education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATES (VOCATIONAL)

ASSESSMENT GUIDELINES

REFRIGERATION PRINCIPLES

NQF Level 2

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CONTENTS

SECTION A: PURPOSE OF THE SUBJECT ASSESSMENT GUIDELINES

This document provides the lecturer with guidelines to develop and implement a coherent, integrated assessment system for Refrigeration Principles, Refrigeration Practice and Refrigeration and Air Conditioning Processes in the National Certificates (Vocational). It must be read with the *National Policy Regarding Further Education and Training Programmes: Approval of the Documents, Policy for the National Certificates (Vocational) Qualifications at Levels 2 to 4 on the National Qualifications Framework (NQF)*. This assessment guideline will be used for National Qualifications Framework Levels 2-4.

This document explains the requirements for the internal and external subject assessment. The lecturer must use this document with the *Subject Guidelines: Refrigeration Principles* to prepare for and deliver Refrigeration Principles. Lecturers should use a variety of resources and apply a range of assessment skills in the setting, marking and recording of assessment tasks.

SECTION B: ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

1 ASSESSMENT IN THE NATIONAL CERTIFICATES (VOCATIONAL)

Assessment in the National Certificates (Vocational) is underpinned by the objectives of the National Qualifications Framework (NQF). These objectives are to:

- Create an integrated national framework for learning achievements.
- Facilitate access to and progression within education, training and career paths.
- Enhance the quality of education and training.
- Redress unfair discrimination and past imbalances and thereby accelerate employment opportunities.
- Contribute to the holistic development of the student by addressing:
  - social adjustment and responsibility;
  - moral accountability and ethical work orientation;
  - economic participation; and
  - nation-building.

The principles that drive these objectives are:

- **Integration**

To adopt a unified approach to education and training that will strengthen the human resources development capacity of the nation.

- **Relevance**

To be dynamic and responsive to national development needs.

- **Credibility**

To demonstrate national and international value and recognition of qualification and acquired competencies and skills.

- **Coherence**

To work within a consistent framework of principles and certification.

- **Flexibility**

To allow for creativity and resourcefulness when achieving Learning Outcomes, to cater for different learning styles and use a range of assessment methods, instruments and techniques.

- **Participation**

To enable stakeholders to participate in setting standards and co-ordinating the achievement of the qualification.

- **Access**

To address barriers to learning at each level to facilitate students' progress.

- **Progression**

To ensure that the qualification framework permits individuals to move through the levels of the national qualification via different, appropriate combinations of the components of the delivery system.

- **Portability**

To enable students to transfer credits of qualifications from one learning institution and/or employer to another institution or employer.

- **Articulation**

To allow for vertical and horizontal mobility in the education system when accredited pre-requisites have been successfully completed.

- **Recognition of Prior Learning**

To grant credits for a unit of learning following an assessment or if a student possesses the capabilities specified in the outcomes statement.

- **Validity of assessments**

To ensure assessment covers a broad range of knowledge, skills, values and attitudes (SKVAs) needed to demonstrate applied competency. This is achieved through:

  - clearly stating the outcome to be assessed;
  - selecting the appropriate or suitable evidence;
  - matching the evidence with a compatible or appropriate method of assessment; and
  - selecting and constructing an instrument(s) of assessment.

- **Reliability**

To assure assessment practices are consistent so that the same result or judgment is arrived at if the assessment is replicated in the same context. This demands consistency in the interpretation of evidence; therefore careful monitoring of assessment is vital.

- **Fairness and transparency**

To verify that no assessment process or method(s) hinders or unfairly advantages any student. The following could constitute unfairness in assessment:

  - Inequality of opportunities, resources or teaching and learning approaches
  - Bias based on ethnicity, race, gender, age, disability or social class
  - Lack of clarity regarding Learning Outcome being assessed
  - Comparison of one student's work with another, based on learning styles and language

- **Practicability and cost-effectiveness**

To integrate assessment practices within an outcomes-based education and training system and strive for cost and time-effective assessment.

2 ASSESSMENT FRAMEWORK FOR VOCATIONAL QUALIFICATIONS

The assessment structure for the National Certificates (Vocational) qualification is as follows:

2.1 Internal continuous assessment (ICASS)

Knowledge, skills values, and attitudes (SKVAs) are assessed throughout the year using assessment instruments such as projects, tests, assignments, investigations, role-play and case studies. The internal continuous assessment (ICASS) practical component is undertaken in a real workplace, a workshop or a "Structured Environment". This component is moderated internally and externally quality assured by Umalusi. All internal continuous assessment evidence is kept in a Portfolio of Evidence (PoE) and must be readily available for monitoring, moderation and verification purposes.

2.2 External summative assessment (ESASS)

The external summative assessment is either a single paper or set of written papers set to the requirements of the Subject Learning Outcomes. The Department of Education administers the theoretical component according to relevant assessment policies.

A compulsory component of external summative assessment (ESASS) is the **integrated summative assessment task (ISAT)**. This assessment task draws on the student's cumulative learning throughout the year. The task requires **integrated application of competence** and is executed under strict assessment conditions. The task should take place in a simulated or "Structured Environment". The integrated summative assessment task is the most significant test of students' ability to apply their acquired knowledge.

The integrated assessment approach allows students to be assessed in more than one subject with the same integrated summative assessment task.

External summative assessments will be conducted annually between October and December, with provision made for supplementary sittings.

3 MODERATION OF ASSESSMENT

3.1 Internal moderation

Assessment must be moderated according to the internal moderation policy of the Further Education and Training (FET) college. Internal college moderation is a continuous process. The moderator's involvement starts with the planning of assessment methods and instruments and follows with continuous collaboration with and support to the assessors. Internal moderation creates common understanding of Assessment Standards and maintains these across vocational programmes.

3.2 External moderation

External moderation is conducted by the Department of Education, Umalusi and, where relevant, an Education and Training Quality Assurance (ETQA) body according to South African Qualifications Authority (SAQA) and Umalusi standards and requirements.

The external moderator:

- monitors and evaluates the standard of all summative assessments;
- maintains standards by exercising appropriate influence and control over assessors;
- ensures proper procedures are followed;
- ensures summative integrated assessments are correctly administered;
- observes a minimum sample of ten (10) to twenty-five (25) percent of summative assessments;
- gives written feedback to the relevant quality assuror; and
- moderates in case of a dispute between an assessor and a student.

Policy on inclusive education requires that assessment procedures for students who experience barriers to learning be customised and supported to enable these students to achieve their maximum potential.

4 PERIOD OF VALIDITY OF INTERNAL CONTINUOUS ASSESSMENT (ICASS)

The period of validity of the internal continuous assessment mark is determined by the *National Policy on the Conduct, Administration and Management of the Assessment of the National Certificates (Vocational)*.

The internal continuous assessment (ICASS) must be re-submitted with each examination enrolment for which it constitutes a component.

5 ASSESSOR REQUIREMENTS

Assessors must be subject specialists and should ideally be declared competent against the standards set by the ETDP SETA. If the lecturer conducting the assessments has not been declared a competent assessor, an assessor who has been declared competent may be appointed to oversee the assessment process to ensure the quality and integrity of assessments.

6 TYPES OF ASSESSMENT

Assessment benefits the student and the lecturer. It informs students about their progress and helps lecturers make informed decisions at different stages of the learning process. Depending on the intended purpose, different types of assessment can be used.

6.1 Baseline assessment

At the beginning of a level or learning experience, baseline assessment establishes the knowledge, skills, values and attitudes (SKVAs) that students bring to the classroom. This knowledge assists lecturers to plan learning programmes and learning activities.

6.2 Diagnostic assessment

This assessment diagnoses the nature and causes of learning barriers experienced by specific students. It is followed by guidance, appropriate support and intervention strategies. This type of assessment is useful to make referrals for students requiring specialist help.

6.3 Formative assessment

This assessment monitors and supports teaching and learning. It determines student strengths and weaknesses and provides feedback on progress. It determines if a student is ready for summative assessment.

6.4 Summative assessment

This type of assessment gives an overall picture of student progress at a given time. It determines whether the student is sufficiently competent to progress to the next level.

7 PLANNING ASSESSMENT

An assessment plan should cover three main processes:

7.1 Collecting evidence

The assessment plan indicates which Subject Outcomes and Assessment Standards will be assessed, what assessment method or activity will be used and when this assessment will be conducted.

7.2 Recording

Recording refers to the assessment instruments or tools with which the assessment will be captured or recorded. Therefore, appropriate assessment instruments must be developed or adapted.

7.3 Reporting

All the evidence is put together in a report to deliver a decision for the subject.

8 METHODS OF ASSESSMENT

Methods of assessment refer to who carries out the assessment and includes lecturer assessment, self assessment, peer assessment and group assessment.

LECTURER ASSESSMENT	The lecturer assesses students' performance against given criteria in different contexts, such as individual work, group work, etc.
SELF-ASSESSMENT	Students assess their own performance against given criteria in different contexts, such as individual work, group work, etc.
PEER ASSESSMENT	Students assess another student’s or group of students' performance against given criteria in different contexts, such as individual work, group work, etc.
GROUP ASSESSMENT	Students assess the individual performance of other students within a group or the overall performance of a group of students against given criteria.

9 INSTRUMENTS AND TOOLS FOR COLLECTING EVIDENCE

All evidence collected for assessment purposes is kept or recorded in the student's Portfolio of Evidence (PoE).

The following table summarises a variety of methods and instruments for collecting evidence. A method and instrument is chosen to give students ample opportunity to demonstrate the Subject Outcome has been attained. This will only be possible if the chosen methods and instruments are appropriate for the target group and the Specific Outcome being assessed.

	METHODS FOR COLLECTING EVIDENCE		
	Observation-based (Less structured)	**Task-based** (Structured)	**Test-based** (More structured)
Assessment instruments	• Observation • Class questions • Lecturer, student, parent discussions	• Assignments or tasks • Projects • Investigations or research • Case studies • Practical exercises • Demonstrations • Role-play • Interviews	• Examinations • Class tests • Practical examinations • Oral tests • Open-book tests
Assessment tools	• Observation sheets • Lecturer's notes • Comments	• Checklists • Rating scales • Rubrics	• Marks (e.g. %) • Rating scales (1-5)
Evidence	• Focus on individual students • Subjective evidence based on lecturer observations and impressions	**Open middle:** Students produce the same evidence but in different ways. **Open end:** Students use same process to achieve different results.	Students answer the same questions in the same way, within the same time.

10 TOOLS FOR ASSESSING STUDENT PERFORMANCE

Rating scales are marking systems where a symbol (such as 1 to 5) or a mark (such as 5/10 or 50%) is defined in detail. The detail is as important as the coded score. Traditional marking, assessment and evaluation mostly used rating scales without details such as what was right or wrong, weak or strong, etc.

Task lists and **checklists** show the student what needs to be done. These consist of short statements describing the expected performance in a particular task. The statements on the checklist can be ticked off when the student has adequately achieved the criterion. Checklists and task lists are useful in peer or group assessment activities.

Rubrics are a hierarchy (graded levels) of criteria with benchmarks that describe the minimum level of acceptable performance or achievement for each criterion. Use of rubrics provides a different way of assessing that cannot be compared to tests. Each criterion described in the rubric must be assessed separately. Mainly two types of rubrics, namely holistic and analytical, are used.

11 SELECTING AND/OR DESIGNING RECORDING AND REPORTING SYSTEMS

The selection or design of recording and reporting systems depends on the purpose of recording and reporting student achievement. **Why** particular information is recorded and how it is recorded determine which instrument will be used.

Computer-based systems, for example spreadsheets, are cost and time effective. The recording system should be user-friendly and information should be easily accessed and retrieved.

12 COMPETENCE DESCRIPTIONS

All assessment should award marks to evaluate specific assessment tasks. However, marks should be awarded against rubrics and not be simply a total of ticks for right answers. Rubrics should explain the competence level descriptors for the skills, knowledge, values and attitudes (SKVAs) that a student must demonstrate to achieve each level of the rating scale.

When lecturers or assessors prepare an assessment task or question, they must ensure that the task or question addresses an aspect of a Subject Outcome. The relevant Assessment Standard must be used to create the rubric to assess the task or question. The descriptions must clearly indicate the minimum level of attainment for each category on the rating scale.

13 STRATEGIES FOR COLLECTING EVIDENCE

A number of different assessment instruments may be used to collect and record evidence. Examples of instruments that can be (adapted and) used in the classroom include:

13.1 Record sheets

The lecturer observes students working in a group. These observations are recorded in a summary table at the end of each project. The lecturer can design a record sheet to observe students' interactive and problem solving skills, attitudes towards group work and involvement in a group activity.

13.2 Checklists

Checklists should have clear categories to ensure that the objectives are effectively met. The categories should describe how the activities are evaluated and against which criteria they are evaluated. Space for comments is essential.

SECTION C: ASSESSMENT IN REFRIGERATION PRINCIPLES

1 SCHEDULE OF ASSESSMENT

At NQF levels 2, 3 and 4, lecturers will conduct assessments as well as develop a schedule of formal assessments that will be undertaken in the year. All three levels also have an external examination that accounts for 50 percent of the total mark. The marks allocated to assessment tasks completed during the year, kept or recorded in a Portfolio of Evidence account for the other 50 percent.

The Portfolio of Evidence and the external assessment include practical and written components. The practical assessment in Refrigeration Principles must, where necessary, be subjected to external moderation by Umalusi or an appropriate Education and Training Quality Assurance (ETQA) body, appointed by the Umalusi Council in terms of Section 28(2) of the General and Further Education and Training Quality Assurance Act, 2001 (Act No. 58 of 2001).

2 RECORDING AND REPORTING

Refrigeration Principles, Refrigeration Practices, and Refrigeration and Air Conditioning Processes, as is the case for all the other Vocational subjects, are assessed according to five levels of competence. The level descriptions are explained in the following table.

Scale of Achievement for the Vocational component

RATING CODE	RATING	MARKS %
5	Outstanding	80-100
4	Highly competent	70-79
3	Competent	50-69
2	Not yet competent	40-49
1	Not achieved	0-39

The programme of assessment should be recorded in the Lecturer's Portfolio of Assessment for each subject. The following at least should be included in the Lecturer's Assessment Portfolio:

- A contents page
- The formal schedule of assessment
- The requirements for each assessment task
- The tools used for each assessment task
- Recording instrument(s) for each assessment task
- A mark sheet and report for each assessment task

The college must standardise these documents.

The student's Portfolio of Evidence must include at least:

- A contents page
- The assessment tasks according to the assessment schedule
- The assessment tools or instruments for the task
- A record of the marks (and comments) achieved for each task

Where a task cannot be contained as evidence in the Portfolio of Evidence, its exact location must be recorded and it must be readily available for moderation purposes.

The following units guide internal assessment in Refrigeration Principles Level 2:

NUMBER OF UNITS	ASSESSMENT	COVERAGE
3	Formal written tests	One or more completed topics
1	Internal written exams	All completed topics
3	Practical assessments	The related Subject Outcomes: 3.1 the identification of trade related tools. 3.2 the function of trade related tools. 3.3 maintaining and checking for damage to tools / instruments and the reporting of faulty and damaged tools. 4.1 handling of refrigerant containers. 4.2 safety requirements for handling and storing of refrigerants, safety equipment to be used and precautions taken prior to working on plants. 5.3 application of jointing methods, and use of solvents. 5.6 compiling a refrigerant piping material list, selecting the correct material, preparation of a work plan and pipe run layout. 5.7 copper to copper brazed joints, copper to brass brazed joints, joints on steel and flared, flanged compression and threaded joints. 5.8 installing refrigerant piping and accessories. 5.9 testing an installation for leaks. 6.3 applying the various fixing methods and the safety requirements to be followed. 6.5 selecting and applying bracketing systems. 7.2 identification of refrigerant containers and checking containers for suitability. 7.3 prepare containers for refrigerant transfer. 7.4 transfer refrigerant into an empty evacuated container. 7.5 the methods for transferring refrigerant, transfer of refrigerant from a container to a service cylinder and possible hazards associated with transferring refrigerant. 7.6 the recovery of refrigerant from a charged system and its transfer into a service cylinder. 7.7 performing leak testing procedures. 7.8 evacuation of a system. 7.9 charging of a refrigeration plant.

ASSESSMENT OF REFRIGERATION PRINCIPLES

LEVEL 2

3 INTERNAL ASSESSMENT OF SUBJECT OUTCOMES IN REFRIGERATION PRINCIPLES LEVEL 2

Topic 1: Explain the operation of a basic vapour compression system.

SUBJECT OUTCOME	
1.1 Explain, with the aid of a block diagram, the operation of a vapour compression refrigeration system *Range: The single stage saturated refrigeration cycle.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• A block diagram of a vapour compression refrigeration system is drawn. • The operation of a vapour compression system is explained.	• Draw a block diagram of a vapour compression refrigeration system. • Explain the operation of a vapour compression system.
ASSESSMENT TASKS OR ACTIVITIES	
• An open book test and an assignment on the vapour compression system.	

SUBJECT OUTCOME	
1.2 Name components and pipes in a block diagram and indicate direction of flow of the refrigerant *Range: The single stage saturated refrigeration cycle;* *Components: The compressor, the expansion valve, evaporator and condenser.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Each component as indicated in the block diagram is named. • Each pipe run as indicated in the block diagram is named. • The direction of flow of the refrigerant is correctly indicated.	• Name each component as indicated in the block diagram. • Name each pipe run as indicated in the block diagram. • Indicate the direction of flow of the refrigerant correctly.
ASSESSMENT TASKS OR ACTIVITIES	
• A written test and an assignment on the vapour compression components within the system, the pipe runs between various components and the direction flow of refrigerant.	

SUBJECT OUTCOME	
1.3 Identify and explain the functions of components and accessories of a refrigeration system *Range: Accessories: Interconnecting piping, receivers, suction accumulators, vibration eliminators, crankcase heaters, sight glass/moisture indicators, service valves, shut-off valves, safety valves, Schraeder valves, filter-driers, mufflers, suction-liquid line heat exchangers, oil separators.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The various components and accessories of a refrigeration system are indicated and identified and each one's position in a refrigeration plant is explained. • The purpose of each component and accessory in the refrigeration system is explained.	• Indicate and identify the various components and accessories of a refrigeration system and explain each one's position in a refrigeration plant. • Explain the purpose of each component and accessory in the refrigeration system.
ASSESSMENT TASKS OR ACTIVITIES	
• Class questions, rubrics and assignments on the accessories and components. • Group discussions on the purpose of each component and accessories.	

SUBJECT OUTCOME	
1.4 Explain the relationship between pressure and temperature of a refrigerant. *Range: Commonly used refrigerants R134A, R22, R404 and R410A*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The relationship between the pressure and temperature of refrigerants is correctly stated. • The reasons for gas temperature increases when compressed are explained. • An explanation why evaporation and condensation of the refrigerant occur at a constant saturated temperature is given.	• Correctly state the relationship between the pressure and temperature of refrigerants. • Explain why gas increases in temperature when being compressed. • Explain why evaporation and condensation of the refrigerant occur at a constant saturated temperature.
ASSESSMENT TASKS OR ACTIVITIES	
• Group research and a case study on the relationship between temperature and pressure. • Group discussions and demonstrations on the increase in temperature of a gas when being compressed and evaporation and condensation of the refrigerant at constant temperatures.	

SUBJECT OUTCOME	
1.5 Explain the interaction between components in a refrigeration system *Range: Condenser, evaporator, compressor and expansion device.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The purpose of the condenser, evaporator, compressor and expansion device and accessories in the system is correctly explained. • The processes taking place in each component are explained. • The phase and temperature of the refrigerant at the inlet and outlet of each component is stated.	• Explain the purpose of the condenser, evaporator, compressor and expansion device and accessories in the system. • Explain the processes taking place in each component. • State the phase and temperature of the refrigerant at the inlet and outlet of each component.
ASSESSMENT TASKS OR ACTIVITIES	
• Group discussions and demonstrations on the purpose of components. • An open book test and assignments on the processes in components. • A written test and observation sheets with checklists on the phase and temperature of the refrigeration at the inlet and outlets of each component.	

Topic 2: Describe and explain the fundamentals of electricity used in Heating Ventilation Air-Conditioning and Refrigeration (HVAC& R) systems

SUBJECT OUTCOME	
2.1 Describe and explain the fundamentals of electricity *Range: Volts, Current, Resistance, Energy and Power, terms frequency, single-phase and three-phase, series circuits, parallel circuits and series-parallel circuits*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Electricity is defined. • The SI units for potential difference, current, resistance, energy and power with the quantity symbol, unit and unit symbol are listed and defined. • The terms frequency, single-phase and three-phase are explained and defined. • The terms AC and DC are explained and typical applications are listed and explained. • The difference between power and energy is defined. • The voltages supplied to large buildings, small buildings and private houses are listed. • The instrumentation required to test for voltage, current and resistance is listed. • Series circuits, parallel circuits and series-parallel circuits are defined and described.	• Define electricity. • List and define the SI units for potential difference, current, resistance, energy and power with the quantity symbol, unit and unit symbol. • Explain and define the terms frequency, single-phase and three-phase. • Explain the terms AC and DC and list typical applications. • Define the difference between power and energy. • List the voltages supplied to large buildings, small buildings and private houses. • List the instrumentation required to test for voltage, current and resistance. • Define and describe series circuits, parallel circuits and series-parallel circuits.
ASSESSMENT TASKS OR ACTIVITIES	
• A written test on the definitions, instrumentation required and series and parallel circuits.	

SUBJECT OUTCOME	
2.2 Explain characteristics and uses of conductors *Range: Copper and aluminium conductors up to 16 mm².*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The commonly used types of conductors are explained and their properties listed. • The characteristics and uses of conductors are explained.	• Explain the commonly used types of conductors and list their properties. • Explain the characteristics and uses of conductors.
ASSESSMENT TASKS OR ACTIVITIES	
• Case studies, an oral test and an assignment on the types of conductors.	

SUBJECT OUTCOME	
2.3 Define and apply Ohm's law *Range: Series / parallel circuits.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Ohm's law is defined. • The total resistance in a series circuit is calculated. • The resistances in a parallel circuit are calculated. • The resistances in a series / parallel circuit are calculated. • The current through each resistance, the voltage over each resistance and the power consumed by each resistance for a series circuit, a parallel circuit and a series / parallel circuit are calculated.	• Define Ohm's law. • Calculate the total resistance in a series circuit. • Calculate the resistances in a parallel circuit. • Calculate the resistances in a series / parallel circuit. • Calculate the current through each resistance, the voltage over each resistance and the power consumed by each resistance for a series circuit, a parallel circuit and a series / parallel circuit.

ASSESSMENT TASKS OR ACTIVITIES
• Observations on Ohm's law. • An open-book test on calculations of resistance in series and parallel circuits. • Case studies on current through, voltage over and power consumed by each resistance • An assignment on the application of Ohm's law.

SUBJECT OUTCOME	
2.4 List potential hazards and methods to prevent injury when using electricity *Range: All potential hazards, electric shock, fires, earth leakage.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Potential hazards when using electricity are explained. • The necessity and reasons for proper earthing of electrical equipment are listed and explained. • Methods to prevent electric shock are explained.	• Explain potential hazards when using electricity. • Explain and list the necessity and reasons for proper earthing of electrical equipment. • Explain methods to prevent electric shock.
ASSESSMENT TASKS OR ACTIVITIES	
• Group discussions, class questions, role-play and a project on potential hazards of electricity, reasons for proper earthing and on the prevention of electric shock.	

Topic 3: Identify, use and maintain refrigeration trade related tools and instruments

SUBJECT OUTCOME	
3.1 Identify, use and maintain the tools/instruments used in the refrigeration trade *Range: Instruments: Voltmeters, ammeters, ohmmeters, multi-testers, gauge manifolds* *Tools: Gas welding sets, arc welders and welding and brazing consumables, tube cutters, pipe benders, bending springs, flaring tools, swaging tools, crimping tools, lock ring pliers, piercing pliers, line tap valves, flare nut wrenches, service valve ratchet wrenches and pinch-off tools.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Each item is correctly identified according to its manufacturer's name or by its generic/trade name. • Each tool / instrument is used to perform the function it was designed for and in a manner consistent with the manufacturer's intent to prevent injury or damage. • Tools/instruments are maintained in accordance with manufacturer's instructions. • Tools/instruments are checked for damage or worn-out before and after use. • Faulty and damaged components are reported and replaced.	• Identify each item correctly according to its manufacturer's name or by its generic/trade name. • Use each tool/instrument only to perform the function for which it was designed and in a manner consistent with its manufacturer's intent so that no injury or damage occurs. • Maintain each tool/instrument in accordance with the manufacturer's instructions. • Inspect each tool/instrument for damaged or worn-out components before and after use. • Report and replace faulty or damaged components.
ASSESSMENT TASKS OR ACTIVITIES	
• Practical exercises, observation sheets, checklists and rating scales on the identification of each trade related tool. • An assignment or task and practical exercises on maintaining and checking for damage to each tool / instrument. • A written test on the reporting of faulty and damaged tools.	

Topic 4: Identify, use and store refrigerants

SUBJECT OUTCOME	
4.1 Name and identify refrigerant types in containers and systems *Range: R22, R134A, R404A, R410A*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The refrigerants commonly used in South Africa are named. • The physical properties of the commonly used refrigerants are stated. • The group and type of refrigerant in various containers are correctly identified. • The group and type of refrigerant in an unmarked system is correctly identified. • The methods used to identify refrigerants in containers and systems are named and explained. • The consequences of mixing refrigerants or using the wrong refrigerant are explained. • Containers are safely handled, so as to ensure that no damage occurs and no refrigerant is released.	• Name the refrigerants commonly used in South Africa. • State the physical properties of the commonly used refrigerants. • Correctly identify the group and type of refrigerant in various containers. • Correctly identify the group and type of refrigerant in an unmarked system. • Name and explain the methods used to identify refrigerants in containers and systems. • Explain the consequences of mixing refrigerants or using the wrong refrigerant. • Safely handle containers, to ensure that no damage occurs and no refrigerant is released.
ASSESSMENT TASKS OR ACTIVITIES	
• A written test on the commonly used refrigerants and their properties and the consequences of mixing refrigerants. • Tasks on identifying groups and types of refrigerants in marked and unmarked systems. • Group discussion and methods of identification used • Practical exercises on handling of refrigerant containers.	

SUBJECT OUTCOME	
4.2 Demonstrate and explain storing of refrigerant containers without endangering self, others, the plant or the environment *Range: Refrigerant containers: Refrigerant storage cylinders, refrigerant service cylinders, disposable refrigerant containers.* *Reasons for rejecting refrigerant containers: non-approved containers, containers damaged, dented or showing burn marks, containers with leaking valves*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The effects of refrigerants on humans if inhaled or spilt on the body are explained. • The effects of releasing refrigerant into the atmosphere are named and explained. • The restrictions imposed by the Montreal Protocol on the use of refrigerants in South Africa are named and explained. • The safety procedures needed when handling, transporting and storing refrigerant containers are named and explained. • The personal protective equipment to be used when handling refrigerants, and their uses are named. • The safety precaution to be established before starting work on a refrigeration plant is named and explained in accordance with work site procedures. • Different work situations where at least two competent persons are required are identified and explained. • The procedures to be followed in the event of an accident or fire when working with refrigerants are named and explained. • Additional hazards that can be encountered when working with flammable and high-pressure refrigerants are named and explained. • Hazards when handling R410A are explained.	• Explain the effects of refrigerants on humans if inhaled or spilt on the body. • Name and explain the effects of releasing refrigerant into the atmosphere. • Name and explain the restrictions imposed by the Montreal Protocol on the use of refrigerants in South Africa. • Name and explain the safety procedures needed when handling, transporting and storing refrigerant containers. • Name the personal protective equipment to be used when handling refrigerants and name their use. • Name and explain the safety precaution to be established before starting work on a refrigeration plant in accordance with work site procedures. • Identify and explain different work situations where at least two competent persons are required. • Name and explain the procedures to be followed in the event of an accident or fire when working with refrigerants. • Name and explain the additional hazards that can be encountered when working with flammable and high-pressure refrigerants. • Explain the hazards when handling R410A.

ASSESSMENT TASKS OR ACTIVITIES
• Group discussion on the effects of refrigerant if inhaled or spilt on the body, the effects of releasing refrigerant into the atmosphere and work situations where two competent persons are required. • Practical exercises, observation sheets and rubrics on the safety requirements for handling and storing of refrigerants, safety equipment to be used and precautions taken prior to working on plants. • A written test on the restrictions imposed by the Montreal Protocol and the procedures to be followed and dangers associated with refrigerants with regard to fire

SUBJECT OUTCOME	
4.3. Identify and describe the use of refrigerants in cooling systems	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The relationship between temperature and pressure of a refrigerant is explained. • The ability to determine the saturation temperature or pressure from tables or gauges for various refrigerants is demonstrated. • Typical applications of various refrigerants are named and discussed. • The type(s) of oil to be used with each of the commonly used refrigerants are stated. • The consequences of using the wrong type of oil are stated and explained. • The labeling requirements in respect of the type of refrigerant and oil charged into an existing system are described.	• Explain the relationship between the temperature and pressure of a refrigerant. • Determine the saturation temperature or pressure for various refrigerants from tables or gauges. • Name and discuss typical applications of various refrigerants. • State the type(s) of oil used with each of the commonly used refrigerants. • State and explain the consequences of using the wrong type of oil. • Describe the labeling requirements in respect of the type of refrigerant and oil charged into an existing system.
ASSESSMENT TASKS OR ACTIVITIES	
• Observation and class questions on the relationship between temperature and pressure, • Practical exercises on the determination of saturation temperature or pressure from tables or gauges and on various applications of refrigerants. • An assignment on the types of oil not to be used, consequences of using wrong type of oil and the requirements for labelling	

Topic 5: Join and install refrigerant piping

SUBJECT OUTCOME	
5.1 List and describe the use of various materials for installation of piping and fittings *Range: Steel, brass, copper, stainless steel, aluminum.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Various materials used in air-conditioning and refrigeration installation piping and fittings are identified. • Typical applications of various materials are listed. • The reasons for the use of various materials are described.	• Identify various materials used in air-conditioning and refrigeration installation piping and fittings. • List the typical applications of various materials. • Describe the reasons for the use of the various materials.
ASSESSMENT TASKS OR ACTIVITIES	
• Observations ,assignments and a written test on various materials used in air-conditioning and refrigeration, typical applications and the use of various materials	

SUBJECT OUTCOME	
5.2. Identify and explain the application of various piping types and sizes. *Range: Soft copper piping between 3mm (⅛") and 20mm (¾") diameter. Hard drawn copper piping between 6mm (¼") and 53mm (2⅛") diameter. Steel or aluminum piping up to 15mm (½") diameter, as used for domestic, commercial and industrial refrigeration and air-conditioning equipment (excluding systems using ammonia as a refrigerant).*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Various types and sizes of piping are identified. • Applications of and reasons for the use of various types of piping are stated and discussed. • Various sizes of piping are identified • The handling and storage procedure of piping is described. • The importance of keeping piping clean and dry is explained. • The consequences of failing to keep piping sealed are explained. • The implications of mismatching piping and fittings are listed and explained.	• Identify various types and sizes of piping. • State and discuss typical applications of and reasons for the use of the various types of piping. • Identify various piping sizes. • Describe piping handling and storage procedure. • Explain the importance of keeping piping clean and dry. • Explain the consequences of failing to keep piping sealed. • List and explain the implications of mismatching piping and fittings.
ASSESSMENT TASKS OR ACTIVITIES	
• Tasks on identification of various sizes and types of piping. • A written test on the handling and storage of piping. • Practical exercises on the cleanliness of piping and importance thereof, and on mismatching of piping.	

SUBJECT OUTCOME	
5.3 Identify and explain the purpose of various pipe fittings and pipe jointing methods *Range: Jointing methods: Copper to copper joints including swaged joints; copper to brass, copper to aluminum and copper to steel. Flared connections. Flanged connections. Compression fittings. Threaded connections. Test pressures. Pipe fittings: Flare fittings, sweat fittings, flanged fittings, and compression fittings, slip-on glued, screwed, and welded. Elbows, tees, reducers, unions, adapters, couplings, check valves. Imperial and SI.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Various fittings, sizes and threads are listed and identified. • Typical applications of and reasons for the use of various fittings are stated. • Various sizes of fittings are identified. • Various jointing methods are identified. • Typical applications of and reasons for the use of a particular method are named and explained. • Types of filler material and flux used in jointing of piping are identified. • Cleaning methods and use of solvents are explained.	• List and identify various piping fittings, sizes and threads. • State the typical applications of and reasons for the use of various fittings. • Identify various sizes of fittings. • Identify various jointing methods. • Name and explain the typical applications of and reasons for the use of one method over the other. • Identify types of filler material and flux used in jointing of piping. • Explain cleaning methods and use of solvents.
ASSESSMENT TASKS OR ACTIVITIES	
• A written test and assignments on various fittings and threads. • Practical exercises on application of jointing methods, and use of solvents.	

SUBJECT OUTCOME	
5.4 Identify and explain the purpose of insulation materials used in refrigeration and air-conditioning installations *Range: Insulation materials: Polystyrene, polyurethane, cork, flexible closed-cell rubber material, slabs, shells and foam types*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Different types of insulating material used for pipes and flat surfaces are identified. • The purpose of insulating material is described. • Types of and the aim of vapour barriers and cladding are described. • The implications of insufficient insulation and improper application of vapour barriers are explained.	• Identify different types of insulating material used for pipes and flat surfaces. • Describe the purpose of insulating material. • Describe the types and aim of vapour barriers and cladding. • Explain the implications of insufficient insulation and improper application of vapour barriers.
ASSESSMENT TASKS OR ACTIVITIES	
• Observation tasks, checklists and rubrics on different types of insulating materials. • An assignment and a written test on insulating material.	

SUBJECT OUTCOME	
5.5 Identify and describe the purpose and applications of pipe support and securing fittings *Range: Pipe support and securing fittings: Horizontal brackets, vertical hangers, floor-mounted supports, saddle clamps*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The methods of supporting and securing piping are described. • The various types of support and securing fittings are identified. • The various sizes of support and securing fittings are identified	• Describe the methods of supporting and securing piping. • Identify the various types of support and securing fittings. • Identify the various sizes of support and securing fittings.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment on supporting and securing of piping. • An observation task on identifying various types and sizes of support and securing fittings	

SUBJECT OUTCOME	
5.6 Plan and prepare to install refrigerant piping *Range: Flare fittings, sweat fittings, flanged fittings, and compression fittings, slip-on glued, screwed, and welded. Elbows, tees, reducers, unions, adapters, check valves. Imperial and SI.* *Pipe jointing methods: Soft solder, brazing, phosphorous-copper brazing, brass brazing, filler material, flux, joining dissimilar materials, swaged connections, flared connections, compression fitting connections, screwed, welded, flanged, glued.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The works order for an installation is obtained. • The location of the jobsite is determined. • A list of the piping, fittings and accessories is prepared. • All piping, fittings and accessories are correctly selected. • The consequences of not preparing oneself for the installation are listed and explained. • The procedure to obtain permission to commence work is explained. • The work site is checked for safety. • The installation of plant components is checked and verified against drawings and work instructions. • A work plan is prepared. • The consequences of bad planning are listed and explained. • All pipe runs are set out correctly. • All piping is correctly measured off and cut according to the drawing supplied and in accordance with work site requirements. • Metal shavings, dirt and moisture are prevented from entering the pipes.	• Obtain the works order for an installation. • Determine the location of the jobsite. • Prepare a list of the piping, fittings and accessories. • Correctly select all piping, fittings, and accessories. • List and explain the consequences of not preparing oneself for the installation. • Explain the procedure to obtain permission to commence work. • Check the work site for safety. • Check the installation of plant components and verify against drawings and work instructions. • Prepare a work plan. • List and explain the consequences of bad planning. • Correctly set out all pipe runs. • Correctly measure off and cut all piping according to the drawing supplied and in accordance with work site requirements. • Prevent metal shavings, dirt and moisture from entering the pipes.
ASSESSMENT TASKS OR ACTIVITIES	
• Group discussion and an assignment on preparation before installing refrigerant piping, consequences of bad preparation, bad planning and work site safety procedures. • Observation sheets, rubrics and practical exercises on compiling a refrigerant piping material list, selecting the correct material, preparation of a work plan and pipe run layout.	

SUBJECT OUTCOME	
5.7 Form brazed and non brazed joints *Range: Soft solder, silver solder, brazing, phosphorous-copper brazing, brass brazing, filler material, flux, joining dissimilar materials, swaged connections, flared connections, compression fitting connections.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Copper to copper brazed joints are made correctly. • Copper to brass brazed joints are made correctly. • Steel joints are made. • Scale-free internal surfaces are ensured upon completion of the brazing process. • Penetration of the entire joint with filler material is ensured. • The consequences of not using nitrogen when brazing are listed and explained. • The consequences of using the wrong filler material are listed and explained. • The advantages and disadvantages of various brazed jointing methods are listed and explained. • Flared joints are formed correctly. • Flanged joints are formed correctly. • Compression joints are formed correctly. • Threaded joints are formed correctly. • The advantages and disadvantages of non-brazed	• Correctly make copper to copper brazed joints. • Correctly make copper to brass brazed joints. • Make joints involving steel. • Ensure that internal surfaces are free of scale upon completion of the brazing process. • Ensure that filler material has penetrated the entire joint. • List and explain the consequences of not using nitrogen when brazing. • List and explain the consequences of using the wrong filler material. • List and explain the advantages and disadvantages of the various brazed jointing methods. • Correctly form flared joints. • Correctly form flanged joints. • Correctly form compression joints. • Correctly form threaded joints. • List and explain the advantages and disadvantages of the various non-brazed jointing methods.

jointing methods are listed and explained.	

ASSESSMENT TASKS OR ACTIVITIES

- Observation sheets, rubrics and practical exercises on copper to copper brazed joints, copper to brass brazed joints, joints on steel and flared, flanged compression and threaded joints.
- An assignment and a written test on the consequences of not using nitrogen, the consequences of using wrong filler, the advantages and disadvantages of various brazed joints and non-brazed joints.

SUBJECT OUTCOME

5.8 Install piping and accessories

Range: Copper to copper joints including swaged joints, copper to brass, copper to aluminum and copper to steel. Flared connections. Flanged connections. Compression fittings. Threaded connections.

ASSESSMENT STANDARDS	LEARNING OUTCOMES
• All pipes and accessories are installed correctly according to the supplied drawing. • All pipes are supported and anchored to prevent sagging and/or vibration. • All pipes are protected against abrasion where they pass through openings, or touch one another or other pieces of equipment. • All pipes carrying vapour are sloped correctly and sufficiently to ensure proper oil return. • Vertical risers carrying vapour are downsized if indicated on the drawing. • Oil traps are inserted in strict accordance with drawings. • The consequences of oil trapping in the system are listed and explained	• Install all pipes and accessories according to the supplied drawing. • Support and anchor all pipes to prevent sagging and/or vibration • Protect all pipes against abrasion where they pass through openings, or touch one another or other pieces of equipment. • Correctly and sufficiently slope all pipes carrying vapour to ensure proper oil return. • Downsize vertical risers carrying vapour if indicated on the drawing • Insert oil traps in strict accordance with the drawing. • List and explain the consequences of oil trapping in the system.

ASSESSMENT TASKS OR ACTIVITIES

- A practical task on installing refrigerant piping and accessories.
- A written test on oil trapping in the system.

SUBJECT OUTCOME

5.9 Test installation for leaks

Range: Soap and water, electronic, dyes, ultra violet, ultra sound.
Various systems: Domestic to commercial applications, filler material, flux, joining dissimilar materials, swaged connections, flared connections, compression fitting connections.

ASSESSMENT STANDARDS	LEARNING OUTCOMES
• The safety and suitability of leak testing tools and equipment are checked. • The installation is pressurized to the correct pressure. • Pressurising procedures are carried out correctly. • The installation is tested for leaks. • All leaks are found. • The consequences of leaks in the system are explained.	• Check for the safety and suitability of leak testing tools and equipment. • Pressurize the installation to the correct pressure. • Correctly carry out pressurising procedures. • Test the installation for leaks. • Find all leaks. • Explain the consequences of leaks in the system.

ASSESSMENT TASKS OR ACTIVITIES

- A practical task on testing an installation for leaks.
- A written test on the consequences of leaks in the system.

SUBJECT OUTCOME	
5.10 Clear the work site *Range: Commercial worksite.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• All excess materials are removed. • All tools are removed. • The installation hand over information and procedure is explained to the commissioning team.	• Remove all excess materials. • Remove all tools. • Explain the installation hand over information and procedure to the commissioning team.
ASSESSMENT TASKS OR ACTIVITIES	
• A task on completion of piping installation • A written report that explains the procedures to be followed when handing over the installation to the commissioning team (indicate what information would be included in a hand-over report).	

Topic 6: Identify and explain fixing methods, bracketing systems, keys and locking devices applicable to the trade.

SUBJECT OUTCOME	
6.1 Identify and state the purpose of various fixing methods, keys and mechanical locking devices applicable to the trade *Range: Fixing methods (fastening devices): Bolts, studs, and nuts: Extra fine, fine, average and coarse thread screws. Washers: Plain, spring, and lock washers. Socket screws: Socket head, flat head, headless and socket pipe plug types. Set screws: head and headless types with flat point, cone point, oval point, cup point, dog point and half dog point. Self-tapping screws: with round head, acorn head, hexagon head, pan head, flat head. Wood screws: with round, flat or oval head. Pop rivets: different sizes and materials. Keys and locking devices: Split pins: different sizes and types. Locking wire: different sizes and fixing methods. Keys: round and flat types. Bracketing systems: Bracketing systems for piping, ducting and equipment (including insulated piping and ducting).*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Fixing methods are identified correctly. • The purpose of each fixing method is identified correctly. • The consequences of using the wrong fixing methods or devices are stated and explained. • Keys and mechanical securing devices are identified correctly. • The purpose of each type of key and mechanical locking device is correctly explained. • The consequences of not using the correct or using the incorrect keys or mechanical locking devices are explained and described.	• Identify fixing methods correctly. • Correctly identify the purpose of each fixing method. • State and explain the consequences of using the wrong fixing methods or devices. • Correctly identify keys and mechanical securing devices. • Correctly explain the purpose of each type of key and mechanical locking device. • Explain and describe the consequences of not using the correct or using the incorrect keys or mechanical locking devices.
ASSESSMENT TASKS OR ACTIVITIES	
• Group discussions; a task and a written test on various fixing methods, the purpose of each fixing method, the consequences of using the wrong fixing method or device, identifying keys and mechanical securing devices, the purpose and type of key and mechanical device and the consequences of not using the correct or using the incorrect keys or mechanical devices.	

SUBJECT OUTCOME	
6.2 Identify and state the purpose, advantages and disadvantages of various bracketing systems. *Range: Bracketing systems for piping, ducting and equipment (including insulated piping and ducting).*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Bracketing systems are identified correctly. • The purpose of each type of bracketing system is explained correctly. • The consequences of using the incorrect bracketing system are explained. • The advantages and disadvantages of various systems are listed and described.	• Correctly identify bracketing systems. • Correctly explain the purpose of each type of bracketing system. • Explain the consequences of using the incorrect bracketing system. • List and describe the advantages and disadvantages of the various systems.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment on identifying bracketing systems, the purpose of each type of bracketing system and the consequences as well as advantages and disadvantages of various systems.	

SUBJECT OUTCOME	
6.3 Apply fixing methods *Range: Fixing methods (fastening devices): Bolts, studs, and nuts: Extra fine, fine, average and coarse thread screws. Washers: Plain, spring, and lock washers. Socket screws: Socket head, flat head, headless and socket pipe plug types. Set screws: head and headless types with flat point, cone point, oval point, cup point, dog point and half dog point. Self-tapping screws: with round head, acorn head, hexagon head, pan head, flat head. Wood screws: with round, flat or oval head. Pop rivets: different sizes and materials.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Correct fixing methods are selected and applied. • Appropriate tools are used correctly. • Work is carried out without damage to self, tools or equipment.	• Correctly select and apply fixing methods. • Correct use of appropriate tools. • Safely carry out work without damage to self, tools or equipment.
ASSESSMENT TASKS OR ACTIVITIES	
• A practical task on applying the various fixing methods and on the safety requirements to be followed.	

SUBJECT OUTCOME	
6.4 Apply keys and locking devices *Range: Split pins: different sizes and types. Locking wire: different sizes and fixing methods. Keys: round and flat types.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Keys and locking devices are selected and applied correctly. • Correct tools are used. • Work is carried out without damage to oneself, tools or equipment. • The selection of keys or locking devices is explained.	• Correctly select and apply keys and locking devices. • Use the correct tools. • Work is carried out without damage to self, tools or equipment. • Explain the selection of keys or locking devices.
ASSESSMENT TASKS OR ACTIVITIES	
• A task and observation sheets with rubrics on the selection and application of keys and locking devices.	

SUBJECT OUTCOME	
6.5 Apply bracketing systems *Range: Bracketing systems: Bracketing systems for piping, ducting and equipment (including insulated piping and ducting).*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Bracketing systems are selected and applied correctly. • The correct bracket is selected for the application. • The selection of the type of bracket is justified. • Work is carried out without danger to person and/or damage to tools or equipment.	• Correctly select and apply bracketing systems. • Select the correct bracket for the application. • Justify the selection of the type of bracket. • Carry out work without danger to person and/or damage to tools or equipment.
ASSESSMENT TASKS OR ACTIVITIES	
• A practical exercise on selecting and applying bracketing systems.	

Topic 7: Handle refrigerants, refrigerant containers, service cylinders, dial-a-charge and compressor oil.

SUBJECT OUTCOME	
7.1 List and explain the hazards when handling refrigerants and containers *Range: Groups of refrigerants: CFCs, HCFCs, HFCs, HCs and natural refrigerants. Typical applications of refrigerants: comfort and industrial air-conditioning, cold rooms, freezer rooms, domestic refrigerators and freezers, automotive air conditioning and transport refrigeration units. Physical properties: smell, colour, toxicity and flammability.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The fundamental properties of refrigerants are listed and explained. • The hazards when handling refrigerants are listed and discussed. • The personal protective equipment to be used when handling refrigerants is named and use demonstrated. • The personal protection equipment to be worn is listed and use demonstrated. • The effect of refrigerants on humans if inhaled or spilt on the body is explained. • The action required in case of exposure to refrigerant liquid and/or vapour is demonstrated. • The procedures to be followed in the event of an accident or fire when working with refrigerants is named and explained. • The effects of releasing refrigerant into the atmosphere is named and explained.	• List and explain the fundamental properties of refrigerants. • List and discuss the hazards when handling refrigerants. • Name the personal protective equipment to be used when handling refrigerants and demonstrate their use. • List the personal protection equipment to be worn and demonstrate their use. • Explain the effect of refrigerants on humans if inhaled or spilt on the body. • Demonstrate the action required in case of exposure to refrigerant liquid and/or vapour. • Name and explain the procedures to be followed in the event of an accident or fire when working with refrigerants. • Name and explain the effects of releasing refrigerant into the atmosphere.
ASSESSMENT TASKS OR ACTIVITIES	
• A task and written test on fundamental properties of refrigerants, the hazards associated with handling of refrigerants and personal protective equipment to be used.	

SUBJECT OUTCOME	
7.2 Identify and inspect refrigerant containers *Range: CFCs, HCFCs, HFCs, HCs and natural refrigerants. Refrigerant storage cylinders, refrigerant service cylinders, disposable refrigerant containers. Reasons for rejecting refrigerant containers: non-approved containers, containers damaged, dented or showing burn marks, containers with leaking valves.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The different commonly used refrigerants are listed by refrigerant number. • Refrigerant containers are identified and inspected for commonly used refrigerants. • The reasons for rejecting refrigerant containers are listed and discussed. • Unacceptable refrigerant containers are rejected. • Acceptable containers are checked for markings, damage and/or leaking valves. • The consequences of using damaged or leaking containers are listed and discussed. • The consequences of using unacceptable containers are listed and discussed. • The consequences of air or moisture in refrigerant containers are listed and explained.	• List by refrigerant number the different commonly used refrigerants. • Correctly identify and inspect refrigerant containers for the commonly used refrigerants. • List and discuss the reasons for rejecting refrigerant containers. • Reject unacceptable refrigerant containers. • Check acceptable containers for markings, damage and/or leaking valves. • List and discuss the consequences of using damaged or leaking containers. • List and discuss the consequences of using unacceptable containers. • List and explain the consequences of air or moisture in refrigerant containers.
ASSESSMENT TASKS OR ACTIVITIES	
• A written test on the different refrigerants available by number, reasons for rejecting different containers and the consequences of using damaged or leaking containers • Practical exercises on identification of refrigerant containers and checking containers for suitability.	

SUBJECT OUTCOME	
7.3 Prepare containers for refrigerant transfer *Range: Refrigerant service cylinders.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The maximum gross mass of a refrigerant container is determined. • The maximum quantity of refrigerant that can be charged into a container is determined. • A refrigerant container is evacuated. • A small amount of refrigerant is introduced into a container. • A container is tested for leaks. • The markings on a cylinder are checked for correctness.	• Determine the maximum gross mass of a refrigerant container. • Determine the maximum quantity of refrigerant that can be charged into a container. • Evacuate a refrigerant container. • Introduce a small amount of refrigerant into a container. • Perform a leak test on a container • Check the markings on a cylinder for correctness.
ASSESSMENT TASKS OR ACTIVITIES	
• Written exercises on calculating the size and quantity of refrigerant containers. • Practical tasks to prepare containers for refrigerant transfer.	

SUBJECT OUTCOME	
7.4 Transfer refrigerant into an empty, evacuated container *Range: Refrigerant service cylinders*.	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The correct refrigerant to be transferred is selected. • The correct hoses and tools are used. • Hoses are purged and connected with a minimum loss of refrigerant. • Refrigerant is transferred using the evacuated container method. • Refrigerant is transferred by releasing vapour from the service cylinder. • The container is filled with the required or maximum quantity of refrigerant.	• Select the correct refrigerant to be transferred. • Use the correct hoses and tools. • Purge hoses and connect with a minimum loss of refrigerant. • Transfer refrigerant using the evacuated container method. • Transfer refrigerant by releasing vapour from the service cylinder. • Fill the container with the required or maximum quantity of refrigerant.
ASSESSMENT TASKS OR ACTIVITIES	
• A practical assignment to transfer refrigerant into an empty evacuated container.	

SUBJECT OUTCOME	
7.5. Transfer refrigerant from a container to a service cylinder or a dial-a-charge. *Range: Refrigerant service cylinders, dial-a-charge*.	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The correct equipment and instrumentation are selected. • The subject equipment and instrumentation for R410A are selected. • All equipment is checked for suitability and safety. • The methods to transfer refrigerant from a container to a service cylinder or charging cylinder are named and demonstrated. • The maximum mass of refrigerant a cylinder can hold is determined. • The mass of refrigerant in a cylinder or charging cylinder is correctly determined. • The minimum refrigerant is released into the atmosphere. • The correct amount of refrigerant is transferred. • The possible hazards associated with transferring refrigerant are named and explained. • Safe working procedures are adhered to according to workshop procedures.	• Select the correct equipment and instrumentation. • Select the subject equipment and instrumentation for R410A. • Check all equipment for suitability and safety. • Name the methods to transfer refrigerant from a container to a service cylinder or charging cylinder and demonstrate the methods. • Determine the maximum mass of refrigerant a cylinder can hold. • Correctly determine the mass of refrigerant in a cylinder or charging cylinder. • Release the minimum refrigerant into the atmosphere. • Transfer the correct amount of refrigerant. • Name and explain the possible hazards associated with transferring refrigerant. • Adhere to safe working procedures according to workshop procedures.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment and practical exercises on the methods for transferring refrigerant, transfer of refrigerant from a container to a service cylinder and possible hazards associated with transferring refrigerant.	

SUBJECT OUTCOME	
7.6 Recover refrigerant from a charged system and transfer it into a service cylinder *Range: R134A or R22 and R410A direct systems*.	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The methods of recovering refrigerant from a system are named and explained. • The correct equipment and instrumentation required for recovering the refrigerant are checked and selected for suitability and safety. • Subject equipment and instrumentation are selected for R410A and checked for safety. • The reasons for the positions where recovery hoses are connected to the system are named and explained. • Evacuation levels required for refrigerant recovery are stated and explained. • The correct procedure to recover refrigerant from a system is demonstrated . • The minimum amount of refrigerant is released into the atmosphere. • At least 80% of the refrigerant is recovered from the system. • Methods to minimize the amount of refrigerant dissolving in compressor oil are named and explained. • The consequences of recovering insufficient refrigerant from the system are named and explained.	• Name and explain the methods of recovering refrigerant from a system. • Check and select for suitability and safety, the correct equipment and instrumentation required for recovering the refrigerant. • Select subject equipment and instrumentation for R410A. and check for safety, • Name and explain the reasons for the positions where the recovery hoses are connected to the system. • State and explain evacuation levels required for refrigerant recovery. • Demonstrate the correct procedure to recover refrigerant from a system. • Release the minimum amount of refrigerant into the atmosphere. • Recover at least 80% of the refrigerant from the system. • Name and explain methods to minimize the amount of refrigerant dissolving in compressor oil. • Name and explain the consequences of recovering insufficient refrigerant from the system.
ASSESSMENT TASKS OR ACTIVITIES	
• A task on methods for recovery of refrigerant from a system, the position for connecting the recovery unit to the system, required evacuation levels, recovery of refrigerant from a system, to minimize the amount of refrigerant dissolved in the oil and the consequences of recovering insufficient refrigerant. • Practical exercises on the recovery of refrigerant from a charged system and its transfer into a service cylinder.	

SUBJECT OUTCOME	
7.7. Test a system for leaks *Range: R134A or R22 and R410A direct systems*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Different leak test methods are named and explained. • The R410A rising leak test is explained. • The purposes of leak testing are named and the consequences of leaks in a system explained. • The equipment and instrumentation required for leak testing are selected and checked for suitability and safety. • The precautions to be taken when using nitrogen for pressurization are named and explained. • The correct leak testing procedure is demonstrated. • The methods to minimise the loss of refrigerant from a system through leaks are named.	• Name and explain different leak test methods. • Explain R410A rising leak test. • Name the purposes of leak testing and explain the consequences of leaks in a system. • Select the equipment and instrumentation required for leak testing and check for suitability and safety. • Name and explain precautions to be taken when using nitrogen for pressurisation. • Demonstrate the correct leak testing procedure. • Name methods to minimise the loss of refrigerant from a system through leaks.
ASSESSMENT TASKS OR ACTIVITIES	
• An assignment on different types of leak testing methods, the purpose of leak testing a system, equipment required for leak testing, precautions to be taken when using nitrogen, and on minimizing leaks. • A practical task on performing leak testing procedures. Make use of observation sheets and rubrics.	

SUBJECT OUTCOME	
7.8 Evacuate a system *Range: R134A or R22 and R410A direct systems.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• The reasons for evacuating a system before charging are named and explained. • The level to which the system is to be evacuated is stated and the reasons for this explained. • The deep vacuum method and the triple evacuation method to remove moisture and non-condensables from a system are named and explained. • The correct equipment and instrumentation required for evacuation are selected. • All equipment and instrumentation are checked for suitability and safety. • The correct procedure to evacuate a system is demonstrated. • The Schroeder valve removal is demonstrated during evacuation. • The method to evaluate the system vacuum is demonstrated and explained. • The vacuum pump and instrumentation is removed from the system without the loss of vacuum and the system correctly isolated.	• Name and explain the reasons for evacuating a system before charging. • State the reasons for and explain the level to which the system is to be evacuated. • Name and explain the deep vacuum method and the triple evacuation method to remove moisture and non-condensables from a system. • Select the correct equipment and instrumentation required for evacuation. • Check all equipment and instrumentation for suitability and safety. • Demonstrate the correct procedure to evacuate a system. • Demonstrate the Schroeder valve removal during evacuation. • Demonstrate and explain the method to evaluate the system vacuum. • Remove the vacuum pump and instrumentation from the system without the loss of vacuum and isolate the system correctly.
ASSESSMENT TASKS OR ACTIVITIES	
• Observation sheet and rubrics on reasons for evacuating a system before charging, the level required for evacuation and evacuation methods. • A practical exercise on performing evacuation of a system.	

SUBJECT OUTCOME	
7.9 Charge an evacuated system with refrigerant. *Range: R134A or R22 and R410A direct systems.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Checks before a system is charged are named and explained. • Potential hazards when charging a system with liquid refrigerant are named and explained. • The consequences of charging with the wrong refrigerant are named and explained. • The method of charging azeotropic blends is stated and explained. • The methods to charge refrigeration systems are named and explained. • The correct procedures to charge a system are demonstrated using a capillary tube-type metering device. • The correct method to charge a system fitted with a thermostatic expansion valve is demonstrated. • The type and mass of refrigerant and the oil the system is charged with are indicated. • The consequences of over- or undercharging a system are named and explained. • The action to be taken if leaks are found after charging is named and explained. • The unit is started according to operating instructions. • The state of the refrigerant is named and explained at locations indicated, with the unit charged and operating correctly.	• Name and explain the checks to be made before a system is charged. • Name and explain the potential hazards when charging a system with liquid refrigerant. • Name and explain the consequences of charging with the wrong refrigerant. • State and describe the method of charging azeotropic blends. • Name and explain the methods to charge refrigeration systems. • Demonstrate the correct procedures to charge a system using a capillary tube-type metering device. • Demonstrate the correct method to charge a system fitted with a thermostatic expansion valve. • Indicate the type and mass of refrigerant and the oil the system is charged with. • Name and explain the consequences of over- or undercharging a system. • Name and explain the action to be taken if leaks are found after charging. • Start the unit according to operating instructions. • State correctly, with the unit charged and operating correctly, the state of the refrigerant (i.e. temperature, pressure and (sub-cooled) liquid or (superheated) vapour), at locations indicated.

ASSESSMENT TASKS OR ACTIVITIES
• Notes and an open book test on checks to be made prior to charging, potential hazards associated with liquid charging, consequences of charging with wrong refrigerant, various charging methods, the consequences of over- and under-charging and action to be taken if leaks are found. • A practical task on charging a refrigeration plant.

SUBJECT OUTCOME	
7.10 Handle, check and store recovered compressor oil and refrigerant. *Range: R134A or R22 and R410A direct systems, mineral and synthetic oils.*	
ASSESSMENT STANDARDS	**LEARNING OUTCOMES**
• Adding or removing oil from a system is demonstrated. • The methods to store recovered refrigerant and oil are named and explained. • The methods to determine whether recovered refrigerant is fit for re-use are stated and explained. • The methods to determine whether recovered oil is fit for re-use are named and explained. • The safety requirements when handling, transporting and storing recovered refrigerant or oil are named and explained.	• Demonstrate adding or removing oil from a system. • Name and explain the methods to store recovered refrigerant and oil. • State and explain the methods to determine whether recovered refrigerant is fit for re-use. • State and explain the methods to determine whether recovered oil is fit for re-use. • Name and explain the safety requirements when handling, transporting and storing recovered refrigerant or oil.
ASSESSMENT TASKS OR ACTIVITIES	
• A practical task on removal and addition of oil to a system. • A written test on methods to store recovered refrigerant and oil, checking fit for purpose recovered refrigerant and oil, and handling, transporting and storing recovered refrigerant and oil.	

4 SPECIFICATIONS FOR EXTERNAL ASSESSMENT IN REFRIGERATION PRINCIPLES - LEVEL 2

4.1 Integrated summative assessment task (ISAT)

A compulsory component of the external assessment (ESASS) is the **integrated summative assessment task (ISAT).** The integrated summative assessment task draws on the student's cumulative learning achieved throughout the year. The task requires **integrated application of competence** and is executed and recorded in compliance with assessment conditions.

Two approaches to the integrated summative assessment task may be as follows:

- The students are assigned a task at the beginning of the year which they will have to complete in phases throughout the year to obtain an assessment mark. A final assessment is made at the end of the year when the task is completed.

OR

- Students achieve the competencies throughout the year but the competencies are assessed cumulatively in a single assessment or examination session at the end of the year.

The integrated summative assessment task is set by an externally appointed examiner and is conveyed to colleges in the first quarter of the year.

The integrated assessment approach enables students to be assessed in more than one subject with the same integrated summative assessment task.

4.2 National Examination

A national examination is conducted annually in October or November by means of a paper(s) set and moderated externally. The following distribution of cognitive application is suggested:

LEVEL 2	KNOWLEDGE AND COMPREHENSION	APPLICATION	ANALYSIS, SYNTHESIS AND EVALUATION
	45%	35%	20%

MARK ALLOCATION PER QUESTION		
All questions are compulsory		
Question 1:	Explain the operation of a basic vapour compression system.	15%
Question 2:	Describe and explain the fundamentals of electricity used in Heating, Ventilation, Air-Conditioning & Refrigeration (HVAC& R) systems.	10%
Question 3:	Identify, use and maintain refrigeration trade related tools & instruments.	12%
Question 4:	Identify, use and store refrigerants.	8%
Question 5:	Join and install refrigerant piping.	20%
Question 6:	Identify and explain fixing methods, bracketing systems, keys and locking devices applicable to the trade.	10%
Question 7:	Handle refrigerants, refrigerant containers, service cylinders, dial-a-charge and	25%
	TOTAL	**100**