education

Department:
Education
REPUBLIC OF SOUTH AFRICA

National Curriculum Statement
Grades 10–12
(General)

MECHANICAL TECHNOLOGY

Department of Education

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HOW TO USE THIS BOOK

This document is a policy document divided into four chapters. It is important for the reader to read and integrate information from the different sections in the document. The content of each chapter is described below.

Chapter 1 – Introducing the National Curriculum Statement

This chapter describes the principles and the design features of the National Curriculum Statement Grade 10–12 (General). It provides an introduction to the curriculum for the reader.

Chapter 2 – Introducing the Subject

This chapter describes the definition, purpose, scope, career links and Learning Outcomes of the subject. It provides an orientation to the Subject Statement.

Chapter 3 – Learning Outcomes, Assessment Standards, Content and Contexts

This chapter contains the Assessment Standards for each Learning Outcome for the subject. The Assessment Standards are arranged to assist the reader to see the intended progression from Grade 10 to Grade 12.

Chapter 4 – Assessment

This chapter deals with the generic approach to assessment being suggested by the National Curriculum Statement. At the end of the chapter is a table of subject-specific competence descriptions. Codes, scales and competence descriptions are provided for each grade. The competence descriptions are arranged to demonstrate progression from Grade 10 to Grade 12.

Symbols

The following are used to identify Learning Outcomes, Assessment Standards, grades, codes, scales, competence description, and content and context.

 = Learning Outcome

 = Scale

 = Assessment Standard

 = Competence Description

 = Grade

 = Content and Contexts

 = Code

CONTENTS

ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
AS	Assessment Standard
CASS	Continuous Assessment
CNC	Computerised Numerical Control
FET	Further Education and Training
GET	General Education and Training
GMAW	Gas Metal Arc Welding
HE	Higher Education
HIV	Human Immune deficiency Virus
HR	Human Rights
IKS	Indigenous Knowledge Systems
LO	Learning Outcome
LP	Learning Programme
LPG	Learning Programme Guideline
LSEN	Learners with special educational needs
LTSM	Learning and Teaching Support Material
NCS	National Curriculum Statement
NQF	National Qualification Framework
OBE	Outcomes Base Education
OHS	Occupational Health and Safety
RPL	Recognition of Prior Learning
SANS	South African National Standards
SAQA	South African Qualification Authority
SI	Système International
SKVA	Skills, Knowledge, Values and Attitudes

CHAPTER 1

INTRODUCING THE NATIONAL CURRICULUM STATEMENT

The adoption of the Constitution of the Republic of South Africa (Act 108 of 1996) provided a basis for curriculum transformation and development in South Africa. The Preamble states that the aims of the Constitution are to:

- heal the divisions of the past and establish a society based on democratic values, social justice and fundamental human rights;
- improve the quality of life of all citizens and free the potential of each person;
- lay the foundation for a democratic and open society in which government is based on the will of the people and every citizen is equally protected by law; and
- build a united and democratic South Africa able to take its rightful place as a sovereign state in the family of nations.

The Constitution further states that "everyone has the right … to further education which the State, through reasonable measures, must make progressively available and accessible ".

The National Curriculum Statement Grades 10–12 (General) lays a foundation for the achievement of these goals by stipulating Learning Outcomes and Assessment Standards, and by spelling out the key principles and values that underpin the curriculum.

PRINCIPLES

The National Curriculum Statement Grades 10–12 (General) is based on the following principles:

- social transformation;
- outcomes-based education;
- high knowledge and high skills;
- integration and applied competence;
- progression;
- articulation and portability;
- human rights, inclusivity, environmental and social justice;
- valuing indigenous knowledge systems; and
- credibility, quality and efficiency.

Social transformation

The Constitution of the Republic of South Africa forms the basis for social transformation in our post-apartheid society. The imperative to transform South African society by making use of various transformative tools stems from a need to address the legacy of apartheid in all areas of human activity and in education in particular. Social transformation in education is aimed at ensuring that the educational imbalances of the past are redressed, and that equal educational opportunities are provided for all sections of our population. If social transformation is to be achieved, all South Africans have to be educationally affirmed through the recognition of their potential and the removal of artificial barriers to the attainment of qualifications.

Outcomes-based education

Outcomes-based education (OBE) forms the foundation for the curriculum in South Africa. It strives to enable all learners to reach their maximum learning potential by setting the Learning Outcomes to be achieved by the end of the education process. OBE encourages a learner-centred and activity-based approach to education. The National Curriculum Statement builds its Learning Outcomes for Grades 10–12 on the Critical and Developmental Outcomes that were inspired by the Constitution and developed through a democratic process.

The Critical Outcomes require learners to be able to:

- identify and solve problems and make decisions using critical and creative thinking;
- work effectively with others as members of a team, group, organisation and community;
- organise and manage themselves and their activities responsibly and effectively;
- collect, analyse, organise and critically evaluate information;
- communicate effectively using visual, symbolic and/or language skills in various modes;
- use science and technology effectively and critically showing responsibility towards the environment and the health of others; and
- demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

The Developmental Outcomes require learners to be able to:

- reflect on and explore a variety of strategies to learn more effectively;
- participate as responsible citizens in the life of local, national and global communities;
- be culturally and aesthetically sensitive across a range of social contexts;
- explore education and career opportunities; and
- develop entrepreneurial opportunities.

High knowledge and high skills

The National Curriculum Statement Grades 10–12 (General) aims to develop a high level of knowledge and skills in learners. It sets up high expectations of what all South African learners can achieve. Social justice requires the empowerment of those sections of the population previously disempowered by the lack of knowledge and skills. The National Curriculum Statement specifies the minimum standards of knowledge and skills to be achieved at each grade and sets high, achievable standards in all subjects.

Integration and applied competence

Integration is achieved within and across subjects and fields of learning. The integration of knowledge and skills across subjects and terrains of practice is crucial for achieving applied competence as defined in the National Qualifications Framework. Applied competence aims at integrating three discrete competences – namely, practical, foundational and reflective competences. In adopting such integration and applied competence, the National Curriculum Statement Grades 10–12 (General) seek to promote an integrated learning of theory, practice and reflection.

Progression

Progression refers to the process of developing more advanced and complex knowledge and skills. The Subject Statements show progression from one grade to another. Each Learning Outcome is followed by an explicit statement of what level of performance is expected for the outcome. Assessment Standards are arranged in a format that shows an increased level of expected performance per grade. The content and context of each grade will also show progression from simple to complex.

Articulation and portability

Articulation refers to the relationship between qualifications in different National Qualifications Framework levels or bands in ways that promote access from one qualification to another. This is especially important for qualifications falling within the same learning pathway. Given that the Further Education and Training band is nested between the General Education and Training and the Higher Education bands, it is vital that the Further Education and Training Certificate (General) articulates with the General Education and Training Certificate and with qualifications in similar learning pathways of Higher Education. In order to achieve this articulation, the development of each Subject Statement included a close scrutiny of the exit level expectations in the General Education and Training Learning Areas, and of the learning assumed to be in place at the entrance levels of cognate disciplines in Higher Education.

Portability refers to the extent to which parts of a qualification (subjects and/or unit standards) are transferable to another qualification in a different learning pathway of the same National Qualifications Framework band. For purposes of enhancing the portability of subjects obtained in Grades 10–12, various mechanisms have been explored, for example, regarding a subject as a 20-credit unit standard. Subjects contained in the National Curriculum Statement Grades 10–12 (General) compare with appropriate unit standards registered on the National Qualifications Framework.

Human rights, inclusivity, environmental and social justice

The National Curriculum Statement Grades 10–12 (General) seeks to promote human rights, inclusivity, environmental and social justice. All newly-developed Subject Statements are infused with the principles and the practices of social and environmental justice and human rights as is defined in the Constitution of the Republic of South Africa. In particular, the National Curriculum Statement Grades 10–12 (General) is sensitive to issues of diversity such as poverty, inequality, race, gender, language, age, disability and other factors.

The National Curriculum Statement Grades 10–12 (General) adopts an inclusive approach by specifying minimum requirements for all learners. It acknowledges that all learners should be able to develop to their full potential provided they receive the necessary support. The intellectual, social, emotional, spiritual and physical needs of learners will be addressed through the design and development of appropriate Learning Programmes and through the use of appropriate assessment instruments.

Valuing Indigenous Knowledge Systems

In the 1960's, the theory of multi-intelligences forced educationists to recognise that there were many ways of processing information to make sense of the world, and that, if one were to define intelligence anew, one would have to take these different approaches into account. Up until then the Western world had only valued logical, mathematical and specific linguistic abilities, and rated people as 'intelligent' only if they were adept in these ways. Now people recognise the wide diversity of knowledge systems through which people make sense of and attach meaning to the world in which they live. Indigenous knowledge systems in the South African context refer to a body of knowledge embedded in African philosophical thinking and social practices that have evolved over thousands of years. The National Curriculum Statement Grades 10–12 (General) has infused indigenous knowledge systems into the Subject Statements. It acknowledges the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution. As many different perspectives as possible have been included to assist problem solving in all fields.

Credibility, quality and efficiency

The National Curriculum Statement Grades 10–12 (General) aims to achieve credibility through pursuing a transformational agenda and through providing an education that is comparable in quality, breadth and depth to those of other countries. Quality assurance is to be regulated by the requirements of the South African Qualifications Authority Act (Act 58 of 1995), the Education and Training Quality Assurance Regulations, and the General and Further Education and Training Quality Assurance Act (Act 58 of 2001).

THE KIND OF LEARNER THAT IS ENVISAGED

Of vital importance to our development as people are the values that give meaning to our personal spiritual and intellectual journeys. *The Manifesto on Values, Education and Democracy* (Department of Education, 2001: 9–10) states the following about education and values:

" Values and morality give meaning to our individual and social relationships. They are the common currencies that help make life more meaningful than might otherwise have been. An education system does not exist to simply serve a market, important as that may be for economic growth and material prosperity. Its primary purpose must be to enrich the individual and, by extension, the broader society."

The kind of learner that is envisaged is one who will be imbued with the values and act in the interests of a society based on respect for democracy, equality, human dignity and social justice as promoted in the Constitution.

The learner emerging from the Further Education and Training band must also demonstrate achievement of the Critical and Developmental Outcomes listed earlier in this document. Subjects in the Fundamental Learning Component collectively promote the achievement of the Critical and Developmental Outcomes, while specific subjects in the Core and Elective Components individually promote the achievement of particular Critical and Developmental Outcomes.

In addition to the above, learners emerging from the Further Education and Training band must:

- have access to, and succeed in, life-long education and training of good quality;
- demonstrate an ability to think logically and analytically, as well as holistically and laterally; and
- be able to transfer skills from familiar to unfamiliar situations.

THE KIND OF TEACHER THAT IS ENVISAGED

All teachers are key the contributors to the transformation process of education in South Africa. The National Curriculum Statement Grades 10–12 (General) visualises teachers who are qualified, competent, dedicated and caring. They will be able to fulfil the various roles outlined in the Norms and Standards for Teachers. These include being mediators of learning, interpreters and designers of Learning Programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors, and subject specialists.

STRUCTURE AND DESIGN FEATURES

Structure of the National Curriculum Statement

The National Curriculum Statement Grades 10–12 (General) consists of an Overview Document, the Qualifications and Assessment Policy Framework, and the Subject Statements.

The subjects in the National Curriculum Statement Grades 10–12 (General) are categorised into Learning Fields.

What is a Learning Field?

A Learning Field is a category that serves as a home for cognate subjects, and that facilitates the formulation of rules of combination for the Further Education and Training Certificate (General). The demarcations of the Learning Fields for Grades 10–12 took cognisance of articulation with the General Education and Training and Higher Education bands, as well as with classification schemes in other countries.

Although, in the development of all the National Curriculum Statement, Grades 10–12 (General) has taken the twelve National Qualifications Framework organising fields as its point of departure, it should be emphasised that those organising fields are not necessarily Learning Fields or "knowledge" fields, but rather are linked to occupational categories.

The following subject groupings were demarcated into Learning Fields to help with learner subject combinations:

- Agricultural Sciences;
- Arts and Culture;
- Business, Commerce and Management Studies;
- Languages;
- Manufacturing, Engineering and Technology;
- Human and Social Studies;
- Physical, Mathematical, Computer and Life Sciences; and
- Services.

What is a subject?

Historically, a subject has been defined as a specific body of academic knowledge. This understanding of a subject laid emphasis on knowledge at the expense of skills, values and attitudes. Subjects were viewed by some as static and unchanging, with rigid boundaries. Very often, subjects mainly emphasised Western contributions to knowledge.

In an outcomes-based curriculum like the National Curriculum Statement Grades 10–12 (General), subject boundaries are blurred. Knowledge integrates theory, skills and values. Subjects are viewed as dynamic, always responding to new and diverse knowledge, including knowledge that traditionally has been excluded from the formal curriculum.

A subject in an outcomes-based curriculum is broadly defined by Learning Outcomes, and not only by its body of content. In the South African context, the Learning Outcomes should, by design, lead to the achievement of the Critical and Developmental Outcomes. Learning Outcomes are defined in broad terms and are flexible, making allowances for the inclusion of local inputs.

What is a Learning Outcome?

A Learning Outcome is a statement of an intended result of learning and teaching. It describes skills, knowledge, values and attitudes (SKVA) that learners should acquire by the end of the Further Education and Training band.

What is an Assessment Standard?

Assessment Standards are criteria that collectively describe what a learner should know and be able to demonstrate at a specific grade. They embody the skills, knowledge, values and attitudes (SKVA) the required to achieve the Learning Outcomes. Assessment Standards within each Learning Outcome collectively show how conceptual progression occurs from grade to grade.

Contents of Subject Statements in the Manufacturing, Engineering and Technology Field

Each draft Subject Statement consists of four chapters:

- *Chapter 1, Introducing the National Curriculum Statement:* This is a generic chapter that introduces the National Curriculum Statement Grades 10–12 (General).
- *Chapter 2, Introducing the Subject:* This chapter introduces the key features of the subject. It consists of a definition of the subject, its purpose, scope, educational and career links, and Learning Outcomes.
- *Chapter 3, Learning Outcomes, Assessment Standards:* This chapter contains Learning Outcomes with their associated Assessment Standards.
- *Chapter 4, Assessment:* This chapter outlines principles for assessment and makes suggestions for recording and reporting on assessment. It also lists subject-specific competence descriptions.
- *Glossary:* Where appropriately, a list of selected general and subject-specific terms are briefly defined.

LEARNING PROGRAMME GUIDELINES

A Learning Programme specifies the scope of learning and assessment for the three grades in the Further Education and Training band. It is the plan that ensures that learners achieve the Learning Outcomes as prescribed by the Assessment Standards for a particular grade. The Learning Programme Guidelines (LPGs) assist teachers and other Learning Programme developers to plan and design quality learning, teaching and assessment programmes.

CHAPTER 2

MECHANICAL TECHNOLOGY

DEFINITION

The subject Mechanical Technology focuses on technological processes from conceptual design through the process of practical problem solving, as well as the application of scientific principles. The subject provides scope for the improvement of the different mechanically related processes, services, systems and the control thereof used in the production and manufacturing of goods and products in order to enhance the quality of life.

PURPOSE

Mechanical Technology plays an increasingly important role in the lives of all South Africans, due to its influence on the scientific and technological developments, which underpins its importance in our country's economic growth and the social well being of our communities. It also underpins many of the technologies taken for granted, from the water we drink to the vehicles we use for movement, and so on.

The subject Mechanical Technology will expose learners to knowledge, skills, values and attitudes (SKVA) relevant to the manufacturing processes. It takes cognisance of and relates to the Critical and Developmental Outcomes outlined in Chapter 1, by teaching learners to:

- understand the social contribution of Mechanical Technology with regard to the promotion of a culture of human rights, economic growth, entrepreneurship, sustainability, and as a tool for change, improving the quality of life and providing solutions that are responsive to individual and community needs;
- identify and solve problems in a Mechanical Technology environment using critical and creative thinking, as well as innovation and ingenuity in order, among others, to develop the creative potential of learners;
- communicate effectively using verbal, written, visual and graphical as well as electronic communication, scientific and mathematical skills as applied to Mechanical Technology;
- organise and manage activities responsibly, and effectively collect, analyse, organise, critically evaluate and present information;
- use science and technology effectively and creatively, showing responsibility towards the environment and the rights and health of others, with particular reference to managing the impact of Mechanical Technology on natural resources, cultural values and socio-economic development; and
- demonstrate an understanding of the ethical considerations, values and attitudes, which relate to Mechanical Technology.

Learners are prepared for various career pathways and additional education and training opportunities by:

- applying knowledge and skills in Mechanical Technology;

- developing entrepreneurial skills;
- exploring education and career opportunities, thus becoming lifelong learners; and
- learning to be sensitive to the rights of others including those living with and affected by HIV/AIDS and learners with special educational needs (LSEN).

SCOPE

The following generic concepts are embedded in Mechanical Technology:

- safety and basic medical emergencies, including HIV/AIDS awareness;
- effective communication techniques including customer relations;
- computer and electronic applications;
- uses and properties of materials
- machines and applications thereof;
- measuring instruments;
- experimentation
- tools and equipment;
- maintenance;
- production;
- manufacturing processes; and
- relevant mathematical and physical science principles.

Mechanical Technology gives learners the opportunity to:

- carry out practical projects, simulations of systems, tasks and real life projects using a variety of processes and skills;
- learn by solving mechanical problems in methodical and creative ways;
- learn by dealing directly with inclusivity, human rights, social and environmental issues in their theoretical and practical tasks;
- use and engage with subject-related knowledge in a purposeful way;
- acquire hand and workshop skills;
- use a variety of life skills when working on projects in an authentic context (e.g. decision making, critical and creative thinking, co-operation, needs identification); and
- develop more positive attitudes and perceptions towards mechanically-based careers.

EDUCATIONAL AND CAREER LINKS

The study of Mechanical Technology builds on the systems, controls, structures and processes found in the Technology Learning Area Statement for the General Education and Training Band. The subject serves to further develop learners' knowledge and understanding of levers, pulleys, gears and mechanisms. Learners are also exposed to the use and application of mechanical advantage, designs and structures as applied in design to promote safety and efficiency. A study of Mechanical Technology provides certain career opportunities for learners with special educational needs allowing them to be economically active.

The Subject Statement is designed to provide learners with a sound academic base that integrates technical and practical competencies. To satisfy the requirements of progression to Higher Education (HE), Mechanical Technology provides a solid foundation in the following tertiary fields of study:

- Mechanical Engineering
- Designing
- Environmental Engineering
- Project Management
- Metallurgic Engineering
- Professional Training and Education

The subject also satisfies the requirements of mobility between National Qualification Framework (NQF) levels within the Further Education and Training sector and career pathways and provides opportunities for learnerships in some related trades encountered in the world of work such as:

- Aircraft technician
- Automotive mechanic
- Boilermaker
- Earth-moving equipment mechanic
- Machinist and fitter in the metal engineering industry
- Welder

LEARNING OUTCOMES

Mechanical Technology enables learners at Further Education and Training Institutions to achieve the following Learning Outcomes. The following four Learning Outcomes are interrelated and should be intergrated.

Learning Outcome 1: Technology, Society and the Environment

The learner is able to demonstrate an awareness and understanding of the interrelationship between Mechanical Technology, society and the environment.

In this Learning Outcome, learners understand the impact of technology on natural resources, culture values and socio-economic development with particular reference to sustainability and indigenous knowledge systems. It also creates awareness in learners about health, fairness and equal access to employment and services and prepares them for the world of work, entrepreneurial opportunities and further studies.

Learning Outcome 2: Technological Process

The learner is able to understand and apply the technological process.

In this Learning Outcome, learners identify, investigate, design, make and evaluate processes and products related to mechanical technology and communicate the findings by using appropriate terminology and a variety of communication media.

Learning Outcome 3: Knowledge and Understanding

The learner is able to demonstrate an understanding of the principles and concepts used in Mechanical Technology.

This Learning Outcome empowers learners to make informed decisions and acquire a broader understanding of how Mechanical Technology relates to their everyday lives.

Learning Outcome 4: Application of Knowledge

The learner is able to apply the principles, practices and skills used in Mechanical Technology by organising and managing activities responsibly and effectively.

In this Learning Outcome learners apply their cognitive and motor skills to engage adequately with challenges encountered in Mechanical Technology.

CHAPTER 3

LEARNING OUTCOMES, ASSESSMENT STANDARDS, CONTENT AND CONTEXTS

INTERRELATEDNESS OF THE LEARNING OUTCOMES

Although all the Learning Outcomes are equally important, they have not been allocated the same weighting in terms of time and resources. Learning Outcome 3 reflects knowledge and understanding, whilst Learning Outcome 4 deals with the application of this knowledge. These two Learning Outcomes are underpinned by Learning Outcome 1, which reflects the interrelationship of technology, society and the environment, and Learning Outcome 2, which outlines the technological process, is used as the organising concept.

THE NUMBERING SYSTEM

All Assessment Standards are numbered in the following manner:

- The first number refers to the grade.
- The second number refers to the Learning Outcome.
- The third number to the Assessment Standard, for example 10.1.4 implies Grade 10, Learning Outcome 1 and Assessment Standard 4.

Grade 10

Learning Outcome 1

Technology, Society and the Environment

The learner is able to demonstrate an understanding of the interrelationship between Mechanical Technology, society and the environment.

Assessment Standards

We know this when the learner is able to:

- 10.1.1
  Describe the interrelationship between technology, society and the environment.
- 10.1.2
  Describe human rights issues.
- 10.1.3
  Describe, explain and respond to basic medical emergencies in context, taking cognisance of health issues such as HIV/Aids.
- 10.1.4
  Identify indigenous knowledge systems of different cultures.
- 10.1.5
  Describe entrepreneurship and its influence on society and environment.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.1.1
  Discuss and evaluate the interrelationship between technology, society and the environment.
- 11.1.2
  Consider human rights issues and discuss fair and equal employment practices.
- 11.1.3
  Describe, explain and respond to medical emergencies in context, taking cognisance of health issues such as HIV/Aids.
- 11.1.4
  Compare how different cultures solve technological problems.
- 11.1.5
  Discuss the competencies required by entrepreneurs.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.1.1
  Predict the impact of future developments in technology on society and environment.
- 12.1.2
  Respect human rights issues and analyse issues relating to employment equity.
- 12.1.3
  Describe, explain and respond to necessary medical emergencies taking cognisance of health issues such as HIV/Aids.
- 12.1.4
  Analyse how solutions to technological problems in different cultures are combined into an optimum solution.
- 12.1.5
  Identify and investigate possible entrepreneurial opportunities.

Grade 10

Learning Outcome 2

Technological Process

The learner is able to understand and apply the technological process.

Note: There is no progression in the Assessment Standards across the grades as Learning Outcome 2 is a process. The progression across the grades is reflected in the degree of increasing complexity of the content.

Assessment Standards

We know this when the learner is able to:

- 10.2.1
  Identify, investigate, define and analyse problems in a given real-life situation.
- 10.2.2
  Generate and/or design possible solutions for problems.
- 10.2.3
  Make or improve products according to a selected design.
- 10.2.4
  Evaluate a final product against the initial design.
- 10.2.5
  Present assignments by means of a variety of communication media.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.2.1
  Identify, investigate, define and analyse problems in a given real-life situation.
- 11.2.2
  Generate and/or design possible solutions for problems.
- 11.2.3
  Make or improve products according to a selected design.
- 11.2.4
  Evaluate a product against the initial design.
- 11.2.5
  Present assignments by means of a variety of communication media.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.2.1
  Identify, investigate, define and analyse problems in a given real-life situation.
- 12.2.2
  Generate and/or design possible solutions for problems.
- 12.2.3
  Make or improve products according to a selected design.
- 12.2.4
  Evaluate the product against the initial design.
- 12.2.5
  Present assignments by means of a variety of communication media.

Grade 10

Learning Outcome 3

Knowledge and Understanding

The learner is able to demonstrate an understanding of the principles and concepts used in Mechanical Technology.

Assessment Standards

We know this when the learner is able to:

- 10.3.1
  Demonstrate an understanding of the Occupational Health and Safety (OHS) Act where applicable.
- 10.3.2
  Describe the functions of appropriate basic tools and equipment.
- 10.3.3
  Explain the reason for using certain engineering materials when taking environmental aspects into consideration.
- 10.3.4
  Understand appropriate terminology and procedures used in the subject.
- 10.3.5
  Explain the uses of semi-permanent joining applications.
- 10.3.6
  Distinguish between different types of forces found in engineering components by graphically determining the nature of these forces.
- 10.3.7
  Explain the effect of inferior maintenance on operating systems.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.3.1
  Demonstrate an understanding of the Occupational Health and Safety (OHS) Act and regulations where applicable.
- 11.3.2
  Explain the functions of purpose-made tools and equipment.
- 11.3.3
  Describe the ways of enhancing the properties of engineering materials by taking environmental aspects like waste management into consideration.
- 11.3.4
  Describe applicable terminology encountered in the subject.
- 11.3.5
  Explain the uses of permanent joining applications.
- 11.3.6
  Demonstrate an understanding of the effect of forces, moments and torques on engineering components applying design principles.
- 11.3.7
  Analyse the causes of malfunctioning of operating systems.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.3.1
  Analyse the use and application of the Occupational Health and Safety (OHS) Act and regulations where applicable.
- 12.3.2
  Describe the principles and functions of advanced engineering equipment.
- 12.3.3
  Classify enhanced materials according to their properties, uses and their environmental aspects.
- 12.3.4
  Apply correct terminology used in the subject in the proper contexts.
- 12.3.5
  Distinguish between the correct and the incorrect application of joining methods.
- 12.3.6
  Demonstrate an understanding of the concepts of stress, strain and modulus of elasticity.
- 12.3.7
  Identify the most suitable preventative maintenance for operating systems.

Grade 10

Learning Outcome 3 (continued)

Knowledge and Understanding

The learner is able to demonstrate an understanding of the principles and concepts used in Mechanical Technology.

Assessment Standards

We know this when the learner is able to:

- 10.3.8
  Describe the functions and control of components used in different operating systems, such as mechanical, hydraulic and pneumatic systems.
- 10.3.9
  Describe the operating principles of heat engines.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.3.8
  Analyse the operation of components applicable to mechanical and/or electronic systems and control.
- 11.3.9
  Describe the operating principles of pumps.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.3.8
  Use calculations to solve problems concerning systems and control.
- 12.3.9
  Describe the operating principles of turbines.

Grade 10

Learning Outcome 4

Application of Knowledge

The learner is able to apply the principles, practice and skills used in Mechanical Technology by organising and managing activities responsibly and effectively.

Assessment Standards

We know this when the learner is able to:

- 10.4.1
  Apply all relevant safety measures.
- 10.4.2
  Select, use and care for appropriate basic tools and equipment.
- 10.4.3
  Distinguish between various materials according to their properties.
- 10.4.4
  Use instructions or basic drawings and apply different cutting methods to make an artefact.
- 10.4.5
  Use working instructions and apply basic semi-permanent joining methods.
- 10.4.6
  Perform basic tests to verify various mechanical principles.
- 10.4.7
  Identify signs of wear on components of mechanical systems due to friction.
- 10.4.8
  Demonstrate competency on basic systems and control.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.4.1
  Apply all relevant safety measures.
- 11.4.2
  Demonstrate the care and use of hand and power tools.
- 11.4.3
  Apply measures to effect changes to the properties of materials so as to enhance their suitability.
- 11.4.4
  Use intermediate instructions and drawings and apply different cutting methods to make an artefact.
- 11.4.5
  Use working instructions and apply complex but relevant joining methods.
- 11.4.6
  Perform intermediate tests to verify various mechanical principles.
- 11.4.7
  Evaluate and report on the deterioration of various mechanical components.
- 11.4.8
  Demonstrate competency on intermediate systems and control.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.4.1
  Apply all relevant safety measures.
- 12.4.2
  Care for and use appropriate specialised engineering equipment.
- 12.4.3
  Select appropriate materials suitable for their application.
- 12.4.4
  Use advanced instructions and/or drawings and apply different cutting methods to make an artefact.
- 12.4.5
  Use working instructions and apply advanced but relevant joining methods.
- 12.4.6
  Perform advanced tests to verify various mechanical principles.
- 12.4.7
  Suggest applicable repair methods and adjustments to various systems.
- 12.4.8
  Demonstrate competency on advanced systems and control.

Grade 10

Learning Outcome 4 (continued)

Application of Knowledge

The learner is able to apply the principles, practice and skills used in Mechanical Technology by organising and managing activities responsibly and effectively.

Assessment Standards

We know this when the learner is able to:

- 10.4.9
  Demonstrate an understanding of the main functions of the components required for the internal combustion engines.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.4.9
  Demonstrate an understanding of the operating principles of pumps.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.4.9
  Demonstrate an understanding of the operating principles of turbines.

CONTENT AND CONTEXTS FOR THE ATTAINMENT OF ASSESSMENT STANDARDS

In this section, content and contexts are provided to support the attainment of the Assessment Standards. The content indicated needs to be dealt with in such a way to empower the learner to achieve the Learning Outcomes. Content must serve the Learning Outcomes and not be an end in itself.

The contexts suggested enable the content to be embedded in situations, which are meaningful to the learner and so assist learning, and teaching. The educators should be aware of and use local contexts, which could be more suited to the experiences of the learner.

Content and contexts, when aligned to the attainment of the Assessment Standards, provide a framework for the development of Learning Programmes. The Mechanical Technology Learning Programme Guidelines give more detail in this respect.

Grade 10

Learning Outcome 1

Technology, Society and the Environment

The learner is able to demonstrate an understanding of the interrelationship between mechanical technology, society and the environment.

Assessment Standards

The content and context could include the following:

- 10.1.1
  Understanding the issues of environmental technology
- 10.1.2
  Understanding human rights as captured in the Bill of Rights
- 10.1.3
  Responding to basic medical emergencies in context, taking cognisance of health issues such as HIV/Aids
- 10.1.4
  Understanding indigenous knowledge systems of different cultures
- 10.1.5
  Understanding the principles of entrepreneurial activity

Grade 11

Assessment Standards

The content and context could include the following:

- 11.1.1
  Describing environmental technology
- 11.1.2
  Discussing human rights issues including fairness, equality and inclusivity
- 11.1.3
  Responding to basic medical emergencies in context, taking cognisance of health issues such as HIV/Aids
- 11.1.4
  Comparing how different cultures solve technological problems
- 11.1.5
  Discussing entrepreneurial principles to help improve the economy

Grade 12

Assessment Standards

The content and context could include the following:

- 12.1.1
  Applying the principles of conservation related to environmental technology
- 12.1.2
  Applying human rights and work ethics
- 12.1.3
  Responding to basic medical emergencies in context, taking cognisance of health issues such as HIV/Aids
- 12.1.4
  Analysing solutions to technological problems in different cultures
- 12.1.5
  Investigating entrepreneurial opportunities

Grade 10

Learning Outcome 2

Technological Process

The learner is able to understand and apply the technological process.

Assessment Standards

The content and context could include the following:

- 10.2.1
  Identifying, investigating, researching, accessing, processing and using data to make a meaningful summary
- 10.2.2
  Designing by taking cognisance of constraints, specifications, alternative solutions and substantiating choice of design
- 10.2.3
  Making products according to the design and specifying materials, tools and equipment, processes and sequence of manufacturing process
- 10.2.4
  Evaluating and testing the product to establish if it satisfies the design brief and suggesting improvements
- 10.2.5
  Choosing and using appropriate technologies such as computers, photocopiers, stencils and audio-visual recordings to combine graphics and text to record and communicate the problem-solving process

Grade 11

Assessment Standards

The content and context could include the following:

- 11.2.1
  Identifying, investigating, researching, accessing-, processing and using data to make a meaningful summary
- 11.2.2
  Designing by taking cognisance of constraints, specifications and alternative solutions and substantiating choice of design
- 11.2.3
  Making products according to the design and specifying materials, tools and equipment, processes and sequence of manufacturing process
- 11.2.4
  Evaluating and testing the product to establish if it satisfies the design brief and suggesting improvements
- 11.2.5
  Choosing and using appropriate technologies such as computers, photocopiers, stencils and audio-visual recordings to combine graphics and text to record and communicate the problem-solving process

Grade 12

Assessment Standards

The content and context could include the following:

- 12.2.1
  Identifying, investigating, researching, accessing, processing and using data to make a meaningful summary
- 12.2.2
  Designing by taking cognisance of constraints, specifications and alternative solutions and substantiating choice of design
- 12.2.3
  Making products according to the design and specifying materials, tools and equipment, processes and sequence of manufacturing process
- 12.2.4
  Evaluating and testing the product to establish if it satisfy the design brief and suggesting improvements
- 12.2.5
  Choosing and using appropriate technologies such as computers, photocopiers, stencils and audio-visual recordings to combine graphics and text to record and communicate the problem-solving process

Grade 10

Learning Outcome 3

Knowledge and Understanding

The learner is able to demonstrate an understanding of the principles and concepts used in Mechanical Technology.

Assessment Standards

The content and context could include the following:

- 10.3.1
  Occupational Health and Safety Act (OHS Act) with reference to general unsafe actions, dangerous practices and unsafe conditions
- 10.3.2
  Basic hand and cutting tools and measuring instruments such as pliers, hammers, hacksaws, screwdrivers, spanners, chisels and punches
- 10.3.3
  Properties of various ferrous and non-ferrous metals such as cast iron, spring steel, mild steel, aluminium, lead, copper, tungsten, chrome, white metal and phosphor bronze
- 10.3.4
  Meaning of symbols, units and terminology applicable to mechanical technology
- 10.3.5
  Use of different types of semi-permanent joining applications
- 10.3.6
  Types of forces applied to mechanical components

Grade 11

Assessment Standards

The content and context could include the following:

- 11.3.1
  Occupational Health and Safety Act (OHS Act) with reference to machine-specific unsafe actions, dangerous practices and unsafe conditions
- 11.3.2
  Applicable hand and power tools such as portable and pedestal drilling machines; angle, surface and bench grinders; guillotines; lathes and welding machines
- 11.3.3
  Methods of enhancing the properties of engineering materials including annealing, case hardening, hardening, normalising, tempering galvanising and powder coating
- 11.3.4
  Interpretation of various Systeme International (SI) units and symbols
- 11.3.5
  Use of different types of permanent joining application
- 11.3.6
  Effects of moments and torque on mechanical components

Grade 12

Assessment Standards

The content and context could include the following:

- 12.3.1
  Occupational Health and Safety Act (OHS Act) with reference to unsafe actions, dangerous practices and unsafe conditions
- 12.3.2
  All relevant specialised mechanical equipment which includes box, plug and valve spanners; bearing and gear pullers; tensile testing apparatus
- 12.3.3
  Classification of the enhanced materials according to their properties and uses including high, medium and low carbon steel and alloys
- 12.3.4
  Interpretation of various symbols and Systeme International (SI) units and terminology
- 12.3.5
  Analysis of correct and incorrect application of joining methods
- 12.3.6
  Concepts of stress, strain and Modulus of Elasticity

Grade 10

Learning Outcome 3 (continued)

Knowledge and Understanding

The learner is able to demonstrate an understanding of the principles and concepts used in Mechanical Technology..

Assessment Standards

We know this when the learner is able to:

- 10.3.7
  Importance of the maintenance of operating systems
- 10.3.8
  Functions and control of components applicable to mechanical, hydraulic, pneumatic and electrical or electronic systems
- 10.3.9
  Principles of operation of heat engines

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.3.7
  Causes for deterioration in operating systems
- 11.3.8
  Operation and control of components applicable to mechanical, hydraulic, pneumatic and electrical or electronic systems
- 11.3.9
  Principles of operation of pumps

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.3.7
  Reducing deterioration in operating systems
- 12.3.8
  Fault-finding techniques on operating mechanical, hydraulic, pneumatic and electrical or electronic systems
- 12.3.9
  Principles of operation of turbines

Grade 10

Learning Outcome 4

Application of Knowledge

The learner is able to apply the principles, practice and skills used in Mechanical Technology by organising and managing activities responsibly and effectively.

Assessment Standards

The content and context could include the following:

- 10.4.1
  Application of the Occupational Health and Safety Act (OHS Act)and proper housekeeping
- 10.4.2
  Use and care of measuring instruments, basic hand and cutting tools
- 10.4.3
  Identification of materials according to their properties including general appearance test, sound test, spark test and appearance of fracture and machining test
- 10.4.4
  Working from a given set of instructions and using production methods such as drilling; cutting, filling, squaring and turning to make an artefact
- 10.4.5
  Using a variety of joining techniques including rivets, locking devices, bolts and nuts
- 10.4.6
  Testing of concepts such as forces, pressure and torque

Grade 11

Assessment Standards

The content and context could include the following:

- 11.4.1
  Application of the Occupational Health and Safety Act (OHS Act) and other safety precautions
- 11.4.2
  Use and care of hand and power tools
- 11.4.3
  Application of measures to change the properties of materials for different uses including but not limited to tempering and case hardening
- 11.4.4
  Working from a given set of intermediate instructions and using production methods such as machining and applying cutting techniques to construct an artefact
- 11.4.5
  Applying a variety of joining techniques including soldering, oxy-acetylene gas welding and arc welding
- 11.4.6
  Testing of concepts such as bending moments and stresses

Grade 12

Assessment Standards

The content and context could include the following:

- 12.4.1
  Application of the Occupational Health and Safety Act (OHS Act) and all other safety measures
- 12.4.2
  Use and care of specialised mechanical equipment
- 12.4.3
  Selection of materials of different applications including but not limited to composites like nylon, glass fibre and carbon fibre
- 12.4.4
  Working from a given set of advance instructions and employing manufacturing methods which include milling, profile cutting and Computerised Numerical Control (CNC) to produce an artefact
- 12.4.5
  Using a variety of joining techniques including Gas Metal Arc Welding (GMAW)
- 12.4.6
  Testing of advanced concepts such as bending moments, shear forces, stresses, strains and elasticity

Grade 10

Learning Outcome 4 (continued)

Application of Knowledge

The learner is able to apply the principles, practice and skills used in Mechanical Technology by organising and managing activities responsibly and effectively.

Assessment Standards

We know this when the learner is able to:

- 10.4.7
  Demonstrating the ability to perform routine maintenance
- 10.4.8
  Application of the principles of mechanisms such as levers, linkages, pulleys, gears, cams and belts
- 10.4.9
  Identifying and describing the operating principles of heat engines

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.4.7
  Monitoring the condition and fault finding of various mechanical systems
- 11.4.8
  Application of the operating principles of pneumatics and hydraulics including compressed air, gas, steam, water and fuel
- 11.4.9
  Identifying and describing the operating principles of pumps

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.4.7
  Understanding numerous repair methods for various mechanical systems
- 12.4.8
  Application of the operating principles of integrated electronic or mechanical systems such as programmable computer control systems
- 12.4.9
  Identifying and describing different types of turbines and their components

CHAPTER 4

ASSESSMENT

INTRODUCTION

Assessment is a critical element of the National Curriculum Statement Grades 10–12 (Schools). It is a process of collecting and interpreting evidence in order to make a judgement on a learner's performance. Evidence can be collected at different times and places, and with the use of various methods, instruments, modes, and media.

To ensure that assessment results can be accessed and used for various purposes at a future date, the results have to be recorded. There are various approaches to recording learners' performances. Some of these will be explored in this chapter. Others will be made more subject specific in the Learning Programme Guidelines.

There are many stakeholders who have an interest in how learners perform in Grades 10–12. These include the learners themselves, parents, guardians, sponsors, provincial departments of education, Department of Education (National), the Ministry of Education, employers, and higher education and training institutions. In order to facilitate access to learners' overall performances and to inferences on learners' competences, assessment results have to be reported. There are many ways of reporting. The Learning Program Guidelines and Assessment Guidelines discuss ways of recording and reporting on school-based assessment as well as giving guidance to assessment issues specific to the subject.

WHY ASSESS

Before a teacher assesses learners, it is crucial that the purposes of the assessment be clearly and unambiguously established. Understanding the purposes of assessment ensures that an appropriate match exists between the purposes and the methods of assessment, in order that decisions and conclusions based on the assessment are fair and appropriate for the particular purpose(s).

There are many reasons why learners' performances are assessed. These include assessment for monitoring progress and providing feedback, diagnosing or remediating barriers to learning, selection, guidance, supporting learning, certification, and for promotion.

In this curriculum, learning and assessment are inextricably linked. Assessment helps learners to gauge the value of their learning. It gives learners information about own progress and enables them to take control of and to make decisions about their learning. In this sense, assessment provides information about whether teaching and learning is succeeding in getting closer to the pre-set outcomes. When assessment indicates lack of progress, teaching and learning plans should be changed accordingly.

TYPES OF ASSESSMENT

This section discusses the following types of assessment:

- baseline assessment;
- diagnostic assessment;
- formative assessment; and
- summative assessment.

Baseline assessment

Baseline assessment is important at the start of a grade, but can occur at the beginning of any learning cycle. It is used to establish what learners already know and can do. It helps in the planning of activities and in learning program development. The recording of baseline assessment is usually informal.

Diagnostic assessment

Any assessment can be used for diagnostic purposes – that is, to discover the cause or causes of a learning barrier. Diagnostic assessment assists in deciding on support strategies or identifying the need for professional help or remediation. It acts as a checkpoint to help redefine the Learning Programme goals, or to discover what learning has not taken place so as to put intervention strategies in place.

Formative assessment

Any form of assessment that is used to give feedback to the learner is fulfilling a formative purpose. Formative assessment is a crucial element of teaching and learning. It monitors and supports the learning process. All stakeholders use this type of assessment to acquire information of the progress of the learners. Constructive feedback is a vital component of assessment.

Summative assessment

When an assessment is used to record a judgment of the competence or performance of the learner, it serves a summative purpose. Summative assessment gives a picture of a learner's competence or progress at any specific moment. It can occur at the end of a single learning activity, a unit, cycle, term, semester, or year of learning. Summative assessment should be planned and a variety of assessment instruments and strategies should be used to enable learners to demonstrate competence.

WHAT ASSESSMENT SHOULD BE AND DO

Assessment should:

- be understood by the learner and by the broader public;
- be clearly focused;
- be integrated with teaching and learning;
- be based on pre-set criteria of the Assessment Standards;
- use a variety of instruments;
- use a variety of methods;
- allow for expanded opportunities for learners;
- be learner-paced and fair;
- be flexible.

HOW TO ASSESS

Educators' assessment of learners' performances must have a great degree of reliability. That means that educators' judgments of learners' competences should be generalisable across different times, assessment items, and markers. The judgments made through assessment should also show a great degree of validity that is, they should be made on the aspects of learning that were assessed.

Because each assessment cannot be totally valid or reliable by itself, decisions on learner progress must be based on more than one assessment. This is the principle behind continuous assessment (CASS). CASS is an assessment strategy that bases decisions about learning on a range of different assessment activities and events that happen at different times throughout the learning process. It involves assessment activities that are spread throughout the year, using various kinds of assessment instruments and methods such as tests, examinations, projects and assignments. Oral, written and performance assessments are included. The different pieces of evidence that learners produce as part of CASS can be included in a portfolio. Different subjects have different requirements for what should be included in the portfolio. The Learning Program Guidelines discuss these requirements further.

CASS is classroom- and school-based and focuses on the ongoing manner in which assessment is integrated into the process of teaching and learning. Educators get to know their learners through their day-to-day teaching, through questioning, through observation, and through interacting with the learners and watching them interact with one another.

CASS should be applied both to those sections of the curriculum that are best assessed through written tests and assignments and those that are best assessed through other methods, such as by performance, using practical or spoken evidence of learning.

METHODS OF ASSESSMENT

Self-assessment

All outcomes and assessment standards are transparent. Learners know what is expected of them. Learners can, therefore play an important part, through self-assessment, in "pre-assessing" work before the educator does the final assessment. Reflection on own learning is a vital component of learning.

Peer assessment

Peer assessment, using a checklist or rubric, helps both the learners whose work is being assessed and the learners who are doing the assessment. The sharing of the criteria for assessment empowers learners to evaluate their own and others' performances.

Group assessment

The ability to work effectively in groups is one of the Critical Outcomes. Assessing group work involves looking for evidence that the group of learners co-operate, assist one another, divide work, and combine individual contributions into a single composite assessable product. Group assessment looks at process as well as product. It involves assessing social skills, time management, resource management and group dynamics, as well as the output of the group.

METHODS OF COLLECTING ASSESSMENT EVIDENCE

There are various methods of collecting evidence. Some of these are discussed below.

Observation-based assessment

Observation-based assessment methods tend to be less structured and allow us to record different kinds of evidence for different learners at different times.

This kind of assessment is often based on tasks that require learners to interact with one another in pursuit of a common solution or product. Observation has to be intentional and should be conducted with the help of an appropriate observation instrument.

Test-based assessment

Test-based assessment is more structured to enable teachers to gather the same evidence for all learners, in the same way and at the same time. This kind of assessment creates evidence of learning that is verified by a specific

score. If used correctly, tests and examinations remain an important part of the curriculum because they give good evidence of what has been learned.

Task-based assessment

Task-based or performance assessment methods aim to show whether learners can apply the skills and knowledge they have learned in unfamiliar contexts or contexts outside of the classroom. Performance assessment also covers the practical components of the subjects, evaluating how learners put theory into practice. The criteria, standards or rules, by which the task will be assessed, described in rubrics or task checklists, help the educator to use professional judgement to assess each learner's performance.

RECORDING AND REPORTING

Recording and reporting involves the capture of data collected during assessment so that it can be logically evaluated and published in an accurate and understandable way.

Methods of recording

There are different methods of recording. It is often difficult to separate methods of recording from methods of evaluating learners' performances.

The following are examples of different types of recording instruments:

- rating scales;
- task lists or checklists; and
- rubrics.

Each example is discussed below.

Rating scales

Rating scales are any marking system, where a symbol (such as an A or B) or a mark (such as 5/10 or 50%) is defined in detail to link the coded score to a description of the competences that are required to achieve that score. The detail is more important than the coded score in the process of teaching and learning as it gives learners a much clearer idea of what has been achieved and where and why their learning has fallen short of the target. Traditional marking used rating scales mostly without the descriptive details, making it difficult to have a sense of the learners' strengths and weaknesses in terms of intended outcomes.

Task lists or checklists

Task lists or checklists consist of discrete statements describing the expected performance in a particular task. When a particular statement (criterion) on the checklist can be observed as having been satisfied by a learner during a performance, the statement is ticked off. All the statements that have been ticked off on the list (as criteria that have been met) describe the learner's performance. These checklists are very useful in peer or group assessment activities.

Rubrics

Rubrics are a combination of rating codes and descriptions of standards. They consist of a hierarchy of standards with benchmarks that describe the minimum standard of acceptable performance in each code band. Rubrics require educators to know exactly what is required by the outcome. Rubrics can be holistic, giving a global picture of the standard required, or analytic, giving a clear picture of the distinct features that make up the criteria, or can combine both. The Learning Program Guidelines give examples of subject specific rubrics.

To design a rubric, an educator has to decide:

- what outcomes are being targeted;
- what assessment standards are targeted by the task;
- what kind of evidence should be collected;
- what are the different parts of the performance that will be assessed;
- what different assessment instruments best suit each part of the task (such as the process and the product);
- what knowledge should be evident;
- what skills should be applied or actions taken;
- what opportunities for expressing personal opinions, values or attitudes arise in the task and which of these should be assessed and how;
- whether the one rubric should target all the outcomes and assessment standards of the task or whether the task needs several rubrics; and
- how many rubrics are, in fact, needed for the task?

It is crucial that an educator shares the rubric/s for the task with learners before they do the required task. The rubric focuses both the learning and the performance and becomes a powerful tool for self-assessment.

Reporting performance and achievement

Reporting performance and achievement informs all those involved with or interested in the learners' progress. Once the evidence has been collected and interpreted, educators need to record learners' achievements. Sufficient summative assessments need to be made so that a report can make a statement about the standard achieved by the learner.

The National Curriculum Statement Grades 10–12 adopts a 6-point scale of achievement. The scale is shown in the table overleaf.

Table 4.1 Scale of achievement for the National Curriculum Statement Grades 10–12 (General)

Rating Code	Description of Competence	Marks (%)
6	Outstanding	80–100
5	Meritorious	60–79
4	Satisfactory	50–59
3	Adequate	40–49
2	Partial	30–39
1	Inadequate	0–29

SUBJECT COMPETENCE DESCRIPTIONS

To assist with benchmarking the achievement of outcomes at each of Grades 10–12, subject competences have been described to distinguish the grade expectations of what learners must know and be able to achieve. Six levels of competence have been described for each subject for each grade. These descriptions will assist educators to assess learners and place them in the correct rating. The descriptions summarize what is spelled out in detail in the learning outcomes and the assessment standards and give the distinguishing features that fix the achievement for a particular rating.

In line with the principles and practice of outcomes-based assessment, all assessment, both school-based and external, should primarily be criterion-referenced. Marks could, however, be used in evaluating specific assessment tasks, but tasks should be assessed against rubrics instead of simply ticking right answers and awarding marks in terms of the number of ticks. The statements of competence for a subject describes the minimum skills, knowledge, attitudes and values that a learner should demonstrate for achievement on each level of the rating scale.

When educators/assessors prepare an assessment task/question, they must ensure that the task/question addresses an aspect of a particular outcome. The relevant assessment standard/s must be used in creating the rubric for assessing the task/question. The descriptions indicate clearly what the minimum level of attainment for each category on the rating scale is.

PROMOTION

Promotion at Grade 10 and Grade 11 level will be based on internal assessment only but must be based on the same conditions as those for the FETC. The requirements, conditions, rules of combination and of condonation are spelled out in the Qualification and Assessment Policy Framework.

WHAT REPORT CARDS SHOULD LOOK LIKE

There are many ways to structure a report card but the simpler the report card the better, providing that all the important information is included. Report cards should include information about a learner's overall progress that shows:

- the learning achievement against outcomes;
- the learner's strengths;
- the support needed or provided where relevant;
- constructive feedback commenting on the performance in relation to the learner's previous performance/s and the requirements of the subject ; and
- the learner's developmental progress in learning how to learn.

In addition, report cards should include the following:

- name of school;
- name of learner;
- learner's grade;
- year and term;
- signature of parent or guardian;
- signature of educator and of principal;
- date;
- dates of closing and re-opening of school;
- school stamp; and
- school attendance profile of learner.

ASSESSMENT OF LEARNERS WHO EXPERIENCE BARRIERS TO LEARNING

The assessment of learners who experience any barriers to learning will be conducted in accordance with the recommended alternative and/or adaptive methods as stipulated in the document *Qualifications and Assessment Policy Framework for Grades 10–12 (Schools)* as it relates to learners who experience barriers to learning.

COMPETENCE DESCRIPTIONS FOR MECHANICAL TECHNOLOGY

The Competence Descriptions are a reporting tool. They report on the learner's level of achievement based on the Assessment Standards and the Learning Outcomes.

Grade 10

Code	Scale	Competence Descriptions
6	**Outstanding 80%–100%**	**At the end of Grade 10 the learner with Outstanding Achievement can:**

- With great sense of responsibility, demonstrate basic safety measures in the workplace, and without hesitation, respond to basic emergency situations showing compassion to health issues such as HIV/Aids.
- Show consideration for human rights issues, entrepreneurial concepts and pollution and waste management.
- Independently and enthusiastically analyse and apply the technological process to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- Easily analyse and critically interpret terminology and symbols and easily select materials for a wide range of applications such as cutting and semi-permanent jointing.
- With ease, correctly use and care for measuring instruments, tools and equipment.
- Independently solve problems and effectively perform tests on mechanical principles such as forces, pressure and torque.
- Demonstrate desirable competencies and control of basic systems.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Outstanding Achievement can:

- With great sense of responsibility, demonstrate machine-specific safety measures in the workplace, and without hesitation, respond to basic emergency situations showing compassion to health issues such as HIV/Aids.
- Confidently analyse and interpret human rights issues and present competencies required by entrepreneurs, taking environmental impact into account.
- Independently and enthusiastically, using relevant terminology, analyse and apply the technological process to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- Easily analyse and critically interpret terminology and symbols and easily select materials for a wide range of applications such as intermediate cutting and permanent jointing.
- With ease, correctly use and care for purpose-made tools and equipment.
- Independently solve problems and effectively perform tests on mechanical principles such as bending moments and shear forces.
- Demonstrate desirable competencies and control of intermediate systems.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Outstanding Achievement can:

- With great sense of responsibility, analyse and evaluate safety measures in the workplace, and without hesitation, respond to basic emergency situations showing compassion to health issues such as HIV/Aids.
- Confidently analyse issues relating to employment equity and entrepreneurial opportunities and predict the interaction between technology society and environment.
- Independently and enthusiastically, using correct terminology, apply the technological process to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- Easily analyse and critically interpret terminology and symbols and easily select materials for a wide range of applications such as advanced cutting and jointing.
- With ease, correctly use and care for specialised mechanical equipment.
- Independently solve problems and effectively perform tests on mechanical principles such as stress and strain.
- Demonstrate desirable competencies and control of advanced systems.

Grade 10

Code	Scale	Competence Descriptions
6 (continued)	**Outstanding 80%–100%**	**At the end of Grade 10 the learner with Outstanding Achievement can:** ■ Independently apply routine maintenance and without hesitation identify signs of wear on components. ■ Unaided, demonstrate a thorough understanding of the main functions of the components required for internal combustion engines.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Outstanding Achievement can:

- Independently monitor the condition of components and effectively identify causes of malfunction.
- Unaided, demonstrate a thorough understanding of the main functions of the components required for the operating principles of pumps.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Outstanding Achievement can:

- Independently identify the most suitable preventative maintenance methods and effectively apply fault-finding techniques.
- Unaided, demonstrate a thorough understanding of the main functions of the components required for the operating principles of turbines.

Grade 10

Code	Scale	Competence Descriptions
5	**Meritoriuos 60%–79%**	**At the end of Grade 10 the learner with Meritoriuos Achievement can:**

- Demonstrate a good understanding of basic safety measures in the workplace and respond confidently to basic emergency situations showing sensitivity to health issues such as HIV/Aids.
- Show respect and awareness for human rights issues, entrepreneurial concepts and pollution and waste management.
- Show sufficient ability to analyse and apply the technological process to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- Analyse and correctly interpret terminology and symbols and carefully select materials for a wide range of applications such as cutting and semi-permanent jointing.
- Correctly use and care for measuring instruments, tools and equipment.
- Solve problems and perform tests on mechanical principles such as forces, pressure and torque.
- Demonstrate competencies and control of basic systems.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Meritoriuos Achievement can:

- Demonstrate a good understanding of machine-specific safety in the workplace and respond confidently to basic emergency situations showing sensitivity to health issues such as HIV/Aids.
- Independently analyse and interpret human rights issues and present competencies required by entrepreneurs, taking environmental impact into account.
- Using relevant terminology, show sufficient ability to analyse and apply the technological process to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- Analyse and correctly interpret terminology and symbols and carefully select materials for a wide range of applications such as intermediate cutting and permanent jointing.
- Correctly use and care for purpose-made tools and equipment.
- Solve problems and perform tests on mechanical principles such as bending moments and shear forces.
- Demonstrate competencies and control of intermediate systems.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Meritoriuos Achievement can:

- Demonstrate a good understanding, analysis and evaluation of safety measures in the workplace and respond confidently to basic emergency situations showing sensitivity to health issues such as HIV/Aids.
- Analyse issues relating to employment equity and entrepreneurial opportunities and predict the interaction between technology society and environment.
- Show sufficient ability to analyse detailed explanations and make recommendations using correct terminology to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- Analyse and correctly interpret terminology and symbols and carefully select materials for a wide range of applications such as advanced cutting and jointing.
- Correctly use and care for specialised mechanical equipment.
- Solve problems and perform tests on mechanical principles such as stress and strain.
- Demonstrate competencies and control of advanced systems.

Grade 10

Code	Scale	Competence Descriptions
5 (continued)	**Meritoriuos 60%–79%**	**At the end of Grade 10 the learner with Meritoriuos Achievement can:** ■ Apply routine maintenance and identify signs of wear on components. ■ Confidently demonstrate an understanding of internal combustion engines.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Meritoriuos Achievement can:

- Monitor the condition of components and identify causes of malfunction.
- Confidently demonstrate an understanding of the operating principles of pumps.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Meritoriuos Achievement can:

- Apply suitable preventative maintenance methods and effectively apply fault-finding techniques.
- Confidently demonstrate an understanding of the operating principles of turbines.

Grade 10

Code	Scale	Competence Descriptions
4	**Satisfactory 50%–59%**	**At the end of Grade 10 the learner with Satisfactory Achievement can:**

- Demonstrate an understanding of basic safety measures in the workplace and respond to basic medical emergencies showing sensitivity to health issues such as HIV/Aids.
- Show awareness of human rights issues, entrepreneurial concepts and pollution and waste management.
- Analyse and apply the technological process to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- To a certain extent, analyse and interpret terminology and symbols and select materials for a wide range of applications such as cutting and semi-permanent jointing.
- Use and care for measuring instruments, tools and equipment.
- To a certain extent, solve most problems and perform tests on mechanical principles such as forces, pressure and torque.
- Show adequate competency and control of basic systems.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Satisfactory Achievement can:

- Demonstrate an understanding of machine-specific safety measures in the workplace and respond to basic medical emergencies showing sensitivity to health issues such as HIV/Aids.
- Analyse and interpret human rights issues and present competencies required by entrepreneurs, taking environmental impact into account.
- Using relevant terminology, analyse and apply the technological process to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- To a certain extent, analyse and interpret terminology and symbols and select materials for a wide range of applications such as intermediate cutting and permanent jointing.
- Use and care for measuring purpose made tools and equipment.
- To a certain extent, solve most problems and perform tests on mechanical principles such as bending moments and shear forces.
- Show adequate competency and control of intermediate systems.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Satisfactory Achievement can:

- Demonstrate an understanding, analysis and evaluation of safety measures in the workplace and respond to basic medical emergencies showing sensitivity to health issues such as HIV/Aids.
- Analyse issues relating to employment equity and entrepreneurial opportunities and predict the interaction between technology society and environment.
- Using correct terminology, detailed explanations and recommendations, analyse and apply the technological process to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- To a certain extent, analyse interpret terminology and symbols and select materials for a wide range of applications such as advanced cutting and jointing.
- Use and care for specialised mechanical equipment.
- To a certain extent, solve most problems and perform tests on mechanical principles such as stress and strain.
- Show adequate competency and control of advanced systems.

Grade 10

Code	Scale	Competence Descriptions
4 (continued)	**Satisfactory 50%–59%**	**At the end of Grade 10 the learner with Satisfactory Achievement can:** ■ To a certain extent, apply some routine maintenance and identify various signs of wear on components. ■ Demonstrate an understanding of internal combustion engines.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Satisfactory Achievement can:

- To a certain extent, monitor the condition of some components and identify causes of malfunction.
- Demonstrate an understanding of the operating principles of pumps.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Satisfactory Achievement can:

- To a certain extent, apply suitable preventative maintenance methods and effectively apply fault-finding techniques.
- Demonstrate an understanding of the operating principles of turbines.

Grade 10

Code	Scale
3	Adequate 40%–49%

Competence Descriptions

At the end of Grade 10 the learner with Adequate Achievement can:

- Show partial knowledge of safety measures in the workplace and to a certain extent respond to medical emergencies showing some sensitivity to health issues such as HIV/Aids.
- With sufficient assistance, show some understanding for human rights issues, entrepreneurial concepts and pollution and waste management.
- With sufficient facilitation, analyse and apply the technological process to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- With some guidance, interpret terminology and symbols and select most materials and procedures to apply cutting and semi-permanent jointing.
- With some guidance, use and care for most measuring instruments, tools and equipment.
- With guidance, solve problems and perform tests on mechanical principles such as forces, pressure and torque.
- With a little help, demonstrate some competencies and control of basic systems.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Adequate Achievement can:

- Show partial knowledge of machine-specific safety in the workplace and to a certain extent respond to medical emergencies showing some sensitivity to health issues such as HIV/Aids.
- With sufficient help, analyse and interpret human rights issues and present competencies required by entrepreneurs, taking environmental impact into account.
- With sufficient facilitation, and analyse and apply the technological process, using relevant terminology, to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- With some guidance, interpret terminology and symbols and select most materials and procedures to apply intermediate cutting and permanent jointing.
- With some guidance, use and care for most purpose-made tools and equipment.
- With guidance, solve problems and perform tests on mechanical principles such as bending moments and shear.
- With a little help, demonstrate some competencies and control of intermediate systems.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Adequate Achievement can:

- Show partial knowledge, analysis and evaluation of safety measures in the workplace and to a certain extent respond to medical emergencies showing some sensitivity to health issues such as HIV/Aids.
- With sufficient guidance, analyse issues relating to employment equity and entrepreneurial opportunities and predict the interaction between technology society and environment.
- With sufficient facilitation, analyse detailed explanations and recommendations using correct terminology to solve a real-life challenge, taking cognisance of indigenous knowledge systems.
- With some guidance, interpret terminology and symbols and select most materials and procedures to apply advanced cutting and permanent jointing.
- With some guidance, use and care for specialised mechanical equipment.
- With guidance, solve problems and perform tests on mechanical principles such as stress and strain.
- With a little help, demonstrate some competencies and control of advanced systems.

Grade 10

Code	Scale	Competence Descriptions
3 (continued)	**Adequate 40%–49%**	**At the end of Grade 10 the learner with Adequate Achievement can:** ■ With guidance, apply some routine maintenance and identify signs of wear on components. ■ With some help, show an understanding of internal combustion engines.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Adequate Achievement can:

- With some assistance, monitor the condition of most of the components and identify most of the causes of malfunction.
- With some help, show an understanding of the operating principles of pumps.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Adequate Achievement can:

- With some assistance, identify preventative maintenance methods and apply effectively fault-finding techniques.
- With some help, show an understanding of the operating principles of turbines.

Grade 10

Code	Scale	Competence Descriptions
2	**Partial 30%–39%**	**At the end of Grade 10 the learner with Partial Achievement can:**

- Demonstrate limited insight into safety measures in the workplace and show uncertainty in medical emergencies situations showing little sensitivity to health issues such as HIV/Aids.
- Even with constant guidance, show limited understanding of human rights issues, entrepreneurial concepts and pollution and waste management.
- With extensive guidance, seldom analyse and apply the technological process to solve a real-life challenge, taking limited cognisance of indigenous knowledge systems.
- With constant assistance, interpret some terminology and symbols and select some materials and procedures to apply cutting and semi-permanent jointing.
- With constant assistance, use and care for measuring instruments, tools and equipment.
- With constant help, solve some problems and perform some tests on mechanical principles such as forces, pressure and torque.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Partial Achievement can:

- Demonstrate limited insight into machine-specific safety in the workplace and show uncertainty in medical emergencies showing little sensitivity to health issues such as HIV/Aids.
- With constant assistance, analyse and interpret human rights issues and present competencies required by entrepreneurs, taking environmental impact into account.
- With extensive guidance, seldom analyse and apply the technological process to solve a real-life challenge, taking limited cognisance of indigenous knowledge systems.
- With constant assistance, interpret some terminology and symbols and select some materials and procedures to apply intermediate cutting and permanent jointing.
- With constant assistance, use and care for purpose-made tools and equipment.
- With constant help, solve some problems and perform some tests on mechanical principles such as bending moments and shear forces.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Partial Achievement can:

- Demonstrate limited insight, analysis and evaluation of safety measures in the workplace and show uncertainty in medical emergencies showing little sensitivity to health issues such as HIV/Aids.
- Even with constant assistance, seldom analyse issues relating to employment equity and entrepreneurial opportunities and predict the interaction between technology society and environment.
- With extensive guidance, seldom analyse detailed explanations and recommendations using correct terminology to solve a real-life challenge, taking limited cognisance of indigenous knowledge systems.
- With constant assistance, interpret some terminology and symbols and select some materials and procedures to apply advanced cutting and permanent.
- With constant assistance, use and care for specialised mechanical equipment.
- With constant help, solve some problems and perform some tests on mechanical principles such as stress and strain.

Grade 10

Code	Scale	Competence Descriptions
2 (continued)	**Partial 30%–39%**	**At the end of Grade 10 the learner with Partial Achievement can:** ■ Depending on constant help, demonstrate some competencies and control of basic systems. ■ With constant help, apply some routine maintenance and identify a few signs of wear on components. ■ With extensive help, show some understanding of internal combustion engines.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Partial Achievement can:

- Depending on constant help, demonstrate some competencies and control of intermediate systems.
- With constant help, monitor some of the condition of components and identify some causes of malfunction.
- With extensive help show some understanding of the operating principles of pumps.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Partial Achievement can:

- Depending on constant help, demonstrate some competencies and control of advanced systems.
- Without constant help, rarely identify some preventative maintenance methods and struggle to suggest any fault-finding techniques.
- With extensive help, show some understanding of the operating principles of turbines.

Grade 10

Code	Scale	Competence Descriptions
1	**Inadequate 0%–29%**	**At the end of Grade 10 the learner with Inadequate Achievement can:**

- Demonstrate very little insight into safety measures in the workplace and panic when medical emergencies occur, showing very little sensitivity to health issues such as HIV/Aids.
- Show very little knowledge of human rights issues, entrepreneurial concepts and pollution and waste management.
- Scarcely analyse and apply the technological process to solve a real-life challenge, taking little cognisance of indigenous knowledge systems.
- With difficulty, interpret some terminology and symbols and seldom select the correct materials and applicable methods to apply cutting and semi-permanent jointing.
- With difficulty, use and care for some measuring instruments, tools and equipment.
- Seldom solve problems and rarely perform tests on mechanical principles such as forces, pressure and torque.
- Rarely demonstrate competencies or control of basic systems.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Inadequate Achievement can:

- Demonstrate very little insight into machine-specific safety in the workplace and panic when medical emergencies occur, showing very little sensitivity to health issues such as HIV/Aids.
- Hardly analyse and interpret human rights issues and present competencies required by entrepreneurs, taking environmental impact into account.
- Scarcely analyse or apply the technological process to solve a real-life challenge, taking very little cognisance of indigenous knowledge systems.
- With difficulty, interpret some terminology and symbols and seldom select the correct materials and applicable methods to apply intermediate cutting and permanent jointing.
- With difficulty, use and care for some purpose-made tools and equipment.
- Seldom solve problems and rarely perform tests on mechanical principles such as bending moments and shear forces.
- Rarely demonstrate competencies or control of intermediate systems.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Inadequate Achievement can:

- Demonstrate very little insight, analysis or evaluation of safety measures in the workplace and panic when medical emergencies occur, showing very little sensitivity to health issues such as HIV/Aids.
- Hardly analyse issues relating to employment equity or entrepreneurial opportunities and predict the interaction between technology society and environment.
- Scarcely analyse detailed explanations and recommendations using correct terminology to solve a real-life challenge, taking very little cognisance of indigenous knowledge systems.
- With difficulty, interpret some terminology and symbols and seldom select the correct materials and applicable methods to apply of advanced cutting and permanent jointing.
- With difficulty, use and care for specialised mechanical equipment.
- Seldom solve problems and rarely perform tests on mechanical principles such as stress and strain.
- Rarely demonstrate competencies or control of advanced systems.

Grade 10

Code	Scale	Competence Descriptions
1 (continued)	**Inadequate 0%–29%**	**At the end of Grade 10 the learner with Inadequate Achievement can:** ■ With much difficulty, apply some routine maintenance and seldom identify signs of wear on components. ■ With great difficulty, show limited understanding of internal combustion engines.

Grade 11

Competence Descriptions

At the end of Grade 11 the learner with Inadequate Achievement can:

- Seldom monitor the condition of components and rarely identify causes of malfunction.
- With great difficulty, show limited understanding of the operating principles of pumps.

Grade 12

Competence Descriptions

At the end of Grade 12 the learner with Inadequate Achievement can:

- With much difficulty, identify suitable preventative maintenance methods and seldom suggest any fault-finding techniques.
- With great difficulty, show limited understanding of the operating principles of turbines.

GLOSSARY

artefact – a product or human art and workmanship or a manufactured object

belt – a band of rubber or leather that moves the wheels or fits around the wheels of a machine

bending moment – the turning effect produced by a force acting at a distance on an object; this effect is expressed as the product of the force and the distance from its line of action to a point

cam – an irregular projection on a wheel or rotating shaft, shaped to transmit regular movement to another part in contact with it

component – part of a set of objects used together for one specific function

control – switches and other devices by which a machine or vehicle is regulated

criteria – statements of a particular standard or requirement that a solution must satisfy

design – includes the study of a variety of processes and a knowledge of the properties of materials that are used to solve technological challenges

deterioration – the wear and tear components undergo during an operation

elasticity – the property of a material to allow it to be stretched or elongated; ability to resume its normal shape spontaneously after contraction or distortion

electronic media – the means by which information is communicated by television, computer or by audio-visual devices

engine – a mechanical devise consisting of several parts working together to generate power

engineering – the application of science to design, build and use machines

entrepreneur – a person who invents or identifies a useful idea and then sets up a business using that idea

entrepreneurial activity – actions by an entrepreneur with the aim to make profit and be of service in the community

environment – the physical surroundings; external conditions as affecting (nature) plant and animal life; the physical conditions on earth

environmental technology – the responsible application of science and the development of conservation principles during manufacturing and construction processes

ferrous – materials containing or relating to iron

force – an influence that changes or tends to change the state of rest of a body

gear – a toothed wheel used to transfer movement between shafts in a mechanical system

heat engine – any device that transforms heat energy into useful mechanical work

hydraulics – the study and use of liquid laws and pressure to create mechanical advantage

joining – a process of putting materials together either with fasteners, glues or electrical or heating processes

lever – a device that can be used to gain mechanical advantage

linkage – a component like a lever that forms part of a system to cause movement or control

machine – an apparatus using or applying mechanical power, having several parts each with a definite function and together performing certain kinds of work

maintenance – precautionary measures, actions and processes that are taken to keep a machine or engine in functional order

malfunction – when a process or component fails to perform the required function

material – physical substance (e.g. iron, steel, alloys, metals and plastics) used in the technological process

mechanism – components joined together to provide for the transfer of motion from one point to another and giving mechanical advantage

modulus of elasticity – the ability of returning to original form or size after stretching, compression or deformation

non-ferrous – materials not containing or relating to iron

pneumatics – the science of the mechanical properties of gases, which involves the use of the properties of air and other gases to do work

power – the capacity for exerting mechanical energy force applied or doing work; the rate of energy output

pressure – the exertion of continuous force of one body on or against another body

process – the parts of a system that combines resources to produce an output in response to the inputs

produce – to make goods from raw materials

product – the physical or tangible artefact that results from a process

property – quality or attribute, for example the property of dissolving easily

pulley – a grooved wheel used to guide a cord or belt to lift a heavy object; a drum fixed on a shaft or a wheel with a groove on its circumference, used with a rope or a belt, to change the direction of a force and especially to increase or decrease speed or power; to transmit movement and caused mechanical advantage

pump – any of various piston-operated or other devices for forcing or driving liquids or gases into or out of something

steam – the colourless gas formed by vaporising water at 100ºC which becomes visible in air due to suspended water droplets

strain – the force exerted in a body subjected to stress

stress – induced in material due to a force acting on it

system – a set of connected components or interlinked parts

torque – the moment of a system of forces tending to cause rotation; a twisting force

turbines – a machine which generates mechanical power from the energy in a stream of fluid or a device that is driven by the impact of a moving fluid against blades or vanes