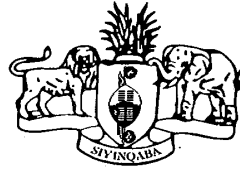


**SWAZILAND**



**GOVERNMENT**

**MINISTRY OF LABOUR AND SOCIAL SECURITY  
DIRECTORATE OF INDUSTRIAL AND VOCATIONAL TRAINING –DIVT  
APPRENTICESHIP JOB TRAINING GUIDE**

**TRADE: HEATING, VENTILATION, AIR-CONDITIONING, AND REFRIGERATION (HVACR)**

**FIRST-YEAR**

**Demonstrate basic knowledge of health and safety in a refrigeration and air-conditioning environment – Unit ID:**

**RE206**

**Element 1: Demonstrate knowledge of hazard and risk control**

**Element 2: Demonstrate knowledge of workplace fire safety**

**Element 3: Interpret an emergency evacuation plan**

**Element 4: Apply knowledge to conduct an emergency response**

**Element 5: Workplace product labels are read**

**Apply basic entrepreneurship skills – Unit ID: EE 202**

**Element 1: Demonstrate basic knowledge of the characteristics of an entrepreneur**

**Element 2: Apply basic skills to generate a business idea**

**Element 3: Apply market research skills**

**Apply basic oxy-acetylene brazing techniques as part of refrigeration and air conditioning – Unit ID: RE203**

**Element 1:** Plan and prepare for work

**Element 2:** Prepare materials for brazing

**Element 3:** Assemble and set up brazing equipment and materials.

**Element 4:** Perform routine welding using fuel gas process.

**Element 5:** Complete the work and carryout house cleaning

**Communicate in refrigeration and the air-conditioning environment – UNIT ID: RE205**

**Element 1:** Find and use available learning resources

**Element 2:** Use learning strategies

**Element 3:** Manage refrigeration and air conditioning occupational learning materials

**Element 4:** Plan and gather relevant information for a given context and purpose

**Element 5:** Function in a team

**Element 6:** Reflect on how characteristics of the workplace and occupational context affect learning

**Apply basic knowledge of engineering drawing in different context – UNIT ID: RE201**

**Element 1:** Demonstrate knowledge of engineering drawing fundamentals

**Element 2:** Apply basic drawing techniques

**Element 3:** Construct basic free-hand drawings

**Element 4:** Construct geometrical drawings.

**Element 5:** Construct reproduction drawings

**Element 6:** Produce basic drawings in first-angle orthographic projection.

**Element 7:** Produce axonometric drawings

**Element 8:** Project prisms and pyramids.

**Element 9:** Produce sectional drawings.

**Apply basic numeracy skills in air conditioning and refrigeration environment – UNIT ID: RE202**

**Element 1:** Apply basic knowledge of numbers and statistics

**Element 2:** Measure materials and objects

**Element 3:** Perform basic geometric calculations

**Demonstrate knowledge of electrical fundamentals – Unit ID: EE207**

**Element 1:** Explain the basic concepts of electricity

**Element 2:** Explain the magnetic theory

**Element 3:** Explain the basic fundamentals of power generation and distribution

**Element 4:** Apply and explain electrical units and symbols

**Element 5:** Draw and interpret series, parallel, and series-parallel DC resistive circuits and calculate variables

**Demonstrate the knowledge of Air conditioning and Refrigeration related principles –UNIT ID: RE20**

**Element 1:** Demonstrate basic knowledge of base and derived units used in the SI system of measurement applicable to air conditioning and refrigeration

**Element 2:** Define Air-conditioning and the principle of operation

**Element 3:** Demonstrate basic science principles of air conditioning

**Element 4:** Demonstrate basic science principles of refrigeration.

**Identify refrigerant, explain hazards, handling, transportation, storage procedures and use of refrigerants – UNIT ID: RE208**

**Element 1:** List and discuss the hazards when handling refrigerants

**Element 2:** Name and identify the types of refrigerants

**Element 3:** Transfer refrigerant from container to a service cylinder.

**Element 4:** Prepare container for refrigerant transfer

**Element 5:** Demonstrate and /or explain the safe handling, transportation and storing of refrigerant containers without endangering self, others, the workplace or the environment

**Element 6:** Effects of refrigerants on the ozone layer is explained

**Carry out fabrication and tubing for air-conditioning and refrigeration systems – UNIT ID: RE204**

**Element 1:** Plan and prepare for work

**Element 2:** Select tube required

**Element 3:** Cut and bend copper tube

**Element 4:** Flare and swage copper pipes

**Element 5:** Pipe Formation

**Element 6:** Complete the work



**SECOND - YEAR**

**Install pipe work for refrigeration and air conditioning systems- unit id: RE209**

**Element 1:** Plan and prepare for work

**Element 2:** Install pipes

**Element 3:** Complete work and carryout housekeeping

**Draw free-hand diagrams of typical electrical control and power circuits used in air conditioning systems – UNIT  
ID:RE 407**

**Element 1:** Produce a free hand drawing of a power circuit for air conditioning and refrigeration machine

**Element 2:** Produce a free hand drawing of a control circuit containing a timer

**Element 3:** Convert any electrical line diagram to a drawing complying with SANS

**Interpret and use information from texts – UNIT ID: RE408**

**Element 1:** Use a range of reading and/or viewing strategies to understand the literal meaning of specific texts.

**Element 2:** Use strategies for extracting implicit messages in texts.

**Element 3:** Respond to selected texts in a manner appropriate to the context.

**Element 4:** Explore and explain how language structures and features may influence a reader/viewer. \_

**Demonstrate an understanding of professional values and ethics – UNIT ID: RE404**

**Element 1:** Describe and reflect on what professional values are and where they come from.

**Element 2:** Describe professional accountability.

**Element 3:** Position professional values within an organizational context.

**Understand the operating principles of domestic fuel gas appliances – UNIT ID:RE 415**

**Element 1:** State the essential requirements for the safe operation of gas appliances

**Element 2:** Understand the fuel gases used in domestic appliances and the principles of their combustion.

**Element 3:** Describe and explain the operating principles of domestic gas appliances.

Performance Criteria:

**Element 4:** The requirements for efficient combustion and operation are stated according to design and construction specifications

**Maintain and repair refrigeration hand and power tools and equipment – UNIT ID: RE210**

**Element 1:** Prepare for the task

**Element 2:** Use air conditioning and refrigeration service hand tools

**Element 3:** Use air conditioning and refrigeration service workshop equipment/instruments

**Element 4:** Service and maintain workplace air conditioning and refrigeration tools and equipment

**Element 5:** Store and secure tools and equipment

**Element 6:** Complete work and do housekeeping

**Replace refrigeration compressor as part of refrigeration operations – UNIT ID: RE211**

**Element 1:** Plan and prepare for work

**Element 2:** Remove compressor

**Element 3:** Install a new compressor

**Element 4:** Complete work and do housekeeping

**Replace refrigeration system components – UNIT ID: RE212**

**Element 1:** Plan and prepare for work

**Element 2:** Use refrigeration manifold gauges

**Element 3:** Pump down a refrigeration unit

**Element 4:** Recover refrigerant

**Element 5:** Replace components

**Element 6:** Complete the work and carry out housekeeping

**THIRD-YEAR**

**Trouble shoot a refrigerator – UNIT ID: RE213**

**Element 1:** Plan and prepare for work

**Element 2:** Carry out troubleshooting procedures on a domestic refrigerator

**Element 3:** Complete work and carryout housekeeping



**Carry out electrical wiring for cold room and freezer room – UNIT ID: RE301**

**Element 1:** Plan and Prepare for the task

**Element 2:** Plan to draw electrical circuit diagram for cold-room and freezer-rooms

**Element 3:** Wiring of cold room and freezer room.

**Element 4:** Complete work and carry out housekeeping

**Carry out repair to commercial refrigeration systems – UNIT ID: RE302**

**Element 1:** Plan and Prepare for the task

**Element 2:** Test commercial refrigeration systems

**Element 3:** Repair commercial refrigeration systems.

**Element 4:** Verify appliance functionality

**Element 5:** Complete work and carry out housekeeping

**Rectify faults in appliance's motors as part of heating, ventilation, air conditioning and refrigeration – UNIT ID: RE309**

**Element 1:** Plan and Prepare for the task

**Element 2:** Test faults in appliance motors

**Element 3:** Repair faults in appliance's motors

**Element 4:** Complete work and carry out housekeeping

**Remove, service and fit bearings used on air-conditioning, refrigeration and ventilation equipment – UNIT ID: RE310**

**Element 1:** State the principle of operation and identify the various types of bearings.

**Element 2:** State and explain typical applications of the various types of bearings

**Element 3:** State the purpose of removing, installing and servicing bearings.

**Element 4:** Carry out removal, installation and servicing of bearings.

**Service electrical appliances as part of air conditioning and refrigeration systems – UNIT ID:RE 311**

**Element 1:** Plan for work

**Element 2:** Inspect and test electrical household appliances.

**Element 3:** Repair electrical household appliance

**Element 4:** Complete work and carry out housekeeping

**Understand electrical and mechanical engineering principles as applicable to HVAC domestic appliances- UNIT**  
**ID: RE416**

**Element 1:** Name and explain the thermodynamic properties of commonly used refrigerants in domestic appliances

**Element 2:** Explain and apply concepts of open and closed systems as used in domestic appliances.

**Element 3:** Explain and apply concepts of fluid mechanics.

Performance Criteria

**Element 4:** Explain and apply concepts of flow rates.

**FORTH-YEAR**

**Demonstrate knowledge of refrigerants management – UNIT ID: RE303**

**Element 1:** Plan and Prepare for the task

**Element 2:** Identify different refrigerants

**Element 3:** Apply knowledge of refrigerant handling and properties.

**Element 4:** Explain and demonstrate recovering, recycling, reclaiming of refrigerants.

**Element 5:** Complete work and carry out housekeeping

**Demonstrate knowledge of absorption refrigeration system – UNIT ID: RE304**

**Element 1:** Demonstrate basic knowledge of base units and derived units

**Element 2:** Describe principles of heating, ventilation, air conditioning and refrigeration

**Element 3:** Demonstrate knowledge of the principles of liquids and vapours in heating, ventilation air conditioning and refrigeration environment

**Element 4:** Demonstrate basic knowledge of engineering science terms and calculations associated with heating, ventilation conditioning and refrigeration.

**Element 5:** Explain the basic absorption refrigeration system



**Diagnose and recondition air conditioning and refrigeration systems components(HVAC) – UNIT ID:RE305**

**Element 1:** Plan and Prepare for the task

**Element 2:** Diagnose faults on HVAC systems

**Element 3:** Retrofit refrigerant and lubricants.

**Element 4:** Complete work and carry out housekeeping

**Install and service automotive air conditioning system – UNIT ID: RE 306**

**Element 1:** Plan and Prepare for the task

**Element 2:** Install air conditioning system components

**Element 3:** Inspect air conditioning system components

**Element 4:** Test air conditioning system performance

**Element 5:** Evacuate air conditioning and refrigeration system

**Element 6:** Recharge and test air-conditioning refrigerant system

**Element 7 :** Complete work and carry out housekeeping

**Maintain heating, ventilation, air conditioning and refrigeration systems – UNIT ID: RE307**

**Element 1:** Plan and Prepare for the task

**Element 2:** Inspect heating, ventilation, air-conditioning and refrigeration system operation

**Element 3:** Maintain the efficiency of lubrication system

**Element 4:** Maintain the integrity of refrigeration system

**Element 5:** Maintain the efficiency of secondary heat transfer mediums and air distribution systems

**Element 6:** Maintain the efficiency of mechanical components and conditions

**Element 7:** Complete work and carry out housekeeping

**Maintain safety in the handling of ammonia refrigerants – UNIT ID: RE308**

**Element 1:** Explain and discuss the use of ammonia in refrigerating systems.

**Element 2:** Identify safe procedures in the handling of ammonia

**Element 3:** Practice safe procedures in the handling of ammonia.

**Element 4:** Charge a system with ammonia refrigerant

**Carry-out elementary airflow measurements and calculations – UNIT ID: RE401**

**Element 1:** Carry out calculations involving sizes and areas of square and round ducts.

**Element 2:** Carry out elementary airflow calculations.

**Element 3:** Prepare for measuring the air pressure in a duct.

**Element 4:** The correct measuring range is selected (where applicable).

**Element 5:** Evaluate results.

**Determine common electronic faults and conduct generic electronic tests – UNIT ID: RE405**

**Element 1:** Identifying symptoms which are related to system malfunctions.

**Element 2:** Applying logical and systematic fault finding approaches to identify and locate fault causes.

**Element 3:** Identifying and selecting appropriate instruments.

**Element 4:** Testing electronic equipment and machinery for compliance.

**Write a technical report – UNIT ID: RE312**

**Element 1:** Collect information for writing the report.

**Element 2:** Plan the writing of the report.

**Element 3:** Write the report

**Element 4:** Revise the report.

**FIFTH-YEAR**

**Construct and test advanced electronic circuits – UNIT ID: RE402**

**Element 1:** Discuss and explain the fundamentals of advanced electronics.

**Element 2:** Discuss and explain the operation of advanced electronic circuits

**Element 3:** Read and interpret advanced electronic circuit diagrams.

**Element 4:** Identify and select advanced electronic and related components for circuit construction.

**Demonstrate an understanding of logic controllers as used in air conditioning, refrigeration and ventilation applications – UNIT ID:RE403**

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

**Element 2:** Explain the purpose and application of pre-programmed logic controllers as fitted to air conditioning, refrigeration or ventilation equipment.

**Element 3:** Explain the purpose and application of programmable logic controllers as used in air conditioning, refrigeration or ventilation installations

**Element 4:** Demonstrate an understanding of the input/output peripherals for a programmable logic controller.

**Element 5:** Demonstrate an understanding of field devices interfaced to programmable logic controllers.

**Element 6:** Demonstrate an understanding of the processor in a logic controller.

**Element 7:** Demonstrate an understanding of the programming terminal (the interface).



**Diagnose operational faults in refrigeration systems and take remedial/corrective action – UNIT ID: RE406**

**Element 1:** Establish the extent of the problem

**Element 2:** Diagnose the problem

**Element 3:** Demonstrate the use of trouble-shooting procedures

**Element 4:** Faults are corrected if possible

**Element 5:** Correct fault or propose remedial action

**Interpret the effect of operating condition on components, safety and control devices – UNIT ID: RE409**

**Element 1:** Explain the effect of actual operating conditions on the performance of various components in the actual vapour compression cycle

**Element 2:** List, Identify and state the purpose of the refrigerant control devices

**Element 3:** Explain the operation of refrigerant control devices.

**Element 4:** List the commonly applied controls and safety devices for refrigeration plants and explain their purpose

**Element 5:** Identify refrigeration plant control and safety devices.

**Element 6:** List the commonly used defrost systems and explain their purpose and operation.

**Represent analyse and calculate shape and motion in 2 and 3 dimensional space in different context – UNIT**  
**ID:RE411**

**Element 1:** Measure, estimate, and calculate physical quantities in practical situations relevant to the adult.

**Element 2:** Explore, analyse & critique, describe & represent, interpret and justify geometrical relationships

**Resolve client request and queries – UNIT ID: RE412**

**Element 1:** Identify customer service problems.

**Element 2:** Select the best solution to resolve customer service problems.

**Element 3:** Implement the solution to customer service problems

**Supervise workers at level 2 and 3 – UNIT ID:RE413**

**Element 1:** Plan the work methods and organize resources with individuals and teams

**Element 2:** Update and achieve work objectives, delegate, control and organise individuals and team.

**Element 3:** Supervise and manage production, work and services of individuals and teams.

**Element 4:** Evaluate performance of individuals and teams.

**Troubleshoot on programmable logic controllers – UNIT ID: RE 414**

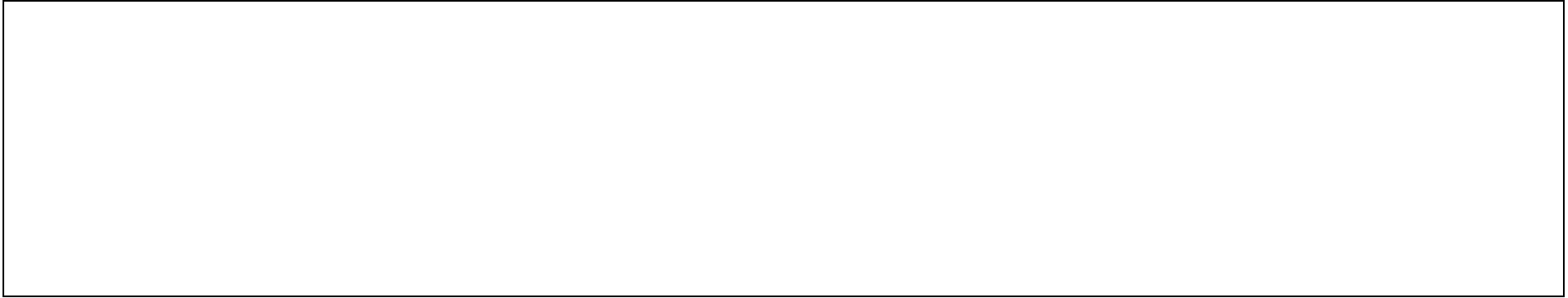
**Element 1:** Plan and prepare for troubleshooting.

**Element 2:** Demonstrate an understanding of Programmable Logic Controllers

**Element 3:** Demonstrate an understanding of programmable process communication.

Performance Criteria:

**Element 4:** Doing basic troubleshooting using software and PLC indicator lights.



**Write a technical report – UNIT ID: RE417**

**Element 1:** Collect information for writing the report.

**Element 2:** Plan the writing of the report.

**Element 3:** Write the report.