# ENSURING THE EXPERTISE TO GROW SOUTH AFRICA

## Guide to the Competency Standards for Registration in a Specified Category

## R-08-CS-GUIDE-SC

**REVISION 2: 16 July 2020**

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## DEFINITIONS

**Competency area:** The performance area where all the outcomes can be demonstrated in an integrated manner at the level prescribed in a specific technology.

**Competency indicators:** The typifying guide to evidence indicating competence that is not normative.

**Continuing Professional Development:** The systematic and accountable maintenance, improvement and broadening of knowledge and skills, and the development of personal qualities necessary for the execution of professional and technical duties throughout the career of an engineering practitioner.

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

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

**Integrated performance:** The overall satisfactory outcome of an activity, which requires several outcomes to be satisfactorily attained. For example, a design will require analysis, synthesis, analysis of impacts, checking of regulatory conformance and judgment in decisions.

**Level descriptor:** A measure of performance demands at which outcomes must be demonstrated in a particular competency area.

**Outcome:** The contextually demonstrated end-products of specific learning processes, which include knowledge, skills and values.

**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.

**Practice area:** A generally recognised or distinctive area of knowledge and expertise developed by an engineering practitioner through 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 in a competency area.

**Specified Category:** A category created for registered persons, other than professional or Candidate Engineers, Certificated Engineers, Engineering Technologists and Engineering Technicians, who have specific training and experience in a specialised field that has to be regulated. It is a category of registration created for persons who must be registered through the Engineering Profession Act, 46 of 2000 (EPA) or a combination of the EPA and external legislation as having specific competencies related to an identified need to protect the safety, health and interest or the environment in relation to engineering activity.

**Sustainable development:** Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. Engineering should not only consider decreasing impacts but also consider restoring and regenerating through design.

## ABBREVIATIONS

| | |
|---|---|
| **CPD** | Continuing Professional Development |
| **ECA** | Environmental Conservation Act, 20 of 1993 |
| **ECSA** | Engineering Council of South Africa |
| **IDP** | Individual Development Plan |
| **ISO** | International Standards of Operation |
| **MHS ACT** | Mine Health and Safety Act, 29 of 1996 |
| **NBR** | National Building Regulations |
| **OHS ACT** | Occupational Health and Safety Act, 85 of 1993 |
| **SANS** | South African National Standards |
| **SC** | Specified Category |
| **SDEA** | Specifically Defined Engineering Activity |

## DOCUMENT CUSTODIAN

The custodian of this document is the Research Policy and Standards Division. The Regulatory Functions Division is responsible for its implementation.

## BACKGROUND

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

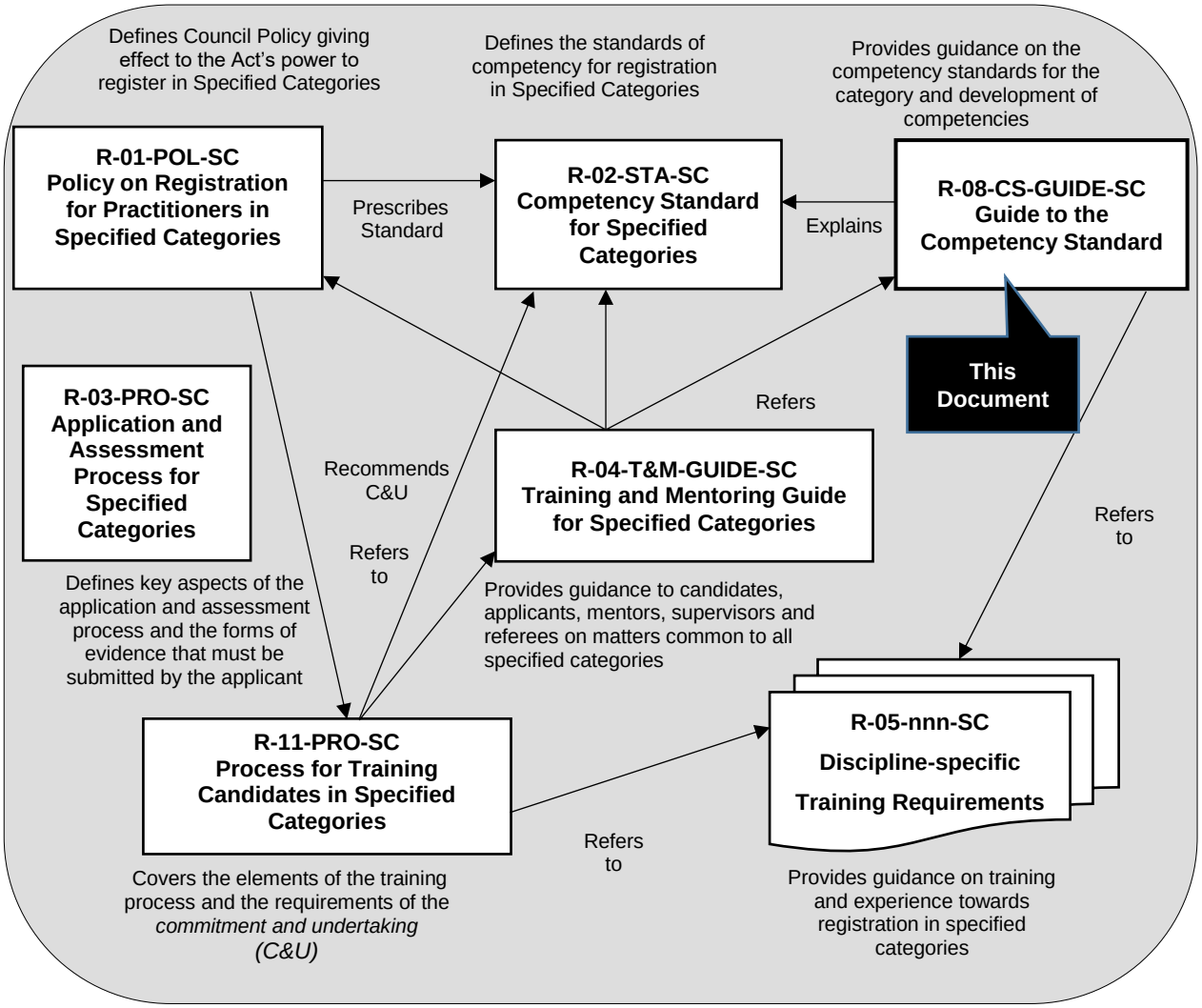


**Figure 1: Documents defining the ECSA Registration system**

## 1. PURPOSE OF THIS DOCUMENT

This guide amplifies the general training and mentoring guide **R-04-T&M-GUIDE-SC**, concentrating on an understanding of the competency standards for Specified Categories defined in document **R-02-STA-SC**. In addition, the document indicates ways of developing the requisite competencies and how the competencies can be demonstrated through engineering work. This guide may, in turn, be supplemented by the Sub-Discipline-Specific Training Guide **R-05-Nnnn-SC**, if available for the applicant's discipline.

The intended audience of this guide includes Candidates undergoing training toward professional registration, mentors, supervisors as well as assessors of applicants for registration. Document **R-08-CS-GUIDE-SC** is also an important document for persons registered under Specified Category who serve as assessors, moderators and reviewers of applicants applying for registration.

## 2. INTRODUCTION TO COMPETENCY, STANDARDS AND PERFORMANCE

What is the competency of a Registered Specified Category Practitioner? In general, competence is the possession of the knowledge, skills and attitudes necessary to perform the activities within the specified category to the defined standards expected in independent employment or practice.

The knowledge component of competency consists of knowledge from the engineering education process and knowledge subsequently acquired, which is likely to be specialised and related to the engineering work context. The skills and attitude component are defined by a set of assessable outcomes.

ECSA Competency standard **R-02-STA-SC** provides the formal definition of the competence that must be demonstrated to register under a Specified Category. The standard applies to all engineering disciplines and specialities. Contexts and functions in which competency may be developed and the outcomes demonstrated are described in the applicable Discipline-Specific Training guideline **R-05-Nnnn-SC**. The following competencies must be demonstrated:

- within specifically defined engineering activities
- by the integrated performance of the outcomes

- at the level defined for each outcome.

This guide enlarges on the outcomes, the level of performance and the integrated performance required of an applicant for registration in a Specified Category.

## 3. OUTCOMES FOR PROFESSIONAL REGISTRATION

Eleven outcomes must be demonstrated by applicants to be considered for professional registration. The following section should be consulted by applicants and used as a rubric to determine if they are receiving the necessary exposure. Assessors, moderators and reviewers specifically use these outcomes to evaluate candidates/applicants for professional registration.

### 3.1 Overview of the Outcomes

The Outcomes required for professional registration as outlined in the Competency Standard, document **R-02-STA-SC**, are summarised in Table 1 below in a nested Group A–E configuration.

**Table 1: Overview of outcomes**

| Group | Outcome | Description |
|---|---|---|
| **Group A** Knowledge-based Engineering Problem-Solving | 1 | Define, investigate and analyse *specifically defined* engineering problems. |
| | 2 | Design or develop or plan solutions to *specifically defined* engineering problems. |
| | 3 | Comprehend and apply knowledge embodied in widely accepted engineering principles, practices, procedures, processes, systems or methodologies specific to the jurisdiction in which the candidate practices. |
| **Group B** Managing Engineering Activities | 4 | Manage part or all of one or more *specifically defined* engineering activities. |
| | 5 | Communicate clearly with others in the course of the candidate's *specifically defined* engineering activities. |
| **Group C** Risk and Impact Mitigation | 6 | Recognise and address the reasonably foreseeable social, cultural and environmental effects of specifically defined engineering activities. |
| | 7 | Meet all legal and regulatory requirements and protect the health and safety of persons in the course of the candidate's |

| Group | Outcome | Description |
|---|---|---|
| | | specifically defined engineering activities. |
| **Group D** Acting Ethically, Exercising Judgement, and Taking Responsibility | 8 | Conduct engineering activities ethically. |
| | 9 | Exercise sound judgement in the course of specifically defined engineering activities. |
| | 10 | Be responsible for making decisions regarding part or all the specifically defined engineering activities |
| **Group E** Initial Professional Development (IPD) | 11 | Undertake professional development that is sufficient to maintain and extend the candidate's competence. |

As described in the Competency Standard, document **R-02-STA-SC**, and depicted in **Table 1** above, the outcomes do not stand alone and the performance of these outcomes must be integrated successfully. Competent engineering work invariably requires the simultaneous performance of several of the actions embodied in the Outcomes.

Outcomes 1, 2, 4 and 5 capture the essential functions of Specified Category Practitioner, which are all supported by communication and involve analysing and solving problems and managing processes, projects and operations to deliver results. To perform these four core functions, Specified Category Practitioners rely on fundamental and specialised engineering knowledge together with knowledge of the context in which the work takes place.

Outcome 3 reflects the importance of the engineering knowledge that is embodied in Outcomes 1, 2 and 4. This is the core of engineering work. While solving problems and managing processes, the Specified Category Practitioner must be able to identify and address the impacts of the solutions and the applicable regulatory requirements as reflected in Group C (i.e. outcomes 6 and 7).

A number of attributes that are not necessarily taught or part of the education component are essential at a personal level; the Specified Category Practitioner must act ethically, exercise judgement and take responsibility as reflected in Group D (i.e. outcomes 8, 9, 10).

The single outcome 11, shown as an underpinning layer to all the other outcomes, demonstrates the need to develop professionally, that is, to increase the knowledge and the competencies required for effective performance of engineering work.

### 3.2 Demonstrating the achievement of outcomes for professional registration

All the outcomes defined in the Competency Standard, document **R-02-STA-SC**, and summarised in Table 1 of this document, may arise from work of varying levels of demand and degrees of responsibility. Thus, at which level must an applicant demonstrate the defined outcomes to be judged competent to register as a Specified Category Practitioner? Two level-defining phrases that have specific meanings appear in the Competency Standard, document **R-02-STA-SC**:

- a set of level descriptors for a *specifically defined* engineering problem
- the level descriptors that allow engineering activity to be classified within *specifically defined* engineering activities.

The degrees of responsibility (i.e. Levels A–E) as defined in the Training and Mentoring Guide, document **R-04-T&M-GUIDE-SC**, are used to measure the progression of the applicant's competency and are illustrated in Table 2 below. The applicant's competency for registration as a Specified Category Practitioner is expected to be at Level E for degree of responsibility regarding solving *specifically defined* engineering problems and carrying out the activities for each outcome.

**Table 2: The nature of work and degrees of responsibility defined in document R-04-T&M-GUIDE-SC**

| A: Being exposed | B: Assisting | C: Participating | D: Contributing | E: Performing |
|---|---|---|---|---|
| Undergoes induction, observes processes and work of competent practitioners | Performs specific processes under close supervision | Performs specific processes as directed with limited supervision | Performs specific work with detailed approval of work outputs | Works in team without supervision, recommends work outputs, responsible but not accountable |

| A: Being exposed | B: Assisting | C: Participating | D: Contributing | E: Performing |
|---|---|---|---|---|
| No responsibility | Limited responsibility for work output | Full responsibility for supervised work | Full responsibility to supervisor for immediate quality of work | Level of responsibility to supervisor is appropriate to that of a registered person, supervisor is accountable for applicant's decisions |
| Mentor explains challenges and forms of solution | Supervisor/mentor or coaches, offers feedback | Supervisor progressively reduces support but monitors outputs | Articulates own reasoning and compares it with that of supervisor | Assumes problem-solving without support, very limited guidance |

### 3.3 Defining engineering activities

The Competency Standard, document **R-02-STA-SC**, takes a broader view of defining engineering activities, listing several possible functions that include the following: design, planning, investigation and problem resolution, improvement of materials, components, systems or processes, implementation, construction, manufacture, engineering operations, maintenance, project management, research, development and commercialisation.

In summary, the following are essential in demonstrating evidence of competent performance:

- The capability to perform a number of defined actions must be demonstrated.
- The performance must be at or exceed a specified level of demand.

The defined actions are the outcomes and the level is defined by a specification for the demands of the engineering activities and the nature of problem-solving. In a professional field, evidence of competent performance is obtained from the competent performance of substantial engineering tasks by the person being assessed. Typical tasks provide evidence of several outcomes and the assessment of activities/knowledge is holistic.

## 4. GROUP A: KNOWLEDGE-BASED ENGINEERING PROBLEM-SOLVING

As described in Table 1 of this document, Group A consists of three outcomes:

- Outcome 1 – Define, investigate and analyse *specifically defined* engineering problems.
- Outcome 2 – Design or develop solutions to *specifically defined* engineering problems.
- Outcome 3 – Comprehend and apply advanced knowledge of the widely applied principles underpinning good engineering practice, specialist knowledge and knowledge that is specific to the jurisdiction and local conditions.

Problem-solving is a process carried out by individuals to bring about a change from a given state to a desired state by means of multistep or multipath activities that have barriers that must be overcome using knowledge and abilities and taking situational requirements into account. Engineering problem-solving relies on the fundamental engineering sciences and specialised engineering knowledge. Proficiency in solving engineering problems at the level described as *specifically defined* is a characteristic of the competency of a Specified Category Practitioner.

Problem-solving is the common feature that runs through engineering activities and is required in many engineering activities, including the design, development, research, investigation, planning, implementation, construction and operation of engineering systems and maintenance of plant infrastructure. Competency in problem-solving involves two phases: analysis and solution synthesis, as captured in Outcomes 1 and 2 of document **R-02-STA-SC**. Because engineering problem-solving is knowledge-based, Outcome 3 is grouped with Outcomes 1 and 2. However, Outcome 3 also supports other Outcomes in line with the notion of integrated performance as described in document **R-02-STA-SC.**

*Specifically defined engineering problem-solving* is perhaps the best starting point for applicants to determine the level at which they are working. *Specifically defined* engineering problem-solving must be demonstrated for an applicant to be considered for professional registration. Candidates/applicants who are unsuccessful in their application are often either not performing at the level of complexity of problem-solving required or did not convey it appropriately in the reports and the review process.

### 4.1 What is engineering problem-solving?

An applicant should refer to the suggested test for a *specifically defined engineering problem* that is presented in the Competency Standard, document **R-02-STA-SC**. The test is based on the four

logical steps illustrated in Table 3. If one or more affirmative answers are possible at each step, the problem is classified as a *broadly defined engineering problem*.

**Table 3: Test for a *specifically defined* engineering problem**

| STEP | MAIN QUESTION | CRITERIA |
|---|---|---|
| **Step 1** Identification of the engineering problem | Is the problem an engineering problem? | a) Does solving the problem require coherent and detailed engineering knowledge underpinning the applicable technology area? |
| **Step 2** Establishment of the level of complexity of the initial problem state | What is the nature of the problem? Does it have one or more of the characteristics b, c and d? | b) The problem is ill-posed, is under or over specified and requires identification and refinement into the technology area. |
| | | c) The problem encompasses systems within complex engineering systems. |
| | | d) The problem is classified as falling within typical engineering requirements and is solved in well accepted and innovative ways. |
| **Step 3** Complexity of the problem path from initial state to the goal state. | What is encountered in the problem investigation and analysis process? Does it have one or more of the characteristics e, f, g and h? | e) The problem can be solved by structural analysis techniques / tools /methodologies. |
| | | f) Standards, codes (SANS, ISO) and procedures must be applied to solve the problem, and justification to operate outside these standards and codes must be provided. |
| | | g) The solutions require information from a variety of sources that are complex, abstract or incomplete. |
| | | h) Involves a set of interested and affected parties with defined needs to be taken into account, including needs for sustainability. |
| **Step 4** Level of decision-making required and potential consequences | | i) Practical solutions to the problem require knowledge and judgement in decision-making in the practice area and require consideration of the interface with other areas. |
| | | j) Decisions have significant consequences that are important in the practice area but may extend more widely. |

**4.2 How will I know when I am performing adequately at problem-solving?**

At completion of the training period, Candidates must demonstrate competence in Outcomes 1, 2 and 3 through their work. The starting point of training is the applicant's level of problem-solving ability. The applicant is expected to produce the same level of problem-solving in the work environment and must develop problem-solving abilities in an environment in which the consequences of engineering decisions and actions are significant.

Mentors, supervisors and applicants/candidates must plan the progression of tasks and responsibility to ensure the development of these competencies. They are advised to use suitable planning and recording assessment tools and feedback sessions. The progress of the applicant/candidate should be evaluated against each Outcome using the Degree of Responsibility scale in the Training and Mentoring Guide, document **R-04-T&M-GUIDE-SC**. It should be noted that the same body of work may serve to develop competencies in other groups.

The strategy for developing problem-solving competence to the level required in the workplace and the degree of responsibility defined in the Training and Mentoring Guide, document **R-04-T&M-GUIDE-SC**, is illustrated in Table 2 of section 3.2 of this document.

Initially, the applicant assists experienced engineering personnel in their problem-analysis and solution activities, receiving detailed guidance and continuous monitoring. The applicant then progresses to contribute individually and as a team member in the solution of engineering problems. Finally, the applicant must achieve Level E of responsibility, performing individually and as a team member to solve problems. In this last phase, the applicant must perform over the entire problem lifecycle.

The applicant should be given the opportunity to experience *specifically defined engineering problem-solving* in contexts such as design, development, research, investigation, planning, implementation, construction and operation of engineering systems and maintenance of plant infrastructure. The candidate should be encouraged to apply first principles to *specifically defined engineering problems* and to develop and apply specialist and contextual knowledge.

Considering the problem of assessing the performance of an applicant/candidate against learning Outcomes 1 and 2, ECSA requires the applicant/candidate to perform a creative, systematic analysis of problems at the required level and to work systematically to synthesise solutions to the problems.

**Outcome 1:** Systematic analysis follows a schema as presented below. The applicant:

- interprets and clarifies requirements, leading to an agreed definition of the problem to be addressed
- identifies interested and affected parties and their expectations
- gathers, structures and evaluates adequate information relating to the problem
- performs a structured analysis
- evaluates the result of the analysis and revises or refines as required
- documents, reports and conveys outcome to the requesting party.

**Outcome 2:** A similar schema applies to the synthesis phase. The applicant:

- proposes potential approaches to the solution
- conducts a preliminary synthesis following selected approaches
- evaluates potential solutions against requirements and wider impacts
- presents reasoned, economical and contextual engineering arguments for the selected option
- fully develops the chosen option
- evaluates the resulting solution
- documents the solution for approval and implementation.

Many types of problems can be offered to demonstrate problem-solving ability. The problem may be a design requirement, an applied research and development requirement or a problematic situation in an existing component, system or process.

The solution may be the design of a component, system or process or a recommendation of the remedy to a problematic situation. Developing solutions to *specifically defined engineering problems* does not only involve the actual design. The applicant/candidate is expected to indicate competence in the choice of the systematic approach to provide the solution, to demonstrate how

alternative options are considered and how the preferred option/solution is selected by developing detailed design specification requirements and other engineering design documentation.

The level of the analysed problem must be gauged by the test described above to determine its suitability for presentation as evidence of competence.

Problem-solving is the core activity of engineering. A wide range of engineering functions are either specific manifestations of problem-solving or rely on problem-solving at different levels. Some examples follow:

- **Design:** This is the systematic process of conceiving and developing materials, components, systems and processes to serve useful purposes. Design involves a transformation from an initial requirement to produce the documented instructions on how to realise the end product. In determining a solution, barriers must be overcome. A design assignment, therefore, is an engineering problem and involves sub-problems that must be addressed.
- **Product or Process Improvement:** It frequently happens that an existing piece of infrastructure, plant, equipment or process is in need of improvement. The proper process is to analyse the existing state and define the desired final state. A process for moving from the initial to the final state must be developed. Again, the investigation is a problem-solving activity as is the solution synthesis phase.

Other engineering activities have problem-solving based on engineering knowledge at their centre, including planning; research, development and technology transfer; quality assurance; risk analysis; domain-specific project management; managing engineering processes; safe work practices; environmental protection; sustainability analysis; and systems engineering.

### 4.3 How will I display my application of engineering and contextual knowledge?

All engineering activities, and problem-solving in particular, rely on the applicant comprehending and applying the relevant ECSA benchmarked qualification theory and knowledge embodied in widely accepted and applied engineering procedures, processes, systems, tools and methodologies that are specific to the practice area.

The statement of Outcome 3 recognises three components comprising the knowledge that must be comprehended by the Specified Category Practitioner:

(a) Knowledge is rooted in principles (generally first principles) of general laws of the natural and engineering sciences, technologies, methodologies and the applied principles of good engineering practice.

(b) It is recognised that individual Specified Category Practitioner develop specialised knowledge regarding either a generally recognised area or a particular combination of topics. This includes understanding *specifically defined* procedures, codes and techniques that are mathematically, scientifically and engineering based and that underpin teamwork.

(c) Knowledge that is specific to the practice area in which the Specified Category Practitioner practises is essential. This includes knowledge of the society, economy, regulatory system and physical environment in which the Specified Category Practitioner practises engineering.

Engineering knowledge is too diverse to allow a detailed specification of knowledge for every discipline, sub-discipline or practice area. Rather, it is recognised that each engineering practitioner develops a practice area. The Sub-Specified Category Practitioners **R-05-Nnnn-SC** may be consulted on this topic. The practice area, for example, may be a commonly understood area such as Structural Engineering or power distribution or may be a blend as a result of the individual's experience. Therefore, the engineering knowledge requirements from the Competency Standard, document **R-02-STA-SC**, are stated in generic terms.

For the Specified Category Practitioner, the engineering knowledge acquired in an accredited engineering programme is the basis for practice area knowledge. The Specified Category Practitioner must be capable of engineering analysis. Engineering knowledge may be used explicitly or tacitly.

Specified Category Practitioners invariably work in teams with specialists from other engineering disciplines, other engineering role-players, other professionals, contractors and other parties. It is therefore essential to have a working knowledge of the discipline and the areas in which

interaction is necessary. The applicant needs to be aware that certain engineering disciplines require more diverse cross-discipline interaction and knowledge. However, this depends on the environment and the level at which the Specified Category Practitioner is performing the work.

Engineering work does not occur in isolation, and knowledge of the regulatory requirements regarding health and safety, the environment, the contract and quality and risk is essential. The application of engineering knowledge as an outcome is normally demonstrated during design, investigation or operation. The applicant typically:

- displays mastery of understanding current and emerging technologies in the practice area
- applies general and underpinning engineering knowledge to support analysis and provide insight into technologist activities
- uses an analytical approach as required
- displays working knowledge of areas that interact with the practice area
- applies related financial, statutory, safety and management knowledge.

## 5. GROUP B: MANAGING ENGINEERING ACTIVITIES

Groups B, C and D reflect competencies that are all linked to problem-solving (Group A) and are essential to engineering activities at the professional level. For example, taking impacts into account is an important stage in the solution of a problem. Similarly, an engineering operation also has impacts that must be assessed and managed.

As described in **Table 1** of this document, Group B consists of two outcomes:

- **Outcome 4** – Manage part or all of one or more specifically defined engineering activities.
- **Outcome 5** – Communicate clearly with others in the course of their specifically defined engineering activities.

### 5.1 What are engineering managing competencies?

Competent Specified Category Practitioner must not only perform engineering functions but must also manage engineering activities. Two statements of management competency in Group B described in the Competency Standard, document **R-02-STA-SC**, are as follows:

- Competency to manage specifically defined engineering activities must be demonstrated.
- Linked with management is the ability to communicate with those involved in the engineering activities.

Engineering management can be defined as the application of the generic management functions of planning, organising, leading and controlling together with engineering knowledge in contexts that include the management of projects, construction, operations, maintenance, quality, risk, change and business. The level of engineering management that a person is involved in or is sufficiently experienced to do is of necessity limited at the stage of applying for registration as a Specified Category Practitioner. However, the applicant must take on the responsibility necessary to demonstrate competency under the guidance of suitable competent persons, as described in the Training and Mentoring Guide, document **R-04-T&M-GUIDE-SC.**

Engineering management is more than project management. Project management in itself is in most cases supportive of engineering activity but does not represent the level of demonstration of performance at the degree of responsibility required.

### 5.2 What level of activities must I be able to manage?

The Competency Standard, document **R-02-STA-SC**, provides a test of whether a given engineering activity is classed as a *specifically defined engineering activity* or not. The test for *specifically defined* engineering activity has been summarised in **Table 3**, in section 4.1 of this document. The test is applied to the activity itself to determine the complexity of its scope and operating environment, its resource intensiveness, the severity of constraints and the risks and consequences. This test is not independent of the test for *specifically defined problem-solving*; most of the factors are those that give rise to barriers in the problem-solving process and also render the problem *specifically defined.*

The definition of the required level of activity as described in the Competency Standard, document **R-02-STA-SC**, does not imply that applicants in every category work at that level all the time. Rather, applicants in each category must demonstrate the ability to practise at the required level. Similarly, at the culmination of training, applicants must be able to demonstrate

that they can perform the required actions at the required level by having in effect done so in the work situation.

The strategy for developing problem-solving competence to the level required in the workplace and to the degree of responsibility is defined in the Training and Mentoring Guide, document **R-04-T&M-GUIDE-SC**, and illustrated in **Table 2**, in section 3.2 of this document**.**

The various phase activities of an applicant assist in developing the ability to plan, organise, lead and control. The applicant must be able to perform these functions both alone and in a team. Conducting engineering work on one's own or in a team requires planning and organising to attain the required engineering outcomes. Team participation and contribution as a team member and as a leader give the opportunity to demonstrate leadership and the ability to control on a limited scale.

### 5.3 How do I know when I am managing and communicating at the required level?

Technical communication at a level that supports analysis, synthesis and implementation of solutions is an inherent part of engineering work. The applicant needs the opportunity to communicate orally and in writing about not only engineering matters but also the financial, social, cultural, environmental and political aspects of engineering activity.

In fulfilling Outcome 5, the applicant is expected to demonstrate personal and work-process management abilities:

- Manage self
- Work effectively in a team environment
- Manage people, work priorities, work processes and resources
- Establish and maintain professional and business relationships.

Effective communication can be demonstrated by the ability to:

- write clear, concise and effective reports that are technically, legally and editorially correct using a structure and style that meets communication objectives and user/audience requirements

- read and evaluate engineering and legal matter relevant to the function of the Specified Category Practitioner
- receive instructions and ensure correct interpretation
- issue clear instructions to subordinates using appropriate language and communication aids and ensure that language and other communication barriers are overcome
- undertake oral presentations using structure, style, language, visual aids and supporting documents appropriate to the audience and purpose.

This outcome will be evaluated at two stages:

1. Applicant's written application for registration.
2. During the professional review process in which the applicant is required to answer engineering questions.

## 6. GROUP C: RISK AND IMPACT MITIGATION

As described in **Table 1** of this document, Group C consists of two outcomes:

- **Outcome 6** – Recognise and address the reasonably foreseeable social, cultural and environmental effects of specifically defined engineering activities.
- **Outcome 7** – Meet all legal and regulatory requirements and protect the health and safety of persons in the course of the specifically defined engineering activities.

These Outcomes deal respectively with the impacts of engineering activity that are not subject to regulation but rely on the professionalism of the applicant and the impacts that are subject to regulation, both specific and general.

Outcome 6 (impacts of engineering), Outcome 7 (legal and regulatory aspects) and Outcome 8 (ethical behaviour in Group D) reflect the professional behaviour and attitudes expected of a Specified Category Practitioner. These are supported by knowledge of the context in which the individual practises (an aspect of Outcome 3). It is recognised that during candidacy, exposure to these issues is not as intensive as for an experienced Specified Category Practitioner.

Candidates are, therefore, expected to supplement experience by reading and reflecting on these issues before applying for registration.

Appendix A of this document and the relevant Discipline-Specific Training guideline list materials that should be consulted and include relevant legislation. Both candidates and applicants should also make use of suitable IPD courses in these areas.

**6.1 How do I know when I am able to analyse and manage the impacts, benefits and consequences of engineering activities?**

Engineering activities deliver benefits to society and the economy in the form of infrastructure, services and goods. Engineering involves the harnessing and control of natural forces or the use and control of complex information. The actions inherent in engineering activity have accompanying risks. These risks must be mitigated to a level that is acceptable to the affected parties. The management of risk accompanying engineering activity is the very rationale for the regulation of the profession. Some risks are well known and understood, and the means of addressing them may be embodied in regulation.

Other situations may not occur frequently or may occur for the first time with the application of new technology and therefore may not be regulated. Certain risks may have objective technical measures, while others are subject to the judgement of individuals and communities. Some risks may be ethical (Outcome 8 in Group D). The ability to assess and deal with all prevailing risks is integral to the competency of a Specified Category Practitioner. The Specified Category Practitioner is expected to be able to identify and deal with wide-ranging risks associated with engineering work.

The applicant should be given the opportunity to study, analyse and recommend measures for:

- Social/cultural impacts
- Community/political considerations
- Environmental impact
- Sustainability analysis
- Regulatory conditions

- Potential ethical dilemmas.

To show competency in *impact analysis and mitigation*, the following should be done:

- Identify interested and affected parties and their expectations.
- Identify interactions between engineering considerations and social-cultural and environmental factors.
- Identify environmental impacts of the engineering activity.
- Identify sustainability issues.
- Propose and evaluate measures to mitigate the negative effects of engineering activity.
- Communicate with stakeholders.
- Adopt measures to mitigate the negative effects of engineering activities.

**6.2 How do I know when I have met all the legal and regulatory requirements in the course of my engineering activities?**

Outcome 7 is concerned with explicitly regulated aspects of engineering practice and the more general legislation that may apply. Applicants should ascertain the legislation that applies in their work environment. Appendix A of this document and the relevant Discipline-Specific Training guideline list certain recommended material that should be consulted, including the relevant legislation.

Of particular importance is Occupational Health and Safety legislation and SANS standards. The following are the principal Acts applicable in the South African context, as depicted in Appendix A of this document:

- Occupational Health and Safety Act, 85 of 1993 as amended, and the associated regulations.
- Mine Health and Safety Act, 29 of 1996 as amended.
- South African National Standards.

All Specified Category Practitioners who are registered or practise as Certificated and Professional Engineers must be cognisant with and comply with the provisions of these Acts.

To demonstrate competency *in regulatory aspects*, the applicant should:

- identify the applicable legal, regulatory and health and safety requirements for the engineering activity
- identify the risk and apply defined, widely accepted risk management strategies
- select safe and sustainable materials, components, processes and systems
- communicate with parties involved in the legal and regulatory aspects of the work.

## 7. GROUP D: TAKING RESPONSIBILITY AND EXERCISING JUDGEMENT

As described in Table 1 of this document, Group D consists of three Outcomes:

- **Outcome 8** – Conduct engineering activities ethically.
- **Outcome 9** – Exercise sound judgement in the course of specifically defined engineering activities.
- **Outcome 10** – Be responsible for making decisions on part or all specifically defined engineering activities.

Specified Category Practitioners must make engineering and managerial decisions that are related to risks arising from their activities. Three outcomes in Group D are concerned with competencies exercised at a personal level.

### 7.1 How do I know when I have developed the competency to conduct engineering activities ethically?

Outcome 8 has the simple statement: Conduct engineering activities ethically. The baseline for ethical behaviour is the ECSA Code of Conduct, which covers the need to practise ethically and within one's area of competency, to work with integrity, to respect the public interest and the environment, and to uphold the dignity of the profession and one's relationship with fellow professionals. Included is a section on administrative matters that relate to ethical practice. The applicant must study the ECSA Code of Conduct and be aware of its implications in situations that arise in engineering work.

As in other professions and business situations, ethical problems arise in engineering activity. These may relate to business practices, inducements or an unregulated impact, for example, the

use of a rare and unsustainable material for a solution that will be required well into the future. The Specified Category Practitioner must be capable of detecting, analysing and handling ethical dilemmas and problems that arise in the course of engineering activity. This is a non-negotiable aspect of the Code of Conduct, and the Specified Category Practitioner must deal with any ethical problems that arise.

An applicant who is capable of dealing with ethical issues adopts a systematic approach to resolve ethical issues that is typified by:

- the identification of the central ethical problem
- the identification of affected parties and their interests
- the search for possible solutions to the dilemma
- the evaluation of each solution using the interests of those involved and according suitable priority
- the selection and justification of a solution that most appropriately resolves the dilemma.

### 7.2 How do I know when I have exercised sound judgement in the course of *specifically defined activities*?

The Specified Category Practitioner is expected to make decisions in situations where the information to underpin the decision may be complex (i.e. the information has more than one part with interactions between parts or the information is incomplete). Such decision-making requires due care by the Specified Category Practitioner and may be informed by experience. The Specified Category Practitioner must therefore have the ability to think of many matters at once and consider their interdependence, their relative importance and their consequences. This process is known as exercising judgement within *specifically defined engineering activities.*

According to the Training and Mentoring Guide, document **R-04-T&M-GUIDE-SC**, applicants should be challenged and given the opportunity to:

- make decisions when full information is not available
- use engineering judgement
- take due care that the outputs and the impacts of an assignment are addressed

- self-assess their competence from time to time.

All the above should be done under the supervision and guidance of a suitably qualified person as described in document **R-04-T&M-GUIDE-SC**.

Additionally, the indication that an applicant exhibits engineering judgement is typically demonstrated by:

- considering several factors, some of which may not be well defined or may be unknown
- considering the interdependence, interactions and relative importance of factors
- foreseeing consequences of actions
- evaluating a situation in the absence of full evidence
- drawing on experience and knowledge
- justifying judgements regarding risks associated with decisions.

### 7.3 How do I know when I have taken responsibility for *specifically defined engineering activities*?

Specified Category Practitioners are accorded professional status in society by their competence and the fact that the profession self-regulates and that practitioners are accountable for their actions. The person registering as a Specified Category Practitioner must therefore understand the obligation to be responsible and to have experience in making decisions since wrong decisions can have adverse consequences. Subject to the limitations regarding taking responsibility as an applicant, as discussed in document **R-04-T&M-GUIDE-SC**, the applicant for registration as a Specified Category Practitioner must demonstrate the capacity to make recommendations that display responsible behaviour in accordance with the ECSA Code of Conduct.

Being responsible at the required degree of responsibility (Levels D–E) is evidenced by:

- demonstrating a professional approach at all times
- exhibiting due regard to engineering, social, environmental and sustainable development considerations
- seeking advice from a responsible authority (or other professional) on any matter considered to be outside the area of competence

- making decisions and taking responsibility for work output.

## 8. GROUP E: CONTINUING PROFESSIONAL DEVELOPMENT

As described in Table 1 of this document, Group E consists of only **Outcome 11:** Undertake professional development activities sufficient to maintain and extend competence.

**How do I know when I have developed and managed my competence?**

Outcome 11 concerns Initial Professional Development (IPD) that consists of activities identified to meet the Continuing Professional Development (CPD) requirements before registration. Continuing Professional Development activities carried out between graduation and applying for professional registration is termed IPD this is an integral part of the professional competence required to practise engineering safely and effectively.

CPD is defined as the activities that a registered professional is required to maintain and complete at the required level to maintain registration. CPD is the systematic maintenance, improvement and broadening of knowledge and skills and the development of personal qualities necessary for the execution of professional and engineering duties throughout the career of a Specified Category Practitioner.

A registered Specified Category Practitioner is required to maintain and extend competence and must complete the required level of CPD at least to maintain registration.

The ability to develop and maintain competency is embodied in Outcome 11, namely the ability to undertake professional development activities sufficient to maintain and extend competence. This involves more than completing courses or other activities. The emphasis falls on the individual's ability to self-develop.

This capability has several dimensions:

- Take responsibility for one's own development.
- Reflect on strengths and weaknesses and recognise needs and plans.
- Execute development activities and overcome obstacles.

Candidates training towards registration do not have to satisfy formal professional development requirements. However, at the time of applying for registration as a professional, candidates will be assessed on their ability to manage and to complete professional development-type activities. Pre-registration IPD is not subject to an annual points requirement. IPD involves learning activities initiated by the applicant that are distinct from the structured learning activities required by the employer.

The essential test is the activity that is appropriate for the specific developmental needs of the individual. In addition, rather than leaving the planning of learning activities to the employer, the applicant's role is important. The ability to develop one's skills continually is seen as sufficiently important in an engineering professional to be enshrined as an Outcome that must be demonstrated to attain registration.

For a Specified Category Practitioner, it should be noted that boundaries of practice areas change over time, new engineering principles are formulated, new procedures, standards and codes are developed, and engineering practice is advanced. IPD should be planned with these factors in mind.

Each of the activities listed below or combinations thereof constitute CPD and hence IPD:

- Attending courses, seminars, congresses and technical/engineering meetings organised by engineering institutions / institutes, universities, other professional bodies and course providers.
- Actively participating in conferences, serving on engineering committees, professional committees and in working groups.
- Undertaking structured self-study (i.e. using textbooks with examples).
- Taking correspondence courses and studying other supervised study packages, including e-learning (i.e. online courses).
- Enrolling for formal postgraduate studies (limited credits).
- Writing technical/engineering papers and presenting papers or lectures at organised events.
- Reading technical/engineering papers such as white papers or peer-reviewed articles.
- Studying engineering literature (i.e. journals and magazines).

- Conducting research and literature reviews that are part of the engineering design and synthesis process.
- Attending in-house training courses offered by companies.
- Participating in accredited CPD training activities.
- Taking credit-bearing courses in higher education institutions that directly complement the individual's engineering-related knowledge.

Applicants typically demonstrate professional development by:

- planning their own professional development strategy
- selecting appropriate professional development activities
- keeping thorough records of professional development strategies and activities
- demonstrating independent learning ability
- completing professional development activities.

## 9. NOTES ON SPECIAL CASES

### 9.1 Applicants in academic and research positions

In certain cases, applicants are employed in engineering academia as lecturers, in the research and development industry or in highly specialised fields during their development towards registration. While these applicants do not conform to the normal industry employment situation, they nevertheless gain the opportunity for development towards meeting the Competency Standards.

Examples of these special cases include:

- teaching/lecturing/facilitation
- research or further studying
- laboratory experimental activities
- conferences/symposia/seminars
- consulting.

Applicants proceeding via this route are likely to have completed higher education programmes beyond the relevant education qualification level benchmarked by the ECSA for registration as a Specified Category Practitioner. The registration policy allows such applicants to offer appropriate

aspects of the advanced programme as part of the evidence of competence against particular Outcomes. It should be noted that applicants who have a number of years of industry experience with an educational level below the relevant ECSA benchmarked qualification can apply via this alternative route.

Applicants employed in teaching and research positions should be alert to opportunities in their work experience that demonstrate competence against the outcomes. For example, the planning, execution and commissioning of a new and substantial laboratory may provide evidence against a number of outcomes. Applicants should seek opportunities to assist senior colleagues who are registered with ECSA with consulting work. This engagement, while never full time, should be sustained over a long period. The senior colleague should fulfil a mentorship role and allow the candidate to take on increasing responsibility, moving up to Level E on the responsibility scale. It is likely that the time needed for the lecturer or researcher to obtain the necessary experience at the required level may be longer than in a conventional industrial situation.

### 9.2 Applicants who have completed advanced qualifications

Applicants who have completed advanced educational studies beyond the NQF level 5 or equivalent educational level (e.g. research degree) required for registration as a Specified Category Practitioner should identify opportunities to present evidence at the required level against the outcomes defined in the Competency Standards. The Training and Mentoring Guide, document **R-04-T&M-GUIDE-SC**, indicates the advanced studies that contribute towards training. In addition, the registration policy allows such applicants to present appropriate aspects (i.e. experimental and investigation) of their advanced studies as part of the evidence of competence against particular Outcomes.

## REVISION HISTORY

| Revision number | Revision date | Revision details | Approved by |
|---|---|---|---|
| Rev 1 Ver A | 16 October 2015 | Adapted from document R-08-PN | Approved by LMI Working Group |
| Rev 1 Ver A | 8 February 2016 | | For consideration by JIC |
| Rev 1 Ver B | 8 February 2016 | Appendix A revised | Approved by JIC for consideration by TC |
| Rev 1 Ver B | 11 April 2016 | Minor editorial changes | Approved by JIC for consideration by TC |
| Rev 1 Ver B | 25 April 2016 | No amendments | Approved by TC |
| Rev 1 Ver B | 25 August 2016 | No amendments | Approved by Council |
| Rev 2 | 16 July 2020 | Alignment to the Policy and Standards Framework on ECSA Policies and other approved R-08 Guideline. | RPSC |

The Guide for

**Competency Standards for Registration in a Specified Category**

Revision 2 dated 16 July 2020 and consisting 32 pages reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research, Policy and Standards **(RPS)**.

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Business Unit Manager

18/08/2020

Date

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Executive: RPS

18/08/2020

Date

This definitive version of this policy is available on our website

## Appendix A: Examples of legislation applicable generally and in particular areas of engineering

| | |
|---|---|
| 1. | Engineering Profession Act, 46 of 2000 |
| 2. | Occupational Health and Safety Act, 85 of 1993, General Machinery Regulations |
| 3. | Occupational Health and Safety Act, 85 of 1993, Construction Regulations |
| 4. | Occupational Health and Safety Act, 85 of 1993, Driven Machinery Regulations |
| 5. | Occupational Health and Safety Act, 85 of 1993, Pressurised Equipment Regulations |
| 6. | Mine Health and Safety Act, 29 of 1996, Design of underground dam walls, plugs and barricades |
| 7. | Regulations on use of water for mining |
| 8. | Environmental Conservation Act, 20 of 1993 |
| 9. | National Building Regulations and Building Standards Act, 103 of 1977, Certify structural system of a building or home |
| 10. | National Building Regulations and Building Standards Act, 103 of 1977, Certification of fire protection system |
| 11. | National Building Regulations and Building Standards Act, 103 of 1977, Certification of artificial ventilation systems |
| 12. | National Building Regulations and Building Standards Act, 103 of 1977, Geotechnical site investigations, Stability of excavations, Geotechnical investigations on sites underlain by dolomites |
| 13. | National Water Act, 36 of 1998, Various measures relating to pollution of a water resource; Waterworks process controller |
| 14. | Water Act, 54 of 1956, Determination of persons permitted to design dams |
| 15. | Health Professions Act, 56 of 1974 |
| 16. | Municipal Finance Management Act 56 of 2003 |