education

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Education
REPUBLIC OF SOUTH AFRICA

National Curriculum Statement
Grades 10–12
(General)

ENGINEERING GRAPHICS AND DESIGN

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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

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ACRONYMS

AIDS	Acquired Immune Deficiency Syndrome
AS	Assessment Standard
CAD	Computer Aided Draughting
CASS	Continuous Assessment
FET	Further Education and Training
GET	General Education and Training
HIV	Human Immunodeficiency Virus
IEC	International Electrotechnical Commission
IKS	Indigenous Knowledge Systems
ISO	International Organisation for Standardisation
LO	Learning Outcome
NCS	National Curriculum Statement
NQF	National Qualifications Framework
OBE	Outcomes-Based Education
SANS	South African National Standards
SAQA	South African Qualifications Authority
SABS	South African Bureau of Standards
SI	Systems 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

ENGINEERING GRAPHICS AND DESIGN

DEFINITION

Engineering Graphics and Design integrates the cognitive and manipulative skills that are used to design and communicate graphically. The subject combinations lines and symbols to render services and design processes and systems that contribute to economic growth and enhanced quality of life.

PURPOSE

Engineering Graphics and Design contributes to learners' technological literacy by giving them opportunities to:

- appreciate the interaction between people's values, attitudes, society, environment, human rights and technology;
- apply the design process to solve civil, electrical and mechanical problems analytically and graphically;
- understand the concepts and knowledge used in Engineering Graphics and Design and use them responsibly and purposefully in of Civil, Electrical and Mechanical Technology; and
- develop and apply specific skills related to Engineering Graphics and Design.

Engineering Graphics and Design provides learners in Further Education and Training Institutions with opportunities to attain the Critical Outcomes, which are embedded in the Learning Outcomes. Learners learn how to:

- identify and solve design problems while making responsible decisions using critical and creative thinking when applied to civil, electrical and mechanical drawings;
- work effectively with others as a member of a team, group, organisation or community;
- organise and manage themselves and their activities responsibly and effectively when applied to Engineering Graphics and Design;
- collect, analyse, organise and critically evaluate information when producing drawings;
- communicate effectively using visual, mathematical, scientific and graphical and/or language skills in oral and/or written modes as applied to Engineering Graphics and Design;
- use science and technology effectively and critically, showing responsibility to the environment and to the health of others when using and producing drawings related to Engineering Graphics and Design and providing services; and
- demonstrate an understanding of the world as a set of related systems by recognising that problem-solving contexts do not exist in isolation.

To contribute fully to the personal development of each learner and the social and economic development of society, Engineering Graphics and Design makes learners aware of the importance of:

- reflecting on and exploring a variety of strategies to learn more effectively;
- participating as responsible citizens in the life of local, national and global communities;
- being culturally and aesthetically sensitive across a range of social contexts;
- exploring education and career opportunities; and
- developing entrepreneurial opportunities.

SCOPE

Engineering Graphics and Design as a subject gives learners the opportunity to:

- communicate ideas graphically by using drawing instruments and computer-based tools;
- learn by solving problems in creative ways;
- carry out projects using the design process;
- learn by dealing directly with human rights and social and environmental issues in their project work;
- use knowledge in a purposeful way; and
- develop positive attitudes, perceptions and aspirations to manufacturing, engineering and technology-based careers.

The four Learning Outcomes in Engineering Graphics and Design are interrelated and are based on the following principles:

- Physical products: Learners demonstrate the ability to design, draw and communicate graphically.
- Processes: Learners demonstrate the ability to learn about and analyse a range of civil, electrical and mechanical production processes.
- Environmental systems: Learners will be able to demonstrate the ability to analyse and learn about different environmental systems and related technologies that make it possible to use or modify those systems. They examine the impact of technology on the natural environment and learn about the beneficial and harmful effects and the short-term consequences of various types of technological interventions. Engineering Graphics and Design also offers new scope and opportunities for people with disabilities to be economically independent.
- Codes of practice: Learners demonstrate an understanding of and are able to apply acceptable codes of practice as applicable to civil, electrical and mechanical drawings (SANS, ISO, IEC, SI and updates).

The following are included to prepare learners for career pathways and for Higher Education and Training in Civil, Electrical and Mechanical Technologies:

- Cognitive development (visualisation, insight and perception)
- Freehand, instrument and computer-aided drafting
- Projection methods
- Pictorial drawings
- Principles of design
- Loci
- Principles of sectioning
- Acceptable codes of practice (sans, ISO, IEC and SI and updates)

EDUCATIONAL AND CAREER LINKS

In the General Education and Training Band, the Technology Learning Area Statement covers a range of technological areas. The Technology Learning Area is organised around the following Learning Outcomes:

- Technological processes and skills
- Technological knowledge and understanding
- Technology, society and the environment

The Technology Learning Area encourages learners to investigating, designing, make, evaluate and communicate solutions. It equips learners with knowledge and skills to competently and confidently operate within a manufacturing, engineering or technological environment.

The study of Engineering Graphics and Design in the Further Education and Training band builds on the Technology Learning Area Statement of the General Education and Training band. Therefore, the purpose of Further Education and Training (schools),, is to equip learners with the knowledge, skills and values that will enable them to meaningfully participate in the economic sector. It also aims to provide a basis for further learning in Higher Education and Training, lay a foundation for future careers and develop learners to be productive and responsible citizens.

To satisfy the requirements of mobility between National Qualifications Framework (NQF) levels, progression to Higher Education and other career pathways, Engineering Graphics and Design includes, but is not limited to:

- application of the principles of Mathematics, Physical Sciences, Computer Applications Technology and Life Sciences to manufacturing, engineering and technology problem solving;
- conceptual design, synthesis and graphics;
- conceptual knowledge, understanding and application of materials and processes in manufacturing and in the built environment;
- civil, electrical and mechanical engineering fields;
- oral and written communication, using appropriate language, structure, style and graphical support;
- application of codes of practice (standards and conventions) and legislation;
- incorporation of indigenous knowledge systems and global knowledge systems; and
- consideration of a range of technological solutions, particularly those that are sustainable and not detrimental to human health, well-being or the environment.

LEARNING OUTCOMES

The four Learning Outcomes in Engineering Graphics and Design are interrelated and should be integrated.

All learning outcomes are equally important, but not all have the same weighting in the allocation of time and resources. Learning Outcome 3 reflects the knowledge and understanding, whilst Learning Outcome 4 deals with the application of this knowledge. These two Learning Outcomes are underpinned by Learning Outcome1, which reflects the interrelationship of technology, society and the environment and Learning Outcome 2, which outlines the technological process that is used as the organising concept.

Learning Outcome 1: Technology, Society and the Environment

The learner is able to demonstrate an awareness and understanding of the interrelationship between Engineering Graphics and Design, society and the environment.

In this Learning Outcome, learners must understand the impact of Engineering Graphics and Design on natural resources, cultural values, socio-economic development and indigenous knowledge systems. It also creates awareness in learners about safety, fairness and equal access to employment, services and further study.

Learning Outcome 2: Design Process

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

In this Learning Outcome, learners solve civil, electrical and mechanical design problems graphically and analytically.

Learning Outcome 3: Knowledge and Understanding

The learner is able to demonstrate knowledge and understanding of the principles and concepts of graphic communications within the contexts of Civil, Electrical and Mechanical Technologies.

In this Learning Outcome, learners investigate various codes of practice and theory related to CAD and methods of projections in the contexts of Civil, Electrical and Mechanical Technologies.

Learning Outcome 4: Application of Knowledge

The learner is able to demonstrate the application of engineering graphical skills and techniques across a range of disciplines effectively and responsibly.

In this Learning Outcome, learners apply cognitive and manipulative skills to create drawings. The specific skills associated with producing freehand, instrument and CAD drawings should be used when developing drawing techniques.

CHAPTER 3

LEARNING OUTCOMES, ASSESSMENT STANDARDS, CONTENT AND CONTEXTS

INTERRELATEDNESS OF LEARNING OUTCOMES

All Learning Outcomes are equally important, but not all the Learning Outcomes have the same weighting in the allocation of time and resources. Learning Outcomes 3 and Learning Outcomes 4 reflect the Knowledge, Understanding and it's application of the Content and Contexts, and is underpinned by Learning Outcomes 1 and Learning Outcomes 2. Learning Outcomes 1 and Learning Outcomes 2 must be assessed within the content as reflected in Learning Outcome 3 and 4.

NUMBERING SYSTEM

All the Assessment Standards are numbered in the following manner:

The first number refers to the grade, the second number refers to Learning Outcome, the third number refers to the Assessment Standard, e.g. 10.1.4 implies Grade 10, LO 1 and AS 4.

Grade 10

Learning Outcome 1

Technology, Society and the Environment

The learner is able to demonstrate an awareness and understanding of the inter-relationship between Engineering Graphics and Design, Society and the Environment.

Note: In this Learning Outcome, learners should understand the impact of Engineering Graphics and Design on natural resources, cultural values and socio-economic development, including indigenous knowledge systems. It also creates awareness in learners about fair and equal access to employment, services and further study.

Assessment Standards

We know this when the learner is able to:

- 10.1.1
  describe the inter-relationship between Engineering Graphics and Design, society and the environment.
- 10.1.2
  identify and discuss pertinent human rights issues.
- 10.1.3
  discuss the ways in which HIV/Aids can be transmitted.
- 10.1.4
  identify contributions made by indigenous South African cultures to graphical communication.
- 10.1.5
  describe entrepreneurship and its influence on society and the environment.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.1.1
  discuss and analyse the inter-relationship between Engineering Graphics and Design, society and the environment.
- 11.1.2
  formulate strategies that show sensitivity to a broad spectrum of human rights issues.
- 11.1.3
  identify and suggest strategies for safe practices in an Engineering Graphics and Design that safeguard against the contact/spread of Aids.
- 11.1.4
  compare contributions made by Global Cultures to graphical communication.
- 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
  evaluate the contributions of Engineering Graphics and Design to technological development and suggest possible future contributions.
- 12.1.2
  formulate strategies that show sensitivity to pertinent human rights issues.
- 12.1.3
  analyse contributions that Engineering Graphics and Design has made to the campaigns against HIV/Aids.
- 12.1.4
  analyse contributions made by Global Cultures to graphical communication.
- 12.1.5
  identify and investigate possible entrepreneurial opportunities.

Grade 10

Learning Outcome 2

Design Process

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

Note: In this Learning Outcome, learners should solve civil, electrical and mechanical design problems graphically and analytically.

Assessment Standards

We know this when the learner is able to:

- 10.2.1
  identify the problem, need or opportunity through the interpretation of a given design brief.
- 10.2.2
  conduct relevant research/case studies and generate a number of ideas/concepts graphically.
- 10.2.3
  select the most relevant possibility, analyse it, and synthesize it into a final solution.
- 10.2.4
  present the final solution using graphics including visual, symbolic, and language skills in appropriate modes.
- 10.2.5
  show evidence of evaluation at each stage of the design process.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.2.1
  identify a problem, need or opportunity by interpreting given information and formulating a design brief.
- 11.2.2
  conduct relevant research / case studies and generate a number of ideas/concepts analytically and graphically.
- 11.2.3
  select the most relevant possibility giving reasons for choice based on manufacturing techniques, analyse it, and synthesize it into a final solution.
- 11.2.4
  present the final solution using graphics including visual, symbolic, and language skills in appropriate modes.
- 11.2.5
  show evidence of evaluation at each stage of the design process.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.2.1
  identify a problem, need or opportunity by performing a needs analysis, interpreting information and formulating a design brief.
- 12.2.2
  conduct relevant research/case studies and generate a number of ideas/concepts analytically and graphically.
- 12.2.3
  select the most relevant possibility giving reasons for choice that are based on sound design principles citing references where possible, analyse it, and synthesize it into a final solution.
- 12.2.4
  present the final solution using graphics including visual, symbolic, and language skills in appropriate modes.
- 12.2.5
  show evidence of evaluation at each stage of the design process.

Grade 10

Learning Outcome 3

Knowledge and Understanding

The learner is able to demonstrate knowledge and understanding of the principles and concepts of graphic communications within the contexts of Civil, Electrical and Mechanical Technologies.

Note: In this Learning Outcome, learners must show that they understand the codes of practice, theory related to CAD and methods of projections that are relevant in the contexts of Civil, Electrical and Mechanical Technologies.

Assessment Standards

We know this when the learner is able to demonstrate knowledge and understanding:

- 10.3.1
  of the SANS codes of practice related to basic civil, electrical and mechanical drawing.
- 10.3.2
  of the principles of projection with respect to basic multi-view and pictorial drawings.
- 10.3.3
  of the theory related to computer hardware and basic functions of CAD software.
- 10.3.4
  of basic design principles
- 10.3.5
  of techniques used to produce basic freehand, instruments and computer drawings.
- 10.3.6
  of the principles of basic sectional views.
- 10.3.7
  of methods of graphical communication and presentation.

Grade 11

Assessment Standards

We know this when the learner is able to demonstrate knowledge and understanding:

- 11.3.1
  of the various codes of practice related to advanced civil, electrical and mechanical drawing.
- 11.3.2
  of the principles of projection with respect to advanced multi-view and pictorial drawings.
- 11.3.3
  of the theory related to computer hardware and advanced functions of CAD software.
- 11.3.4
  of advanced design principles.
- 11.3.5
  of techniques used to produce advanced freehand, instruments and computer drawings.
- 11.3.6
  of the principles of advanced loci, assemblies, sectional views and detail drawings.
- 11.3.7
  of methods of graphical communication and presentation.

Grade 12

Assessment Standards

We know this when the learner is able to demonstrate knowledge and understanding:

- 12.3.1
  of the various codes of practice related to complex civil, electrical and mechanical drawing.
- 12.3.2
  of the principles of projection with respect to complex multi-view and pictorial drawings.
- 12.3.3
  of the theory related to computer hardware and complex functions of CAD software.
- 12.3.4
  of complex design principles.
- 12.3.5
  of techniques used to produce complex freehand, instruments and computer drawings.
- 12.3.6
  of the principles of complex loci, assemblies, sectional views and detail drawings.
- 12.3.7
  of methods of graphical communication and presentation.

Grade 10

Learning Outcome 4

Application of Knowledge

The learner is able to demonstrate the application of engineering graphical skills and techniques across a range of disciplines effectively.

Note: In this Learning Outcome, learners apply cognitive and manipulative skills to create graphics in the contexts of Civil, Electrical and Mechanical Technologies. The specific skills associated with producing freehand, instrument and CAD drawings must be used when developing drawing techniques.

Assessment Standards

We know this when the learner is able to:

- 10.4.1
  apply basic visualisation, cognitive and perception skills to analysing and interpretation of information and drawings.
- 10.4.2
  apply principles of measuring, dimensioning, printing, annotations, constructions, projections to produce basic freehand, instrument and CAD drawings.
- 10.4.3
  apply the principles of single and multi-view projections to produce freehand, instrument and CAD drawings of:
  - basic 1st and 3rd angle orthographic views,
  - descriptive geometry and geometrical solids,
  - circuit diagrams,
  - castings and
  - floor plans.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.4.1
  apply advanced visualisation, cognitive and perception skills to analysing and interpretation of information and drawings.
- 11.4.2
  apply principles of measuring, dimensioning, printing, annotations, constructions, projections to produce advanced freehand, instrument and CAD drawings.
- 11.4.3
  apply the principles of single and multi-view projections to produce freehand, instrument and CAD drawings of:
  - advanced 1st and 3rd angle orthographic views,
  - descriptive geometry and geometrical solids,
  - interpenetrations,
  - development,
  - advanced loci,
  - circuit diagrams,
  - dwellings,
  - assemblies and
  - surface textures.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.4.1
  apply complex visualization, cognitive and perception skills to analyzing and interpretation of information and drawings.
- 12.4.2
  apply principles of measuring, dimensioning, printing, annotations, constructions, and projections to produce complex freehand, instrument and CAD drawings.
- 12.4.3
  apply the principles of single and multi-view projections to produce freehand, instrument and CAD drawings of:
  - advanced 1st and 3rd angle orthographic views,
  - descriptive geometry and geometrical solids,
  - interpenetrations,
  - development,
  - complex loci,
  - wiring and circuit diagrams,
  - roof trusses,
  - dwellings,
  - assemblies and
  - surface textures.

Grade 10

Learning Outcome 4 (continued)

Application of Knowledge

The learner is able to demonstrate the application of engineering graphical skills and techniques across a range of disciplines effectively.

Note: In this Learning Outcome, learners apply cognitive and manipulative skills to create graphics in the contexts of Civil, Electrical and Mechanical Technologies. The specific skills associated with producing freehand, instrument and CAD drawings must be used when developing drawing techniques.

Assessment Standards

We know this when the learner is able to:

- 10.4.4
  apply the principles of pictorial drawings to produce freehand, instrument or CAD drawings of:
  - oblique,
  - isometric and
  - perspective.

Grade 11

Assessment Standards

We know this when the learner is able to:

- 11.4.4
  apply the principles of pictorial drawings to produce freehand, instrument or CAD drawings of:
  - isometric and
  - perspective.

Grade 12

Assessment Standards

We know this when the learner is able to:

- 12.4.4
  apply the principles of pictorial drawings to produce freehand, instrument or CAD drawings of:
  - isometric and
  - perspective.

CONTENT AND CONTEXTS FOR THE ATTAINMENT OF ASSESSMENT STANDARDS

In this section, contexts and content are provided to support the attainment of the Assessment Standards. The content needs to assist the learner in progressing towards the attainment of the Learning Outcome and as such serves the Learning Outcome and is not an end in itself. Contexts that are given, assist in embedding the content in situations that is meaningful to learners and also assist learning and teaching.Content and contexts when aligned to the attainment of Assessment Standards, provide a framework for the development of Learning Programmes.

The contexts for Engineering Graphics and Design are: Civil Technology, Electrical Technology and Mechanical Technology.

Grade 10

Learning Outcome 1

Technology, Society and the Environment

The learner is able to demonstrate an awareness and understanding of the inter-relationship between Engineering Graphics and Design, Society and the Environment.

Assessment Standards

The content and contexts should include:

- 10.1.1
  development of Graphical communication through the ages.

- 10.1.4
  gender, challenged and biases with respect to access to careers in the Engineering Graphics and Design field.

- 10.1.5
  the impact of HIV/Aids on the environment and society.

- 10.1.6
  indigenous graphical communication.

Grade 11

Assessment Standards

The content and contexts should include:

- 11.1.1
  development of Graphical communication through the ages.
- 11.1.2
  the advantages/disadvantages of electronics/ computer technologies that impact on graphical communication.
- 11.1.4
  gender, challenged and biases with respect to access to careers in the Engineering Graphics and Design field.
- 11.1.5
  the impact of HIV/Aids on the environment and society.
- 11.1.6
  indigenous and global graphical communication.

Grade 12

Assessment Standards

The content and contexts should include:

- 12.1.1
  development of Graphical communication through the ages.
- 12.1.2
  the advantages/disadvantages of electronics/ computer technologies that impact on graphical communication.
- 12.1.3
  the demands that society and the environment make on Engineering Graphics and Design
- 12.1.4
  gender, challenged and biases with respect to access to careers in the Engineering Graphics and Design field.
- 12.1.5
  the impact of HIV/Aids on the environment and society.
- 12.1.6
  indigenous and global graphical communication.

Grade 10

Learning Outcome 2

Design Process

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

Assessment Standards

The content and contexts should include:

- 10.2.1
  design principles,
- 10.2.2
  investigative techniques,
- 10.2.3
  data processing techniques,
- 10.2.4
  calculations and
- 10.2.5
  communication techniques,within the contexts of Civil, Electrical and Mechanical Technologies.

Grade 11

Assessment Standards

The content and contexts should include:

- 11.2.1
  design principles,
- 11.2.2
  investigative techniques,
- 11.2.3
  data processing techniques,
- 11.2.4
  calculations and
- 11.2.5
  communication techniques,within the contexts of Civil, Electrical and Mechanical Technologies.

Grade 12

Assessment Standards

The content and contexts should include:

- 12.2.1
  design principles,
- 12.2.2
  investigative techniques,
- 12.2.3
  data processing techniques,
- 12.2.4
  calculations and
- 12.2.5
  communication techniques,within the contexts of Civil, Electrical and Mechanical Technologies.

Grade 10

Learning Outcome 3

Knowledge and Understanding

The learner is able to demonstrate knowledge and understanding of the principles and concepts of graphic communications within the contexts of Civil, Electrical and Mechanical Technologies.

Assessment Standards

The content and contexts should include:

- 10.3.1
  Drawing principles as contained in SANS code of Practice as related to basic Electrical, Civil and Mechanical drawings.

- 10.3.2
  Basic freehand and instrument drawing

- 10.3.3
  Single and multi-view drawing principles:
  - 1st and 3rd angle orthographic projection,
  - geometrical solids,
  - descriptive geometry,
  - circuit diagrams,
  - castings and
  - dwelling

- 10.3.4
  Principles of pictorial drawings:
  - oblique,
  - isometric and
  - perspective.

- 10.3.5
  Principles of sectioning:
  - multi-view drawings

Grade 11

Assessment Standards

The content and contexts should include:

- 11.3.1
  Drawing principles as contained in SANS code of Practice as related to advanced Electrical, Civil and Mechanical drawings.
- 11.3.2
  Advanced freehand, instruments and CAD
- 11.3.3
  Single and multi-view drawing principles:
  - 1st and 3rd angle orthographic projection,
  - interpenetrations,
  - development,
  - circuit diagrams,
  - simple assemblies,
  - detail drawings and
  - dwellings
- 11.3.4
  Principles of pictorial drawings:
  - isometric and
  - perspective.
- 11.3.5
  Principles of sectioning:
  - multi-view drawings

Grade 12

Assessment Standards

The content and contexts should include:

- 12.3.1
  Drawing principles as contained in SANS code of Practice as related to complex Electrical, Civil and Mechanical drawings.
- 12.3.2
  Complex freehand, instruments and CAD.
- 12.3.3
  Single and multi-view drawing principles:
  - 1st and 3rd angle orthographic projection,
  - interpenetrations,
  - development,
  - wiring and circuit diagrams,
  - complex assemblies,
  - detail drawings,
  - dwellings and
  - components of steel structures
- 12.3.4
  Principles of pictorial drawings:
  - isometric and
  - perspective.
- 12.3.5
  Principles of sectioning:
  - pictorial drawings and
  - multi-view drawings

Grade 10

Learning Outcome 3 (continued)

Knowledge and Understanding

The learner is able to demonstrate knowledge and understanding of the principles and concepts of graphic communications within the contexts of Civil, Electrical and Mechanical Technologies.

Assessment Standards

The content and contexts should include:

- 10.3.7
  Principles of design.
- 10.3.8
  Terminology, concepts and functions of CAD as related to hardware and software.

Grade 11

Assessment Standards

The content and contexts should include:

- 11.3.6
  Loci of points.
- 11.3.7
  Principles of design.
- 11.3.8
  Terminology, concepts and functions of CAD as related to hardware and software.

Grade 12

Assessment Standards

The content and contexts should include:

- 12.3.6
  Loci of points on the components of mechanisms.
- 12.3.7
  Principles of design.
- 12.3.8
  Terminology, concepts and functions of CAD as related to hardware and software.

Grade 10

Learning Outcome 4

Application of Knowledge

The learner is able to effectively demonstrate the application of engineering graphical skills and techniques across a range of disciplines.

Assessment Standards

We know when the learner is able to apply:

- 10.4.1
  drawing principles as contained in SANS code of Practice as related to basic Electrical, Civil and Mechanical drawings.

- 10.4.2
  single and multi-view drawing principles:
  - 1st and 3rd angle orthographic projection,
  - geometrical solids,
  - descriptive geometry,
  - circuit diagrams,
  - castings and
  - dwelling.

- 10.4.3
  pictorial drawings principles:
  - oblique,
  - isometric and
  - perspective.

- 10.4.4
  principles of sectioning:
  - multi-view drawings

Grade 11

Assessment Standards

We know when the learner is able to apply:

- 11.4.1
  drawing principles as contained in SANS code of Practice as related to advanced Electrical, Civil and Mechanical drawings.
- 11.4.2
  single and multi-view drawing principles:
  - 1st and 3rd angle orthographic projection,
  - interpenetrations,
  - developments,
  - circuit diagrams,
  - simple assemblies,
  - limits & fits, tolerances, measurement and surface textures,
  - detail drawings and
  - dwellings.
- 11.4.3
  pictorial drawings principles:
  - isometric and
  - perspective.
- 11.4.4
  principles of sectioning:
  - multi-view drawings

Grade 12

Assessment Standards

We know when the learner is able to apply:

- 12.4.1
  drawing principles as contained in SANS code of Practice as related to complex Electrical, Civil and Mechanical drawings.
- 12.4.2
  single and multi-view drawing principles:
  - 1st and 3rd angle orthographic projection,
  - interpenetrations,
  - developments,
  - wiring and circuit diagrams,
  - complex assemblies,
  - detail drawings,
  - limits & fits, tolerances, measurement and surface textures,
  - dwellings and
  - components of steel structures.
- 12.4.3
  pictorial drawings principles:
  - isometric and
  - perspective.
- 12.4.4
  principles of sectioning:
  - pictorial drawings and
  - multi-view drawings

Grade 10

Learning Outcome 4 (continued)

Application of Knowledge

The learner is able to effectively demonstrate the application of engineering graphical skills and techniques across a range of disciplines.

Assessment Standards

We know when the learner is able to apply:

- 10.4.6
  the design process.
- 10.4.7
  visualization, cognitive and perception skills related to the analysis and interpretation of;
  - data and information and
  - multi-view drawing.
- 10.4.8
  terminology, concepts and functions of CAD as related to hardware and software:
  - setting up of drawing environment: drawing and printing templates,
  - file management and
  - transferring drawings to and from hardcopy.

Grade 11

Assessment Standards

We know when the learner is able to apply:

- 11.4.5
  Loci of points.
- 11.4.6
  the design process.
- 11.4.7
  visualization, cognitive and perception skills related to the analysis and interpretation of:
  - data and information and
  - multi-view drawing.
- 11.4.8
  terminology, concepts and functions of CAD as related to hardware and software:
  - setting up of drawing environment: drawing and printing templates,
  - file management and
  - transferring drawings to and from hardcopy.

Grade 12

Assessment Standards

We know when the learner is able to apply:

- 12.4.5
  Loci of points.
- 12.4.6
  the design process.
- 12.4.7
  visualization, cognitive and perception skills related to the analysis and interpretation of:
  - data and information and
  - multi-view drawing.
- 12.4.8
  terminology, concepts and functions of CAD as related to hardware and software:
  - setting up of drawing environment: drawing and printing templates,
  - file management and
  - transferring drawings to and from hardcopy.

CHAPTER 4

ASSESSMENT

INTRODUCTION

Assessment is a critical element of the National Curriculum Statement Grades 10–12 (General). It is a process of collecting and interpreting evidence in order to determine the learner's progress in learning and to make a judgment about 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 are explored in this chapter. Others are dealt with in a more subject-specific manner in the Learning Programme Guidelines.

Many stakeholders have an interest in how learners perform in Grades 10–12. These include the learners themselves, teachers, parents, guardians, sponsors, Provincial Departments of Education, the Department of Education, 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 Programme Guidelines and the Assessment Guidelines discuss ways of recording and reporting on school-based and external assessment as well as giving guidance on assessment issues specific to the subject.

WHY ASSESS

Before a teacher assesses learners, it is crucial that the purposes of the assessment be clear and unambiguous. Understanding the purpose of assessment ensures that an appropriate match exists between the purposes and the methods of assessment. This, in turn, will help to ensure that decisions and conclusions based on the assessment are fair and appropriate for the particular purpose or purposes.

There are many reasons why learners' performance is assessed. These include monitoring progress and providing feedback, diagnosing or remediation barriers to learning, selection, guidance, supporting learning, certification and promotion.

In this curriculum, learning and assessment are very closely linked. Assessment helps learners to gauge the value of their learning. It gives them information about their 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 specified Learning 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 Programme 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 learners 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 on the progress of learners. Constructive feedback is a vital component of assessment for formative purposes.

Summative assessment

When assessment is used to record a judgment of the competence or performance of learners, it serves a summative purpose. Summative assessment gives a picture of learners' 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 learners and by the broader public;
- be clearly focused;
- be integrated with teaching and learning;
- be based on pre-set criteria of the Assessment Standards;
- allow for expanded opportunities for learners;
- be learner-paced and fair;
- be flexible;
- use a variety of instruments; and
- use a variety of methods.

HOW TO ASSESS

Teachers' assessment of learners' performances must have a great degree of reliability. This means that teachers' judgments of learners' competences should be generalised 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). Continuous assessment is a 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 the continuous assessment process can be included in a portfolio. Different subjects have different requirements for what should be included in the portfolio. The Learning Programme Guidelines discuss these requirements further.

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

Continuous assessment should be applied both to 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 Learning 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 teacher does the final assessment. Reflection on one's 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 the development of a record of 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 and enables 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 are 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 in contexts outside of the classroom. Performance assessment also covers the practical components of subjects by determining how learners put theory into practice. The criteria, standards or rules by which the task will be assessed are described in rubrics or task checklists, and help the teacher to use professional judgment to assess each learner's performance.

RECORDING AND REPORTING

Recording and reporting involves the capturing of data collected during assessment so that it can be logically analysed 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 recording instruments:

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

Each is discussed below.

Rating scales

Rating scales are any marking system where a symbol (such as 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 tended to use rating scales without the descriptive details, making it difficult to have a sense of the learners' strengths and weaknesses in terms of intended outcomes. A six-point scale of achievement is used in the National Curriculum Statement Grades 10–12 (General).

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 range of acceptable performance in each code band. Rubrics require teachers 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 combine both. The Learning Programme Guidelines give examples of subject-specific rubrics.

To design a rubric, a teacher has to decide the following:

- Which outcomes are being targeted?
- Which 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?
- Should one rubric target all the Learning Outcomes and Assessment Standards of the task or does the task need several rubrics?
- How many rubrics are, in fact, needed for the task?

It is crucial that a teacher shares the rubric or rubrics for the task with the learners before they do the required task. The rubric clarifies what both the learning and the performance should focus on. It becomes a powerful tool for self-assessment.

Reporting performance and achievement

Reporting performance and achievement informs all those involved with or interested in learners' progress. Once the evidence has been collected and interpreted, teachers need to record a learner's 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 (General) adopts a six-point scale of achievement. The scale is shown in Table 4.1.

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 Learning Outcomes in 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 teachers 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. The various achievement levels and their corresponding percentage bands are as shown in Table 4.1.

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 be used in evaluating specific assessment tasks, but the tasks should be assessed against rubrics instead of simply ticking correct answers and awarding marks in terms of the number of ticks. The statements of competence for a subject describe the minimum skills, knowledge, attitudes and values that learners should demonstrate for achievement on each level of the rating scale.

When teachers/assessors prepare an assessment task or question, they must ensure that the task or question addresses an aspect of a particular outcome. The relevant Assessment Standard or Standards must be used when creating the rubric for assessing the task or question. The descriptions clearly indicate the minimum level of attainment for each category on the rating scale.

The competence descriptions for this subject appear at the end of this chapter.

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 Further Education and Training Certificate. The requirements, conditions, and rules of combination and condonation are spelled out in the *Qualifications and Assessment Policy Framework for the Grades 10–12 (General).*

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 important information is included. Report cards should include information about a learner's overall progress, including the following:

- 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 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;
- space for signature of parent or guardian;
- signature of teacher 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 *Qualifications and Assessment Policy Framework for Grades 10–12 (General)* as it relates to learners who experience barriers to learning. Refer *to White Paper 6 on Special Needs Education: Building an Inclusive Education and Training System.*

COMPETENCE DESCRIPTIONS FOR ENGINEERING GRAPHICS AND DESIGN

Grade 10

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

- Independently, using a range of high-level skills, demonstrate in-depth knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing simple isometric, oblique and perspective drawings;
  - applying basic principles of CAD functions;
  - applying analytical and graphical solutions to basic design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of multiview drawing;
  - showing insight into generating outside and sectional views of castings including dimensions, scales and symbols;
  - drawing the layout of simple electronic circuits using given symbols and inserting them into circuit diagrams;
  - drawing basic floor plans of dwellings incorporating scale and dimensioning techniques; and
  - producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 11

Competence Descriptions

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

- Independently, using a range of high-level skills, demonstrate in-depth knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing advanced isometric and perspective drawings;
  - applying advanced principles of CAD functions;
  - applying analytical and graphical solutions to advanced design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing· applying advanced solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;
  - drawing basic electrical circuits with parallel and series connections using values of components and notes;

Grade 12

Competence Descriptions

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

- Independently, using a range of high-level skills, demonstrate in-depth knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing complex isometric and perspective drawings;
  - applying complex principles of CAD functions;
  - applying analytical and graphical solutions to complex design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing· applying complex solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary and permanent fasteners, dimensions, scales, annotations, notes, symbols limits & fits, tolerances, measurement and surface textures;
  - drawing all aspects of single level dwellings including foundation to roof, electrical wiring

Grade 10

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

Grade 11

Competence Descriptions

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

- drawing single level dwellings including foundation to ceiling using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 12

Competence Descriptions

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

- diagrams and plumbing using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 10

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

- Independently, using a range of advanced skills, demonstrate comprehensive knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing simple isometric, oblique and perspective drawings;
  - applying basic principles of CAD functions;
  - applying analytical and graphical solutions to basic design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of multiview drawing;
  - showing insight into generating outside and sectional views of castings including dimensions, scales and symbols;
  - drawing the layout of simple electronic circuits using given symbols and inserting them into circuit diagrams;
  - drawing basic floor plans of dwellings incorporating scale and dimensioning techniques; and
  - producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 11

Competence Descriptions

At the end of Grade 11 a learner with Meritorious Achievement can:

- Independently, using a range of advanced skills, demonstrate comprehensive knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing advanced isometric and perspective drawings;
  - applying advanced principles of CAD functions;
  - applying analytical and graphical solutions to advanced design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying advanced solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;
  - drawing basic electrical circuits with parallel and series connections using values of components and notes;

Grade 12

Competence Descriptions

At the end of Grade 12 a learner with Meritorious Achievement can:

- Independently, using a range of advanced skills, demonstrate a comprehensive knowledge and understanding in:·
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing complex isometric and perspective drawings;
  - applying complex principles of CAD functions;
  - applying analytical and graphical solutions to complex design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying complex solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary and permanent fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;

Grade 10

Code	Scale	Competence Descriptions
5 (continued)	**Meritorious 60%–79%**	**At the end of Grade 10 a learner with Meritorious Achievement can:**

Grade 11

Competence Descriptions

At the end of Grade 11 a learner with Meritorious Achievement can:

- drawing single-level dwellings including foundation to ceiling using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 12

Competence Descriptions

At the end of Grade 12 a learner with Meritorious Achievement can:

- drawing all aspects of single-level dwellings including foundation to roof, electrical wiring diagrams and plumbing using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 10

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

- Independently, using some advanced skills, demonstrate clear knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing simple isometric, oblique and perspective drawings;
  - applying basic principles of CAD functions;
  - applying analytical and graphical solutions to basic design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of multiview drawing;
  - showing insight into generating outside and sectional views of castings including dimensions, scales and symbols;
  - drawing the layout of simple electronic circuits using given symbols and inserting them into circuit diagrams;
  - drawing basic floor plans of dwellings incorporating scale and dimensioning techniques; and
  - producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 11

Competence Descriptions

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

- Independently, using some advanced skills, demonstrate clear knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing advanced isometric and perspective drawings;
  - applying advance principles of CAD functions;
  - applying analytical and graphical solutions to advanced design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying advanced solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;
  - drawing basic electrical circuits with parallel and series connections using values of components and notes;

Grade 12

Competence Descriptions

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

- Independently, using some advanced skills, demonstrate clear knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing complex isometric and perspective drawings;
  - applying complex principles of CAD functions;
  - applying analytical and graphical solutions to complex design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying complex solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary and permanent fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;
  - drawing all aspects of single-level dwellings including foundation to roof, electrical wiring

Grade 10

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

Grade 11

Competence Descriptions

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

- drawing single-level dwellings including foundation to ceiling using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 12

Competence Descriptions

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

diagrams and plumbing using appropriate sections, scale and dimensioning techniques; and

- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 10

Code	Scale	Competence Descriptions
3	**Adequate 40%–49%**	**At the end of Grade 10 a learner with Adequate Achievement can:**

- With minimum guidance, using a range of basic skills, demonstrate average knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing simple isometric, oblique and perspective drawings;
  - applying basic principles of CAD functions;
  - applying analytical and graphical solutions to basic design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of multiview drawing;
  - showing insight into generating outside and sectional views of castings including dimensions, scales and symbols;
  - drawing the layout of simple electronic circuits using given symbols and inserting them into circuit diagrams;
  - drawing basic floor plans of dwellings incorporating scale and dimensioning techniques; and
  - producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 11

Competence Descriptions

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

- With minimum guidance, using a range of basic skills, demonstrate average knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing advanced isometric and perspective drawings;
  - applying advance principles of CAD functions;
  - applying analytical and graphical solutions to advanced design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying advanced solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;
  - drawing basic ;electrical circuits with parallel and series connections using values of components and notes;

Grade 12

Competence Descriptions

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

- With minimum guidance, using a range of basic skills, demonstrate average knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing complex isometric and perspective drawings
  - applying complex principles of CAD functions;
  - applying analytical and graphical solutions to complex design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying complex solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary and permanent fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;

Grade 10

Code	Scale	Competence Descriptions
3 (continued)	**Adequate 40%–49%**	**At the end of Grade 10 a learner with Adequate Achievement can:**

Grade 11

Competence Descriptions

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

- drawing single level dwellings including foundation to ceiling using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 12

Competence Descriptions

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

- drawing all aspects of single level dwellings including foundation to roof, electrical wiring diagrams and plumbing using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 10

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

- With guidance, using some basic skills, demonstrate limited knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing simple isometric, oblique and perspective drawings;
  - applying basic principles of CAD functions;
  - applying analytical and graphical solutions to basic design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of multiview drawing;
  - showing some insight into generating outside and sectional views of castings including dimensions, scales and symbols;
  - drawing the layout of simple electronic circuits using given symbols and inserting them into circuit diagrams;
  - drawing basic floor plans of dwellings incorporating scale and dimensioning techniques;
  - producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 11

Competence Descriptions

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

- With guidance, using some basic skills, demonstrate limited knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing advanced isometric and perspective drawings;
  - applying advanced principles of CAD functions;
  - applying analytical and graphical solutions to advanced design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying advanced solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing some insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;
  - drawing basic electrical circuits with parallel and series connections using values of components and notes;

Grade 12

Competence Descriptions

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

- With guidance, using some basic skills, demonstrate limited knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing complex isometric and perspective drawings;
  - applying complex principles of CAD functions;
  - applying analytical and graphical solutions to complex design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying complex solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing some insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary and permanent fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;

Grade 10

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

Grade 11

Competence Descriptions

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

- drawing single-level dwellings including foundation to ceiling using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 12

Competence Descriptions

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

- drawing all aspects of single-level dwellings including foundation to roof, electrical wiring diagrams and plumbing using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation

Grade 10

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

- With much support, using a narrow range of elementary skills, demonstrate little knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing simple isometric, oblique and perspective drawings;
  - applying basic principles of CAD functions;
  - applying analytical and graphical solutions to basic design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of multiview drawing;
  - showing some insight into generating outside and sectional views of castings including dimensions, scales and symbols;
  - drawing the layout of simple electronic circuits using given symbols by inserting them into circuit diagrams;
  - drawing basic floor plans of dwellings incorporating scale and dimensioning techniques; and
  - producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 11

Competence Descriptions

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

- With much support, using a narrow range of elementary skills, demonstrate little knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing advanced isometric and perspective drawings;
  - applying advanced principles of CAD functions;
  - applying analytical and graphical solutions to advanced design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying advanced solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing some insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;
  - drawing basic electrical circuits with parallel and series connections using values of components and notes;·

Grade 12

Competence Descriptions

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

- With much support, using a narrow range of elementary skills, demonstrate little knowledge and understanding in:
  - applying SANS codes of practice, within the contexts of civil, electrical and mechanical technologies;
  - drawing complex isometric and perspective drawings
  - applying complex principles of CAD functions;
  - applying analytical and graphical solutions to complex design problems through investigation, research and design;
  - accessing, processing and using data;
  - applying the principles of loci;
  - applying the principles of multiview drawing;
  - applying complex solid and descriptive geometry, including sections, interpenetrations and surface developments;
  - showing some insight into generating outside and sectional views of simple assembled and detail mechanical components including temporary and permanent fasteners, dimensions, scales, annotations, notes, symbols, limits and fits, tolerances, measurement and surface textures;·

Grade 10

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

Grade 11

Competence Descriptions

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

- drawing single-level dwellings including foundation to ceiling using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

Grade 12

Competence Descriptions

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

- drawing all aspects of single-level dwellings including foundation to roof, electrical wiring diagrams and plumbing using appropriate sections, scale and dimensioning techniques; and
- producing freehand, instrument or CAD drawings displaying clear line distinction, precision and clarity of presentation.

GLOSSARY

aesthetic – relating to beauty and attractiveness

analytically – to analyse by means of mathematical and scientific laws, principles and calculations

annotate – add explanatory notes to a drawing

assembly drawing – an orthographic drawing with the components fitted together

auxiliary view – an additional orthographic view used to help with the positioning of features

assessment – the process of determining the quality of a learner's work

built environment – civil and architectural engineering industries and related services

calculate – to work out using mathematics

computer aided drafting (CAD) – computer software and hardware used as a drawing tool to produce drawings

cam – a machine part used to change rotational motion into reciprocating motion incorporating a follower

case study – a systematic investigation of an existing situation which could be a short, structured tasks linking real examples in the world outside to classroom activities

casting – a component formed by pouring molten material into a mould

circuit diagram – a systematic use of symbols to show how the components are connected to form an electric circuit

Civil Technology – focuses on the technological processes from conceptual design to practical problem solving by the application of scientific principles; the subject provides scope for the improvement of the different processes, systems and services used in the built environment

cognitive skills – thinking and problem-solving skills

communicate graphically – transfer information through the medium of a drawing using a combination of lines and symbols

computer-based tools – computer software and hardware components

computer hardware – computer components including keyboard, monitor, mouse and power supply

concept – idea that can be transformed into visual drawing applications

continuous assessment – process of assessing a learner's performance on an ongoing basis

convention – a universally acceptable means of representing complex features clearly and simply

culture – the customs, ideas and values of a specific civilisation at a particular time

data – facts and figures that can be processed into information

descriptive geometry – involves points, lines and plane figures

design (noun) – a plan, sketch, model or drawing that outlines or shows the intention of a proposed solution before it is implemented or made

design brief – a short, concise statement that defines what has to be done

design process – an organised and orderly approach that combines scientific principles, resources and existing products in a creative way to solve problems to satisfy needs and wants

detail drawing – describes the features and dimensions of the details of various components

development – the unfolding of the surfaces of an object so that the surfaces are seen in their true shape

dimension – measurements indicating the actual size and position of features

drawing – a means of conveying information using lines, symbols and signs

drawing environment – a cad concept that refers to the drawing setup as seen on the monitor

drawing instruments – equipment that is used to produce a drawing (such as, set squares, t-square, templates)

Electrical Technology – focuses on the understanding and application of electrical and electronic principles and the technological processes inherent in the production of products, services and systems to improve the quality of life

engineering design – application of calculations with relation to aspects such as forces, stresses

ethics – high standard of moral values

environment – the physical, built and social area within which something exists

file management – to store drawings in such a way that they can easily be retrieved

first angle orthographic projection – a multiview of an object placed in the first quadrant

follower – the mechanism that has reciprocating motion resulting from the rotational motion of a cam

geometrical solid – a three dimensional geometric object bounded by, triangular or rectangular surfaces (prism, pyramid, cone and cylinder)

global – refers to the entire world

global graphical communication – internationally recognised drawing language comprising a combination of lines, symbols and signs

graphically – using drawings, sketches, models as the means of communication

surfaces (different materials have specific conventions for sectioning)

human rights – a person's right to humanity, equity, fairness and to be treated justly

indigenous knowledge – the knowledge located naturally within the community

insight – understanding concepts that influence design or drawing

instrument drawing – a method of drawing that uses conventional drawing tools to generate drawings

interpenetration – the line that is formed when two solids are adapted to fit around each other

investigative techniques – methods of finding information; such as examining, exploring, inspecting, experimenting

isometric drawing – a pictorial drawing where the height, width and depth axes are set at 120° angles to each other

locus (plural loci) – the path generated by a point as it moves subject to given conditions

manipulative skills – fine motor skills that are needed when producing a drawing (incorporates hand-eye co-ordination)

material – physical substance used in technology (e.g. wood, textiles, plastics, metal)

mechanical system – a combination of mechanisms that function as a whole

Mechanical Technology – focuses on technological processes from conceptual design to practical problem solving to the application of scientific principles; it provides scope for the improvement of the different processes, systems and services used in the production and manufacturing of the goods and products used to enhance the quality of life of both the individual and society

multiview drawing – a method of orthographic drawing that uses more than one view of an object to explain the shape, size and proportion

oblique drawing – a pictorial drawing that shows one face of the object in its true shape and other faces projected at 45°

orthographic projection – a method of representing three-dimensional objects through the use of views which are projected perpendicularly onto planes (first angle orthographic projection and third angle orthographic projection)

perception – powers of observation and visual insight

perspective drawing – a pictorial drawing that shows objects as they appear to the eye

pictorial drawing – a drawing that looks like a picture

problem – a situation that leads to a need, want or opportunity

process – the part of a system that combines resources to produce an output in response to input

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

projection – a method of drawing perpendiculars from the edges or contours of a part or object to a plane of projection in accordance with a definite rule

reciprocating – back and forth movement; this movement can be in a straight line (linear) or in an arc (oscillating)

SANS code of practice – South African approved drawing standards for presentation and delivery of services (formerly SABS)

scale drawing – a drawing that has been systematically sized relative to a standard unit

sectional view – a projection of a geometrical solid or component indicating the surface that has been cut by an imaginary plane

society – humankind as a whole

software – programmes that are used in a computer system

synthesis – the process of putting together separate parts to form a complex whole

system – a set of interlinked parts that function together as a whole

symbol – representing or standing for something

techniques, tools and technologies – applications of conventional use of instruments and computer-based or computer-aided drawing tools with the applicable software

technological literacy – the ability to use, understand, manage and assess technology

technological processes – creative human activities to develop technological solutions to satisfy human needs and wants

technological solution – a successful product that is achieved by using a systematic problem-solving process

three-dimensional drawing – a computer-generated drawing that includes the 'z' axis and can be rotated to facilitate views from different angles

third angle orthographic projection – a multiview drawing of an object placed in the third quadrant

true length – a view of a line that shows its full undistorted length

true shape – a projected orthographic view that shows the undistorted shape of a surface

visualisation – a mental picture or envisioned solution