

Unit ID: 894

Domain

**FOUNDATION ENGINEERING SCIENCE
AND DRAWING SKILLS**

Title:

**Apply knowledge of fundamental
engineering science in different contexts**

Level: 3

Credits: 6

Purpose

This unit standard specifies the competencies required to apply knowledge of fundamental engineering science in different context. It includes competencies to apply fundamental knowledge of dynamics in engineering science, apply fundamental knowledge of statics in engineering science, apply knowledge of energy and momentum, perform calculations related to work, power and efficiency, apply knowledge related to mechanical drives and lifting machines, apply knowledge of friction, apply fundamental knowledge of heat, demonstrate fundamental knowledge of particle structure of matter and basic principles of electricity and demonstrate basic knowledge of hydraulics. This unit standard is intended for people requiring fundamental engineering science skills as applied in different contexts.

Special Notes

1. This unit standard gives users exposure to a holistic approach of study and world of work to gain an understanding of the world as a set of related systems, by recognizing that problem solving contexts do not exist in isolation but that they may differ from context to context according to the area of application.
2. This unit standard may be assessed in any context of operation and may be assessed in conjunction with other relevant technical unit standards selected from a particular domain that has a thematic link to this unit standard.
3. Assessment evidence may be collected at any realistic place where logical collection of such evidence can be achieved.
4. The correct use of the suitable technical terminology must be stressed, especially in formulating definitions and principles.
5. $g = 9,8 \text{ m/s}^2$ should be taken as the value for gravitational acceleration in all applicable calculations.
6. Scientific pocket calculators may be used in solving mathematical problems. Basic instruction must be offered in the practical use and operational abilities of the calculator. A comma has to be used for the decimal sign throughout calculations.
7. 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.

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 on www.nta.com.na.

Elements and Performance Criteria

Element 1: Apply fundamental knowledge of dynamics in engineering science.

Performance Criteria

- 1.1 Terms related dynamism are described, distinguished and their relationship to one another are indicated.
- 1.2 Displacement/time and velocity/time linear graphs are plotted.
- 1.3 Slops of displacement/time, velocity/time graphs and area beneath a velocity/time graphs are explained and calculated.
- 1.4 Motion equations are derived from graphs.

Element 2: Apply fundamental knowledge of statics in engineering science.

Performance Criteria

- 2.1 Parallelogram, resultant and equilibrant of forces are explained and determined graphically.
- 2.2 A force is resolved graphically and analytically into mutually perpendicular components. .
- 2.3 The experiment is described and the apparatus used for determining the horizontal and vertical components of force is sketched.
- 2.4 Terms related to law of moments are described and the law of moments is reproduced.
- 2.5 The reaction at the support of a light horizontal beam supported at two positions and carrying perpendicular point loads are determined.
- 2.6 Couples are defined, examples of couples are given and the moment of couples is calculated.

Element 3: Apply knowledge of energy and momentum.

Range

Calculations performed using formula $P = mv$, $KE = \frac{1}{2}mv^2$, $PE = mgh$.

Performance Criteria

- 3.1 The terms energy, potential energy and kinetic energy are explained.
- 3.2 The law of conservation of energy is formulated, derived, manipulated and applied to calculate gravitational potential energy and kinetic energy and on a free falling object.
- 3.3 The terms momentum and angular momentum are described and calculations related to unknown values are performed.

Element 4: Perform calculations related to work, power and efficiency.

Performance Criteria

- 4.1 Terms related to work and power is defined.
- 4.2 A force/distance graphs are plotted according to scale of the work done to lift a load by means of a cable, rope and/or chain.
- 4.3 The average effective force and work done are determined from a graph and the required power is calculated.
- 4.4 Work done and the power required against resistance on a horizontal plane are calculated. (Restricted to motion at constant velocity and applied forces parallel to the plane only.)
- 4.5 Work done and power exerted against gravitational forces are calculated. (Restricted to vertical motion only.)
- 4.6 Work done and power exerted against a smooth and inclined plane are calculated. (Excluding friction.)
- 4.7 Work done by torque is calculated.
- 4.8 The term efficiency is defined and the unit symbol of efficiency is expressed.
- 4.9 Efficiency is calculated by manipulating the formula $\eta = \left(\frac{\text{output}}{\text{input}}\right) \times 100\%$

Element 5: Apply knowledge related to mechanical drives and lifting machines.

Range

Quantities of belt drives may include but are not limited to belt speed, effective pulling force, pulling force ration, slack and tight side forces and power transmitted by a belt drive.

Performance Criteria

- 5.1 Different drives and their applications are described.
- 5.2 Compound gear trains indicating the direction of rotation of the components are sketched and the rotational frequency, the number of teeth and the velocity ratio of the gear system are calculated.
- 5.3 Applicable formulae are applied and/or manipulated to calculate various quantities of a belt drive.
- 5.4 Practical method applied to reduce belt slip are identified and a neat sketch of a belt drive showing the direction of rotation and the slack and tight sides of the belt is drawn.
- 5.5 Applications of chain drives and toothed belt drives are explained and the drives are compared in terms of advantages and disadvantages.
- 5.6 Calculation of number of revolutions per second and the number of teeth on sprocket for chain drives are performed.
- 5.7 Lifting devices are described in terms of their construction, efficiency, mechanical advantage and displacement/velocity ratio.
- 5.8 Neatly labelled line sketches of lifting machines are drawn and applicable formulae are applied and/or manipulated to calculate mechanical advantage, displacement ratio and efficiency.

Element 6: Apply knowledge of friction.

Performance Criteria

- 6.1 Different forms of frictions, the applications of friction in practice and the laws of friction are described.
- 6.2 Terms angle of repose (rest) and angle of friction are defined.
- 6.3 All the forces acting on a body, subject to friction on both horizontal and inclined planes are represented by means of a diagram.
- 6.4 A diagrammatical representation of the angle of friction is shown and the relation between the coefficient of friction and the angle of friction is indicated.

- 6.5 The coefficient of friction, angle of friction, weight components and the effective upward and downward pulling forces are calculated by applying and/or manipulating the applicable formulae.

Element 7: Apply fundamental knowledge of heat and linear expansion of material.

Performance Criteria

- 7.1 Heat and temperature are defined, distinguished and their units of measurements are stated.
- 7.2 Heat and capacity and specific heat capacity are defined and calculations related to heat gained and/or lost by manipulating the formula
- 7.3 The law of conservation of heat is formulated and applied in calculations on mixtures consisting of a maximum of two substances.
- 7.4 Fuel and the heat value of fuel are described and related calculations are performed.
- 7.5 A fuel and 3 types of fuels are described and examples are given.
- 7.6 The heat value of fuel is described and related calculations are performed.
- 7.7 The concept of linear expansion of materials is described and calculation of all reliables in formula $\Delta l = \alpha l_0 \Delta t$ are performed.
- 7.8 Terms related to steam and the effects on the boiling point of water when the pressure changes are described.
- 7.9 Using a graph, the different stages in the production of steam indicating what happens during each of the changes taking place is explained.

Element 8: Demonstrate fundamental knowledge of particle structure of matter and principles of electricity.

Range

Concepts of induction may include but are not limited to electromagnetic induction, mutual induction, self induction.

Performance Criteria

- 8.1 The structure of an atom is described in terms of construction, properties and transfer of electrons and the forming of positive and negative ions.
- 8.2 Terminologies related to electrolyte are described.
- 8.3 The concept of electrolytes (conductors and liquids) is described in terms of bonding and conduction.
- 8.4 Principle of construction and operation of series, parallel and series-parallel circuits are described and related calculations performed

- 8.5 The concept of resistivity is explained and related calculations are performed using the formula $\rho = \frac{R \times A}{l}$.
- 8.6 The concepts of induction are described and illustrated using sketches and examples and practical application of mutual induction are given.

Element 9: Demonstrate basic knowledge of hydraulics.

Performance Criteria

- 9.1 The concept of atmospheric pressure is described and applied in calculations.
- 9.2 Factors determining the pressure exerted by a vertical liquid (fluid) column are described.
- 9.3 The effect of the depth and density of a liquid on the pressure exerted are described.
- 9.4 Pascal's law is explained by means of an example.
- 9.5 Gauge and absolute pressure is described and calculated from given data.
- 9.6 Calculations on pressure concerning hydraulic presses are performed.

Registration Data

Subfield:	Engineering Science and Drawing
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