ENSURING THE EXPERTISE TO GROW SOUTH AFRICA

Code of Practice for the Performance of Agricultural Engineering Work

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ENGINEERING COUNCIL OF SOUTH AFRICA
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ECSA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

API	American Petroleum Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BMPs	Best Management Practices
BSI	British Standards Institution
CAD	Computer-aided design
CAM	Computer-aided manufacturing
CFD	Computational fluid dynamics
CoP	Code of Practice
CPD	Continuing Professional Development
ECSA	Engineering Council of South Africa
EPA	Engineering Profession Act (Act. No. 46 of 2000)
FEA	Finite element analysis
IFE	The Institution of Fire Engineers
ISO	International Standard Organization
SANS	South African National Standards
SAE	Society of Automotive Engineers

DEFINITIONS

Act means the Engineering Profession Act, 46 of 2000 “as revised”.

Code of Conduct means the Code of Conduct for Registered Persons: Engineering Profession Act, 46 of 2000, Board Notice 41 of 2017 – Government Gazette 142 No. 40691.

Competency means a combination of knowledge, training, experience and applicable qualifications that enables an individual to perform a task or an activity successfully.

Competent Person means a person who has the required knowledge, training, experience and, where applicable, qualifications specific to the work or task being performed, provided that, where appropriate, qualifications and training are registered in terms of the provisions of the National Qualification Framework Act, 67 of 2008, those qualifications and that training are regarded as the required qualifications.

Council means the Engineering Council of South Africa established by Section 2 of the Act.

Discipline means the disciplines of engineering as recognised by the Engineering Council of South Africa.

ECSA means the Engineering Council of South Africa established by Section 2 of the Act.

Agricultural Engineering Work means the process of applying engineering and scientific principles, concepts, contextual and engineering knowledge to the research, planning, design, implementation, maintenance and management of work in the natural and built environments. It includes advisory services, assessment of engineering designs and determination of the risks posed by the design on workers, the public, and the environment.

Identification of Engineering Work Regulations means the Identification of Engineering Work Regulations, Board Notice 21 of 2021, Gazette No. 44333, dated 26 March 2021, as amended.

Overarching Code of Practice means the Overarching Code of Practice for the Performance of Engineering Work, Board Notice 20 of 2021, Government Gazette No. 44333, 26 March 2021, as amended.

Practice means any engineering professional service, advisory service or creative work requiring engineering education, training and experience and the application of special knowledge of the mathematical, physical and engineering sciences, or creative work such as consultation, research, investigation, evaluation, planning, surveying, risk assessment and design, in connection with any public or private utility, structure, building, machine, equipment, process, work or project.

Practitioner (or engineering practitioner) means a person who performs engineering work or provides advisory services relating to engineering work. It includes both registered persons and unregistered persons.

Profession means Engineering Profession.

Professional Registration Category means a professional registration category as specified under Section 18(1) (a)–(c) of the Act, including Professional Engineer, Professional Engineering Technologist, Professional Certificated Engineer, Professional Engineering Technician, Candidate and Specified Category Practitioner.

Registered Person means a person registered under a category referred to in Section 18 of the Act.

Specified Categories means those registration categories classified as such by ECSA, for example, those related to fire protection systems, lifting machinery and medical equipment.

Unregistered Person means any person undertaking engineering work who is not registered in terms of the Act. This does not include persons registered by other statutory bodies and are part of teams undertaking engineering work.

1. INTRODUCTION

In terms of Section 27(1) of the Act, the Council must draw up a Code of Conduct for Registered Persons and may draw up a Code of Practice in consultation with the Council for the Built Environment, Voluntary Associations, and registered persons. The Council is also responsible for administering the Code of Conduct and the Code of Practice and ensuring that these codes are available to all members of the public at all reasonable times. An "Overarching Code of Practice for the Performance of Engineering Work" was therefore developed and published in the Government Gazette dated 26 March 2021, which further in this document is referred to as the "Overarching Code of Practice", for brevity. The Overarching Code of Practice applies to all engineering disciplines.

Respective disciplines and subdisciplines may develop their own codes of practice to complement this code, of which this Agricultural Engineering Code of Practice is an example. The Agricultural Engineering Code of Practice is specifically aimed at Agricultural Engineering and should be read in conjunction with the Overall Code of Practice and is not intended to duplicate the requirements thereof.

2. POLICY STATEMENT

This code is a statement of good practice for the performance of Agricultural Engineering work by Registered or Unregistered Persons. It is applicable to the entire Agricultural Engineering profession. Section 27(3) of the Act requires Registered Persons to adhere to the requirements of this code when they perform agricultural work.

3. PURPOSE AND SCOPE OF THIS DOCUMENT

The purpose of this Code of Practice is to ensure that any person undertaking Agricultural Engineering work meets the prescribed requirements when practicing and executing Agricultural Engineering work within the jurisdiction of the Act. This Agricultural Engineering Code of Practice describes fields of work for Agricultural Engineering, sets appropriate levels

of competence, regulating the execution of Agricultural Engineering work and specifying technical standards and best practices.

This Code of Practice also applies when an Agricultural Engineering practitioner performs Agricultural Engineering work in the specified categories, such as those related to dam safety, fire protection systems, lifting machinery and medical equipment. Additional codes of practice, specific to the specified category, may also apply in these contexts.

4. APPLICABLE LEGISLATIVE FRAMEWORK

This Agricultural Engineering Code of Practice should be read in conjunction with the Act and related documents, in particular the Code of Conduct for Registered Persons, the Overarching Code of Practice, and the Identification of Engineering Work Regulations.

Section 27 of the Act empowers the Council to draw up Codes of Practice in addition to codes of conduct and requires all registered persons to comply with such codes.

5. AGRICULTURAL ENGINEERING FIELDS OF WORK

Agricultural Engineers use engineering knowledge and skills with and within the environment to connect the living world of plants, soil, water, and animals with the technology of engineering (i.e., systems, structures, and machines). They operate at the interfaces between engineering science and practice, agricultural production and processing and environmental management, as illustrated in **Figure 1**.

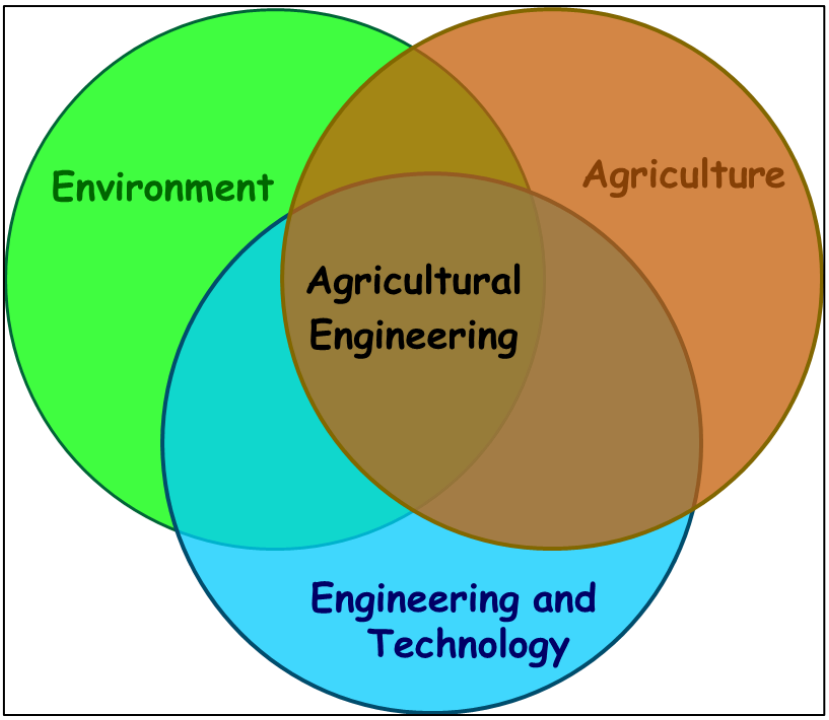

Figure 1: Focus of Agricultural Engineering

Agricultural Engineers design, develop and apply technology in the following broad fields:

- Land and water engineering
- Animal production
- Plant production
- Aquacultural engineering
- Agro-processing engineering
- Energy and biomass engineering
- Application of information technology and precision agricultural principles in agricultural production systems.

Due to the multidisciplinary nature of Agricultural Engineering, Agricultural Engineers generally practice in one or more of the following areas:

5.1 Food, Fibre and Energy Production Systems

The design, management and/or advising on technology for food, fibre and energy production systems in a highly variable and changing climate which includes the following:

- The design, sizing, selection, and management of agricultural machinery, implements and equipment for field operations (e.g., for soil preparation, planting, harvesting, storage, and transport of produce).
- The testing and evaluation of new agricultural machinery and equipment.
- The use of precision agriculture technologies (e.g., GIS, GPS, remote sensing, mechatronics) to ensure optimal and sustainable agricultural production systems which takes due consideration of the environment.
- The design and operation of transportation and logistics systems to move produce from fields to storage facilities, factories, and consumers.

5.2 Intensive Controlled Agricultural Environments

The design and management of intensive animal and plant production structures and control systems which may have controlled environments for optimal plant (e.g., greenhouses) and animal (e.g. broiler units, dairy plants, milking parlours) production. This includes hydroponics, aeroponics, aquaculture production systems and integrated agri-aquaculture systems, i.e., plant and fish production in the same controlled environment system.

5.3 Renewable Energy

The use of renewable sources of energy by the design, development of infrastructure and the application of technology to grow and utilise sustainable sources of energy (e.g. hydro, biogas, biofuels, solar, wind) and the processing of agricultural products and biomass into bio-energy

(e.g. anaerobic digesters).

5.4 Agricultural Product Processing Engineering

The design and management of food processing and storage systems to add value to raw products using technology to process and preserve food and animal feed, and ensuring products are safe for human and animal consumption. This involves structures such as cold stores, pack houses, factories and processing plants for agricultural produce, including cooling, heating, dehydration and pasteurisation facilities, produce handling, processing and storage, silo facilities, fish processing plants and abattoirs.

5.5 Agricultural Infrastructure Engineering

The design, construction, operation, repairs and maintenance of agricultural structures and infrastructure (e.g., farm buildings, farm roads, minor river crossings and bridges, animal handling facilities, waste handling and management facilities, spray races and dips), including the determination and specification of construction methods, materials and quality standards and construction supervision.

5.6 Agricultural Mechanisation Engineering

Design, manufacture, manage and advise on power and energy systems for agricultural production, including design, sizing, selection and management of agricultural machinery and equipment (e.g. engines, motors, pumps, fans, pipes), testing and evaluating new agricultural machinery and equipment.

5.7 Irrigation and Drainage Engineering and Management

The design, manufacture, testing and evaluation, and management of irrigation systems to meet crop water requirements and irrigate plants efficiently to obtain optimal yield per unit of water applied, including the design and installation of surface and subsurface drainage systems for land conservation, limiting soil erosion and promoting sustainable optimal crop production.

5.8 Hydrology and Agricultural Water Use Management

The design and management of agricultural and rural water resource systems, including the design of dams, canals, boreholes, extraction works and pipe networks for water supply to agriculture and humans, the assessment of the availability of water resources to meet demands for water in a highly variable climate in South Africa, the management of water resources by reconciling demands for water with the available supplies, the design of soil and water conservation systems to control runoff and thus minimise erosion and maximise agricultural production, and by sustaining the environment by minimising any negative impacts of agricultural practices.

5.9 Food and Fibre Process Engineering

The design and management of food and fibre processing and storage systems to add value to raw products by the use of technology to preserve and process food and animal feed, and ensuring products are safe for human consumption (e.g. structures, cold stores, pack houses, factories and plants for agricultural produce value addition, cooling, heating, dehydration and pasteurisation facilities, grain handling, storage and silo facilities, fish processing plants, abattoirs, marketing structures).

5.10 Handling and Management of Agricultural Waste

The design, construction and management of effluent and waste from both intensive animal production (e.g., dairies, piggeries, broilers) and processing facilities (e.g. abattoirs) and plant/crop-based processing facilities (e.g. residues and wastewater) required to cycle nutrients and to minimise any impact on the environment.

5.11 Natural Resources and Environmental Engineering

This involves applying engineering principles to conserve, sustain and, if necessary, regenerate natural functioning in the environment which is impacted by agricultural production practices. This includes the design of structures and systems for wetlands protection, water supply structures such as dams and reservoirs, surface runoff management and control, subsurface drains where necessary, design of erosion control structures, and the design and

management of pesticide and nutrient runoff and treatment systems to improve the quality of runoff.

5.12 Education & Training

Registered persons in the Education and training sector present lectures, tutorials & seminars on theoretical topics associated with agricultural engineering. They run practicals and projects that illustrate implementation of the theory, They also evaluate understanding and comprehension of material presented.

5.13 Reference to the Overarching Code of Practice

Please also refer to the Overarching Code of Practice for an overarching description of the nature of engineering work, the range of engineering problems and engineering activities and the categories of registration; and to the **Identification of Engineering Work Rules** for "Identified engineering work", "Category Differentiation and Engineering Activities" and "Identified Engineering Work in Agricultural Engineering Discipline".

6. COMPETENCY REQUIREMENTS OF AGRICULTURAL ENGINEERING PRACTITIONERS

The Overarching Code of Practice for “General Requirements" and "Requirements for Registered Persons"; and the Identification of Engineering Work Regulations stipulates the "Core Competencies Required to Perform Identified Engineering Work".

Any person who performs any Agricultural Engineering work must comply with the Engineering Profession Act. An Agricultural Engineering practitioner should be registered with ECSA in the appropriate professional registration category applicable to the level of service performed. An Agricultural Engineering practitioner should possess the necessary core competency in the applicable field to perform such core service as a professional engineer, professional engineering technologist or professional engineering technician.

Agricultural Engineering practitioners, depending on their tertiary education, training and

experience, category of registration and recognition by the profession, generally function at one of two distinct levels. The Levels 1 to 2 of competence required for Agricultural Engineering practitioners, and a career path to achieving these levels, are indicated in **Figure 6.1**.

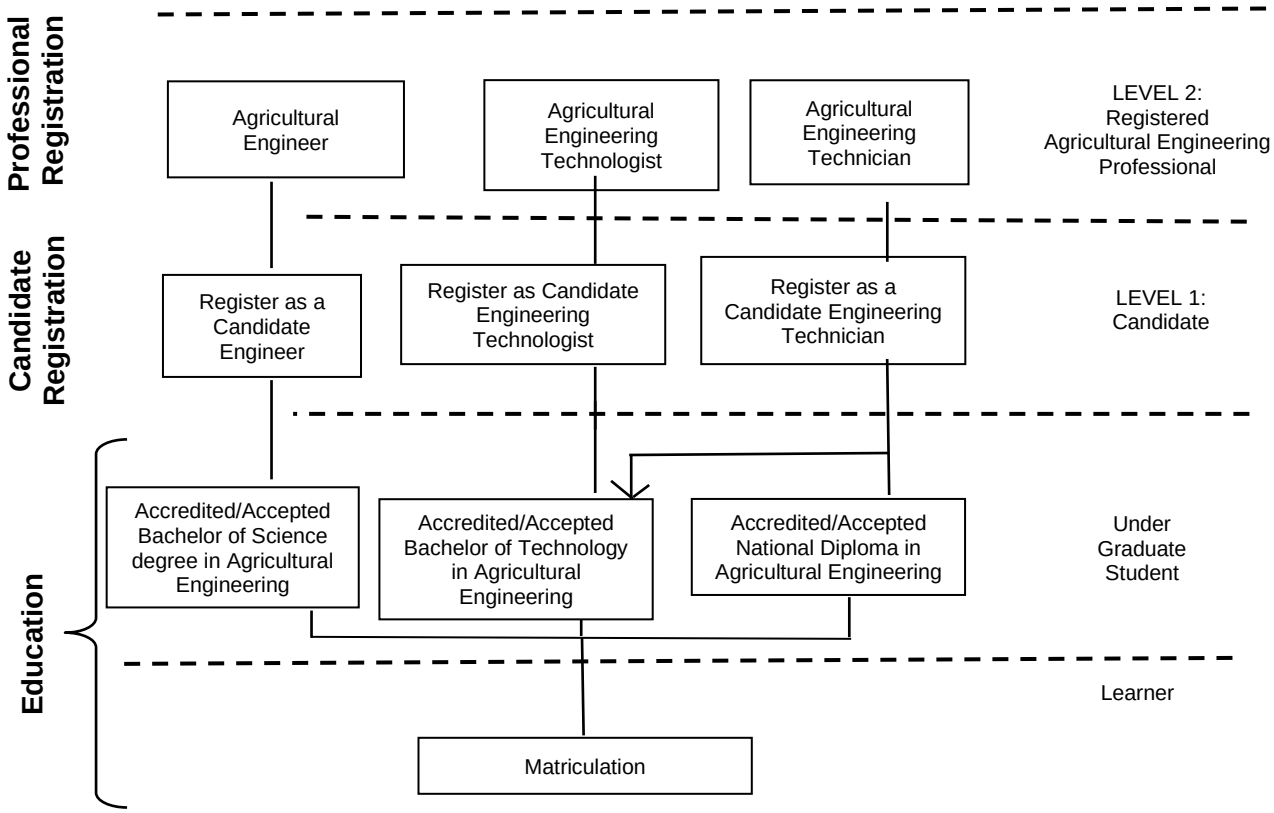

Figure 6.1:The Competence Levels of Agricultural Engineering Practitioners

Depending on the tertiary education, training and experience, category of registration and recognition by the profession, Agricultural Engineering practitioners function at one of two distinct levels as indicated in **Table 1**. The level of practitioner assuming responsibility for engineering solutions and the design is linked to the category of risk. The risk may include (where appropriate) risk to the health and safety of people and society, the natural and built environment, property, financial interests and related project timescales.

Table 1. Competence levels of Agricultural Engineering practice

Level	Designation	Typical characteristics of the practitioner
1	Candidate Agricultural Engineer	The practitioner shall have the required tertiary education qualification in Agricultural Engineering. The practitioner shall work under the supervision and control of an appropriately registered professional.
2	Registered Agricultural Engineering professional	The practitioner shall be registered with the Engineering Council of South Africa as a Professional Engineer or Professional Engineering Technologist or Professional Engineering Technician in the Agricultural Engineering discipline. The registered professional shall possess a level of knowledge and experience in keeping with the norms of the profession.

6.1 Practicing within Level of Competence

All Agricultural Engineering practitioners shall execute Agricultural Engineering work and they shall conduct work within their area and level of competence.

6.2 Continuing Professional Development

Competence may be developed through a combination of knowledge and understanding, generally acquired through educational programmes, Continuing Professional Development (CPD) and experience. Agricultural Engineering practitioners shall continue to continuously develop their knowledge, skills and expertise according to ECSA's Standard for Continuing Professional Development (**ECPD-01-STA**).

7. AGRICULTURAL ENGINEERING GOOD PRACTICE

7.1 Minimum Practice Requirements

All work shall be carried out or services rendered shall be:

- in accordance with the requirements of the applicable Acts and regulations;
- in an ethical and responsible manner in accordance with the Code of Conduct;

- in accordance with accepted norms and standards in the industry;
- within the practitioner's area of competency.

7.2 Agricultural Engineering Design

For the fields of work summarized in section 5 above, Agricultural Engineering design combines the use of principles and elements from various engineering disciplines and natural and animal sciences to provide sustainable engineering solutions for living and life-giving resources in such a way as to protect and preserve them. In Agricultural Engineering, a "system" is implied to be an element of civil, mechanical, electrical, and electronic engineering systems or a combination of these to form a multidisciplinary system. A system may include natural resources, devices, equipment, machinery, processes, services, structures, and software.

Prior to undertaking the design of a system, the Agriculture Engineering practitioner shall ascertain and document:

- current knowledge and state of practice of the problem to be solved;
- the use to which the system is to be put;
- the bounds of the system, including delineating the bounds of responsibility of the practitioner;
- the actions (loads, displacements, environmental controls, operating conditions, etc.) to be exerted on the system under normal and permissible limits or tolerances;
- the expected performance levels and constraints for the system under normal and permissible limits;
- the conditions under which the system is to be operated; and
- all relevant statutory, regulatory, or other requirements that may pertain to the system as listed in section 7.6, including Occupational Health and Safety issues

related to the construction and operation of the system.

When designing a system, prudent engineering principles shall be followed, emphasising efficiency, flexibility, maintainability, safety, and reliability in an economical and environmentally responsible and sustainable manner.

A design document should record the application of the overall design principles to the system. At a minimum, the design document shall provide the following information:

- Principles used and assumptions made in the design;
- Acts and regulations, codes, standards, considered and applied in the design;
- Design criteria applied;
- Selection criteria, which may include operating conditions, materials, geometries, etc.;
- Descriptions of analyses performed and their relevant results, such as system performance, capacity and life; and
- Strategies selected for relevant system life cycle stages, such as commissioning, operation, maintenance, support, and decommissioning;
- Instructions for operation, maintenance, support, etc., should be appended to the design document.

All design calculations shall be verified independently by a suitably qualified person.

7.3 Design Drawings

The design drawings shall be prepared in accordance with accepted industry standards such as SANS, ANSI, ASAE/ASABE, ISO, BSI or ASME. It is the duty of the responsible Agricultural Engineering practitioner to ensure that the drawings are complete, accurate, unambiguous, and clear. A responsible registered Agricultural Engineering (i.e. Level ≥ 2)

practitioner shall approve all design drawings of agricultural engineering solutions. Engineering drawings record design decisions and shall form part of a design document for Agricultural Engineering work.

The design drawing shall include the following:

- Name and signature of the responsible registered Agricultural Engineering practitioner;
- Name and address of the Agricultural Engineering consulting firm, government department or private company responsible for the design.
- All symbols and units used shall be consistent with the symbols used in the code of practice or the standard used in the design.

7.4 Retention of Project Documents

Retention of documents such as calculations, design notes, construction documents/drawings or reports must be kept for a minimum of 10 years, as required by the Code of Conduct, or for a more extended period mandated by an Act or regulation, applicable in the context after commissioning the project. The documents shall be kept in an appropriately secured paper, digital or electronic format and shall be accessible for the required period. The Agricultural Engineering practitioner must take reasonable safe-keeping measures such as keeping offsite and cloud backups of the documents.

7.5 Due Diligence

The Engineering Management Institute1 defines due diligence as follows:

> "*By definition, due diligence is any number of concepts or processes involving an investigation of a design, engineering calculation, contract, or some other item where a certain standard of care is needed".*

[1] Engineering Management Institute. 2011. Due diligence in your life. [Accessed: 13 February 2022]

In the engineering practice context, due diligence is the requirement that an engineering practitioner takes all reasonable steps to protect the interests of all parties and resources that might be affected by his/her actions or inaction before an incident occurs.

Agricultural Engineering practitioners shall apply due diligence and comply with the competence levels and responsibilities detailed in Table 6.1 and be able to demonstrate that they have:

- identified all actual or potential hazards to the interests of the client, employer or public associated with the work;
- assessed the risk to the interests of all affected parties associated with the identified hazards;
- taken steps to control or reduce the identified hazards and risks; and
- communicated the risks to all affected parties.

7.6 Compliance with Acts, Regulations and Legislation

Agricultural Engineering practitioners shall ensure compliance with the following Acts and legislation:

- Occupational Health and Safety Act (Act 85 of 1993)
- Engineering Profession Act (Act No. 46 of 2000)
- National Water Act (Act No. 36 of 1998)
- Water Services Act (Act No. 108 of 1997)
- National Building Regulations and Building Standards Act 103 of 1997
- National Environment Management Act 107 of 1998
- Agricultural Legislation covering the following Acts, among others, as the case may

be:

- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
- Fertilisers, Farm Feeds, Agricultural Remedies and Stock Remedies Act, 1947 (Act No. 36 of 1947)
- Abattoir Hygiene Act, 1992 (Act no. 121 of 1992)
- Conservation of Agricultural Resources Act, 1983 (act no. 43 of 1983) (provincial)
- Fencing Act, 1963 (Act No. 31 of 1963)

7.7 Application of Codes and/or Standards

All Agricultural Engineering work must be carried out in accordance with the norms and standards of the discipline. These norms and standards include the Agricultural Engineering national and international standards, industry standards, codes of practice and best management practices (BMPs).

As an accepted industry norm, standards and codes shall be applied as and when required by government regulation, customers, or end-user requirements. The Agricultural Engineering practitioner must ensure that all standards and codes used abide by the applicable Acts and regulations. Standards and codes may be used in place of regulations where it can be proven that the requirements of the standard or code meet and/or exceed those prescribed by regulations and/or law. Any deviations from the standards or codes requested by the customer or end-user shall be communicated to the appropriate stakeholders, supported by evidence that the deviation will not compromise the performance and safety of the system, structure or device.

Various local and international professional and regulatory bodies are recognised and accepted within the industry that develops and publishes standards, norms and guidelines related to Agricultural Engineering, notably:

- SAIAE – South African Institute of Agricultural Engineers
- SABI – South-African Irrigation Institute
- ASABE – American Society of Agricultural and Biological Engineers
- CIGR – International Commission of Agricultural and Biosystems Engineering
- SANS – South African National Standards
- ASME – American Society of Mechanical Engineers
- ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
- ISO – International Standard Organization
- SAE – Society of Automotive Engineers
- ASTM International - American Society for Testing and Material

8. ADMINISTRATION

This Code of Practice is subject to revision by the Council from time-to-time, in consultation with the Council for the Built Environment, Voluntary Associations and Registered Persons.

The Council is responsible for administering this Code of Practice (CoP) and must ensure that the latest version of the code is posted on the Council's website.

REVISION HISTORY

Revision Number	Revision Date	Revision Details	Approved By
Rev 0. Draft A	20 March 2022	Proposed by the working group to ECSA	Working Group
Rev0. Draft B	11 May 2022	Steering Committee Draft	Steering Committee
Rev0. Draft C	08 August 2022	Broader Consultation draft	Working Group
Rev.0 Draft D	09 September 2022	Incorporation of comments received from Broader consultation	Working Group
Rev.0 Draft E	26 January 2023	Steering Committee recommendation to submit to RPSC for approval	Steering Committee
Rev 0.	14 February 2023	Approval by RPSC	RPSC
Rev 0.	30 March 2023	Ratification	Council

The Code of Practice for:

Agricultural Engineering

Revision 0 dated 30 March 2023 and consisting of 22 pages reviewed for adequacy by the Business Unit Manager and approved by the Executive: Research, Policy and Standards (**RPS**).

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Business Unit Manager

14 April 2023
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Date

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Executive: RPS

2023/04/14
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Date

This definitive version of this policy is available on our website