2. Fundamental principles of occupational health and safety, by ILO www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/.../wcms\_093550.pdf
	3. Numerous videos, toolbox talks and safety tips and checklists can be found at: www.safety.cat.com
	4. Manufacturers’ manuals; Equipment maintenance documentation
	5. **Tools and equipment and materials**

a) PPE including, Range of basic fire fighting equipment, coveralls, ear plugs and muffs, eye wash station, face shields, safety glasses, goggles, first aid kit, gloves, hard hat, masks

(particle, vapour), safety boots, spill kit, high visibility vest

# WORKPLACE ESSENTIAL SKILLS

**Unit Code:** CGEN002(Internal code)

**Unit Title:** Apply workplace essential skills

**Relationship to Occupational Standards**

This unit addresses the unit standard: GEN002-Apply workplace essential skills

**Duration of Unit:** 60 hours

**Unit Description**

This module describes the skills, knowledge and attitudes required by people who wish to gain paid employment in a variety of contexts. It includes general work ethic practices, basic conflict resolution, verbal and non-verbal communication skills, and team work practices.

**Summary of Learning Outcomes**

1. Demonstrate work ethics and principles
2. Demonstrate basic conflict resolution techniques
3. Demonstrate effective speaking and listening skills
4. Read and interpret work documents
5. Demonstrate effective participation in a team

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |
| --- | --- |
| **Learning Outcome 1:**Demonstrate work ethics and principles |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 1.1 Define work ethics and principles | * Meaning of work ethics
* Importance of work ethics and principles including, but not limited to:

honesty  selflessness  consistency  moral  courage  respect | Written and/or oral evidence of core work ethicsPerformance evidence of work ethics |
| 1.2 Describe core work ethics applicable to an organisation |  Principles of work ethics and expectations of an organisation may include but are not limited to:  being punctual  prepared for work  co-operative  productive  respectful  technology minded  innovative |
| 1.3 Apply work ethics for activities in an organisation | * Purpose of work ethics to an organisation  presenting positive image of the industry

instilling confidence  maintaining relations with the general public* Demonstration of work ethic procedures
 |
| **Learning Outcome 2:**Demonstrate basic conflict resolution techniques |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 2.1 Analyse problem at the work site |  Definition of conflict and conflict resolution | Written and/or oral evidenceof identifying conflict resolution techniques |
| 2.2 Identify conflict resolution techniques |  Resolution techniquesListen, then speak outGather the groupBe impartial  Do not postpone conflict resolutionPromote teamworkBroadcast praise |
| 2.3 Apply conflict resolution techniques | * Procedures for conflict resolution
* Consider corganisation’s regulations and policies
* Evaluate problem or conflict resolution
 | Performance evidence of applying conflict resolution techniques |

|  |
| --- |
| **Learning Outcome 3:**Demonstrate effective speaking and listening skills |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 3.1 Apply contextual knowledge | * Language variations  social interactions  workplace interactions
* Facial expressions
* Gestures
 | Performance evidence of effective speaking and listening skills that may include but are not limited to:role plays  site or field visits  group interactions  simulation |
| 3.2 Apply knowledge of language forms and features | * Ways of asking for:

information  making offers  giving commands* Pronunciations  intonation  accent  variations
* Express emotions  verbal  visual  body language  facial expressions
 |
| 3.3 Respond to and compose texts | * Active listening
* Contribute to ideas, information and questions
* Use of intonation
* Formulate open and closed questions appropriate to the context
* Use of comments or questions to expand on ideas
* Use of interaction skills

initiating topics  making positive |
|  | statementsvoicing disagreement in an appropriate mannerspeaking clearly and varying tonevolume and pace appropriately |  |

|  |
| --- |
| **Learning Outcome 4:**Read and interpret work documents |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 4.1 Describe and interpret work documents | * Types and use of work documents:

Work plansChartsJob cardsMapsWorkschedule/proceduresJob safety analysisSafety manuals  Lift plans  others* Procedures for completing documents
 | Written and/or oral evidenceof types and use of work documentsPerformance evidence of completing documents |
| 4.2 Complete workdocuments for a specific task |
| 4.3 Demonstrate document filing and storage procedures | * Storage and filing methods
* Procedures for filing and storing documents
 | Performance evidence of document filing and storing |
| 4.4 Retrieve documents |  Procedures for identifying and locating documents:Date of storageFile reference numberStorage facility, e.g. shelves, cabinets | Performance evidence of document retrieval |

1

|  |
| --- |
| **Learning Outcome 5:**Demonstrate effective participation in a team |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 5.1 Define team members and their individual role within the team | * Identification of team members, including:  cross cultural diversities  language barriers
* Role of individual team members
 | Performance evidence of effective participation in a team including assistance and support to individual team members to achieve group targets |
| 5.2 List the features of effective teamwork |  Features of effective teamwork:team goals are clear and understoodteam roles are balanced  communication is open and cleara positive attitude  conflict is managed constructivelyideas, not individuals, are critically analysedtimelines and benchmarks are set and monitored  outcomes are delivered |
| 5.3 Determine strengths and weaknesses of working inteams | * Strengths of team work  sharing of skills and knowledge

improved efficiency  productivitysome tasks are complex and cannot be done by one individual* Weaknesses of team work  some work is not suited for team approach
 |
|  |  | Team work requires negotiation of roles and responsibilities |  |
| 5.4 Provide assistance and support to team members |  | Identification of strengths and weaknesses of individual team members |
|  |  | Identification of required team member support |  |
|  |  | Procedures for providingassistance to individual team members |  |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Group and individual activities
* Practical demonstration of task
* Guided practice by learners
* Self-paced learning

**List of Recommended Resources**

**1. Text books, websites, manuals**

1. Employment, by Cathy Filmore Hoyt ISBN-13: 978-1881020349 Communication and Writing

(Workplace essential skills), by Cathy Filmore Hoyt ISBN-13: 978-1881020356

1. Numerous videos, CD-ROM, Workbooks, Online lessons can be found at: www.litlink.ket.org ›

Home Space › WES, Pre-GED, & GED Info

1. Manufacturers’ manuals; Equipment maintenance documentation

**2. Tools and equipment and materials**

a) Overhead projector and screen, Computer and LCD projector and screen, Computers with internet access, Flipchart stand, Flipchart paper, Flipchart markers, OHP transparencies,

Transparency pens, Pencils and writing paper Smartboard/Whiteboard/Chalkboard, Markers/chalk

# PLANNING AND ORGANISING WORK ACTIVITIES

**Unit Code:** CGEN003(Internal code)

**Unit Title:** Plan and organise work activities

**Relationship to Occupational Standards**

This unit addresses the unit standard: GEN003-Plan and organise work activities

**Duration of Unit:** 60 hours

**Unit Description**

This module describes the skills, knowledge and attitudes required by people who wish to gain paid employment in a variety of contexts. It includes general time management techniques, quality improvement principles, and productivity improvement measures.

**Summary of Learning Outcomes**

1. Develop and implement time management plan
2. Apply quality improvement principles
3. Apply productivity improvement measures

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |
| --- | --- |
| **Learning Outcome 1:**Develop and implement time management plan |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 1.1 Outline the importance of time management | * Enhanced efficiency
* Improved decision-making

ability* Reduced stress-level
* Improved self-discipline
 | Written and/or oral evidence |
| 1.2 Select the type of activity plan for a given task | * Types of activity time plan: clock cards; timesheets; attendance registers; diaries, Gantt Chart, job cards and electronic access cards
* Description of features of each activity time plan
 | Oral task and/or performance evidence of the trainee selection of activity plan |
| 1.3 Prepare the activity plan for the selected task |  Interpretation and preparation of activity time plan for a given task - typical practical exercise common to workplace operations | Evidence of prepared activity plan |
| 1.4 Use the prepared activity plan to accomplish given task | * Reading of a time plan time schedule purpose of the time plan activity, work load
* Relationship between time

plan and give activities | Written and/or oral evidence |

|  |  |
| --- | --- |
| **Learning Outcome 2:**Apply quality improvement principles |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 2.1 Explain quality management principles |  Management principle  customer focus  leadershipinvolvement of people  process approach  system approach tomanagementcontinuous improvement  factual approach to decision makingmutually beneficial supplier relationships | Written and/or oral evidence |
| 2.2 Describe principles of quality control | * Quality control / improvement principles  product improvement  process improvement  people based

improvement* PDCA cycle
 | Written and/or oral evidence |
| 2.3 Select and apply quality improvement principles for agiven task |  Procedures for quality improvement principles | Presentation and/or performance evidence of applying qualityimprovement principles for agiven task |

|  |  |
| --- | --- |
| **Learning Outcome 3:**Apply productivity improvement measures |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 3.1 Describe the term‘Productivity’ | * Define ‘productivity’
* Productivity cycle
* Output versus Input
* Resources expected to be used / Resources actually consumed
* Non-productive time (NPT),

e.g. equipment downtime | Performance evidence of effective speaking and listening skills that may include but are not limited to:role plays  site or field visits  group interactions  simulation |
| 3.2 Determine generalchallenges in production activities | * Define ‘Production’

Finished goodsFinished services* Common factors for production:

LandLabourCapital* Challenges
 |
|  |  |
| 3.3 Describe measures to enhance workplace productivity for a simulated environment |  Measures to enhanceproductivityTraining programme for labour/Skills developmentEffective and efficient communication  Set clear goals and provide feedbackMotivation, e.g. incentives for good performanceOptimising site facilitiesAvailability of resources |  |

**Suggested Delivery Methods**

* Instructor led facilitation of theory
* Group and individual activities
* Practical demonstration of task
* Guided practice by learners
* Self-paced learning

**List of Recommended Resources**

**1. Text books, websites, manuals**

1. Employment, by Cathy Filmore Hoyt ISBN-13: 978-1881020349 Communication and Writing

(Workplace essential skills), by Cathy Filmore Hoyt ISBN-13: 978-1881020356

1. Numerous videos, CD-ROM, Workbooks, Online lessons can be found at: www.litlink.ket.org ›

Home Space › WES, Pre-GED, & GED Info

1. Manufacturers’ manuals; Equipment maintenance documentation

**2. Tools and equipment and materials**

a) Overhead projector and screen, Computer and LCD projector and screen, Computers with internet access, Flipchart stand, Flipchart paper, Flipchart markers, OHP transparencies,

Transparency pens, Pencils and writing paper Smartboard/Whiteboard/Chalkboard,

Markers/chalk

# INSTALLING AND MAINTAINING BASIC INSTRUMENTATION AND CONTROL EQUIPMENT

**Unit Code:** CIAC001(Internal code)

**Unit Title:** Install and maintain basic instrumentation and control equipment

**Relationship to Occupational Standards**

This unit addresses the unit standard: IAC001- Install and maintain basic instrumentation and control equipment

**Duration of Unit:** 60 hours

**Unit Description**

This module provides trainees with the knowledge and skills to install and maintain instrumentation and control equipment. This includes the safe use, handling, maintenance and storage tools, testing equipment and materials needed for device installation; performing device installation, calibration, configuration, testing and commissioning; preparing calibration, configuration, testing and maintaining documents according to workplace procedures; and sorting and storing devices according to according to workplace procedures.

**Summary of Learning Outcomes**

1. Install basic instrumentation and control equipment
2. Calibrate and configure equipment
3. Test basic instrumentation and control equipment
4. Maintain equipment
5. Maintain tools

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |
| --- | --- |
| **Learning Outcome 1:**Install basic instrumentation and control equipment |  |
| 1.1 Demonstrate the safe and correct use, handling, maintenance and storage tools, equipment and materials used for the installation of basic instrumentation and control equipment | * Types of instrumentation and control installation tools and equipment, their principles of operation and uses
* Preparation of a checklist and inventory of tools and equipment
* Tools and equipment inspection procedures
* Tools and equipment repair procedures
* Tools and equipment cleaning and lubrication procedures
* Tools and equipment storage procedures
* Instrumentation and control installation materials and their uses
 | Written and/or oral and practical tasks on tools, equipment and materials used for the installation of basic instrumentation and control equipment |
| 1.2 Demonstrate procedures for installing basic instrumentation and control equipment | * Installation procedures
* Observation of occupational and environmental health and safety requirements
* Interpretation of drawings and circuit diagrams
* Installation of equipment according to manufacturers’ specifications and procedures
* Testing and commissioning
 | Written and/or oral and practical tasks on installing basic instrumentation and control equipment |

|  |
| --- |
| **Learning Outcome 2:**Calibrate and configure equipment |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 2.1 Describe the meaning, importance and procedure for calibrating and configuring equipment | * Meaning and importance of calibration and configuration
* Calibration and configuration procedures
* Identification, inspection and testing of calibration tools and equipment according to manufacturers’ specifications
* Performing the calibration, and configuration of equipment according to manufacturers’ specifications
* Confirmation and updating of software versions according to manufacturers’ specifications
* Storing of calibrated equipment and devices
* Completion of calibration, configuration and documents and preparation of assessment report
* Storing of calibrated and configured equipment documents
* Filing of reports and regulatory documents
* Document storage
* Updating of records and operational manuals
 | Written and/or oral tasks on the meaning, importance and procedure for calibrating and configuring equipment |
| 2.2 Demonstrate proceduresfor calibrating and configuring equipment |  Demonstration of procedures for calibrating and configuring equipment | Practical assessment on the calibration and configuration of equipment |

|  |  |
| --- | --- |
| **Learning Outcome 3:**Test basic instrumentation and control equipment |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 3.1 Describe the different tests used for basic instrumentation and control equipment | * Different tests and their applications
* Procedure for performing

different tests | Written and/or oral tasks on different types of tests, their applications and procedures for their performance |
| 3.2 Demonstrate the testing of basic instrumentation and control equipment | * Identification of test equipment, their principles of operation and applications
* Checking of test equipment according to manufacturers’ specifications
 | Practical tasks on testing basic instrumentation and control equipment |
| 3.3 Prepare test documention | * Preparation of test documentation
* Reading and recording of essential measurements
 | Practical tasks on the preparation of test documentation and readingand recording of essentialmeasurements |

|  |  |  |
| --- | --- | --- |
| **Learning Outcome 4:**Maintain equipment |  |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 4.1 Describe the procedure for maintaining equipment | * Development and updating of maintenance procedures
* Categorising storage areas
* Shelving calibrated devices
* Storage of equipment
* Preparing inventory of equipment
* Device labelling and tagging
* Sorting procedures
* Creation, backing up and documentation of databases of equipment configuration and software
* Updating of calibration sheets according to maintenance procedures
* Updating and documentation of maintenance records and operation manuals
* Preparation and presentation of assessment reports of equipment to supervisors
* Use of forms and data sheets to create service reports
* Updating and filing of regulatory documents
* Use of asset management systems
 | Written and/or oral tasks on the procedure for maintaining equipment |
| 4.2 Demonstrate procedures for maintaining equipment |  Demonstration of procedures of maintaining equipment | Practical tasks on maintaining equipment |

|  |  |  |
| --- | --- | --- |
| **Learning Outcome 5:**Maintain tools |  |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 5.1 Describe the procedure for maintaining tools | * Inspection of hand tools inspected for damage according to workplace procedures
* Replacement of damaged

hand tool parts according to manufacturers’ specifications* Checking tool batteries and according to manufacturers’ specifications
* Repalacement of tool batteries and chargers according to manufacturers’ specifications
* Inpsection and cleaning of power tools
* Replacement of damaged components of power tools according to manufacturers’ specifications
* Reapir of defective components of power tools according to manufacturers’ specifications
* Cleaning of tools after use according to manufacturers’ specifications
* Lubrication of tools according to manufacturers’ specifications
* Storage of tools according to workplace procedures
 | Written and/or oral tasks on the procedure for maintaining tools |
| 5.2 Demonstrate procedures for maintaining tools |  Demonstration of procedures of maintaining tools | Practical tasks on maintaining tools |

**Suggested Delivery Methods**

* + Instructor led facilitation of theory
	+ Group and individual activities
	+ Practical demonstration of task
	+ Guided practice by learners
	+ Self-paced learning

**List of Recommended Resources**

* 1. **Text books, websites, manuals**
	2. www.instrumentationtoolbox.com

www.us.endress.com/en

* 1. Numerous videos, toolbox talks and safety tips and checklists can be found at: www.safety.cat.com
	2. Manufacturers’ manuals; Equipment maintenance documentation
	3. Instrumentation Symbols and Identification - ISA (Instrument Society of America)
	4. The Instrumentation, Systems, and Automation Society ISBN 0-87664-844-8
	5. **Tools and equipment and materials**
	6. Drawings and symbols (P&ID/P&C, ISA SAMA, isometric and orthographic drawings)
	7. PPE including, coveralls, ear protection, safety shoes, fire extinguishers, first aid kit, safety glasses, glove, hard hat

# INSTALL AND SERVICE INSTRUMENTATION AND CONTROL INDICATING DEVICES

**Unit Code:** CIAC002 (Internal code)

**Unit Title:** Install and service instrumentation and control indicating devices

**Relationship to Occupational Standards**

This unit addresses the unit standard: IAC002- Install and service instrumentation and control indicating devices

**Duration of Unit:** 50 hours

**Unit Description**

This module provides trainees with the knowledge and skills to install and maintain instrumentation and control indicating devices. This includes measuring, monitoring and controlling various processes and equipment. The module includes installing, maintaining, diagnosing and repairing instrumentation and control indicating devices and optimizing process control systems.

**Summary of Learning Outcomes**

1. Install pressure, temperature, level and flow devices
2. Service pressure, temperature, level and flow devices
3. Repair pressure, temperature, level and flow devices

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |
| --- | --- |
| **Learning Outcome 1:**Install pressure, temperature, level and flow devices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 1.1 Plan and prepare for installation of pressure, temperature, level and flow devices | * Occupational and environmental health and safety rules, regulations and precautions
* OSHA installation procedures
* Preparation of work schedule and procedure
* Installation diagrams
* Safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/or oral and practical assessment on planning and preparing for device installation |
| 1.2 Demonstrate procedures for the installation of pressure, temperature, level and flow devices | * Interpretation of installation diagrams and drawings
* Installation procedures for the different devices as per the manufacturers’ specifications and workplace procedures
* Emergency response procedures
 | Practical assessment on the installation of pressure, temperature, level and flow devices |
| 1.3 Test and commission the installation of pressure, temperature, level and flow devices | * Device inspection procedure
* Device testing procedure
* Work site cleaning
* Device commissioning procedure
* Testing and commissioning of the different devices
 | Written and/or oral and practical assessment on testing and commissioning of the installation of pressure, temperature, level and flow devices |

|  |  |
| --- | --- |
| **Learning Outcome 2:**Service pressure, temperature, level and flow devices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 2.1 Plan and prepare for the servicing of pressure, temperature, level and flow devices | * Occupational and environmental health and safety rules, regulations and precautions
* Work plan maintenance procedures
* OSHA maintenance procedures
* Instrumentation and control maintenance standards
* Safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/or oral and practical assessment on planning and preparing for the servicing of pressure, temperature, level and flow devices |
| 2.2 Maintain indicating devices | * Type of devices, their principles of operation and applications including thermometers, manometers, and level and flow indicating devices
* Types of job cards and their uses
* Job card completion
* Device inspection procedures
* Device servicing procedures
* Demonstration of procedures for the inspection and servicing of the different devices
* Preparation and maintenance of records
 | Written and/or oral and practical assessment on the maintenance of indicating devices |

|  |  |
| --- | --- |
| **Learning Outcome 3:**Repair pressure, temperature, level and flow devices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 3.1 Plan and prepare for the repair of pressure, temperature, level and flow devices | * Occupational and environmental health and safety rules, regulations and precautions
* Work plan
* OSHA repair procedures
* Instrumentation and control repair procedures
* Safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/or oral and practical assessment on the preparation for the repair of pressure, temperature, level and flow devices |
| 3.2 Demonstrate procedures for the repair of pressure, temperature, level and flow devices | * Interpretation of job card instructions
* Device inspection and diagnosis procedures
* Device repair procedures
* Modification procedures
* Device testing procedures
* Completion of the job card after completing the work
 | Written and/or oral and practical assessment on the repair of pressure, temperature, level and flow devices |

**Suggested Delivery Methods**

* + Instructor led facilitation of theory
	+ Group and individual activities
	+ Practical demonstration of task
	+ Guided practice by learners
	+ Self-paced learning

**List of Recommended Resources**

* 1. **Text books, websites, manuals**
	2. www.instrumentationtoolbox.com

www.us.endress.com/en

* 1. Numerous videos, toolbox talks and safety tips and checklists can be found at: www.safety.cat.com
	2. Manufacturers’ manuals; Equipment maintenance documentation
	3. Instrumentation Symbols and Identification - ISA (Instrument Society of America)
	4. The Instrumentation, Systems, and Automation Society ISBN 0-87664-844-8
	5. **Tools and equipment and materials**
	6. Drawings and symbols (P&ID/P&C, ISA SAMA, isometric and orthographic drawings)
	7. Basic hand tools (Hammer, set of screw drivers, side cutters, long nose pliers, pinchers, allen keys, spirit level and spanners)
	8. Portable power tools (Hand drilling machine)
	9. Soldering iron
	10. PPE including, coveralls, ear protection, safety shoes, fire extinguishers, first aid kit, safety glasses, glove, hard hat

# INSTALLING AND SERVICING INSTRUMENTATION AND CONTROL MOTION DEVICES

**Unit Code:** CIAC003 (Internal code)

**Unit Title:** Install and service instrumentation and control motion devices

**Relationship to Occupational Standards**

This unit addresses the unit standard: IAC003- Install and service instrumentation and control motion devices**.**

**Duration of Unit:** 50 hours

**Unit Description**

This module provides trainees with the knowledge and skills to install and maintain instrumentation and control motion devices. The module includes installing, maintaining, diagnosing and repairing motion devices, and the monitoring of the operation of the devices and protecting the integrity of equipment.

**Summary of Learning Outcomes**

1. Mount motion, speed, position and vibration devices
2. Service motion, speed, position and vibration devices
3. Repair motion, speed, position and vibration devices

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |
| --- | --- |
| **Learning Outcome 1:**Mount motion, speed, position and vibration devices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 1.1 Plan and prepare for the mounting of motion, speed, position and vibration devices | * Occupational and environmental health and safety rules, regulations and precautions
* OSHA mounting procedures
* Work schedule procedure
* Mounting locations
* Mounting diagrams
* Safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/or oral and practical assessment on planning and preparing for the mounting of motion, speed, position and vibration devices |
| 1.2 Demostrate procedures for the mounting of motion, speed, position and vibration devices | * Interpretation of mounting diagrams and drawings.
* Procedures for the mounting of motion, speed, position and vibration devices as per manufacturers’ specifications and workplace procedures
* Mounting of motion devices
 | Written and/or oral and practical assessment on the mounting of motion devices |
| 1.3 Test motion, speed, position and vibration devices | * Device mounting inspection procedure
* Device testing procedure
* Work site cleaning
* Demonstration of procedures

for the testing of different motion devices | Written and/or oral and practical assessment on the testing of motion devices |

|  |  |
| --- | --- |
| **Learning Outcome 2:**Service motion, speed, position and vibration devices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 2.1 Plan and prepare for the servicing of motion, speed, position and vibration devices | * Occupational and environmental health and safety rules, regulations and precautions
* Preparation for device servicing
* Work plan maintenance procedures
* OSHA maintenance procedures
* Instrumentation and control maintenance standards
* Safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/or oral and practical assessment on planning and preparing for the servicing of motion, speed, position and vibration devices |
| 2.2 Demonstrate procedures for the servicing of motion, speed, position and vibration devices | * Device inspection procedures
* Device servicing procedures
* Demonstration of procedures for the servicing of motion devices
* Preparation and maintenance of servicing records
 | Written and/or oral and practical assessment on the servicing of motion devices |

|  |  |
| --- | --- |
| **Learning Outcome 3:**Repair motion, speed, position and vibration devices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 3.1 Plan and prepare for the repair of motion, speed, position and vibration devices | * Occupational and environmental health and safety rules, regulations and precautions
* Work plan
* OSHA repair procedures
* Instrumentation and control repair procedures
* Safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/or oral and practical assessment on planning and preparing for the repair of motion, speed, position and vibration devices |
| 3.2 Demonstrate procedures for the repair of motion devices | * Interpretation of job card instructions
* Inspection and diagnosis procedures for motion, speed, position and vibration devices
* Repair procedures for motion, speed, position and vibration devices
* Testing procedures for motion, speed, position and vibration devices
* Completing the job card after comleting the work
 | Written and/or oral and practical assessment on the repair of motion, speed, position and vibration devices |

**Suggested Delivery Methods**

* + Instructor led facilitation of theory
	+ Group and individual activities
	+ Practical demonstration of task
	+ Guided practice by learners
	+ Self-paced learning

**List of Recommended Resources**

* 1. **Text books, websites, manuals**
	2. www.instrumentationtoolbox.com

www.us.endress.com/en

* 1. Numerous videos, toolbox talks and safety tips and checklists can be found at: www.safety.cat.com
	2. Manufacturers’ manuals; Equipment maintenance documentation
	3. Instrumentation Symbols and Identification - ISA (Instrument Society of America)
	4. The Instrumentation, Systems, and Automation Society ISBN 0-87664-844-8
	5. **Tools and equipment and materials**
	6. Basic hand tools (Hammer, set of screw drivers, side cutters, long nose pliers, pinchers, allen keys, spirit level and spanners)
	7. Portable power tools (Hand drilling machine)
	8. Soldering iron
	9. PPE including, coveralls, ear protection, safety shoes, fire extinguishers, first aid kit, safety glasses, glove, hard hat

# INSTALLING AND SERVICING INSTRUMENTATION AND CONTROL PARAMETER MEASURING DEVICES

**Unit Code:** CIAC004(Internal code)

**Unit Title:** Install and service instrumentation and control parameter measuring devices

**Relationship to Occupational Standards**

This unit addresses the unit standard: IAC004 - Install and service instrumentation and control parameter measuring devices.

**Duration of Unit:** 60 hours

**Unit Description**

This module provides trainees with the knowledge and skills to install and maintain instrumentation and control parameter measuring devices. This includes the installation, servicing, diagnosis and repairing of the devices.

**Summary of Learning Outcomes**

1. Install mass, density and consistency devices
2. Maintain mass, density and consistency devices
3. Repair mass, density and consistency devices

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |
| --- | --- |
| **Learning Outcome 1:**Install mass, density and consistency devices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 1.1 Describe the features, applications, advantages and disadvantages of different instrumentation and control parameter measuring devices | * Features of the different instrumentation and control parameter measuring devices
* Applications of the different instrumentation and control parameter measuring devices
* Advantages and disadvantages

of the different instrumentation and control parameter measuring devices | Written and/oral tasks on the features, applications, advantages and disadvantages of different instrumentation and control parameter measuring devices |
| 1.2 Explain the principles of operation of different instrumentation and control parameter measuring devices | * Components and principles of operation of different instrumentation and control parameter measuring devices
* Maintenance and storage of different instrumentation and control parameter measuring devices
 | Written and/or oral tasks on the principles of operation, maintenance and storage of instrumentation and control parameter measuring devices |
| 1.3 Explain the process and procedure of installing instrumentation and control parameter measuring devices | * Occupational and environmental health and safety rules, regulations and precautions
* Selection and safe use, handling, maintenance and storage of tools, equipment and materials
* Identification of site or location
* Interpretation of drawings and diagrams
* Steps to be followed when installing instrumentation and control parameter measuring devices
 | Written and/or oral tasks on process and procedure of installing instrumentation and control parameter measuring devices |

|  |  |  |  |
| --- | --- | --- | --- |
| 1.4 Demonstrate procedures for the installation of instrumentation and control parameter measuring devices |  | Occupational and environmental health and safety rules, regulations and precautionsPreparation of work site* cleaning location
* clearing obstacles

Procedure for mounting instrumentation and control parameter measuring devices* wiring
* cable termination
* testing
* commissioning

Demonstration of installation procedures for different instrumentation and control parameter measuring devices | Practical tasks on the installation ofinstrumentation and control parameter measuring devices |

|  |  |
| --- | --- |
| **Learning Outcome 2:**Maintain mass, density and consistency devices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 2.1 Clean instrumentation and control parameter measuring devices | * Cleaning equipment and detergents
* Cleaning solutions
* Methods of cleaning
* Safe use, handling, storage and disposal of detergents
 | Written and/or oral and practical tasks on the cleaning of instrumentation and control parameter measuring devices |
| 2.2 Lubricate moving parts | * Procedures for lubrication
* Methods of lubrication and their applications: oiling and greasing
* Types of oil and their uses
* Types of grease and their uses
 | Written and/or oral and practical tasks on the lubrication of moving parts of instrumentation and control parameter measuring devices |
| 2.3 Secure instrumentation and control parameter measuring devices | * Tightening of loose bolts, screws and nuts
* Alignment of shafts
* Alignment of pulleys
 | Written and/or oral andpractical tasks on securingequipment |

|  |  |
| --- | --- |
| **Learning Outcome 3:**Repair mass, density and consistency devices |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 3.1 Plan and prepare for the repair of mass, density and consistency devices | * Occupational and environmental health and safety rules, regulations and precautions
* Work plan
* OSHA repair procedures
* Instrumentation and control repair procedures
* Safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/oral and practical assessment on planning and preparing for the repair of mass, density and consistency devices |
| 3.2 Repair mass, density and consistency devices | * Interpretation of job card instructions
* Device inspection and diagnosis procedures
* Device repair procedures
* Device testing procedures
* Completing the job card after completion of work
 | Written and/oral and practical assessment on the repair of mass, density and consistency devices |

**Suggested Delivery Methods**

* + Instructor led facilitation of theory
	+ Group and individual activities
	+ Practical demonstration of task
	+ Guided practice by learners
	+ Self-paced learning

**List of Recommended Resources**

* 1. **Text books, websites, manuals**
	2. www.instrumentationtoolbox.com

www.us.endress.com/en

* 1. Numerous videos, toolbox talks and safety tips and checklists can be found at: www.safety.cat.com
	2. Manufacturers’ manuals; Equipment maintenance documentation
	3. Instrumentation Symbols and Identification - ISA (Instrument Society of America)
	4. The Instrumentation, Systems, and Automation Society ISBN 0-87664-844-8
	5. **Tools and equipment and materials**
	6. Basic hand tools (Hammer, set of screw drivers, side cutters, long nose pliers, pinchers, allen keys, spirit level and spanners)
	7. Portable power tools (Hand drilling machine)
	8. Soldering iron
	9. PPE including, coveralls, ear protection, safety shoes, fire extinguishers, first aid kit, safety glasses, glove, hard hat
	10. Materials for use in demonstrating safe manual handling techniques
	11. Motion, speed, position and vibration calibration instruments such as strobe lights, multimeters and tachometers.
	12. Speed devices such as tachometers, strobes and proximeters.
	13. Vibration devices such as probes and proximeters

# INSTALLING AND SERVICING PROCESS ANALYZERS

**Unit Code:** CIAC005 (Internal code)

**Unit Title:** Install and service process analyzers

**Relationship to Occupational Standards**

This unit addresses the unit standard: IAC005- Install and service process analyzers

**Duration of Unit:** 80 hours

**Unit Description**

This module provides trainees with the knowledge and skills to install and maintain process analyzers.

**Summary of Learning Outcomes**

1. Install process analyzers
2. Maintain process analyzers
3. Repair process analyzers

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome 1:**Install process analyzers |  |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 1.1 Identify the features, applications, advantages and disadvantages of different instrumentation and control process analyzers | * Different instrumentation and control process analyzers
* Features
* Applications
* Advantages and disadvantages
 | Written and/or oral task on the features, applications, advantages and disadvantages of different instrumentation and control process analyzers |
| 1.2 Explain the operating principles of different instrumentation and control process analyzers | * Constructional features, components, and their use
* Operating principles of different instrumentation and control process analyzers
* Safe handling, maintenance and storage
 | Written and/or oral tasks on the constructional features, operating principles, handling, maintenance and storage of instrumentation and control process analyzers |
| 1.3 Explain the process and procedure of installjng instrumentation and control process analyzers | * OHS&E rules, regulations and precautions
* Use of PPE
* Steps to be followed when installing process analyzers
* Interpretation of drawings and diagrams
* Identification of site or location
* Preparation of location or site
	+ clean location
	+ clear obstacles
* Different tools, equipment and materials and their uses
* Selection and safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/or oral tasks on the process and procedure of installing instrumentation and control process analyzers |

|  |  |  |  |
| --- | --- | --- | --- |
| 1.4 Mount instrumentation and control process analyzers |  | Mounting procedureWiringCable terminationTestingCommissioning | Written and/or oral and practical tasks on the mounting of instrumentation and control process analyzers |

|  |  |  |
| --- | --- | --- |
| **Learning Outcome 2:**Maintain process analyzers |  |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 2.1 Explain the process and procedure of servicing instrumentation and control process analysers | * Identification of occupational and environmental health and safety requirements
* Identification of tools and equipment
* Interpretation of circuit and wiring diagrams
* Listing of steps to be followed in logical sequence
 | Written and/or oral tasks on the process and procedure of servicing instrumentation and control process analysers |
| 2.2 Clean instrumentation and control process analyzers | * Cleaning equipment and detergents
* Cleaning solutions
* Methods of cleaning
* Safe handiling and storage of cleaning equipment and materials
* Safe and environmentally friendly disposal of detergents and cleaning solutions
 | Written and/or oral and practical tasks on the cleaning of instrumentation and control process analyzers |
| 2.3 Lubricate moving parts | * Procedures for lubrication
* Oiling and greasing
* Types of oil and grease and their applications
 | Written and/or oral and practical tasks on the lubrication of moving parts |

|  |  |  |
| --- | --- | --- |
| **Learning Outcome 3:**Repair process analyzers |  |  |
| **Specific Learning Outcomes** | **Content** | **Suggested Assessment Methods** |
| 3.1 Plan and prepare for the repair of process analysers | * Occupational and environmental health and safety rules, regulations and precautions
* Work plan
* OSHA repair procedures
* Instrumentation and control repair procedures
* Safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/oral and practical assessment on planning and preparing for the repair of process analyzers |
| 3.2 Repair instrumentation and control process analyzers | * Interpretation of job card instructions
* Completing the job card after completion of work
* Trouble shooting procedures
* Device inspection and diagnosis procedures
* Device repair procedures
* Device testing procedures
* Identification of faulty components
* Replacement of faulty components
* Repair of faulty components
 | Written and/or oral and practical tasks on repairing instrumentation and control process analyzers |

**Suggested Delivery Methods**

* + Instructor led facilitation of theory
	+ Group and individual activities
	+ Practical demonstration of task
	+ Guided practice by learners
	+ Self-paced learning

**List of Recommended Resources**

* 1. **Text books, websites, manuals**
	2. www.instrumentationtoolbox.com

www.us.endress.com/en

* 1. Numerous videos, toolbox talks and safety tips and checklists can be found at: www.safety.cat.com
	2. Manufacturers’ manuals; Equipment maintenance documentation
	3. Instrumentation Symbols and Identification - ISA (Instrument Society of America)
	4. The Instrumentation, Systems, and Automation Society ISBN 0-87664-844-8
	5. **Tools and equipment and materials**
	6. Basic hand tools (Hammer, set of screw drivers, side cutters, long nose pliers, pinchers, allen keys, spirit level and spanners)
	7. Portable power tools (Hand drilling machine)
	8. Soldering iron
	9. PPE including, coveralls, ear protection, safety shoes, fire extinguishers, first aid kit, safety glasses, glove, hard hat

# BASIC KNOWLEDGE OF INSTRUMENTATION AND CONTROL

**Unit Code:** CIAC026(Internal code)

**Unit Title:** Apply basic knowledge of Instrumentation and Control

**Relationship to Occupational Standards**

This unit addresses the unit standard: IAC026 - Apply basic knowledge of Instrumentation and Control

**Duration of Unit:** 80 hours

**Unit Description**

This module provides trainees with the knowledge and skills to interpret schematics, datasheets and drawings; interpret standards and codes; apply basic instrumentation and control strategies; measure process variables; and carryout basic mathematical calculations.

**Summary of Learning Outcomes**

1. Interpret schematics, datasheets and drawings
2. Interpret standards and codes
3. Apply basic instrumentation and control strategies
4. Measure process variables
5. Carryout basic mathematical calculations

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |
| --- | --- |
| **Learning Outcome 1:** Interpret schematics, datasheets and drawings  |  |
| **Specific Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 1.1 Interpret schematic diagrams  | * Importance and functions of schematic diagrams
* Types of schematic diagrams including wiring and circuit diagrams and their applications
* Meaning of different types of lines, signs and symbols
* Reading and interpretation of schematic diagrams in line with drawing conventions
 | Written and/oral and practical tasks on the interpretation of schematic diagrams  |
| 1.2 Interpret different types of drawings  | * Line diagrams
* Pictorial
* Isometric
* Orthographic (first and third angle)
* Oblique
* Isometric circles
* The standard conventions and applications of different types of drawings
* Meanings of different lines, signs and symbols
* Interpretation of different types of drawings in line with drawing conventions
 | Written and/or oral and practical tasks on the interpretation of different types of drawings   |
| 1.3 Interpret datasheets  | * Information collection
* Collation
* Representation
* Presentation
* Illustration and interpretation of datasheets
 | Written and/oral and practical tasks on the compilation, illustration and interpretation of datasheets  |

|  |  |
| --- | --- |
| **Learning Outcome 2:** Interpret standards and codes  |  |
| **Specific Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 2.1 Explain the importance and applications of standards and codes  | * Different types of standards and codes, their importance and applications
* Product standards
* Process standards
* Codes
 | Written and/or oral tasks on the importance and applications of standards and codes  |
| 2.2 Interpret standards and codes   | * Referencing
* Procedures
* Interpretation of standards and codes
 | Written and/or oral and practical tasks on interpreting standards and codes  |

|  |  |
| --- | --- |
| **Learning Outcome 3:** Apply basic instrumentation and control strategies |  |
| **Specific Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 3.1 Select instrumentation and control strategies  | * Different instrumentation and control strategies, their applications, advantages and disadvantages
* Selection of instrumentation strategies based on application and system requirements
 | Written and/or oral and practical tasks on the selection of instrumentation and control strategies  |
| 3.2 Apply instrumentation and control strategies  |  Application of different instrumentation and control strategies  | Written and/or oral and practical tasks on the application of instrumentation and control strategies  |

|  |  |  |
| --- | --- | --- |
| **Learning Outcome 4:** Measure process variables |  |  |
| **Specific Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 4.1 Identify different types of process variables   | * Types of process variables
* Features, operating principles, applications, advantages and disadvantages different types of process variables
 | Written and/or oral tasks on identifying different types of process variables  |
| 4.2 Use process measuring tools and equipment  | * Features and uses of different measuring tools and equipment
* Operating principles of different tools and equipment
* Correct and safe use, handling, maintenance and storage of measuring tools and equipment
 | Written and/or oral and practical tasks on identifying and using process measuring tools and equipment  |
| 4.3 Demonstrate the procedure of process measurement  | * Process measurement process and procedure
* Advantages and different process measurement procedures: variables
* Stages of process measurement procedure
* Components of process
* Demonstration of process measurement
 | Written and/or oral and practical tasks on process measurement  |

|  |  |  |
| --- | --- | --- |
| **Learning Outcome 5:** Measure process variables |  |  |
| **Specific Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 5.1 Use basic equations and formulae to solve problems  | * Manipulating different equations and formulae
* Conversion of units: metric and imperial
* Solving problems using basic equations and formulae including the use of algebra, ratios and proportions
* Solving basic electrical problems
 | Written and/or oral and practical tasks on solving problems using basic equations and formulae   |
| 5.2 Use graphical methods to solve mathematical problems  | * Graphs
* Ratios
 | Written and/or oral and practical tasks on solving problems using graphical methods  |
| 5.3 Use basic sinusoidal functions to calculate Alternating Current quantities  | * Calculation of voltage, current and power
* Calculation of power factor
* Showing wave forms
 | Written and/or oral amd practical tasks on using basic sinusoidal functions to calculate Alternating Current quantities  |
| 5.4 Use basic vector diagrams to calculate different electrical quantities  | * Calculation of impedance, resistance and inductance
* Calculation of resultants
* Calculation of voltage, current, true power, apparent power
 | Written and/or oral and practical tasks on using basic vector diagrams to calculate different electrical quantities   |

**Suggested Delivery Methods**

* + Instructor led facilitation of theory
	+ Group and individual activities
	+ Practical demonstration of task
	+ Guided practice by learners
	+ Self-paced learning

**List of Recommended Resources**

 **1. Text books, websites, manuals**

* 1. www.instrumentationtoolbox.com

 www.us.endress.com/en

* 1. Numerous videos, toolbox talks and safety tips and checklists can be found at: www.safety.cat.com
	2. Manufacturers’ manuals; Equipment maintenance documentation

# BASIC ELECTRICAL INSTALLATION

**Unit Code:** CIAC027(Internal code)

**Unit Title:** Conduct basic electrical installation

**Relationship to Occupational Standards**

This unit addresses the unit standard: IAC027- Conduct basic electrical installation

**Duration of Unit:** 60hours

**Unit Description**

This module provides trainees with the knowledge and skills to conduct basic electrical installation. This includes selecting electrical materials, installing cable enclosures and carrying out electrical installation.

The outcomes of learning described in this module should be able applied in the planning, implementation and evaluation of all tasks and activities in the other modules.

**Summary of Learning Outcomes**

1. Select electrical materials
2. Install cable enclosures
3. Carryout electrical installation

**Learning Outcomes, Specific Learning Outcomes and Content**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome 1:** Select electrical materials  |  |  |
| **Specific Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 1.1 Select eletrical materials for different applications  | * Characteristics and properties of different electrical materials
* Similarities and differences of electrical materials in relation to resistance and conductivity
* Features, applications, advantages and disadvantages

of different electrical materials * Selection of eletrcical materials for different applications
 | Written and/oral and practical tasks on identifying and selecting electrical materials for different applications  |
| 1.2 Demonstrate the safe use, handling and storage of electrical materials  | * Safe use, handling and storage of different electrical materials
* Hazards associated with different electrical materials
 | Written and/or oral and practical tasks on the safe use, handling and storage of electrical materials  |

|  |
| --- |
| **Learning Outcome 2:** Install cable enclosures  |
| **Specific Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 2.1 Use tools, equipment and materials  | * Features and applications of different tools, equipment and materials
* Correct and safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/or oral and practical tasks on selecting and using tools, equipment and materials  |
| 2.2 Identify types of cable enclosures and cable trays  | * Features, characteristics and applications of different types of cable enclosures and cable trays
* Conduits  Trunking
* Cable trays
 | Written and/or oral tasks on the identification of different types of cable enclosures and cable trays  |
| 2.3 Explain the characteristics of cable enclosures  | * Space factors
* Losing heat
* Implications of the characteristics of cable enclosures
 | Written and/or oral tasks on characteristics of cable enclosures  |
| 2.4 Install cable enclosures  | * Mounting procedures
* Safety
* Wearing PPE
* Measurements
* Electrical regulations
* Demonstration of installation procedures
 | Written and/or oral and practical tasks on installation cable enclosures   |

|  |  |
| --- | --- |
| **Learning Outcome 3:** Carryout electrical installation |  |
| **Specific Learning Outcomes**  | **Content**  | **Suggested Assessment Methods**  |
| 3.1 Describe different concepts and applications electricity  | * Power quality, specifications and hazards
* Types of electrical equipment, constructional features, principles of operation and applications including AC/DC power supplies and UPS
* Energy regulatory commission codes and their meanings
* Required tolerances of electrical and electronic

equipment  | Written and/or oral tasks on different concepts and applications of electricity  |
| 3.2 Conduct calculations using different electrical theories and formulae  | * Describe different electrical theories and their applications including:
	+ Ohm’s Law
	+ Kirchhoff’s Laws
	+ Faraday’s Law
* Condcuting calculations involving the different electrical theories and associated formulae
 | Written and/or oral and practical tasks on conducting calculations using different electrical theories and formulae  |
| 3.3 Use tools, equipment and materials for carrying out electrical installation work  | * Features and applications of different tools, equipment and materials
* Correct and safe use, handling, maintenance and storage of tools, equipment and materials
 | Written and/or oral and practical tasks on selecting and using tools, equipment and materials  |

|  |  |  |  |
| --- | --- | --- | --- |
| 3.4 Install cables  |          | Safety Wearing PPE Measurements Electrical regulations Installation procedures Laying cables according to wiring and circuit diagrams Drawing cables through cable enclosures Termination of cables  | Written and/or oral and practical tasks on installing cables   |
| 3.5 Conduct tests on electrical installations  |     | Different types of tests and their applications Procedures for conducting the different tests * Insulation resistance
* Open circuit test
* No load

Full load  | Written and/or oral and practical tasks on conducting tests on electrical installation   |

**Suggested Delivery Methods**

* + Instructor led facilitation of theory
	+ Group and individual activities
	+ Practical demonstration of task
	+ Guided practice by learners
	+ Self-paced learning

**List of Recommended Resources**

* 1. **Text books, websites, manuals**
	2. www.instrumentationtoolbox.com

 www.us.endress.com/en

* 1. Numerous videos, toolbox talks and safety tips and checklists can be found at: www.safety.cat.com
	2. Manufacturers’ manuals; Equipment maintenance documentation

* 1. **Tools and equipment and materials**
	2. Basic hand tools (Hammer, set of screw drivers, side cutters, long nose pliers, pinchers, allen keys, spirit level and spanners)
	3. Portable power tools (Hand drilling machine)
	4. Soldering iron
	5. PPE including, coveralls, ear protection, safety shoes, fire extinguishers, first aid kit, safety glasses, glove, hard hat
	6. Markers/chalk
	7. Pencils and writing paper
	8. Cleaning facilities, equipment and materials including a well-equipped wash room, soaps, detergents, hand towels
	9. Layers of protection analysis (LOPA) and risk reduction
	10. Safety integrity level (SIL)/reliability of the SIS to get the process to a safe state
	11. Safety instrumented functions (SIFs) such as pressure relief and redundant control