ENSURING THE EXPERTISE TO GROW SOUTH AFRICA

Discipline Specific Training Guide for Registration as a Professional Engineer in Agricultural Engineering

R-05-AGR-PE

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ENGINEERING COUNCIL OF SOUTH AFRICA
Tel: 011 6079500 | Fax: 011 6229295
Email: engineer@ecsa.co.za | Website: www.ecsa.co.za
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DEFINITIONS

Complex engineering work: This work is characterised by the following:

(a) Scope of activities may encompass entire complex engineering systems or complex subsystems.

(b) A context that is complex and varying, is multidisciplinary, requires teamwork, is unpredictable and may need to be identified.

(c) It requires diverse and significant resources including people, money, equipment, materials and technologies.

(d) Significant interactions exist among wide-ranging or conflicting technical, engineering or other issues.

(e) It is constrained by time, finance, infrastructure, resources, facilities, standards and codes, and applicable laws.

(f) It has significant risks and consequences in a range of contexts.

Competency Standard: Statement of competency required for a defined purpose.

Engineering problem: A problematic situation that is amenable to analysis and solution using engineering sciences and methods.

Engineering science: A body of knowledge that is based on the natural sciences and uses mathematical formulation where necessary, which extends knowledge and develops models and methods to support its application, to solve problems and to provide the knowledge base for engineering specialisations.

Ill-posed problem: Problems for which the requirements are not fully defined or may be defined erroneously by the requesting party.

Integrated performance: An overall satisfactory outcome of an activity requires several outcomes to be satisfactorily attained. For example, a design requires analysis, synthesis, analysis of impacts, checking of regulatory conformance and judgement in decisions.

Level descriptor: A measure of performance demands at which outcomes must be demonstrated.
Management of engineering works or activities: The co-ordinated activities required are to:

- direct and control everything that is constructed or results from construction or manufacturing operations
- operate engineering works safely and in the manner intended
- return the engineering works, the plant and the equipment to an acceptable condition by the renewal, replacement or mending of worn, damaged or decayed parts
- direct and control the engineering processes, systems, commissioning, operation and decommissioning of equipment
- maintain engineering works or equipment in a state in which it can perform its required function.

Over-determined problem: A problem for which the requirements are defined in excessive detail, making the required solution impossible to attain in all its aspects.

Outcome: A statement of the performance that a person must demonstrate to be judged competent at the professional level.

Practice area: A generally recognised or distinctive area of knowledge and expertise developed by an engineering practitioner by virtue of the path of education, training and experience followed.

Range statement: The required extent of or limitations on expected performance stated in terms of situations and circumstances in which outcomes are to be demonstrated.

Specified category: A category of registration for persons registered through the Engineering Profession Act, 46 of 2000, or through a combination of the Engineering Profession Act and external legislation with specific Engineering competencies at NQF Level 5 regarding an identified need to protect the safety, health and interest of the public and the environment, in relation to an engineering activity.
### ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CAD</td>
<td>Computer-aided Design</td>
</tr>
<tr>
<td>C&amp;U</td>
<td>Commitment and Undertaking</td>
</tr>
<tr>
<td>DSTG</td>
<td>Discipline-specific Training Guide</td>
</tr>
<tr>
<td>BEng</td>
<td>Bachelor of Engineering</td>
</tr>
<tr>
<td>BScEng</td>
<td>Bachelor of Science in Engineering</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographic Information Systems</td>
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<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>IPD</td>
<td>Initial Professional Development</td>
</tr>
<tr>
<td>MEng</td>
<td>Master of Engineering</td>
</tr>
<tr>
<td>OFO</td>
<td>Organising Framework for Occupations</td>
</tr>
<tr>
<td>PCE</td>
<td>Professional Certificated Engineer</td>
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<tr>
<td>PE</td>
<td>Professional Engineer</td>
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<tr>
<td>PGDip</td>
<td>Post-graduate Diploma</td>
</tr>
<tr>
<td>PN</td>
<td>Professional Engineering Technician</td>
</tr>
<tr>
<td>PT</td>
<td>Professional Engineering Technologist</td>
</tr>
<tr>
<td>QCTO</td>
<td>Quality Council for Trades and Occupations</td>
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<tr>
<td>RPS</td>
<td>Research Policy and Standards</td>
</tr>
<tr>
<td>TES</td>
<td>Training and Experience Summary</td>
</tr>
<tr>
<td>TERs</td>
<td>Training and Experience Reports</td>
</tr>
<tr>
<td>VIPs</td>
<td>Value Improved Practices</td>
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</table>
BACKGROUND

The illustration below defines the documents that comprise the Engineering Council of South Africa (ECSA) system for registration in professional categories. The illustration also locates the current document.

Figure 1: Documents defining the ECSA Registration System
1. PURPOSE OF THIS DOCUMENT

All persons applying for registration as Professional Engineers are expected to demonstrate the competencies specified in the Competency Standard for Registration in Professional Categories (document R-02-STA-PE/PT/PCE/PN) through work performed at the prescribed level of responsibility, irrespective of the trainee’s discipline.

This document supplements the Training and Mentoring Guide for Professional Categories (document R-04-T&M-GUIDE-PC) and the Guide to the Competency Standards for Professional Engineers (document R-08-PE).

In document R-04-T&M-GUIDE-PC, attention is drawn to the following sections:

- Duration
- Planning principles
- Progression of training programme
- Documenting training and experience
- Demonstrating responsibility

Document R-08-PE provides a high-level, outcome-by-outcome understanding of the competency standards that form an essential basis for this Discipline-specific Training Guide (DSTG).

This guide and documents R-04-T&M-GUIDE-PC and R-08-PE are subordinate to the Policy on Registration (document R-01-POL-PC), the Competency Standard (document R-02-STA-PE/PT/PCE/PN) and the application process definition (document R-03-PRO).

2. AUDIENCE

This DSTG is directed towards Candidates and their Supervisors and Mentors in the sub-disciplines of Agricultural Engineering. The guide is intended to support a programme of training and experience through incorporating good practice elements.
This guide applies to persons who have:

- completed the tertiary educational requirements in Agricultural Engineering by obtaining an accredited:
  - BEng/BSc(Eng)/BEng-type programmes (document E-02-PE) listed on the ECSA website.
  - MEng programme (document E-22-PE) (with cognate BEng Tech (Hons)/PGDip plus BEng Tech as prerequisites) as listed on the ECSA website.

- obtained a Washington Accord recognised qualification, or
- through ECSA educational qualification evaluation/assessment;
- registered with ECSA as a Candidate Engineer; and/or
- embarked on a process of acceptable training under a registered Commitment and Undertaking (C&U) programme under the supervision of an assigned Mentor guiding the professional development process at each stage.

3. PERSONS NOT REGISTERED AS A CANDIDATE AND/OR NOT TRAINED UNDER COMMITMENT AND UNDERTAKING

Irrespective of the development path followed, all applicants for registration must present the same evidence of competence and be assessed against the same competence standards. Application for registration as a Professional Engineer is permitted without being registered as a Candidate Engineer and without training under C&U. Mentorship and adequate supervision are, however, key factors in effective development to the level required for registration.

If the trainee’s employer does not offer C&U, the trainee should establish the level of mentorship and supervision the employer is able to provide. In the absence of an internal Mentor, the services of an external Mentor should be secured. The Voluntary Association (VA) for the discipline may be consulted for assistance in locating an external Mentor. A Mentor should keep abreast of all stages of the development process.

This guide is written for the recent Candidate who is training and gaining experience towards registration. Applicants who have not enjoyed mentorship are advised to request an experienced Mentor (internal or external) to act as an application adviser while they prepare their applications for registration.
4. ORGANISING FRAMEWORK FOR OCCUPATIONS

Agricultural Engineering – Organising Framework for Occupations (OFO)

Agricultural Engineers have unique skills to connect the living world of plants, soil, water, aquatic life and animals with the technology of engineering (i.e., systems, structures and machines). Agricultural Engineers are required to ensure sustainable environments with adequate energy, efficient machinery, water supplies and food production, and processing systems. Agricultural Engineers thus operate at the interfaces between engineering science and practice, agricultural production and processing and rural environmental management. The implication is that Agricultural Engineers must be aware of the factors that are important in agricultural production and processing and environmental sustainability. This is promoted by including introductory agricultural courses in the Agricultural Engineer’s tertiary education. Candidates who have degrees in Engineering Specialities other than Agricultural Engineering must show that they have attained this knowledge through accredited learning bodies or institutes and/or practical experience in at least one of the many diverse areas of sustainable agricultural production and processing if they are to be registered as Agricultural Engineers.

An Agricultural Engineer plans, designs, performs and supervises engineering work related to the development and/or improvement or revitalisation of infrastructure, machinery and processes for agricultural production. In addition, the Agricultural Engineer is responsible for post-harvest handling and processing of agricultural produce and similar engineering processes in associated environmental and biological contexts. This may include the use and development of agricultural land, the environment, infrastructure (buildings, roads, river crossings, dams, irrigations systems, electrification, soil retaining walls, crush pens etc.), machines, equipment and processes.

Due to the multi-disciplinary nature of Agricultural Engineering, practising Agricultural Engineers generally concentrate on one or more of the following areas:

- Agricultural Energy Engineering
- Agricultural Renewable Energy Engineering
- Agricultural Product Processing Engineering
- Agricultural Structures and Facility Engineering
Potential fields of work for Agricultural Engineers include the following:

- Advising or lecturing on and/or conducting research and developing new or improved theories, methods and technologies relating to the fields of agricultural infrastructure, agro-processing, irrigation and drainage engineering, mechanisation and precision agriculture and renewable energy. (i.e., soil and water, power and machinery, the processing and handling of agricultural/biological products, structures, the environment, energy, particularly renewable energy, and biological systems).
- Designing, managing and/or advising on technology for food, fibre- and energy-production systems, including the design, sizing, selection and management of agricultural machinery, implements and equipment for field operations (e.g., soil preparation, planting, harvesting, storage and transport of produce).
- Testing and evaluating new agricultural machinery and equipment.
- Using precision agriculture technologies (e.g., GIS, GPS) to ensure optimal and sustainable agricultural production systems that consider the environment.
- Designing and overseeing the operation of transportation systems that move produce from fields to and within storage facilities, factories and to consumers.
- Designing and managing irrigation systems to irrigate plants efficiently to obtain optimal yield per unit of water applied and sustainability of the water resource.
- Designing and installing drainage systems for land conservation and optimal crop production.
- Designing and managing agricultural and rural water-resource systems through the design of dams, canals, boreholes, extraction works and pipe networks for water supply to agriculture and society.
• Assessing the availability of water resources and the development of supporting infrastructure:
  o Water Resource Planning – managing water resources by reconciling demands for water with the available supply
  o Options Analysis – identifying the best technical solution for a water supply project and hence which projects best meet public needs
  o Systems Operation – allocation of the water resource with respect to the available demands as influenced by the supply detected by natural occurrences and developments
  o Reserve Determination – determination of the ecological water requirements to include the basic human needs) for the sustainability and equity identified as central guiding principles in the protection, use, development, conservation, management and control of the water resources in the variable climate of South Africa.

• Designing soil and water conservation systems to control runoff, thus minimising erosion, maximising agricultural production and sustaining the environment through minimizing the negative impacts of agricultural practices.

• Designing and overseeing the operation of agricultural structures and infrastructure (e.g., farm buildings, farm roads, minor river crossings and bridges, soil retaining structures, animal handling facilities, agricultural waste handling and management facilities, spray races and dips).

• designing and managing food processing and storage systems (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) to add value to raw products using technology to preserve and process food and animal feed, thus ensuring products are safe for human consumption.

• Designing and managing intensive animal handling and plant production structures and control systems that may have controlled environments for optimal plant production (e.g., greenhouses), animal breeding (e.g., housing structures, broiler units) and generation of animal products (dairy plants, milking parlours).

• Using renewable sources of energy through the design and development of technology to grow and utilise sustainable sources of energy (e.g., hydro, biofuels, solar, wind) and processing agricultural products and biomass into bioenergy (e.g., anaerobic digesters).
• Designing, managing and advising on power and energy systems for agricultural production, including the design, sizing, selection and management of agricultural machinery and equipment (e.g., engines, motors, pumps, fans, pipes) together with testing and evaluating new agricultural machinery and equipment.
• Determining and specifying construction methods, materials and quality standards and directing construction work for agricultural purposes.
• Establishing control systems to ensure efficient functioning of infrastructure and safety and environmental protection.
• Organising and directing the operation, maintenance and repair of agricultural production structures and facilities.
• Analysing the stability of structures, machinery and implements and testing the behaviour and durability of the materials used in their construction.

5. NATURE AND ORGANISATION OF THE INDUSTRY

The close association of Agricultural Engineering with biological and environmental systems requires specific attention to risk and impact mitigation, which requires the Candidate Engineer to develop a good working knowledge of specific laws and regulations.

In executing Engineering Work, Practitioners must comply with all relevant legislation and amendments thereto, among others:

• Engineering Profession Act, 46 of 2000
• Occupational Health and Safety Act, 85 of 1993
• National Building Regulations and Building Standards Act, 103 of 1977
• National Environmental Management Act, 107 of 1998
• Employment Equity Act, 55 of 1998.

All Engineering Work must be conducted in accordance with the norms of the profession. Such norms are generally represented by national and international standards, industry standards, codes of practice and best practice guidelines. Candidate Engineers should ensure that the work they engage in during the training period gradually increases their degree of responsibility and is relevant to their progression towards registration. Candidate Engineers should further ensure that they gain
experience in all the typical tasks that present in the lifecycle of agricultural engineering projects, specifically practical site work and engineering design.

The tasks in the engineering project lifecycle listed below are elaborated upon in Appendix A: Training Elements (QCTO Curriculum):

- Solving complex engineering problems using engineering and contextual knowledge
- Planning, implementing and operating engineering projects, systems, products and processes
- Mitigating risk and impact
- Managing engineering activities.

The Candidate Engineer can develop further insight into the typical stages involved in implementing engineering projects by studying the Guideline Professional Fees (Scope of Service and Tariff of Fees for Persons Registered in terms of the Engineering Profession Act, 46 of 2000) as amended.

The six stages for implementing normal services in an engineering project are the following:

**Stage 1** – Inception (including assessment of needs and resources).

**Stage 2** – Concept and Viability (often called Preliminary Design).

**Stage 3** – Design Development (also termed Detail Design).

**Stage 4** – Documentation and Procurement (development of tender documentation, including drawings, specifications, quantities and tenders/contracts, and procurement, including tendering process).

**Stage 5** – Contract Administration and Inspection (requiring adequate, first-hand, practical experience in site work such as fabrication, construction, manufacturing, installation, construction administration and inspection).

**Stage 6** – Close-out (project close-out and hand-over, including commissioning, operating documentation and as-built plans).

For continuing projects in an operational environment, the Agricultural Engineer may be responsible for project management involving ongoing operation and maintenance, optimisation and asset management and renewal as follows:

- Post-implementation/operation/management
- Shut-down, preventative maintenance
6. DEVELOPING COMPETENCY: ELABORATING ON SECTIONS IN THE GUIDE REGARDING COMPETENCY STANDARDS (DOCUMENT R-08-PE)

Candidate Engineers can demonstrate competency in their field by compiling a portfolio of evidence that is structured according to the 11 outcomes mentioned in document R-02-STA-PE-PT-PCE-PN and further described in document R-08-PE. The 11 outcomes are organised into five groups (groups A–E) and nested as shown below:

Group A: Knowledge-based problem-solving (this should be a strong focus)
The Candidate Engineer may develop and demonstrate competency in outcomes 1, 2 and 3 by providing evidence of problem identification and analysis that successfully interprets a diversity of factors affecting possible engineering solutions in farming, rural development or agro-industrial contexts. Examples of evidence for competency include identification, evaluation, selection, design, implementation of suitable engineering solutions (may include infrastructure and/or processes) and application of engineering and non-engineering knowledge and insight to achieve workable solutions.
Group B: Management and communication

Evidence for competency of the Candidate Engineer in outcomes 4 and 5 (management and communication in Agricultural Engineering) includes examples of planning and organising and human resource management plus funds, machinery, methods and materials in site work and Agricultural Engineering office contexts. Also included is professional and effective communication with farmers, rural communities, contractors, persons engaged in the agro-industry, relevant government departments, clients and peers.

Group C: Identifying and mitigating the impacts of engineering activity

Examples demonstrating competency in Outcome 6 (identifying and mitigating the impacts of agricultural engineering activity) include responsible development, utilisation and protection of natural resources related to agriculture, including water, soil, biodiversity and air quality. Competency may further include mitigation of non-regulated impacts such as disturbances to social and economic stability through ill-considered engineering developments, particularly in remote rural areas.

Evidence of competency in outcome 7 includes examples of human, animal and plant health protection in farming and agro-industrial contexts and compliance with the relevant regulatory requirements in the design of engineering solutions.

Group D: Judgement and responsibility

For outcomes 8, 9 and 10: In terms of engineering judgement, resolutions require judgement in decision-making in uncertain contexts. Engineering judgement is typically demonstrated by considering several factors, some of which may be ill-defined or unknown: considering the interdependence, interactions and relative importance of factors; foreseeing consequences of actions; evaluating a situation in the absence of full evidence; and drawing on experience and knowledge. Candidates should develop solutions with a method or process used to adequately resolve the field needs when a tested design, system, process or assembly is unavailable. Engineers who develop safety-related systems are required to work to remarkably high standards. Safety cases should argue and seek to show that the required probability of failure has been achieved according to prescribed safety standards or norms with the method or process used.
Candidate Engineers should demonstrate that they are willing and able to take responsibility for decisions and are competent in judgement and responsible conduct in accordance with the ECSA Code of Conduct and Safety Standards.

**Group E: Independent learning**

Towards achievement of outcome 11, the Candidate Engineer should develop the ability and habit of independent and lifelong learning. Candidates should provide evidence of relevant Initial Professional Development (IPD) activities completed during the training period.

**6.1 Contextual knowledge**

By nature, work in the Agricultural Engineering sector is tightly integrated with biological systems and the natural environment. Thus, an Agricultural Engineer requires a thorough understanding of the people and circumstances when devising a suitable agricultural engineering solution. Circumstances may vary from ultramodern, agro-industrial factories and complex, multi-faceted, commercial farming enterprises to robust, pro-poor, rural food security systems within complex multi-user social structures.

The strong contextual nature of agricultural engineering solutions holds specific implications for training Candidate Engineers. It is strongly recommended that Candidate Engineers also acquire first-hand exposure and experience of the non-engineering context (farms, rural communities, agri-businesses) within which agricultural engineering solutions need to be relevant. Adequate first-hand exposure will enable Candidate Engineers to:

- understand that they are working with the uncertainties of economy, climate, social contexts and farming environments
- understand, respect and be able to collaborate with related disciplines in a complex environment, including specialists in crops, soils, food science and health in addition to chemical suppliers and environmental experts and authorities
- appreciate the economic realities in agriculture, including low margins and resource-poor communities plus the socio-economic impacts of and on engineering interventions.
6.2 Functions performed, statutory and regulatory requirements and recommended formal learning

The following formal learning activities and objectives are recommended for inclusion in the training period for the Candidate Engineer in Agricultural Engineering:

- Gaining practical exposure to non-engineering skills and achieving underlying background experience in farming, rural development and/or agro-processing industry contexts – it is strongly recommended that Candidate Agricultural Engineers work in a farming or agro-processing industrial environment for at least 3 months to a year upon graduation.
- Acquiring the habit of IPD in functions related to the discipline plus networking and becoming acquainted with peers and related disciplines.
- Developing targeted soft skills to act effectively in social realities and management contexts.
- Attending industry-related conferences, presentations, seminars and workshops.
- Applying IT/software and basic coding relevant to the discipline (e.g., CAD programmes, Modelmaker).
- Encompassing project planning and management.
- Incorporating engineering management and entrepreneurship and business management.

7. PROGRAMME STRUCTURE AND SEQUENCING

7.1 Best practices

No ideal training programme structure or unique sequencing constitutes best practice. The training programme for each Candidate depends on the available work opportunities which the employer assigns to the Candidate at the time.

It is suggested that Candidates work with their Mentors to determine appropriate projects to gain exposure to the elements of the asset lifecycle and to ensure that their designs are constructible and operable and are designed considering lifecycle costing and long-term sustainability. A regular reporting structure with suitable recording of evidence of achievement against the competency outcomes and responsibility levels needs to be in place.

The training programme should be such that the Candidate progresses through the levels of work capability as described in document R-04-T&M-GUIDE-PC so that by the end of the
training period, the Candidate exhibits a Level E degree of responsibility and is able to perform individually and as a team member at the level of problem-solving and engineering activity that is required for registration.

Value Improved Practices (VIPs) are out-of-the-ordinary practices used to improve cost, schedule and/or reliability of capital construction projects. VIPs are:

- used primarily during front-end-loading
- formal, documented practices involving a repeatable work process
- mainly facilitated by specialists outside the project team.

Examples include the following:

- Technology selection
- Process simplification
- Classes of facility quality
- Waste minimisation
- Energy optimisation
- Process reliability modelling
- Customisation of standards and specifications
- Predictive maintenance
- Design to capacity
- Value engineering
- Constructability.

7.2 Realities

ECSA prescribes a minimum period of 3 years for the Candidacy Phase; the likelihood, however, is that the training period will be longer. This time frame is determined by the availability of opportunities and the exposure to various functions in the actual work environment.

Irrespective of the route followed, the overriding consideration is that the applicant must provide evidence of competence against the standard prescribed in document R-02-STA-PE-PT-PCE-PN and provide objective evidence of meeting the 11 specified outcomes.
7.3 Generalists, specialists, researchers and academics

Document R-08-PE adequately describes what is expected of persons whose formative development has not followed a conventional path, for example, academics, researchers and specialists.

Irrespective of the route followed, the overriding consideration is that the applicant must provide evidence of competency against the standard prescribed in document R-02-STA-PE-PT-PCE-PN and provide objective evidence of meeting all the required outcomes. Research work submitted for competency evaluation must have been undertaken by the Candidate in a personal capacity i.e., not work done by students supervised by the Candidate.

7.4 Multi-disciplinary exposure

Interface management among different disciplines needs to be formalised. Details of signed-off interface documents among different disciplines are essential.

7.5 Orientation requirements

The requirements comprise the following:

- Introduction to company safety regulations
- Introduction to the company code of conduct
- Introduction to the company staff code and regulations
- Typical functions and activities of the company
- Hands-on experience and orientation in each of the major company divisions.

7.6 Moving into or changing candidacy training programmes

This guide assumes that the Candidate enters a programme after graduation and continues with the programme until ready to apply for registration. It also assumes that the candidate is supervised and mentored by persons who meet the requirements stated in document R-04-T&M-GUIDE-PC. In the case of a person changing from one candidacy programme to another or moving into a candidacy programme from a less structured environment, it is essential that the following steps are completed:
• The candidate must complete the Training and Experience Summary (TES) and the Training and Experience Reports (TERs) for the previous programme or unstructured experience. In the latter case, it is important to reconstruct the experience as accurately as possible. The TERs must be signed off by the relevant Supervisor or Mentor.

• On entering the new programme, the Mentor and Supervisor should review the Candidate’s development while being mindful of past experience and the opportunities and requirements of the new programme. At minimum, the Mentor and Supervisor should plan the next phase of the Candidate’s programme.

7.7 Degree of responsibility

Together with their Supervisors and Mentors, Candidate Engineers should ensure that their work is structured and sequenced to enable systematic progression towards registration. Progress can be planned and measured using the scales for degree of responsibility, engineering activity and engineering problem-solving as described in document R-04-T&M-GUIDE-PC: Training and Mentoring Guide and in document R-08-PE: Guide to Competency Standards.

Table 4: Progression throughout the candidacy period presented in document R-04-T&M-GUIDE-PC specifically refers to the gradual increase in the degree of responsibility that Candidate Engineers are expected to acquire and exhibit during their engineering training. Specific examples and outcomes appropriate to training in Agricultural Engineering are given below:

<table>
<thead>
<tr>
<th>Degree of responsibility</th>
<th>Nature of work</th>
<th>Activities/duties to be undertaken during training</th>
</tr>
</thead>
</table>
| A: Being exposed          | The Candidate undergoes induction and observes processes and work of competent practitioners. | While working under the close supervision of a competent Professional Engineer and senior colleagues in the firm/organisation, trainees should:  
  • be directed to read the various Acts and regulations that affect the work of a Professional Engineer  
  • be exposed to the firm’s/organisation’s work environment, including the organisational structure  
  • read materials concerning the firm/organisation  
  • be exposed to field work and the engineering office-work environment and culture  
  • attend and participate in meetings, including office meetings, field/site meetings, seminars and workshops |
<table>
<thead>
<tr>
<th>Degree of responsibility</th>
<th>Nature of work</th>
<th>Activities/duties to be undertaken during training</th>
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<tr>
<td></td>
<td></td>
<td><em>be sensitised to the importance of IPD and relevant vocational society meetings</em></td>
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<td></td>
<td></td>
<td><em>be exposed and/or trained in the use of both the general and the specialised computer software packages used by the firm/organisation in its delivery of day-to-day work</em></td>
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<td><em>be part of a team comprising competent Engineers and Candidate Engineers working on engineering projects in a sub-discipline of Agricultural Engineering</em></td>
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<td></td>
<td></td>
<td><em>if possible, be attached/exposed to different projects in the known sub-disciplines of Agricultural Engineering</em></td>
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<td></td>
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<td><em>be personally committed to their development and training by gaining experience in the full range of engineering activities available in the firm/organisation.</em></td>
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<tr>
<td>B: Assisting</td>
<td>The Candidate performs specific processes under close supervision.</td>
<td>While working under close supervision of a Professional Engineer, trainees should:</td>
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<td></td>
<td></td>
<td><em>be engaged in engineering tasks under close supervision of a competent engineer</em></td>
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<td><em>develop and display an appreciation of the numerous resources at the disposal of an Agricultural Engineer</em></td>
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<td><em>be engaged in conducting special studies or research to solve customer-service problems</em></td>
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<td><em>assist in the selection of outside consultants and contractors</em></td>
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<td><em>assist in preparing and issuing proposals to consultants and contractors</em></td>
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<td><em>be assigned the responsibility of assisting and supervising new staff at the ‘A: Being Exposed’ level and other lower-level technical staff</em></td>
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<td><em>assist in reviewing bid proposals, make recommendations and forward their report to the supervising Professional Engineer</em></td>
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<td></td>
<td></td>
<td><em>be personally committed to their development and training by gaining experience in the entire range of engineering activities available in the firm/organisation.</em></td>
</tr>
<tr>
<td>C: Participating</td>
<td>The Candidate performs specific processes as directed with limited supervision.</td>
<td>While working under less supervision than Candidates exhibiting levels A and B in degree of responsibility, trainees should:</td>
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<td></td>
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<td><em>administer assigned contracts and provide administrative support in preparing construction and maintenance contracts</em></td>
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<tr>
<td></td>
<td></td>
<td><em>participate in preparing budgets for assigned projects, submit budget recommendations and monitor expenditure</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>assist in monitoring outside consultants’ work and assist in monitoring the progress of projects and the disbursement of payments</em></td>
</tr>
<tr>
<td>Degree of responsibility</td>
<td>Nature of work</td>
<td>Activities/duties to be undertaken during training</td>
</tr>
<tr>
<td>--------------------------</td>
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<td>--------------------------------------------------</td>
</tr>
</tbody>
</table>
|                          |                | • compile engineering data and other relevant data for assigned projects to be used by other engineering project team members  
|                          |                | • participate in minor engineering work design as directed by a Competent Engineer. |
| D: Contributing          | The Candidate performs specific work with detailed approval of work outputs. | While working under minimum supervision, trainees apply engineering technology and knowledge of biological sciences to agricultural problems concerned with power and machinery, electrification, structures, soil and water conservation and processing of agricultural products to:  
|                          |                | • develop criteria for design, manufacture or construction of equipment, structures and facilities  
|                          |                | • design and use sensing, measuring and recording devices and instrumentation to study problems such as effects of temperature, humidity and light on plants or animals or to study the relative effectiveness of the different methods for applying insecticides  
|                          |                | • design and direct the manufacture of equipment for land tillage and fertilisation, plant and animal disease control, insect control, harvesting and transport of commodities  
|                          |                | • design and supervise the erection of structures for crop storage, animal shelter and human dwelling, including light, heat, air-conditioning, water supply and waste disposal  
|                          |                | • plan and direct the construction of irrigation, drainage and flood-control systems for soil and water conservation  
|                          |                | • design and supervise the installation of equipment and instruments used to evaluate and process farm products and automate agricultural operation groups and related farm cooperatives  
|                          |                | • remain committed to IPD.  
|                          |                | Because the firm/organisation may not be involved in Engineering work that covers all the Agricultural Engineering sub-disciplines, it should be noted that trainees do not need to contribute/work in all the said areas. |
| Performing               | The Candidate works in a team without supervision, recommends work outputs and is responsible but not accountable. | While working under no supervision, trainees apply engineering technology and knowledge of biological sciences to agricultural problems concerned with power and machinery, electrification, structures, soil and water conservation and processing of agricultural products to:  
|                          |                | • develop criteria for design and manufacture or develop criteria for construction of equipment, structures and facilities  
|                          |                | • develop and implement production, processing and management systems  

**QM-TEM-001 Rev 0 – ECSA Policy/Procedure**

**CONTROLLED DISCLOSURE**

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### Degree of responsibility

<table>
<thead>
<tr>
<th>Nature of work</th>
<th>Activities/duties to be undertaken during training</th>
</tr>
</thead>
<tbody>
<tr>
<td>design and use sensing, measuring and recording devices and instrumentation to study problems such as effects of temperature, humidity and light on plants or animals or to study the relative effectiveness of different methods for applying insecticides</td>
<td></td>
</tr>
<tr>
<td>design and direct the manufacture of equipment for land tillage and fertilisation, plant and animal disease control, insect control, harvesting and transport of commodities and</td>
<td></td>
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<tr>
<td>design and supervise the erection of structures for crop storage, animal shelter and human dwelling, including light, heat, air-conditioning, water supply and waste disposal.</td>
<td></td>
</tr>
<tr>
<td>plan and direct construction of irrigation, drainage, and flood-control systems for soil and water conservation design and supervise the installation of equipment and instruments used to evaluate and process farm products and automate agricultural operation groups and related farm cooperatives</td>
<td></td>
</tr>
<tr>
<td>assume technical responsibility and coordinate the work of their juniors</td>
<td></td>
</tr>
<tr>
<td>manage multi-disciplinary engineering projects</td>
<td></td>
</tr>
<tr>
<td>exercise engineering judgement and take responsibility for the project, the output of which must be confirmed by a Professional Engineer</td>
<td></td>
</tr>
<tr>
<td>remain committed to IPD.</td>
<td></td>
</tr>
</tbody>
</table>

Because the firm/organisation may not be involved in Engineering work that covers all the Agricultural Engineering sub-disciplines, it should be noted that trainees do not need to contribute/work in all the said areas.
## REVISION HISTORY

<table>
<thead>
<tr>
<th>Revision number</th>
<th>Revision date</th>
<th>Revision details</th>
<th>Approved by</th>
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<tbody>
<tr>
<td>Rev 0: Concept A</td>
<td>15 September 2012</td>
<td>Initial attempt by task Ag. Eng. PAC team</td>
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<tr>
<td>Rev 0: Concept B</td>
<td>19 October 2012</td>
<td>Draft to SAIAE Council</td>
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<tr>
<td>Rev 0: Concept C</td>
<td>25 October 2012</td>
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<tr>
<td>Rev 2</td>
<td>22 September 2017</td>
<td>Reviewed in line with approved DSTG framework</td>
<td>P Moodley</td>
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<tr>
<td>Rev 2</td>
<td>9 October 2017</td>
<td>For approval via round robin</td>
<td>PDSGC</td>
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<tr>
<td>Rev 2</td>
<td>23 October 2017</td>
<td>Reviewed and checked</td>
<td>B Collier-Reed, TP Maphumulo, J Cato</td>
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<tr>
<td>Rev 2</td>
<td>16 November 2017</td>
<td>Approval</td>
<td>PDSG</td>
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<tr>
<td>Rev 3</td>
<td>28 June 2021</td>
<td>The document has been revised to include definitions, abbreviations, update document numbering of referenced document. Additional information was also added under the following headings: Nature and Organisation of the Industry Group D: Judgement and responsibility</td>
<td>Executive: RPS – EL Nxumalo</td>
</tr>
<tr>
<td>Rev 3</td>
<td>15 July 2021</td>
<td>Approval</td>
<td>RPSC</td>
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The Discipline-specific Training Guide for:

**Candidate Professional Engineer in Agriculture Engineering**

Revision 3 dated 15 July 2021 and consisting of 25 pages has been reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research Policy and Standards (RPS).

.....................................      ..................................
Business Unit Manager                  Date

.....................................       ..................................
Executive: RPS                          Date

This definitive version of this policy is available on our website.
REFERENCES

4. R-03-PRO – Processing of Applications for Registration of Candidates and Professionals.
6. R-08-PE – Guide to the Competency Standards for Registration as a Professional Engineer.
### APPENDIX A: TRAINING ELEMENTS

#### 1 Introduction

1.1 *Induction programme* (typically 1–5 days)

1.1.1 Company structure
1.1.2 Company policies
1.1.3 Company Code of Conduct
1.1.4 Company safety regulations
1.1.5 Company staff code
1.1.6 Company regulations

#### 1.2 *Exposure to Practical Aspects of Engineering* (Typically 6–12 months) and covers how things are: (Responsibility Levels A & B)

Experience in one or more of these sectors but not all:

1.2.1. Manufacturing
1.2.2 Construction
1.2.3 Erection
1.2.4 Field installation
1.2.5 Testing
1.2.6 Commissioning
1.2.7 Operation
1.2.8 Maintenance
1.2.9 Fault location
1.2.10 Problem investigation

#### 2 Design or develop solution

2.1 *Experience in design and application of design knowledge* (Typically 12–18 months) Focus is on planning, design and application (Responsibility Levels C & D)

In one or more of the above sectors:

2.1.1 Analysis of data and systems
2.1.2 Planning of networks and systems
2.1.3 System modelling and integration
2.1.4 System design
2.1.5 Network/circuit design
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.6</td>
<td>Component/product design</td>
</tr>
<tr>
<td>2.1.7</td>
<td>Software design</td>
</tr>
<tr>
<td>2.1.8</td>
<td>Research and investigation</td>
</tr>
<tr>
<td>2.1.9</td>
<td>Preparation of specifications and associated documentation</td>
</tr>
<tr>
<td>2.1.10</td>
<td>Preparation of contract documents and associated documentation</td>
</tr>
<tr>
<td>2.1.11</td>
<td>Development of standards</td>
</tr>
<tr>
<td>2.1.12</td>
<td>Application of quality systems</td>
</tr>
<tr>
<td>2.1.13</td>
<td>Configuration Management</td>
</tr>
</tbody>
</table>

### 3 Engineering tasks

#### 3.1 Experience in the execution of engineering tasks (rest of training period). Focus should be on projects and project management (Responsibility Level E)

Working in one or more of these sectors but not all:

- 3.1.1 Design or develop solution
- 3.1.2 Manufacture
- 3.1.3 Construction
- 3.1.4 Erection
- 3.1.5 Installation
- 3.1.6 Commissioning
- 3.1.7 Maintenance
- 3.1.8 Modifications

#### 3.2 Organising for implementation of 3.1 (Responsibility Level E)

- 3.2.1 Manage resources
- 3.2.2 Optimisation of resources and processes

#### 3.3 Controlling for implementation or operation of 3.1 (Responsibility Level E)

- 3.3.1 Monitor progress and delivery
- 3.3.2 Monitor quality

#### 3.4 Completion of 3.1 (Responsibility Level E)

- 3.4.1 Commissioning completion
- 3.4.2 Documentation completion
- 3.4.3 Documentation handover

#### 3.5 Maintenance and repair of 3.1

- 3.5.1 (Responsibility Level E) Planning and scheduling maintenance
<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>3.5.2</td>
<td>Monitor quality</td>
</tr>
<tr>
<td>3.5.3</td>
<td>Oversee maintenance and repair</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td><strong>Risk and impact mitigation</strong></td>
</tr>
<tr>
<td>4.1</td>
<td><em>Impact and risk assessments (Responsibility Level E)</em></td>
</tr>
<tr>
<td>4.1.1</td>
<td>Risk assessments</td>
</tr>
<tr>
<td>4.2</td>
<td><em>Regulatory compliance (Responsibility Level E)</em></td>
</tr>
<tr>
<td>4.2.1</td>
<td>Health and safety</td>
</tr>
<tr>
<td>4.2.2</td>
<td>Codes and standards</td>
</tr>
<tr>
<td>4.2.3</td>
<td>Legal and regulatory</td>
</tr>
<tr>
<td><strong>5</strong></td>
<td><strong>Managing engineering activities</strong></td>
</tr>
<tr>
<td>5.1</td>
<td><em>Self-management (Responsibility Level C–D)</em></td>
</tr>
<tr>
<td>5.1.1</td>
<td>Manages own activities</td>
</tr>
<tr>
<td>5.1.2</td>
<td>Communicates effectively</td>
</tr>
<tr>
<td>5.2</td>
<td><em>Team environment (Responsibility Level C–D)</em></td>
</tr>
<tr>
<td>5.2.1</td>
<td>Participates in and contributes to team planning activities</td>
</tr>
<tr>
<td>5.2.2</td>
<td>Manages people</td>
</tr>
<tr>
<td>5.3</td>
<td><em>Professional communication and relationships (Networking) (Responsibility Level C–D)</em></td>
</tr>
<tr>
<td>5.3.1</td>
<td>Establishes and maintains professional and business relationships</td>
</tr>
<tr>
<td>5.3.2</td>
<td>Communicates effectively</td>
</tr>
<tr>
<td>5.4</td>
<td><em>Exercising judgement and taking responsibility (Responsibility Level E)</em></td>
</tr>
<tr>
<td>5.4.1</td>
<td>Ethical practices</td>
</tr>
<tr>
<td>5.4.2</td>
<td>Code of Conduct</td>
</tr>
<tr>
<td>5.4.3</td>
<td>Exercises sound judgement in the course of complex engineering activities</td>
</tr>
<tr>
<td>5.4.4</td>
<td>Is responsible for decision-making in some or all engineering activities</td>
</tr>
<tr>
<td>5.5</td>
<td><em>Competency development (Responsibility Level D)</em></td>
</tr>
<tr>
<td>5.5.1</td>
<td>Plans own development programme</td>
</tr>
<tr>
<td>5.5.2</td>
<td>Constructs initial professional development record</td>
</tr>
</tbody>
</table>