



ESWATINI VOCATIONAL QUALIFICATIONS PACKAGE
FOR

INSTRUMENTATION

LEVEL 3



Prepared by the Directorate of Industrial and Vocational Training (DIVT)

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February 2026

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Registration documents can be downloaded at the link:

<https://www.divt.org.sz/qualification>

Funded by the Taiwan Technical Mission in Eswatini



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ACKNOWLEDGEMENT

The qualifications package was developed through consultations and combined efforts of individuals, organizations and collaborating partners. The qualification contains unit standards benchmarked from other countries in the SADC Region and internationally. The DIVT facilitated the whole process of developing this package.

The following individuals together with their organizations are acknowledged for their special inputs

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4. Sicelo Phakathi	Gilbarco AFS
5. Phumlani Hlanze	EWSC
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7. Mphumelelo Mavuso	CONCO
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9. Sipho Dlamini	Eswatini College of Technology
10. Thamie Dlamini	Eswatini College of Technology
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12. Mazambane Dlamini	Taiwan Technical Mission

THE QUALIFICATION

NATIONAL VOCATIONAL CERTIFICATE INSTRUMENTATION LEVEL 3

Originator	DIVT		
Qualification Type:	Certificate	Descriptor:	Instrumentation
Specialisation:			
Level:	3	Minimum Credits:	80
Actual Credits	83		
Sub-Framework	TVET		
Field name	Engineering, Manufacturing and Construction	Field no:	07
Sub-field no:	Mechanics and metal trades	Sub-field no:	0715

Rationale

Describe the context of ETSDS

The Technical and Vocational System in Eswatini lacks occupational standards and harmonised curricula for training which has the input for the industry players. There is general dissatisfaction with the competencies produced by the system in terms of relevance with the labour market. There is currently no correlation between the required industry skills and the qualification the system produces.

Describe how the qualification will impact positively within the sketched context:

The qualification will provide the much-needed correlation between the required industry skills and the competencies produced by the system. The qualification will also harmonise curricula for training with the input of industry players.

Why do you need the qualification?

This qualification will enhance the status and productivity of the learner as well as contribute to improved quality, production rate and growth within the engineering sector. The range of typical learners at this level could include individuals preparing to qualify as an Instrumentation Technician. Qualifying learners will obtain a National Vocational Certificate in Instrumentation which places the learner in a position to investigate requirements for advancement to qualified artisan status or progress to a National Certificate at NQF Level 4.

Purpose

The purpose of the qualification is to develop learners who have the competencies required for performing Instrumentation tasks. It is awarded to people who have demonstrated the skills and knowledge of Instrumentation tasks within this broad industry.

Learners attracted to this qualification include those who are training in institutions to be Instrumentation Technicians at an Artisan level, learners who are in the apprenticeship training system and those who are in the non-formal sector who will acquire through trade testing.

Graduates will be able to ...

The qualification is developed to produce an Instrumentation Technician who can operate with minimum supervision and be able to supervise an Instrumentation Technician at level 2. Graduates will be able to relate their learning to scientific and technological principles and concepts.

Entry Requirements

Minimum requirements for entry:

- Successful completion of level 2 qualification (Instrumentation)
- RPL

Associated Level Descriptors

Knowledge	• To demonstrate advanced knowledge in understanding and application of theoretical and technical knowledge of key concepts to perform tasks and solve problems within given parameters. • To understand key concepts, terms, rules and established principles and theories in one or more fields or disciplines.
Skills	• To apply strategic approaches to tasks that arise in work and using expert sources of information. • To use technology to solve existing and emerging situations.
Personal Attributes	• To demonstrate accountability and responsibility in work/ learning situations. • To show proactivity and reliability in the performance of tasks.

Learning Outcomes Statements and Associated Assessment Criteria

This qualification will enable the learner to find employment as a skilled worker to perform Artisan duties in the Fabrication field.

The learner when competent should be able to:

- Demonstrate basic understanding of programmable logic controllers (PLC)
- Construct basic electrical and electronic circuit
- Demonstrate fault finding techniques on field instrumentation
- Design and construct relay logic circuits
- Maintain programmable field instruments
- Read and interpret instrumentation drawings
- Demonstrate an understanding of the Principles of Process Control Loops
- Install, test and maintain a basic pneumatic system
- Demonstrate knowledge of control valves, actuators, and positioners
- Demonstrate knowledge of transducers and strain gauges and their applications in industrial measurement
- Demonstrate knowledge of the physical principles of instrumentation systems
- Maintain analytical equipment

Assessment criteria identify the specific skills, knowledge, and behaviours necessary to achieve the learning outcomes. It makes it clear to learners what they are expected to do. It demonstrates to learners how to achieve the learning outcomes. It also contains range statements.

- Own work is planned and scheduled in terms of productivity, safety, health and the environment.
- A variety of common problems, both familiar and unfamiliar are solved by applying knowledge of advanced fabrication theory and practice.
- Responsibility for own actions is demonstrated within the sphere of operation.
- Effective interaction and communication is conducted with clients, colleagues and management.
- Knowledge of and application of statutory requirements is demonstrated as they relate to integrated systems.

Components of Qualifications

The components of the qualification which, in their combination, make up the complete qualification.

Unit No.	Unit Standard Title	Level	Credit
EE305	Demonstrate basic understanding of programmable logic controllers (PLC)	3	10
EEI300	Construct basic electrical and electronic circuit	3	10
EEI301	Demonstrate fault finding techniques on field instrumentation	3	8
EEI302	Design and construct relay logic circuits	3	6
EEI303	Maintain programmable field instruments	3	12
EEI304	Read and interpret instrumentation drawings	3	4
EEI305	Demonstrate an understanding of the Principles of	3	4

	Process Control Loops		
EEI306	Install, test and maintain a basic pneumatic system	3	10
EEI307	Demonstrate knowledge of control valves, actuators, and positioners	3	4
EEI308	Demonstrate knowledge of transducers and strain gauges and their applications in industrial measurement	3	7
EEI309	Demonstrate knowledge of the physical principles of instrumentation systems	3	5
EEI310	Maintain analytical equipment	3	7
Total Credits			83

Rules of Combination

Specific rules? The learner should be competent in all units in this qualification
Compulsory modules, units learning? All units are compulsory in these qualifications
Any subminimum credits to be achieved? The learner should acquire all 83 credits in these qualifications

Integrated Assessment

How will the assessment be done? This qualification will have compulsory theory and practice
How often will the assessment be done? • Trade testing • Institutional theory exams and practice • Formative assessment for apprenticeship training through log books and institutional evidence of theory training
Who will be responsible for the assessment? • DIVT • Vocational training institutions • There will be collective awarding of certificates for institutional learners

International Comparability

SADC	This qualification contains unit standards from the South African Qualifications Authority and aligns with the level descriptors in the SADC Qualifications Framework and also compares with TVET Qualifications in South Africa (Qual ID 74531)
African Continent	N/A
Globally, including TQF	N/A

Articulation Possibilities/Learning Pathways

A provision to learners, on successful completion of accredited prerequisites, to move between components of the delivery system.

Vertical	NVC Instrumentation Level 4
Horizontal	None
Diagonal	No match

Notes

Could be used by the office to let the public know the status of various issues. Here are 3 possibilities.

Programmes recorded against this registered qualification N/A
Accredited Providers N/A
Registered, re-registered, de-registered? N/A

Name of Registered Provider

Information on all providers accredited to offer this qualification must be indicated here. In the final database this information must be updatable.

Name:	DIVT
Address:	P. O. Box 1218 Mbabane

UNIT STANDARDS

EE305: Demonstrate basic understanding of programmable logic controllers

Title		Demonstrate basic understanding of programmable logic controllers (PLC)			
Domain		Physical Planning and Construction			
Subfield		Electrical Engineering Core			
SZNQF Level	3	Unit ID	EE305	Credits	10

Purpose

This unit standard specifies the competencies required for basic understanding of programmable logic controllers. It includes listing and discussing the functions and applications of programmable logic controllers, demonstrating an understanding of the input/output peripherals for a programmable logic controller, understanding of the programming terminal (the interface), demonstrating an understanding of field devices interfaced to programmable logic controllers. This unit standard is for Electrician Level 3.

Special Notes

1. Entry information/Prerequisite
EE301 Understand electrical and electronic theory and components.
EE304 Construct basic electrical and electronics circuits
2. Assessment evidence may be collected from a real workplace or a simulated real workplace or an appropriate simulated realistic environment in which instrumentation operations are carried out.
3. Glossary of terms:
‘Specifications’ refers to all or any of the following: manufacturers’ specifications and recommendations, workplace specific requirements etc. ‘
4. All inspection, operation and maintenance procedures associated with the use of tools and equipment shall comply with manufacturers’ specifications and/or company’s guidelines and instructions.
5. Regulations and legislation relevant to this unit standard include but not limited to the following:
 - Labour Act 2005
 - Workmen’s Compensation Act No.7 of 1983
 - SZNA-SANS 10142-1
 - Occupational Health and Safety (OHS) Act 2001And all subsequent amendments
6. Performance of all elements in this unit standard must comply with industry standards.

7. Unit standard range may include but not limited to power circuits from three to five loads, of which complex motor starters constitute a single load on the control circuit.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: List and discuss the functions and applications of programmable logic controllers

Range

This may include but not limited to minor repair on site, minor overhaul, repair and reconditioning, major overhaul and repair and complete reconditioning of components and ancillaries.

Performance Criteria

- 1.1 The terms used to describe the functions of logic controllers are explained.
- 1.2 The basic functions and principles of operation of logic controllers are listed and explained.
- 1.3 Hardware components are identified and their functions explained.
- 1.4 The methods and programming languages are listed and explained.
- 1.5 The information required to program and commission a programmable logic controller is listed and discussed.
- 1.6 The applications of programmable logic controllers are listed and discussed.
- 1.7 The advantages and disadvantages of programmable logic controllers are listed and discussed.

Element 2: Demonstrate an understanding of the input/output peripherals for a programmable logic controller.

Performance Criteria

- 2.1 The various peripherals are defined and their function explained and discussed.
- 2.2 The various input and output peripherals are identified.
- 2.3 Hazards associated with the use of logic controllers are recognised and the necessary precautions are taken according to work site procedure.
- 2.4 The correct operation of the peripheral devices is verified.
- 2.5 The peripherals are correctly removed and replaced according to manufacturer's specification.
- 2.6 Personal safety procedures are demonstrated according to activity requirements.

Element 3: Demonstrate an understanding of the programming terminal (the interface).

Performance Criteria

- 3.1 Handheld or programming terminal is correctly connected to the controller.
- 3.2 Communication between the programmer and the processor is established.

- 3.3 The correct sequence is used to monitor the on-line program that resides in the processor.
- 3.4 Programming the logic controller by means of a PC, laptop or hand-held interface is demonstrated.

Element 4: Demonstrate an understanding of field devices interfaced to programmable logic controllers

Performance Criteria

- 4.1 The correct field device is identified.
- 4.2 The field device is correctly connected to the appropriate peripheral.
- 4.3 The operation of the field device is verified.
- 4.4 Personal safety equipment is selected and used according to activity requirement.

Registration Data

Date first registered	2022
Anticipated review	2027
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI300: Construct basic electrical and electronic circuit

Title		Construct basic electrical and electronics circuits			
Domain		Physical Planning and Construction			
Sub-field		Electrical Engineering Core			
SZNQF Level	3	Unit ID	EEI300	Credits	10

Purpose

This unit standard specifies the competencies required to install, test and maintain single phase, industrial and commercial installations. It includes, planning the electrical tests to be done, testing the electrical installation and complete the required tests and inspection documentation. This unit standard is for Instrumentation level 3.

Special Notes

1. Entry information/Prerequisite
EE301 : Understand electrical and electronics theory and components.
2. This unit standard is to be delivered and assessed in the context of instrumentation and should be assessed in conjunction with other relevant technical unit standards selected from this domain.
3. Assessment may be conducted at a real workplace or simulated workplace, or an appropriately realistic environment in which instrumentation is carried out.
4. Regulations and legislation relevant to this unit standard may include but not limited to the following:
 - Occupational Health and Safety Act 2001
 - Worker's Compensation Act No.7 of 1983
 - SZNA-SANS 10142-1and all subsequent amendments
5. Statutory requirements include but not limited to current national regulations applicable to instrumentation, including regulations; ordinances; bylaws; directives; standards; guidelines; and codes; issued by legislative body such as parliament, local authorities and other bodies so empowered by any of the former.
6. Electrical and electronic drawings include but not limited to, schematic diagrams, wiring diagrams, connection and or terminal connections and cable schedule.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Plan and prepare for the electrical installation to be done

Performance Criteria

- 1.1 Safety rules and regulations are followed as per statutory requirements and safe working procedures.
- 1.2 Job instructions are interpreted and sequence of operations is determined according to the installation environment and the required task.
- 1.3 Tools, equipment and instruments are selected to meet the requirements of the task according to statutory and environmental requirements.
- 1.4 The documentation necessary to complete the task is obtained as per data management requirements.
- 1.5 Environmental hazards and safety risks are identified according to environmental standards and safety risks analysis.

Element 2: Carrying out electrical installation

Performance Criteria

- 2.1 Hazard Identification and Risk Assessment (HIRA) is carried out.
- 2.2 Components are assembled as per the given task.
- 2.3 Statutory regulations and standards adhered to.
- 2.4 Integrity of connections is checked/verified.

Element 3: Perform electrical tests on the installation

Performance Criteria

- 3.1 All safety precautions are observed and demonstrated during the test as per safe work procedures.
- 3.2 Installation is tested as per statutory requirements from SZNS SANS 10142 code.
- 3.3 Documentation is completed as per data management requirements.
- 3.4 Test instruments are used to obtain readings in accordance with statutory requirements.
- 3.5 Measurements obtained from the test are interpreted as per SZNS SANS 10142 requirements.

Element 4: Maintain electrical installations

Performance Criteria

- 4.1 All safety requirements are observed and demonstrated during maintenance as per safe working procedures.
- 4.2 All maintenance activities are carried out according to specific procedures.

Element 5: Complete the required task documentation

Performance Criteria

- 5.1 All personnel, tools, Instruments and excess equipment are removed from the installation according to work site procedures.
- 5.2 The work area is restored to its original condition on completion of the test and inspection procedures as per safety requirements.
- 5.3 The certificate of compliance completed according to SZNS SANS 10142 requirement.

- 5.4 The results of the inspection and test are communicated to all concerned according to reporting procedures.
- 5.5 A defect list is compiled and corrective action taken, if necessary, as per quality requirements.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI301: Demonstrate fault finding techniques on field instrumentation

Title		Demonstrate fault finding techniques on field instrumentation			
Field		Physical Planning and Construction			
Subfield		Mechanical Engineering Core			
SZNQF Level	3	Unit ID	EEI301	Credits	8

Purpose

This unit standard specifies the competencies required to explain the principles and techniques to be applied during fault-finding on the field Instrumentation. This unit standard is intended for persons in Instrumentation Level 3.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment may be conducted at a real or simulated workplace.
3. This unit standard may be used as core or elective within any vocationally based qualification.
4. Evidence of competence may be gathered while learner undertaking their study or work.
5. Regulations and legislation relevant to this unit standard include the following
 - Competition Act 2007
 - Labour Act 2005
 - Workmen's Compensation Act No.7 of 1983
 - Occupational Health and Safety (OHS) Act 2001

And all subsequent amendments

6. Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Explain the principles and techniques to be applied during fault finding

Performance Criteria

- 1.8 Workplace safety rules and regulations are correctly explained as set out in the companies' safety policies and OSH act
- 1.9 The symptoms and analysis of faults on Field Instrumentation are correctly explained.
- 1.10 The correct fault-finding procedures which should be followed for the specific field instrumentation is explained.
- 1.11 The techniques applicable to Field Instrumentation are explained.

Element 2: Plan and prepare for fault finding on Field Instrumentation

Performance Criteria

- 2.1 The appropriate documentation is acquired according to job instructions.
- 2.2 The job instructions are effectively communicated with the team leader according to workplace procedures.
- 2.3 The appropriate personal protective equipment is selected and examined in a manner that protects the individual.
- 2.4 The appropriate tools, material and equipment for the job are selected and transported to the workplace.
- 2.5 The work site is examined for hazardous and sub-standard conditions. Critical hazards and sub-standard conditions encountered in a particular context are addressed.
- 2.6 The work site area is verified according to workplace procedures.
- 2.7 The consequences of not preparing to find faults in line with specified requirements are explained with reference to personal and team safety, impact on environment, production costs and lost time.

Element 3: Find faults on Field Instrumentation

Performance Criteria

- 3.1 The correct system operation is determined according to workplace procedures.
- 3.2 The system operation is observed according to workplace procedures.
- 3.3 The system operation is analysed according to workplace procedures.
- 3.4 The fault is correctly diagnosed according to work site procedures.
- 3.5 The fault is traced by applying the correct techniques and procedures.
- 3.6 The fault is correctly identified according to the analysis carried out.
- 3.7 The appropriate safety, good housekeeping and correct environmental practices are followed before, during and after the fault-finding activity.
- 3.8 The correct system operation is determined according to work site procedures.

Element 4: Complete fault finding on Field Instrumentation

Performance Criteria

- 4.1 The appropriate documentation is completed, filed or submitted to the relevant personnel.
- 4.2 The correct measuring, test equipment and hand tools are selected and used according to safety policies and manufacturers specifications.
- 4.3 The appropriate tests are carried out according to workplace procedures and statutory requirements.
- 4.4 The tests are accurately recorded and reported to the relevant personnel according to workplace procedures.
- 4.5 The appropriate repairing, rectifying and fault-finding procedures are carried out according to company quality standards and manufacturers specifications.
- 4.6 The final testing and commissioning is correctly carried out and all relevant documentation completed and filed or submitted to the relevant personnel.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI302: Design and construct relay logic circuits

Title		Design and construct relay logic circuits			
Field		Physical Planning and Construction			
Subfield		Mechanical Engineering Core			
SZNQF Level	3	Unit ID	EEI302	Credits	6

Purpose

This unit standard specifies the competencies required to draw, construct and test relay logic circuits. This unit standard is intended for persons in Instrumentation Level 3.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment may be conducted at a real or simulated workplace.

3. This unit standard may be used as core or elective within any vocationally based qualification.

4. Evidence of competence may be gathered while learner undertaking their study or work.

5. Regulations and legislation relevant to this unit standard include the following

- Competition Act 2007
- Labour Act 2005
- Workmen's Compensation Act No.7 of 1983
- Occupational Health and Safety (OHS) Act 2001

And all subsequent amendments

6. Components may include, but not limited relays, bulbs, pilot lamps, buzzers, timers, alarms.

7. Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Draw Relay Logic Circuits

Performance Criteria

- 1.1 Process requirements are determined from given documentation or instructions.
- 1.2 Relevant symbols are used to indicate specific design criteria.

- 1.3 The circuit is drawn in accordance with company format requirements.
- 1.4 Circuit logic is verified in accordance with workplace procedures.

Element 2: Construct relay logic circuits

Performance Criteria

- 2.1 A bill of materials is compiled in accordance with circuit specific requirements.
- 2.2 Hardware specifications are compiled in accordance with design requirements.
- 2.3 The relay circuit is wired in accordance with design specifications.

Element 3: Test Relay Logic Circuit

Performance Criteria

- 3.1 Circuit wiring is checked for compliance to design specifications.
- 3.2 Faults are identified and corrected in accordance with workplace procedures and design criteria.
- 3.3 The relay circuit is tested for correct operation according to design specifications.
- 3.4 Workplace, tools and equipment are cleared and cleaned in accordance with workplace procedures.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI303: Maintain programmable field instruments

Title		Maintain programmable field instruments			
Field		Physical Planning and Construction			
Subfield		Mechanical Engineering Core			
SZNQF Level	3	Unit ID	EEI303	Credits	12

Purpose

This unit standard specifies the competencies required to plan and prepare to isolate and de-isolate programmable field instrumentation, isolate and remove programmable field instruments, calibrate, install and commission field instruments. It also specifies competencies required to restore normal conditions after maintenance of programmable field instrumentation. This unit standard is intended for Instrumentation Technician Level 3.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment may be conducted at a real or simulated workplace.

3. This unit standard may be used as core or elective within any vocationally based qualification.

4. Evidence of competence may be gathered while learner undertaking their study or work.

5. Regulations and legislation relevant to this unit standard include the following

- Competition Act 2007
- Labour Act 2005
- Workmen's Compensation Act No.7 of 1983
- Occupational Health and Safety (OHS) Act 2001
- Environmental management Act of 2002

And all subsequent amendments

6. Programmable field instruments refer to Pressure, Level and Flow instrumentation and the range of pressure equipment includes, but is not limited to any two of pressure gauges, pressure switches and pressure indicators.

7. Maintaining field instrumentation includes isolation, removal, calibration, installation and commissioning.

8. Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

9. Housekeeping is carried out according to worksite procedures and local regulations.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Plan and prepare to isolate and de-isolate programmable field instruments

Performance Criteria

- 1.1 Job requirements are correctly interpreted according to instructions and/or instrumentation diagrams.
- 1.2 Tools and equipment are correctly selected according to job requirement.
- 1.3 The location for the isolation of programmable field instruments is correctly identified and prepared.
- 1.4 Authorisation for access to restricted areas is obtained from the relevant personnel.
- 1.5 The correct safety equipment and material required is obtained from the appropriate sources.
- 1.6 The working schedule is effectively communicated to all affected parties.

Element 2: Isolate and remove programmable field instruments

Performance Criteria

- 2.1 The correct tools are used according to the job requirements.
- 2.2 Programmable field instrumentation is correctly identified and isolated according to the isolation procedure.
- 2.3 All safety precautions are adhered to before, during and after the isolation and removal procedure.
- 2.4 The programmable field instrumentation is removed in accordance with manufacturers procedures.

Element 3: Calibrate programmable field instruments

Performance Criteria

- 3.1 Tools, equipment and data required are identified for the calibration procedure in accordance with workplace procedures.
- 3.2 The correct tools are selected and used according to the job requirements.
- 3.3 The calibration and testing equipment and instrumentation is prepared for the calibration process in accordance with manufacturer specifications.
- 3.4 The programmable field instruments are calibrated within the tolerances specified by the manufacturer's calibration manuals.
- 3.5 The calibration sheets and associated documentation is completed in accordance with workplace procedures.

Element 4: Install and commission programmable field instrumentation

Performance Criteria

- 4.1 The programmable field instruments are installed in the correct location as per Measurement, Control and Instrumentation drawing.
- 4.2 The programmable field instruments are de-isolated and commissioned in accordance with workplace procedure.
- 4.3 All safety precautions are adhered to before, during and after the installation, de-isolation and commissioning process.
- 4.4 The operation of the programmable field instrumentation is verified to be in accordance with the workplace operating instructions and Instrumentation drawings (sketches and flow diagrams).

Element 5: Restore normal conditions after maintenance of programmable field instrumentation

Performance Criteria

- 5.1 The waste is disposed of correctly according to workplace and manufacturer's instructions taking environmental awareness into account.
- 5.2 All tools and equipment are checked, cleaned and correctly stored as per workplace and manufacturers procedures.
- 5.3 The workplace is restored to original state as per housekeeping standards and work site procedures.
- 5.4 All documentation is accurately completed and filed or submitted to the relevant personnel.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI304: Read and interpret instrumentation drawings

Title		Read and interpret instrumentation drawings			
Field		Physical Planning and Construction			
Subfield		Mechanical Engineering Core			
SZNQF Level	3	Unit ID	EEI304	Credits	4

Purpose

This unit standard specifies the competencies required to select, interpret and analyse Instrumentation drawings and further demonstrate knowledge of different types and applications of Instrumentation drawings in an instrumentation environment. This unit standard is intended for persons in Electrical Engineering; Measurement, Control and Instrumentation Level 3.

Special Notes

1. Entry information/Prerequisite

None

- Assessment may be conducted at a real or simulated workplace.
- This unit standard may be used as core or elective within any vocationally based qualification.
- Evidence of competence may be gathered while learner undertaking their study or work.
- Regulations and legislation relevant to this unit standard include the following
 - Competition Act 2007
 - Labour Act 2005
 - Workmen's Compensation Act No.7 of 1983
 - Occupational Health and Safety (OHS) Act 2001

And all subsequent amendments

- Instrumentation Drawings include, but are not limited to loop diagrams, process and instrumentation diagrams, flow diagrams, hook-ups and schematic diagrams.
- Care of drawings include but is not limited to proper storage and ensuring drawings are relevant.
- Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Identify and select Instrumentation drawings

Performance Criteria

- 1.1 Correctly differentiate between the different types of Measurement, Control and Instrumentation drawings.
- 1.2 The correct Measurement, Control and Instrumentation drawings are chosen according to the activity required.
- 1.3 The correct Measurement, Control and Instrumentation drawing is obtained using the drawing numbering system that is implemented in the workplace.

Element 2: Demonstrate an understanding of Instrumentation drawings

Performance Criteria

- 2.1 The symbols and abbreviations on the Measurement, Control and Instrumentation drawings are correctly identified.
- 2.2 The purpose of Measurement, Control and Instrumentation and diagrams are correctly explained.
- 2.3 The Measurement, Control and Instrumentation drawing legends are correctly used to extract appropriate information from the drawing.

Element 3: Interpret and use instrumentation drawings and diagrams

Performance Criteria

- 3.1 The physical equipment and control loops are correctly located as per the Measurement, Control and Instrumentation drawings.
- 3.2 The physical equipment and control loops are correctly verified and correspond to the Measurement, Control and Instrumentation drawings.
- 3.3 The activity is correctly completed by using the Measurement, Control and Instrumentation drawings.
- 3.4 The deviations from standards are accurately recorded and reported to the relevant personnel.

Element 4: Care and Storage of Instrumentation Drawings

Performance Criteria

- 4.1 Workshop procedures including housekeeping practices according to statutory requirements.
- 4.2 Specific work site safety practices relating to the use of drawings.
- 4.3 The deviations from manufacturer standards are accurately recorded.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

E EI305: Demonstrate an understanding of the Principles of Process Control Loops

Title		Demonstrate an understanding of the Principles of Process Control Loops			
Field		Physical Planning and Construction			
Subfield		Mechanical Engineering Core			
SZNQF Level	3	Unit ID	E EI305	Credits	10

Purpose

This unit standard specifies the competencies required to explain the principles and techniques to be applied in order to identify the different types and methods of control loops identify and connect various equipment in a process control loop and further interpret and analyse control loop response. This unit standard is intended for persons in Instrumentation Level 3.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment may be conducted at a real or simulated workplace.
3. This unit standard may be used as core or elective within any vocationally based qualification.
4. Evidence of competence may be gathered while learner undertaking their study or work.
5. Regulations and legislation relevant to this unit standard include the following
 - Competition Act 2007
 - Labour Act 2005
 - Workmen's Compensation Act No.7 of 1983
 - Occupational Health and Safety (OHS) Act 2001
 - Environmental management Act of 2002And all subsequent amendments
6. This unit standard applies to the following but not limited to open loops; closed loops; cascade loops; PID control and On/Off control.
7. Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Understand process control loops

Performance Criteria

- 1.1 Identify the different types of process control loops.
- 1.2 Explain the operation of the different types of process control loops.
- 1.3 Connect up the loops in accordance with loop drawings.

Element 2: Understand the control concepts within a loop

Performance Criteria

- 2.1 Identify the different types of loop control.
- 2.2 Explain the operation of the different types of loop control with the aid of graphs or diagrams.
- 2.3 Use the relevant calculations/methods to obtain the correct PID (proportional-integral-derivative) parameters.

Element 3: Interpret and Analyse Process Control Loop Response

Performance Criteria

- 3.1 Use relevant trends to explain the response from the various types of control.
- 3.2 Apply the appropriate type of control in order to achieve a stable response.
- 3.3 Ensure documentation is updated with latest parameters.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI306: Install, test and maintain a basic pneumatic system

Title	Install, test and maintain a basic pneumatic system				
Field	Physical Planning and Construction				
Subfield	Mechanical I Engineering Core				
SZNQF Level	3	Unit ID	EEI306	Credits	10

Purpose

This unit standard specifies the competencies required to read and interpret basic pneumatic circuit diagrams and related component, identify and select pneumatic components, install, test and maintain basic pneumatic circuits. This unit standard is intended for persons in Instrumentation Level 3.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment may be conducted at a real or simulated workplace.
3. This unit standard may be used as core or elective within any vocationally based qualification.
4. Evidence of competence may be gathered while learner undertaking their study or work.
5. Regulations and legislation relevant to this unit standard include the following
 - Competition Act 2007
 - Labour Act 2005
 - Workmen's Compensation Act No.7 of 1983
 - Occupational Health and Safety (OHS) Act 2001
 - Environmental management Act of 2002And all subsequent amendments
6. The pneumatic components include compressors, air service units (filters, pressure regulators), instrumentation piping, seals, connectors, valves, manometers, actuators (rotary/linear). The pneumatic circuits must include basic lifting circuits, basic air motor circuits, basic pushing circuits. Pneumatic testing includes pressure testing and leakage testing.
7. Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Read and interpret basic pneumatic circuit diagrams and related component symbols

Performance Criteria

- 1.1 Pneumatic circuit diagrams and symbols are interpreted in terms of the required operation and functions.
- 1.2 Symbols used are explained in terms of industry application and classification.
- 1.3 Circuits are traced and identified from circuit diagrams.

Element 2: Identify and select pneumatic components

Performance Criteria

- 2.1 Components are identified for specific functions from given documentation or instructions.
- 2.2 Alternate components that are able to perform the same function are identified from manufacturer specifications.
- 2.3 Components are selected for specific functions in accordance with manufacturer specifications.
- 2.4 Components selected are suited to each other and to the overall function of the system.

Element 3: Install basic pneumatic circuits

Performance Criteria

- 3.1 Hazards identification and risk assessment is carried out.
- 3.2 Suitable tools and equipment are selected and used that enable the task to be carried out.
- 3.3 Components are removed and fitted in accordance with manufacturer specifications and workplace procedures.
- 3.4 Pneumatic circuits installed to specifications.
- 3.5 Lines joined and terminated.
- 3.6 Pneumatic circuits are tested and results recorded.
- 3.7 Installations are maintained to specifications.

Element 4: Test basic pneumatic circuits and record results

Performance Criteria

- 4.1 Suitable tools and equipment are selected and used that enable the test to be carried out effectively.
- 4.2 Test equipment is connected in accordance with manufacturer specifications.
- 4.3 Components are tested for operational performance in accordance with manufacturer specifications.
- 4.4 The entire circuit is tested for operational performance in accordance with manufacturer specifications.

Element 5: Maintain basic pneumatic circuits

Performance Criteria

- 5.1 Circuits are cleaned and maintained in accordance with manufacturer specifications.
- 5.2 Leaks are detected and repaired in accordance with workplace requirements.
- 5.3 Work conducted is recorded and reported in accordance with workplace procedures.
- 5.4 Reports are accurate and provide adequate detail of work performed.
- 5.5 Reports are submitted in accordance with accepted work schedules.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI307: Demonstrate knowledge of control valves, actuators, and positioners

Title		Demonstrate knowledge of control valves, actuators, and positioners			
Field		Physical Planning and Construction			
Subfield		Mechanical Engineering Core			
SZNQF Level	3	Unit ID	EEI307	Credits	4

Purpose

This unit standard specifies the competencies required to demonstrate knowledge of control valves, control valve sizing for liquid flow, valve actuators and positioners. This unit standard is intended for persons in Instrumentation Level 3.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment may be conducted at a real or simulated workplace.

3. This unit standard may be used as core or elective within any vocationally based qualification.

4. Evidence of competence may be gathered while learner undertaking their study or work.

5. Regulations and legislation relevant to this unit standard include the following

- Competition Act 2007
- Labour Act 2005
- Workmen's Compensation Act No.7 of 1983
- Occupational Health and Safety (OHS) Act 2001
- Environmental management Act of 2002

And all subsequent amendments

6. Control valve positioners referenced for this unit standard includes but not limited to: electro-pneumatic (4-20mA input), digital valve controllers, motion balance, force balance, double acting (5 port spool valve). The comparison of the control valves is limited to linear and rotary.

7. Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Demonstrate knowledge of control valves

Performance Criteria

- 1.1 Define terms associated with control valve components.
- 1.2 Describe control valve types and compare their features.
- 1.3 Describe control valve inherent flow versus lift characteristics under constant pressure drop conditions.
- 1.4 Describe control valve installed flow versus lift characteristics.
- 1.5 Explain the terms 'rangeability' and 'turndown' in the context of control valve operation.
- 1.6 Describe damage associated with control valves and describe causes.

Element 2: Demonstrate knowledge of control valve sizing for liquid flow

Performance Criteria

- 2.1 Calculate control valve sizes for liquid flow, based on valve sizing coefficients C_v (imperial), A_v (metric), or K_v (metric).
- 2.2 Calculate size of control valve, based on differential pressure and flow with the valve fully open.

Element 3: Demonstrate knowledge of valve actuators

Performance Criteria

- 3.8 Explain air operated control valve actuators
- 3.9 Describe electrically operated control valve actuators.
- 3.10 Describe hydraulic and electro-hydraulic actuators and servo valves.
- 3.11 Compare features of control valve actuator types.

Element 4: Demonstrate knowledge of valve positioners

Performance Criteria

- 4.1 Explain reasons for using control valve positioners.
- 4.2 Describe control valve positioners.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI308: Demonstrate knowledge of transducers and strain gauges and their applications in industrial measurement

Title		Demonstrate knowledge of transducers and strain gauges and their applications in industrial measurement			
Field		Physical Planning and Construction			
Subfield		Mechanical Engineering Core			
SZNQF Level	3	Unit ID	EEI308	Credits	7

Purpose

This unit standard specifies the competencies required to demonstrate knowledge of transducers and their applications in industrial measurement, transducer installation requirements; strain gauge theory and load cells in weighing systems. It also specifies the competencies required to demonstrate knowledge in describing weighing system calibration methods. This unit standard is intended for persons in Instrumentation Level 3.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment may be conducted at a real or simulated workplace.

3. This unit standard may be used as core or elective within any vocationally based qualification.

4. Evidence of competence may be gathered while learner undertaking their study or work.

5. Regulations and legislation relevant to this unit standard include the following

- Competition Act 2007
- Labour Act 2005
- Workmen's Compensation Act No.7 of 1983
- Occupational Health and Safety (OHS) Act 2001
- Environmental management Act of 2002

And all subsequent amendments

6. The position transducer types intended for this unit standard includes but not limited to: potentiometers, linear variable differential transformers and inductors, capacitive, rotary shaft encoders (absolute and incremental).

7. The proximity detector applications for this unit standard is limited to eccentricity, linear displacement, proximity, vibration, speed sensing.

8. Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Demonstrate knowledge of transducers and their applications in industrial measurement

Performance Criteria

- 1.1 Categorise common transducer types and specify associated units of measurement.
- 1.2 Describe position transducer types (linear and rotary), compare their features, and identify their applications.
- 1.3 Describe velocity transducer types, compare their features, and identify their applications.
- 1.4 Describe proximity detector types, compare their features, and identify their applications.
- 1.5 Describe vibration transducer types, compare their features, and identify their applications.
- 1.6 Describe displacement transducer types, compare their features, and identify their applications.

Element 2: Demonstrate knowledge of transducer installation requirements

Performance Criteria

- 2.1 Describe the installation requirements of inductive and capacitive proximity detectors.

Element 3: Demonstrate knowledge of strain gauge theory

Performance Criteria

Range: The strain gauge types for this unit standard is limited to foil etched, semi-conductor and wire on paper backing.

- 3.1 Define terms associated with strain gauge weighing systems.
- 3.2 Explain the operation of strain gauges based on applied load.
- 3.3 Perform calculations to find change in resistance of strain gauge.
- 3.4 Describe and compare strain gauge types.

Element 4: Demonstrate knowledge of load cells in weighing systems

Performance Criteria

- 4.1 Describe and compare strain gauge load cells.
- 4.2 Describe strain gauge load cells in belt weighing systems
- 4.3 Describe typical methods used for calibrating weighing systems with reference to precision weights, alignment, and bridge measuring circuit calibration.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI309: Demonstrate knowledge of the physical principles of instrumentation systems

Title	Demonstrate knowledge of the physical principles of instrumentation systems				
Field	Physical Planning and Construction				
Subfield	Electrical Engineering Core				
SZNQF Level	3	Unit ID	EEI309	Credits	5

Purpose

This unit standard specifies the competencies required to demonstrate knowledge of the physical principles of; pressure measurement, level measurement, temperature measurement, flow measurement and density measurement. This unit standard is intended for persons in Instrumentation Level 3.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment may be conducted at a real or simulated workplace.

3. This unit standard may be used as core or elective within any vocationally based qualification.

4. Evidence of competence may be gathered while learner undertaking their study or work.

5. Regulations and legislation relevant to this unit standard include the following

- Competition Act 2007
- Labour Act 2005
- Workmen's Compensation Act No.7 of 1983
- Occupational Health and Safety (OHS) Act 2001
- Environmental management Act of 2002

And all subsequent amendments

6. The gas laws intended for this unit standard are limited to Boyle's Law, Charles' Law and the General Gas Law. The laws and equations relating to flow measurement and calculations is limited to Reynolds number, equation of continuity, Bernoulli's equation.

7. Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Demonstrate knowledge of the physical principles of pressure measurement

Performance Criteria

- 1.1 Describe units used for pressure measurement.
- 1.2 Explain gas laws and perform calculations.
- 1.3 Describe effects of liquid pressure head and perform calculations.
- 1.4 Use calculations and tables to convert pressure units.

Element 2: Demonstrate knowledge of the physical principles of level measurement

Performance Criteria

- 2.1 Describe effects of liquid pressure head and perform calculations.
- 2.2 Use calculations and tables to convert pressure units used in level measurement.
- 2.3 Explain Archimedes' Principle as used in displacer level measurement.

Element 3: Demonstrate knowledge of the physical principles of temperature measurement

Performance Criteria

- 3.1 Define common temperature scales.
- 3.2 Use calculations to convert units used in temperature measurement.

Element 4: Demonstrate knowledge of the physical principles of flow measurement

Performance Criteria

- 4.1 State the units for volumetric and mass flow measurement.
- 4.2 Define laws and equations relating to flow measurement and apply to calculations.
- 4.3 Describe pressure and temperature compensation required on oil, gas and mass flowmeters.

Element 5: Demonstrate knowledge of the physical principles of density measurement

Performance Criteria

- 5.1 Define terms and units used in density measurement and perform unit conversions by calculation.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)

EEI310: Maintain analytical equipment

Title		Maintain analytical equipment			
Field		Physical Planning and Construction			
Subfield		Mechanical Engineering Core			
SZNQF Level	3	Unit ID	EEI310	Credits	7

Purpose

This unit standard specifies the competencies required to plan and prepare to isolate and de-isolate analytic equipment; isolate, remove, calibrate and commission the analytic equipment. This unit standard is intended for Instrumentation Level 3.

Special Notes

1. Entry information/Prerequisite

None

2. Assessment may be conducted at a real or simulated workplace.

3. This unit standard may be used as core or elective within any vocationally based qualification.

4. Evidence of competence may be gathered while learner undertaking their study or work.

5. Regulations and legislation relevant to this unit standard include the following

- Competition Act 2007
- Labour Act 2005
- Workmen's Compensation Act No.7 of 1983
- Occupational Health and Safety (OHS) Act 2001
- Environmental management Act of 2002

And all subsequent amendments

6. The range of analytical equipment includes but is not limited to conductivity meters, pH meters, densitometers, lead analysers and turbidity meters; and analytical measurement principles includes but is not limited to nuclear, electrical conductivity, optic and consistency.

7. Maintaining analytical equipment includes isolation, removal, cleaning, calibration, installation and commissioning.

8. Safety precautions include the use of all appropriate personal protective equipment, electrical and fire protection.

9. Housekeeping is carried out according to worksite procedures and local regulations.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which comply with the accreditation, national assessment and moderation requirements set by the Eswatini Qualifications Authority.

Elements and Performance Criteria

Element 1: Plan and prepare to isolate and de-isolate analytical equipment

Performance Criteria

- 1.1 Job requirements are correctly interpreted according to instructions and/or instrumentation diagrams.
- 1.2 Tools and equipment are correctly selected according to job requirement.
- 1.3 The location for the isolation of analytical equipment is correctly identified and prepared.
- 1.4 Authorisation for access to restricted areas is obtained from the relevant personnel.
- 1.5 The correct safety equipment and material required is obtained from the appropriate sources.
- 1.6 The working schedule is effectively communicated to all affected parties.

Element 2: Isolate and remove analytical equipment

Performance Criteria

- 2.1 The correct tools are used according to the job requirements.
- 2.2 The process associated with Measurement, Control and Instrumentation is correctly identified and isolated according to the isolation procedure.
- 2.3 All safety precautions are adhered to before, during and after the isolation and removal procedure.
- 2.4 The analytical equipment is correctly removed in accordance with manufacturers procedures.

Element 3: Calibrate analytical equipment

Performance Criteria

- 3.1 The correct calibration, test equipment and relevant manuals/data sheets are selected for the calibration procedure.
- 3.2 The correct tools are selected and used according to the job requirements.
- 3.3 The calibration, test and analytical equipment are correctly prepared for the calibration process.
- 3.4 Authorization access for calibration is obtained from the relevant personnel.
- 3.5 The analytical equipment is calibrated within the tolerances specified by the manufacture's calibration manuals.
- 3.6 The calibration sheets and associated documentation is accurately completed.

Element 4: Install, de-isolate and commission the analytical equipment

Performance Criteria

- 4.1 The analytical equipment is installed in the correct location as per Measurement, Control and Instrumentation drawing.
- 4.2 The process associated with Measurement, Control and Instrumentation is correctly de-isolated according to the de-isolation procedures.
- 4.3 All safety precautions are adhered to before, during and after the installation, de-isolation and commissioning process.
- 4.4 The correct operation of the analytical equipment is verified according to the workplace operating instructions and Measurement, Control and Instrumentation drawing.

Element 5: Restore normal conditions after maintenance of analytical equipment

Performance Criteria

- 5.1 The waste is disposed of correctly according to workplace and manufacturer's instructions taking environmental awareness into account.
- 5.2 All tools and equipment are checked, cleaned and correctly stored as per workplace and manufacturers procedures.
- 5.3 The workplace is restored to original state as per housekeeping standards and work site procedures.
- 5.4 All documentation is accurately completed and filed or submitted to the relevant personnel.

Registration Data

Date first registered	2024
Anticipated review	2029
Standard setting body (SSB)	Directorate of Industrial and Vocational Training (DIVT)
Body responsible for review	Directorate of Industrial and Vocational Training (DIVT)