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SOUTH AFRICA

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

R-05-IND-PE

REVISION No. 3: 15 July 2021

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ECSA

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DEFINITIONS

Certification: Formal recognition awarded to an education or training programme through a quality assurance procedure specifying that it meets the criteria laid down for the type of programme.

Competency Assessment: A summative assessment of an applicant's competence against the prescribed standard that is based on evidence from the applicant's work and other tests that include a Professional Review.

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 based on the natural sciences that 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.

Mentor: A professionally registered person who guides the competency development of a candidate in an appropriate category.

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.

Supervisor: A person who oversees and controls engineering work performed by a Candidate.

ABBREVIATIONS

CPD	Continuous Professional Development
ECSA	Engineering Council of South Africa
ELO	Exit Level Outcome
ER	Engineering Report
IE	Industrial Engineering
IPD	Initial Professional Development
OFO	Organising Framework for Occupations
SAIIE	Southern African Institute for Industrial Engineering
TERs	Training and Experience Reports

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.

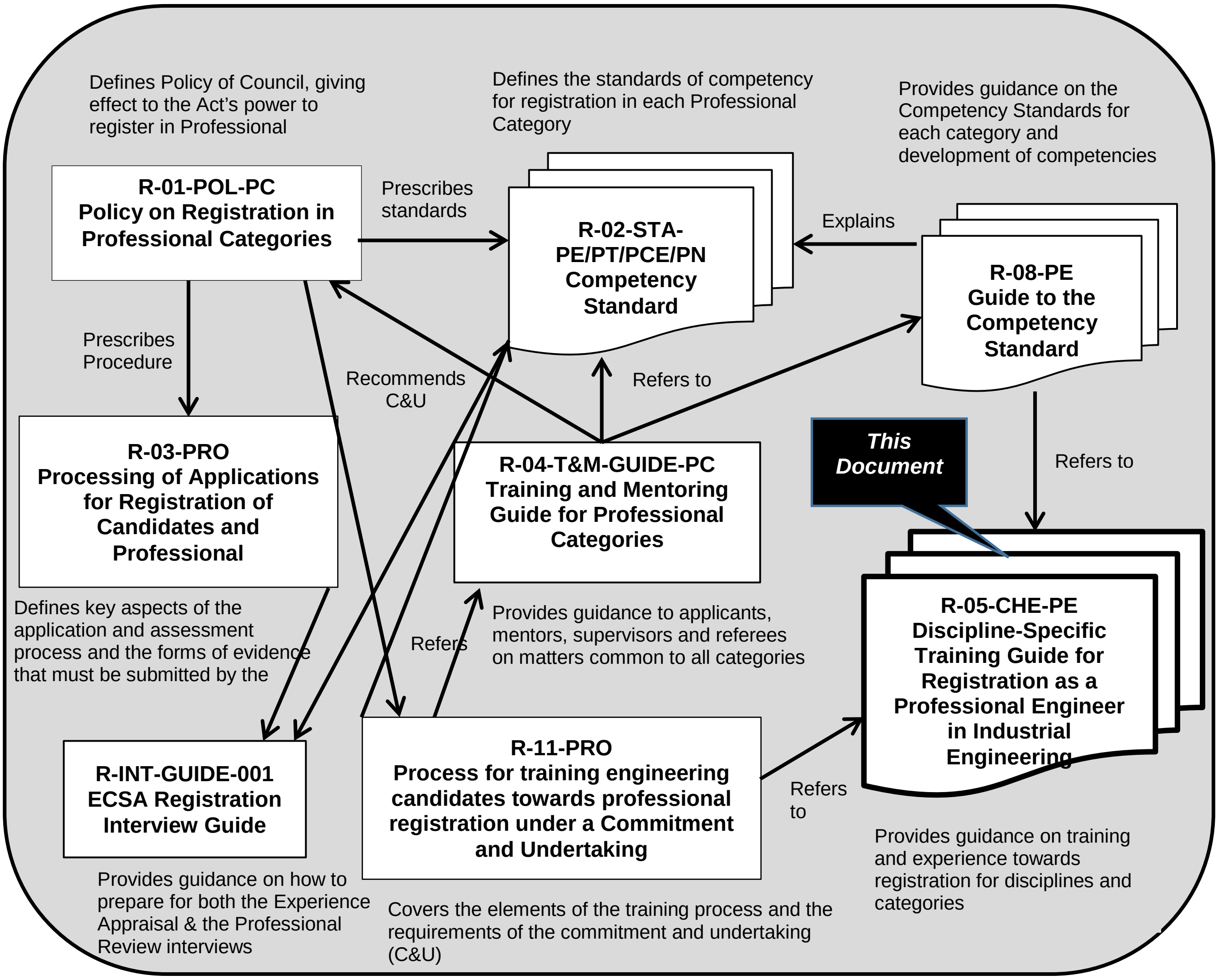

Figure 1: Documents defining the ECSA Registration System

1. PURPOSE OF THIS DOCUMENT

All persons applying for registration as Professional Engineers are expected to demonstrate the competencies specified in 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 generic 'Training and Mentoring Guide for Professional Categories' (document **R-04-T&M-GUIDE-PC**) and the 'Guide to the Competency Standard' (document **R-08-PE**).

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

- Duration of training and length of time working at level required for registration
- Principles of planning, training and experience
- 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).

Documents **R-04-T&M-GUIDE-PC** and **R-08-PE** are subordinate to the 'Policy on Registration in Professional Categories' (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, Mentors and Referees (refer to document **R-04T&M-GUIDE-PC**) in the discipline of Industrial 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 Chemical Engineering by obtaining an accredited:
  - o BEng/BSc(Eng)/BIng-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) listed on the ECSA website

- registered with the 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.
- been part of the ECSA certified Training Academy (Refer to **A-01-POL**, Framework on Academies Policy, **A-02-STA**, **A-03-PRO**, **A-04-GL**, **A-06-TEM**, **A-07-PRO**, **A-08-GL**, **A-15-P**).

3. PERSONS NOT REGISTERED AS A CANDIDATE AND/OR NOT TRAINED UNDER COMMITMENT AND UNDERTAKING AND/OR NOT PART OF CERTIFIED TRAINING ACADEMY

Irrespective of the development path followed, all applicants for registration must present the same evidence of competence and be assessed against the same standards. Application for registration as a Professional Engineer is permitted without being registered as a Candidate Engineer, without training under C&U and without being part of a certified training academy. 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 (to the employer organisation) Mentor, the services of an external (to the employer organisation) Mentor should be secured. The Voluntary Association 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 followed by the trainee.

The DSTG is written for the recent graduate who is training and gaining experience towards registration. Mature applicants for registration may apply the guide retrospectively to identify possible gaps in their development.

Applicants who have not enjoyed mentorship are advised to request an experienced Mentor (internal or external) to assist with the process of application for professional registration.

4.ORGANISING FRAMEWORK FOR OCCUPATIONS

Industrial Engineering – Organising Framework for Occupations (OFO)

The Department of Higher Education and Training defines an Industrial Engineer in the OFO 2013:

An Industrial Engineer investigates and reviews the utilisation of personnel, facilities, equipment and materials, current operational processes and established practices to recommend improvement in the efficiency of operations in a variety of commercial, industrial and production environments.

The OFO 2013 offers the following alternatives for titles and specialisations. These alternatives give an *indication* of the various areas of specialisation, many of which are industry specific:

- Produce Process Engineer
- Automation and Control Engineer
- Enterprise Resource Management Engineer
- Health and Safety Engineer
- Industrial Efficiency Engineer
- Manufacturing Logistics Engineer
- Manufacturing Technology Engineer
- Operations Research Engineer
- Plant Engineer
- Process Design Engineer
- Process Engineer
- Quality Management Engineer
- Safety Engineer
- Supply Chain Management Engineer
- Value Engineering

- Systems Engineer
- Project Management
- Business/Data Analyst
- Engineering Management
- Production/Service Planning

4.1 Industrial Engineers

The Southern African Institute for Industrial Engineering (SAIIE), on its website (https://www.saiie.co.za/) defines Industrial Engineers as follows:

'Industrial engineers figure out how to do things better. They engineer processes and systems that improve quality and productivity. They work to eliminate waste of time, money, materials, energy, and other commodities.'

SAIIE also indicates the typical tasks and activities that Industrial Engineers may be involved in as follows:

4.1.1 Industrial Engineer tasks

- Analyse data and product specifications to determine standards and establish quality and reliability objectives of finished product.
- Develop manufacturing/service methods, labour utilisation standards and cost analysis systems to promote efficient staff and facility utilisation.
- Draft and design layout of equipment, materials and workspace to illustrate maximum efficiency, using drafting tools and computer.
- Plan and establish sequence of operations to fabricate and assemble parts or products.
- Review production schedules, engineering specifications, orders and related information to obtain knowledge of manufacturing/service methods, procedures and activities.
- Study operations sequence, material flow, functional statements, organisation charts and project information to determine worker functions and responsibilities.
- Formulate sampling procedures, designs and develop forms and instructions for recording, evaluating and reporting quality and reliability data.
- Apply statistical methods and perform mathematical calculations to determine processes, staff requirements and standards.

- Estimate production cost and effect of product design changes.
- Complete production reports, purchase orders and material, tool and equipment lists.
- Record or oversee recording of information to ensure accuracy of engineering drawings and documentation.
- Regulate and alter workflow schedules according to established sequences and lead times to expedite operations.
- Implement methods and procedures for disposition of discrepant material and defective or damaged parts and assess cost and responsibility.
- Confer with vendors, staff, and management personnel regarding purchases, procedures, product specifications, manufacturing capabilities and project status.
- Schedule deliveries based on production forecasts, material substitutions, storage and handling facilities, and maintenance requirements.

4.1.2 Industrial Engineer activities

- Communicating with supervisors, peers or subordinates.
- Processing information. Compiling, coding, categorising, calculating, tabulating, auditing or verifying information or data.
- Collecting information. Observing, receiving and obtaining information from all relevant sources.
- Making decisions and solving problems. Analysing information and evaluating results to select the best solution and solve problems.
- Monitor processes, materials or surroundings. Monitoring and reviewing information from materials, events or the environment to detect or assess problems.
- Identifying objects, actions and events. Identifying information by categorising, estimating, recognising differences or similarities and detecting changes in circumstances or events.
- Analysing data or information. Identifying the underlying principles, reasons or facts of information by breaking down information or data into separate parts.
- Providing consultation and advice. Providing guidance and expert advice to management or other groups on technical, systems- or process-related topics.
- Updating and using relevant knowledge. Keeping up-to-date technically and applying new knowledge to the job.

5. NATURE AND ORGANISATION OF THE INDUSTRY

5.1 Investigation

Due to the dynamic nature of the profession, the diverse range of industries in which Industrial Engineers could be employed and the diverse range of sub-disciplines and specialised skills characterising the profession, it is virtually impossible to define a set of predetermined training paths for the Industrial Engineering Candidacy Phase. Instead of predetermined paths, a set of guiding principles is proposed whereby Candidates can shape the course of their own Candidacy Phase.

The guiding principles are as follows:

- Be involved with the solution of at least one complex problem through its entire lifecycle (refer to Test for a complex engineering problem in document R-08-PE), starting with problem definition and continuing with evaluation and selection of proposed solutions and solution design through to implementation and post-implementation support.
- Seek a fair balance between width of exposure and depth of specialisation and do not compromise one for the other.
- Actively seek diversity across assignments in terms of:
  - exposure to the underlying complexities of problems
  - exposure to the management and leadership styles of business leaders, managers and mentors
  - involvement in teams, teamwork and individual work.
- Seek a level of continuity across at least one area of specialisation (e.g., industry, discipline or problem-solving technique).

5.2 Process design

Process design – the process followed during the life cycle of a project – must include System Engineering. Candidates must include the cycles in which they have been involved and their contributions.

5.3 Risk and impact mitigation

Risk and impact mitigation must include the probability and impact of all the risks connected with the project. The focus areas of the project must be indicated on a risk matrix. Mitigation must include the time of mitigation and the person responsible. Solutions should include a Plan A and a Plan B. The risk document must be a live document through the life cycle of a project and must include the following:

- Technical risk
- Environmental risk
- Quality risk
- Commercial and financial risk
- Schedule risk
- Social risk
- Construction risk
- Health and safety risk.

5.4 Implementation

Project Engineers must install, test and commission/implement the necessary equipment or system for the desired result. This process must include all actions taken during construction (quality). This can refer to a project quality plan. During commissioning/implementation, Candidates must clearly indicate their contributions. Stated contributions can also refer to the commissioning/implementation plan.

5.5 Production

Candidates must state the requirements of the project in terms of delivery. They must refer to the initial production requirements for the project. They must also state whether they obtained results and if not, why they were unsuccessful.

5.6 Operations and maintenance

Candidates are required to state the operational requirements of the projects. They must also state the percentage of the plant that is available for implementing the project as well as the maintenance philosophy and substantiate what they have provided.

6. DEVELOPING COMPETENCY: ELABORATING ON SECTIONS IN THE GUIDE REGARDING COMPETENCY STANDARDS (DOCUMENT R-08-PE)

This section elaborates on the discipline-independent competency standards outlined in document **R-08-PE** and highlights specific competencies across the respective areas that are most relevant to Industrial Engineers.

All applicants for registration are required to demonstrate insight and ability to use and interface various engineered and innovative solutions with practical problems experienced in their work environments. In addition, applicants must develop the skills required to demonstrate the advanced use of Industrial Engineering knowledge in optimising the efficiency of operations or the constructability of projects.

Candidate Engineers must obtain experience in solving a variety of problems in their work environment. The solutions to these problems should also involve the use of the fundamental and the advanced engineering knowledge obtained at university.

The problems that require a scientific and engineering approach to their solutions may be encountered in any engineering or related (such as a services) work environment that consists of integrated systems, equipment, machinery and infrastructure. From early in their training years, Candidates must actively seek opportunities to obtain experience simulating solutions to real-life engineering problems encountered in the workplace.

In applying technical and scientific knowledge gained through academic training, the applicant must also demonstrate the financial and economic benefits of engineered solutions at a sufficiently advanced level. In addition, applicants must show evidence of adequate training in these functions/skills through complex project work.

6.1 Contextual knowledge

All successful solutions and interventions consider the context in which they exist. The integrative nature of Industrial and Systems Engineering, the fact that the discipline draws from specialised knowledge and a variety of skills, and the requirement of satisfying multiple objectives simultaneously place added emphasis on the understanding and consideration of context.

Successful professionals develop the art and skills to discern which contexts are most important for the situation at hand and try to understand the opportunities, limitations and rules of engagement associated with the particular environment and context in which they find themselves.

6.2 Functions performed

Candidates must prove that during their training period, they have mastered the competencies defined in document **R-08-PE** to a satisfactory level.

From the reports submitted as part of the application for registration (i.e., Training and Experience Reports [TERs] and the Engineering Report [ER]), it should be clear to the reviewers that the 11 outcomes are met.

These outcomes are defined in document **R-08-PE**:

- Group A outcomes: Knowledge-based, problem-solving
- Group B outcomes: Managing engineering activities
- Group C outcomes: Risk and impact mitigation
- Group D outcomes: Act ethically, exercise judgement and take responsibility
- Group E outcomes: Professional development.

It is useful to measure the progression of Candidates' competency by using the degree of responsibility. The degree of responsibility shows the gradual increase in responsibility to which Candidate Engineers are exposed during their professional training (See Table 1).

6.3 Statutory and regulatory requirements

Candidates are expected to have a working knowledge of the following regulations and Acts and how this legislation affects their working environment:

- Engineering Profession Act, 46 of 2000, including the ECSA rules and Code of Conduct

- Occupation Health and Safety Act, 85 of 1993, as amended by Act 181 of 1993 (latest revision used)
- Wiring Code – SANS 10142
- Building Regulations – National Building Regulations and Building Standards Act, 103 of 1977, as amended by Act 49 of 1995, SANS 10400
- Factory Regulations
- Machinery and Works Regulations
- Labour Relations Act, 66 of 1995
- Environment Conservation Act, 73 of 1989, as amended by Act 52 of 1994 and Act 50 of 2003
- Mine Health and Safety Act, 29 of 1996
- Industry-specific work instructions and specifications
- South African National Standard (SANS) applicable specifications.

Other Acts not listed here may also be pertinent to a Candidate's work environment. Candidates will be expected to have a basic knowledge of the applicable Acts.

6.4 Recommended formal learning

As part of the documentation required in the application for registration, the Candidate needs to provide evidence of initial professional development (IPD) by supplying a list of formal activities for continued education that were completed during the training period.

Formal learning activities for Candidate Engineers include postgraduate programmes in Industrial Engineering and related fields which are offered by universities with accredited engineering degree programmes.

Other academic institutions and commercial entities that provide formal training offer a variety of continued education programmes in the broad field of Industrial Engineering. These programmes have varying degrees of accreditation and the Candidate Engineer should verify the status of the educational programme before enrolling.

SAIIE offers an annual conference and specialist group meetings through which Candidate Engineers can pursue continuous professional development (CPD). The institute also provides a list of possible CPD activities for which CPD points are awarded. These courses can also be used as IPD in the application for registration process.

Short courses offered by training institutions that are accredited by SAIIE in terms of CPD include courses of both a generalist and a specialist nature.

Training and courses that do not carry official CPD points are also appropriate such as courses or training offered within the employer organisation or by other organisations.

6.5 Best practice

There is no ideal training programme structure or unique sequencing that constitutes best practice. The training programme for each Candidate depends on the available work opportunities the employer assigns to the Candidate at the time. It is suggested that Candidates work with the appointed Mentors to determine appropriate projects to gain exposure to elements of the asset cycle and to ensure that their designs are constructable, operable and are designed considering lifecycle costing and long-term sustainability.

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

The Mentor and Candidate must identify the level of responsibility required for an activity to be compliant and demonstrate the various exit level outcomes. Evidence of the Candidate's activities and their acceptance by the Mentor are recorded on the appropriate system to meet the requirements of **Appendix A:** Training Elements.

6.6 Realities

Document **R-08-PE** adequately describes what is expected of persons whose formative developments have not followed conventional paths, for example, academics, researchers and specialists.

6.7 Generalists, specialists, researchers and academics

The overriding consideration is that irrespective of the route followed, the applicant must provide evidence of competency against the standard.

The Competency Standard defined in document **R-02-STA-PE/PT/PCE/PN** applies to generalists, specialists, researchers and academics alike.

6.8 Moving into or changing candidacy training programmes

The DSTG assumes that the Candidate enters a programme after graduation and continues with the programme until ready to submit an application for registration. The guide 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 TERs for the previous programme or the unstructured experience. In regard to the latter, it is important to reconstruct the experience as accurately as possible. The TERs must be signed off by the relevant Supervisor or Mentor.
- In entering the new programme, the Mentor or 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 or Supervisor should plan the next phase of the Candidate's programme. Candidate Engineers should ensure that their career development continues to be aligned with document **R-04-T&M-GUIDE-PC**. In addition, Candidate Engineers from disciplines other than Industrial Engineering must demonstrate their competencies in Industrial Engineering in accordance with the document **R-04-T&M-GUIDE-PC**.

6.9 Degree of responsibility

Progression throughout the candidacy period presented in document **R-04-T&M-Guide-PC** and below in **Table 1** refers to the gradual increase in the degree of responsibility to which the Candidate Engineer is exposed during professional training. Considering the nature of work, specific examples and outcomes appropriate to training in Industrial Engineering are given in the table presented below:

Table 1: Progression throughout the candidacy period

Degree of responsibility	Nature of work	Activities/duties to be undertaken during training
A: Being exposed	The Candidate undergoes induction and observes processes and the work of competent practitioners.	• Understand the business environment and the dynamics that shape the businesses and the industries in which they operate. • Understand the business model, its key conversion processes and critical outcomes. • Understand the value added by Industrial Engineers and other professionals in the business.
B: Assisting	The Candidate performs specific processes under close supervision.	• Develop insight and understanding of the different processes and systems in the transformation of inputs into goods and services • Develop an appreciation of the numerous resources that are at the disposal of the Industrial Engineer. • Obtain experience in the day-to-day operations of the business to gain insight and understanding of the different processes and systems involved in the transformation of inputs into goods and services, with specific emphasis on productivity and quality measurements.
C: Participating	The Candidate performs specific processes as directed with limited supervision.	• Gain first-hand experience of a broad range of Industrial Engineering activities (e.g., process design and re-engineering, planning and control, work study, Value Engineering, materials and information management, people management skills, logistics, specialists' inputs, tools and equipment and quality assurance). • Note the problems and limitations of particular philosophies, methods and techniques, with emphasis on cost/effort and relative benefit.

Degree of responsibility	Nature of work	Activities/duties to be undertaken during training
D: Contributing	The candidate performs specific work with detailed approval of work outputs.	• Be involved in activities such as the planning of production, the control of quality and costs of process study and work study, good material handling and workplace layout, activity-based costing, benchmarking, business cases, process re-engineering, maintenance practice and procedures, project management and system specification. Of particular importance is the collective working of such activities in the economic use of people, materials and machines. • Give specific attention to human aspects concerning communication, interpersonal relationships and teamwork, training and cost analysis, budget control and profit accountability. These should proceed in parallel, applying Industrial Engineering techniques and utilising computers in problem-solving.
E: Performing	The candidate works in a team without supervision, recommends work outputs and is responsible but not accountable.	• Assume escalating technical responsibility and increasingly, co-ordinate the work of others. • Gain exposure to and develop skills in management areas such as labour relations, management accounting, business law and general business management. This is important for the development of a well-rounded Industrial Engineer. • Seek assignments that require judgement, even if full information is not available. This leads to a position of professional responsibility, which is of great value and should be pursued.

REVISION HISTORY

Revision number	Revision date	Revision details	Approved by
Rev 0 concept A	3 November 2011	Drafting of paras 2 and 3	Carien Botha
Rev 0: Concept B	4 November 2011	Editing of paras 2 and 3	Schalk Claasen
Rev 0: Concept C	7 November 2011	Transfer of paras 2 and 3 to template	Carien Botha
Rev 0: Concept D	6 September 2012	Complete revision of document following the ECSA workshop on Discipline-specific Training Guidelines	Schalk Claasen and Carien Botha
Rev 0: Concept E	29 October 2012	Revision number corrected Standard sections 1–3 inserted	
Rev 1	12 March 2013		Reg. Committee for Professional Engineers
Rev 2	22 September 2017	Reviewed as per ECSA	Henk van Tonder
Rev 2	9 October 2017	For approval by PDSGC via round robin	PDSGC
Rev 2	23 October 2017	Reviewed and checked	J Cato, B Collier-Reed
Rev 2	16 November 2017	Approval	PDSGC
Rev 3 Draft A	28 June 2021	The document has been revised to include definitions, abbreviations and to update document numbers of referenced documents. The working group further added additional information under the following headings: • Industrial Engineers • IE Tasks • IE Activities • Investigation • Process Design • Risk and impact mitigation • Engineering Project Management • Implementation • Production	Executive: RPS – EL Nxumalo
Rev 3	15 July 2021	Approval	RPSC

The Discipline-specific Training Guide for:

Candidate Professional Engineer in Industrial Engineering

Revision 3 dated 15 July 2021 and consisting of 23 pages has been reviewed for adequacy by the Business Unit Manager and is approved by the Executive: Research Policy and Standards **(RPS).**

....2021/08/26................

Business Unit Manager Date

....26 August 2021..........

Executive: **RPS** Date

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

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
2.1.6	Component/product design
2.1.7	Software design
2.1.8	Research and investigation
2.1.9	Preparation of specifications and associated documentation
2.1.10	Preparation of contract documents and associated documentation
2.1.11	Development of standards
2.1.12	Application of quality systems
2.1.13	Configuration management
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* (Responsibility Level E)
3.5.1	Planning and scheduling maintenance
3.5.2	Monitor quality
3.5.3	Oversee maintenance and repair
4	**Risk and impact mitigation**
4.1	*Impact and risk assessments* (Responsibility Level E)
4.1.1	Risk assessments
4.2	*Regulatory compliance* (Responsibility Level E)
4.2.1	Health and safety
4.2.2	Codes and standards
4.2.3	Legal and regulatory
5	**Managing engineering activities**
5.1	*Self-management* (Responsibility Levels C–D)
5.1.1	Manages own activities
5.1.2	Communicates effectively
5.2	*Team environment* (Responsibility Levels C–D)
5.2.1	Participates in and contributes to team planning activities
5.2.2	Manages people
5.3	*Professional communication and relationships (networking)* (Responsibility Levels C–D)
5.3.1	Establishes and maintains professional and business relationships
5.3.2	Communicates effectively
5.4	*Exercising judgement and taking responsibility* (Responsibility Level E)
5.4.1	Ethical practices
5.4.2	Code of Conduct
5.4.3	Exercises sound judgement in the course of complex engineering activities
5.4.4	Is responsible for decision-making in some or all engineering activities
5.5	*Competency development* (Responsibility Level D)
5.5.1	Plans own development programme
5.5.2	Constructs initial professional development record