	Unit ID: 580
Domain	**AIR CONDITIONING AND REFRIGERATION**
Title:	**Demonstrate knowledge of physics related to air conditioning and refrigeration**
Level: 2	**Credits: 8**

Purpose

This unit standard specifies the competencies required to demonstrate knowledge of physics related to air conditioning and refrigeration. It includes demonstrating basic knowledge of base and derived units used in the SI system of measurement applicable to air conditioning and refrigeration, describing principles of heat and refrigeration, demonstrating knowledge of the principle of liquids and vapours in refrigeration and air conditioning environment and demonstrating basic knowledge of engineering science terms and calculations associated with air conditioning and refrigeration. This unit standard is intended for those who work as air conditioning and refrigeration mechanics.

Special Notes

1. Entry information:

   Prerequisite
   - Unit 567 - *Apply health and safety routines in an air conditioning and refrigeration workplace* or demonstrated equivalent knowledge and skills.

2. Assessment evidence may be collected from a real workplace or a simulated real workplace or an appropriate simulated realistic environment in which air conditioning and refrigeration operations are carried out.

3. All inspection, operation and maintenance procedures associated with the use of tools and equipment shall comply with manufacturers' specifications and/or company's guidelines and instructions.

4. Glossary of terms:
   - 'specifications' refers to any, or all of the following: manufacturers' specifications and recommendations, workplace specific requirements
   - 'PH chart' refers to pressure enthalpy chart. The PH chart is an important tool used to describe the property changes that take place during each phase of the refrigeration cycle and provides a graphical means of study
   - 'SI units' refers to metric systems used in Namibia based on the International System of Units
   - 'calculation' means determining the dimensions, quality or capacity of an object by applying mathematical methods.

5 Regulations and legislation relevant to this unit standard include the following:
   - Labour Act, No. 11, 2007
   - Occupational Health and Safety Regulations No. 18, 1997

and all subsequent amendments.

6. Performance of all elements in this unit standard must comply with industry standards.

7. This unit standard applies to single-phase and three-phase air conditioning and refrigeration systems.

Quality Assurance Requirements

This unit standard and others within this subfield may be awarded by institutions which meet the accreditation requirements set by the Namibia Qualifications Authority and the Namibia Training Authority and which comply with the national assessment and moderation requirements. Details of specific accreditation requirements and the national assessment arrangements are available from the Namibia Qualifications Authority and the Namibia Training Authority. All approved unit standards, qualifications and national assessment arrangements are available on the Namibia Training Authority website www.nta.com.na.

Elements and Performance Criteria

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

Range

Base and derived units may include but are not limited to metre, kilogram, second, ampere, Kelvin and/or Celsius, Newton, joule, Pascal, watt, volt, ohm and hertz.

Conversion of common metric base and derived units to imperial units and vice versa may include but are not limited to length, mass, area, volume, volume liquids, speed, force, torque, pressure energy, vacuum, power and temperature.

Performance Criteria

1.1 Information required for base and derived units calculations are identified.

1.2 The meaning of base and derived units is explained.

1.3 Appropriate calculation method to convert base and derived units to imperial units and vice versa is selected and applied.

1.4 Results of calculations are confirmed and recorded.

Element 2: Describe principles of heat and refrigeration.

Range

Principles of heat and refrigeration may include but are not limited to the basics of heat theory such as state of matter, unit of heat, heat transfer, specific, sensible and latent heat, pressure, atmospheric pressure, vaporisation, condensation and laws of thermodynamics.

Methods of heat transfer are limited to conduction, convection and radiation.

Performance Criteria

2.1 Principles of heat and refrigeration are determined and explained.

2.2 The three methods of heat transfer are explained with reference to their applications in air conditioning and refrigeration.

2.3 The term saturation, latent heat of fusion, latent heat of evaporation, specific heat, relative humidity, and dry and wet bulb temperature are defined as used in air conditioning and refrigeration.

2.4 Laws of thermodynamic are described.

2.5 Appropriate calculation methods to calculate heat are selected and applied.

2.6 Results of calculations are confirmed and recorded.

2.7 The SI units for temperature and pressure are stated together with symbols.

2.8 The term specific volume, specific density, and specific gravity are explained, and their SI units including symbols are stated.

Element 3: Demonstrate knowledge of the principle of liquids and vapours in refrigeration and air conditioning environment

Range

Principles may include but are not limited to temperature; scales measurement instruments and pressure; gas laws, pressure measurement instruments.

Refrigerant conditions may include but are not limited to saturation, saturated liquid, saturated vapour, superheated vapour and sub cooled liquid.

Performance Criteria

3.1 Temperature and pressure are defined.

3.2 Measurement instruments are identified and uses are stated.

3.3 Gas laws are listed and described.

3.4 Refrigerant conditions are stated and described in relation to vapour compression cycle.

3.5 Pressure/enthalpy diagram is drawn; plot and pressure/enthalpy chart lines are described.

3.6 Differences between saturation, saturated liquid, saturated vapour, superheated vapour and sub cooled liquid are described.

Element 4: Demonstrate basic knowledge of engineering science terms and calculations associated with air conditioning and refrigeration.

Range

Engineering science terms may include but are not limited to piston displacement, compression ratio and efficiency and calculations related to basic engineering science such as force, work, power, torque, and calculations related to compressor performance such as, piston displacement, compressor capacity, compression ratio, power output, and efficiency.

Performance Criteria

4.1 Basic engineering science terms are defined.

4.2 Calculations related to basic engineering science terms are identified and described.

4.3 Calculations related to compressor performance are identified and applied.

4.4 Results of calculations are explained, confirmed and recorded.

Element 5: Explain the basic refrigeration cycle.

Range

Refrigeration may include but is not limited to commercial, industrial and air conditioning components such as contactors, circuit breaker, driers, and/or sight glass, solenoid, pressure switch, receiver, compressor, condenser and evaporator.

Performance Criteria

5.1 Refrigeration components and PH chart is sketched and explained in line with refrigeration system operational requirements.

5.2 Components and control devices' functions are explained and related with the refrigeration cycle.

5.3 Cycle stages are identified and described.

Registration Data

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