

A photograph of a multi-story building under construction. A large concrete pump truck with a long, articulated boom is positioned on the right, pouring concrete into the structure. A yellow tower crane stands in the background. The sky is clear and blue. The image is framed by a blue curved border at the top and bottom.

# ENSURING THE EXPERTISE TO GROW SOUTH AFRICA


## Competency Standard for Registration as a Professional Engineer

**R-02-PE**

**Revision: 2: 23 October 2018**

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## DEFINITIONS

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

**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

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

**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 judgement in decisions.


**Level descriptor:** A measure of performance demands at which outcomes must be demonstrated

**Management of engineering works or activities:** Management of the co-ordinated activities that are required

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

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


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

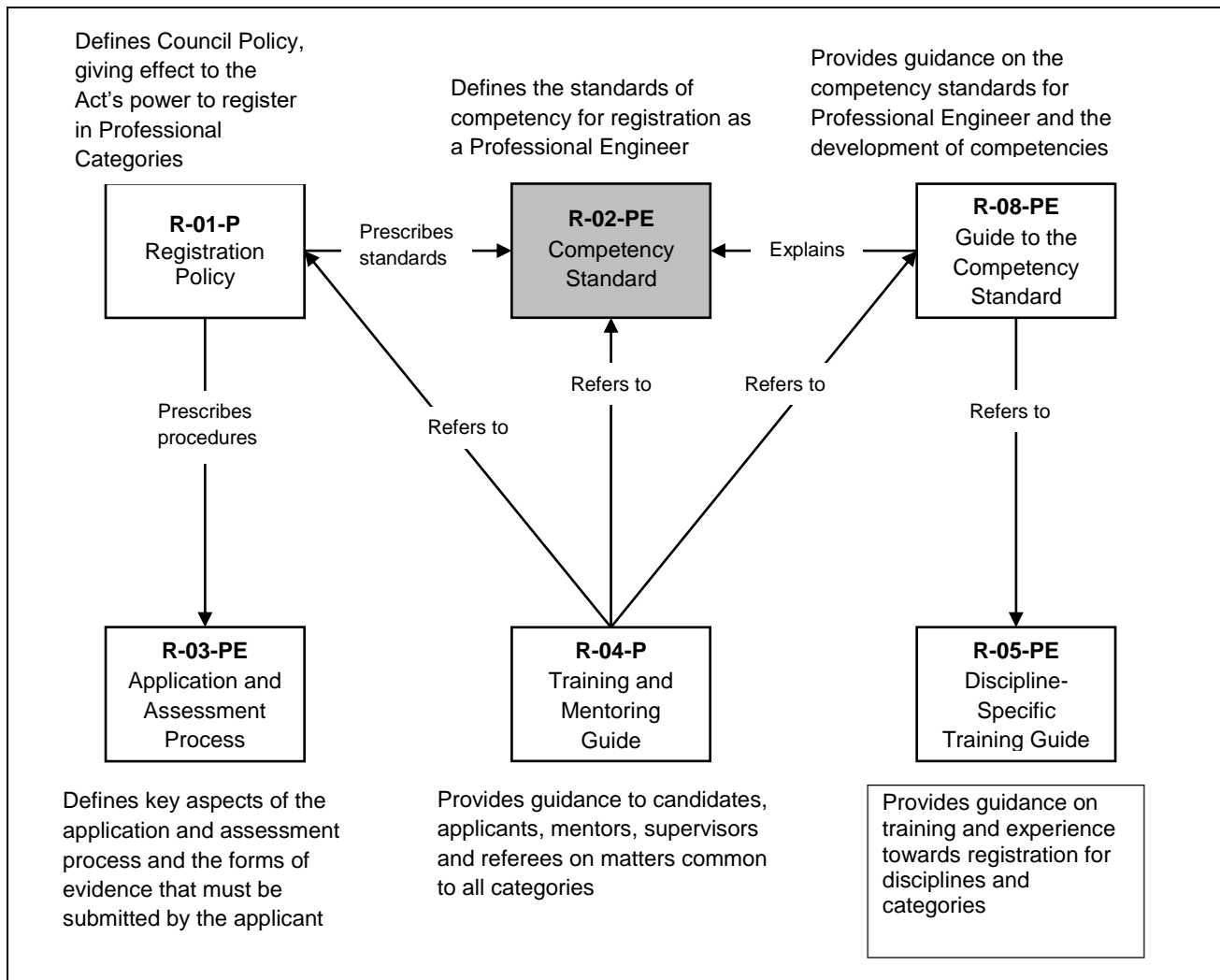
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## BACKGROUND: ECSA REGISTRATION SYSTEM DOCUMENTS

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.




### Documents defining the ECSA Registration System

## 1. PURPOSE

This Competency Standard defines the competencies required for registration as a Professional Engineer. Terms that have particular meaning within this standard are defined both in the text and in the section headed 'Definitions'.

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## 2. DEMONSTRATION OF COMPETENCE

Competence must be demonstrated within *complex engineering activities* by integrated performance of the outcomes at the level defined for each outcome. Required contexts and functions are specified in the applicable Discipline-Specific Guide.

### 2.1 Level descriptor

*Complex engineering activities* have some or all of the following characteristics:

- *Scope of activities* may encompass entire complex engineering systems or complex subsystems or may extend beyond previous experiences.
- A *context* that is complex and varying is multidisciplinary, requires teamwork, is unpredictable and may need to be identified.
- The activities require diverse and significant *resources*, including people and money.
- The activities involve equipment, materials and technologies.
- Significant *interactions* exist between wide-ranging or conflicting technical, engineering and other issues.
- The activities are *constrained* by time, finance, infrastructure, resources, facilities, applicable laws, and standards and codes.
- The activities have significant *risks* and *consequences* in a range of contexts.

### 2.2 Activities

**Activities include:** design; planning; investigation and problem resolution; improvement of materials, components, systems and processes; implementation, manufacture and construction; engineering operations; maintenance; closure or disposal; project management; and research, development and commercialisation.


## 3. GROUP A OUTCOMES: ENGINEERING PROBLEM-SOLVING

This group of outcomes requires the candidate to apply appropriate theoretical and practical methods to *identify, analyse* and *solve* complex engineering problems.

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### 3.1 Outcome 1

Define, investigate and analyse *complex engineering problems*

#### ***Complex engineering problems***

*Complex engineering problems* require in-depth, fundamental and specialised engineering knowledge that facilitates an analytical approach from first principles. The characteristics of *complex engineering problems* include one or more of the following:

- Complex engineering problems are ill-posed, under or over specified and require identification and refinement.
- Complex engineering problems are high-level problems and include component parts or sub-problems.
- Complex engineering problems are unfamiliar or involve infrequently encountered issues.

And one or more of the following:

- Solutions to complex engineering problems are not obvious and require abstract thinking or originality in analysis to formulate suitable models.
- Complex engineering problems are outside the scope of standards and codes.
- Complex engineering problems require information from a variety of sources that is complex, abstract or incomplete.
- Complex engineering problems involve wide-ranging or conflicting issues such as technical and engineering issues and interested or affected parties.

And one or both of the following:


- Complex engineering problems require judgement in decision-making in uncertain contexts.
- Complex engineering problems have significant consequences in a range of contexts.

#### ***Range statement***

The problem may be a design requirement, an applied research and development requirement or a problematic situation in an existing component, system or process. This outcome is concerned

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with the understanding and judgement of a problem: Outcome 2 is concerned with the solution.

### 3.2 Outcome 2

Design or develop solutions to *complex engineering problems*

#### **Range statement**

The solution may be the design of a component, system or process or a recommendation of the remedy to a problematic situation within the context of 3.1.1 above.

### 3.3 Outcome 3

Comprehend and apply advanced knowledge – principles underpinning good practice, specialist knowledge, jurisdictional knowledge and local knowledge.

#### **Range statement**

Applicable knowledge includes

- Specialist knowledge that has depth in the practice area and is underpinned by the fundamental knowledge of an engineering discipline or cross-disciplinary area. In-depth specialist knowledge in the practice area supports a fundamentals-based, first-principles analytical approach and develops models as required.
- A working knowledge of interacting disciplines (engineering and other) to underpin teamwork
- Jurisdictional knowledge that includes legal and regulatory requirements in addition to locally relevant codes of practice


## 4. GROUP B OUTCOMES: MANAGING ENGINEERING ACTIVITIES

This group of outcomes requires the candidate to demonstrate technical leadership and effective interpersonal skills.

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#### 4.1 Outcome 4

Manage part or all of one or more *complex engineering activities*

##### **Range statement**

Management is directed at achieving engineering results through the management of people, resources, processes, systems and money. Management involves

- planning *complex engineering activities*;
- organising *complex engineering activities*;
- leading *complex engineering activities*; and
- controlling *complex engineering activities*.

#### 4.2 Outcome 5

Communicate clearly with others in the course of the engineering activities

##### **Range statement**

Communication involves strategic, managerial, technical and wider impacts of engineering work. Material communication includes concepts, analyses, proposals and informative subjects. The audience includes peers, superiors, persons implementing designs and other work, persons in other disciplines, clients and wider stakeholders. Communication functions must be performed reliably and be repeatable.

### **5. GROUP C OUTCOMES: IMPACTS OF ENGINEERING ACTIVITY**


This group of outcomes requires the candidate to demonstrate recognition of an obligation to society, the profession and the environment and to make a commitment to abide by the professional Code of Conduct.

#### 5.1 Outcome 6

Recognise and address the reasonably foreseeable social, cultural and environmental effects of *complex engineering activities*.

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## 5.2 Outcome 7

Meet all legal and regulatory requirements and protect the health and safety of persons in the course of his/her *complex engineering activities*

### **Range statement for outcomes 6 and 7**

Impacts and regulatory requirements include

- Direct, indirect, immediate and long-term effects of engineering solutions
- Due regard for the principles of sustainability
- Regulatory requirements that are explicit for the context and are generally applicable
- Recognition that protection of society is the highest priority

## 5.3 Outcome 8

Conduct engineering activities ethically

### **Range statement**

Ethical behaviour of no less than that defined by the Code of Conduct

## **6. GROUP D OUTCOMES: EXERCISE JUDGEMENT, TAKE RESPONSIBILITY AND ACT ETHICALLY**

This group of outcomes requires a candidate to evaluate the outcomes and impacts of *complex engineering activities*.

### 6.1 Outcome 9


Exercise sound judgement in the course of *complex engineering activities*.

### **Range statement**

*Judgement* in decision-making involves consideration of

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- diverse and wide-ranging risk factors
- significant consequences in a range of contexts
- wide ranges of interested and affected parties with widely varying needs

## 6.2 Outcome 10

Be responsible in the decision-making for part or all of the *complex engineering activities*

### **Range statement**

*Responsibility* exercised for outcomes of significant parts of one or more *complex engineering activities*

## 7. GROUP E OUTCOMES: CONTINUING PROFESSIONAL DEVELOPMENT

This outcome requires a candidate to demonstrate a commitment to lifelong learning.

### 7.1 Outcome 11

Undertake sufficient professional development activities to maintain and extend competence


### **Range statement**

Professional development involves

- planning own professional development strategy;
- selecting appropriate professional development activities; and
- recording of professional development strategy and activities while displaying independent learning ability.

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### REVISION HISTORY

Revision Number	Revision Date	Revision Details	Approved By
Rev. 1.0			Approved by Council
Rev. 1.1 Draft A	26 Nov 2010	Fine tuning definition of level of problem-solving; reformatting; assessment criteria moved to R-04-P	JIC Working Document
Rev. 1.1 Draft B	15 Feb 2011	Editorial and formatting	Submitted to Council for approval
Rev. 1.1	17 March 2011	Minor editorial changes	Approved by Council
Rev. 1.2	11 Jan 2012	Preamble added; minor changes	Approved by Council
Rev. 1.3	2 Aug 2012	Split Range statements for outcomes 4 and 5 and enhancement of latter	JIC proposal to Council
Rev. 1.3	24 Nov 2012		Approved by Council
Rev. 1.4 Draft A	12 Sep 2018	Background added; minor changes added to outcome wording; explanation of outcome groupings	
Rev. 2	23 Oct 2018	Approval	PDSGC

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The Competency Standard for:

**Registration as a Professional Engineer**

Revision 2 dated 23 October 2018 and consisting of 13 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

14/02/2019  
 .....  
 Date

  
 .....  
 Executive: RPS

15/02/2019  
 .....  
 Date

The definitive version of the policy is available on our website.

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