

## **AUSTRALIAN ENGINEERING COMPETENCY STANDARDS STAGE 2 - EXPERIENCED PROFESSIONAL ENGINEER**

The Stage 2 Competency Standards are the profession's expression of the knowledge and skill base, engineering application abilities, and professional skills, values and attitudes that must be demonstrated in order to practise independently or unsupervised.

### **Purpose of the Stage 2 competency standards**

The Stage 2 competency standards are used as the basis of assessment for Chartered membership of Engineers Australia (CPEng) and registration on the National Engineering Register (NER).

Chartered membership is exclusive to Engineers Australia. It is a professional credential recognised by government, business and the general public worldwide. The achievement of CPEng brings with it a career-long obligation to maintain competence in a chosen practice area.

### **What is expected of an experienced professional engineer?**

The community has certain expectations of experienced professional engineers, their competence, how they apply this competence and how they will conduct themselves.

Experienced professional engineers:

- understand the requirements of clients, wide ranging stakeholders and of society as a whole
- work to optimise social, environmental and economic outcomes over the full lifetime of the engineering product or program
- interact effectively with other disciplines, professions and people
- ensure that the engineering contribution is properly integrated into the totality of the project, program or process
- are responsible for:
  - interpreting technological possibilities to society, business and government
  - ensuring, as far as possible, that policy decisions are properly informed by possibilities and consequences
  - ensuring that costs, risks and limitations are properly understood in the context of the desirable outcomes
  - bringing knowledge to bear from multiple sources to develop solutions to complex problems and issues
  - ensuring that technical and non-technical considerations are properly integrated
  - managing risk as well as sustainability issues
  - ensuring that all aspects of a project, program or process are soundly based in theory and fundamental principle
  - for understanding clearly how new developments relate to established practice and experience and to other disciplines with which they may interact

While the outcomes of engineering generally have physical forms, the work of experienced professional engineers recognises the interaction between people and technology. Professional engineers may conduct research concerned with advancing the science of engineering and with developing new principles and technologies within a broad engineering discipline. Alternatively, they may contribute to the education of engineers, continual improvement in the practice of engineering and to devising and updating the codes and standards that govern it.

## Stage 2 competency standards

The Stage 2 competency standards are generic in the sense that they apply to all disciplines of engineering in four units:

- personal commitment
- obligation to community
- value in the workplace
- technical proficiency

Each unit contains elements of competence and indicators of attainment. The elements of competence are the capabilities necessary to the unit of competence and the indicators of attainment serve as a guide to the engineering work likely to be considered as demonstrating attainment of that competence.

### Demonstration of competence – Professional Engineer

The demonstration of competence requires the presentation of written accounts of work that involves engineering contributions – contributions based on the bodies of knowledge associated with established engineering practice and engineering science. Many aspects of engineering practice may be based on well-established but unpublished guidelines, or even practices that are not commonly documented or written but learned through the experience of practice under the guidance and supervision of a more experienced engineer.

When selecting work experience to offer as evidence of competence, provide examples of contributions to work that has some or all of the characteristics of either an *engineering problem* or *engineering activity* as described below:

#### Engineering problems

- Involve wide-ranging or conflicting technical, sociological, environmental and other requirements
- Have no obvious solution and require abstract thinking and originality in analysis to formulate suitable models
- Require the application of first principles
- Involve infrequently encountered issues
- Have complex or conflicting stakeholder requirements and consequences that involve diverse groups of stakeholders with widely varying needs
- Can be dissected into component parts or sub-problems
- Require the creation of successful, timely engineering solutions.

#### Engineering activities

- Involve the coordination of diverse resources (and for this purpose, resources include people, money, equipment, materials, information and technologies) in the timely delivery of outcomes
- Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, sociological, environmental or other requirements
- Involve creative use of engineering principles and knowledge, much of which is at, or informed by, the forefront of a practice area
- Have significant consequences in a range of contexts, characterised by difficulty of prediction and mitigation
- Can extend beyond previous experiences by applying first principles
- Require the achievement of successful outcomes on time and on budget.

At any particular time, a professional engineer applying for Stage 2 assessment would expect some areas to be developing with others at a functional or proficient level as described below.

- **Developing:** an aspect of practice that you are learning, with help from more experienced practitioners and possibly supervision to help you practice at an acceptable standard.
- **Functional:** an aspect of practice in which you have a basic capability to practice independently at an acceptable standard without help or supervision.
- **Proficient:** an aspect of practice in which your capability to practice independently has been recognised through formal peer review, and in which you have the capacity to help others develop their capability.

A successful assessment at Stage 2 will formalise a transfer from functional to proficient.

## AUSTRALIAN ENGINEERING COMPETENCY STANDARDS STAGE 2 – PROFESSIONAL ENGINEER

### Elements of Competence – PERSONAL COMMITMENT

This unit of competence requires you to demonstrate:

- how you deal with ethical issues when they arise
- how you develop and define your areas of competence
- how you display a personal sense of responsibility for your work

<b>ELEMENT OF COMPETENCE – PROFESSIONAL ENGINEER</b>	<b>What this competence means in practice</b>	<b>Indicators of Attainment</b> Refer to only as many Indicators of Attainment as you need to demonstrate the Element of Competence
1. Deal with ethical issues	<p><i>means</i> you anticipate the consequences of your intended action or inaction and understand how the consequences are managed collectively by your organisation, project or team; and</p> <p><i>means</i> you demonstrate an ability to identify ethical issues when they arise and to act appropriately</p>	<ul style="list-style-type: none"> <li>• appraise and respond appropriately to ethical dilemmas in your practice area</li> <li>• recognise an unethical situation; take appropriate action</li> <li>• engage in ethical reflective practice</li> <li>• seek appropriate advice and consult Engineers Australia Code of Ethics</li> </ul>
2. Practise competently	<p><i>means</i> you assess, acquire and apply the competencies and resources appropriate to <i>engineering activities</i></p>	<ul style="list-style-type: none"> <li>• regularly assess your own competence (in the absence of assessment by more experienced engineers) and continually acquire new knowledge and skills</li> <li>• maintain a concise description of your areas of competence</li> <li>• carry out engineering work only within the boundaries of your known areas of competence</li> <li>• maintain records of Continuing Professional Development activities</li> </ul>
3. Responsibility for <i>engineering activities</i>	<p><i>means</i> you display a personal sense of responsibility for your work; and</p> <p><i>means</i> you clearly acknowledge your own contributions and the contributions from others and distinguish contributions you may have made as a result of discussions or collaboration with other people</p>	<ul style="list-style-type: none"> <li>• consistently document work in a way that would enable another person of comparable ability to continue and complete your work should you be unable to do so due to circumstances beyond your control</li> <li>• seek peer reviews and comments of your own contributions, and make improvements to work based on their suggestions</li> <li>• provide reviews and constructive comments to help others improve their own work</li> <li>• authorise engineering outputs only on the basis of an informed understanding of the costs, risks, consequences and limitations</li> </ul>

## Elements of Competence – OBLIGATION TO COMMUNITY

‘Community’ will change depending on the nature of the work you are doing. Sometimes it will be the client; sometimes the general public; sometimes your students; sometimes the regulatory authorities and sometimes it will be your employer. This unit of competence requires you to demonstrate:

- how you delivered a safe and sustainable solutions
- how you defined the community and considered the community benefit at various stages of *engineering activities* (within the context of your work)
- how you identified and managed the risks associated with the engineering activities
- how you incorporated legal and regulatory requirements into your solutions

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4. Develop safe and sustainable solutions	<p><i>means</i> that you apply and implement current workplace health and safety requirements; and</p> <p><i>means</i> that you identify the economic, social and environmental impacts of <i>engineering activities</i>; and</p> <p><i>means</i> that you anticipate and manage the short and long-term effects of <i>engineering activities</i></p>	<ul style="list-style-type: none"> <li>• provide for the safety of workers and others in design, manufacture, construction, commissioning, use, decommissioning, demolition, removal and disposal of plant, products, substances or structures</li> <li>• take into account well-accepted standards of practice for design safety, while making the most economic use of financial, human effort, energy and material resources</li> <li>• develop designs or solutions to engineering problems that balance the impact of present engineering activities with the economic, social and environmental prospects of future generations</li> <li>• manage engineering activities to enhance the economic, social and environmental prospects of future generations</li> </ul>
5. Engage with the relevant community and stakeholders	<p><i>means</i> you identify stakeholders, individuals or groups of people who could be affected by the short, medium and long-term outcomes of <i>engineering activities</i>, or could exert influence over the engineered outcomes, including the local and wider community; and</p> <p><i>means</i> you identify stakeholder interests, values, requirements and expectations using the terminology of the stakeholder through consultation and accurate listening; and</p> <p><i>means</i> you work ethically to influence perceptions and expectations of stakeholders and negotiate acceptable outcomes in the best overall interest of relevant communities.</p>	<ul style="list-style-type: none"> <li>• consider safety, environmental, public health and other public interest issues relevant to the <i>engineering activities</i></li> <li>• engage responsibly with appropriate communities to convey information on the consequences of <i>engineering activities</i> and potential solutions to <i>engineering problems</i></li> <li>• take into account the reliance of others on engineering expertise when engaging with the community</li> </ul>

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6. Identify, assess and manage risks	<i>means</i> that you develop and operate within a hazard and risk framework appropriate to <i>engineering activities</i>	<ul style="list-style-type: none"> <li>• identify, assess and manage product, project, process, environmental or system risks that could be caused by material, economic, social or environmental factors</li> <li>• establish and maintain a documented audit trail of technical and operational changes during system or product development, project implementation or process operations</li> <li>• follow a systematic documented method and work in consultation with stakeholders and other informed people to identify unpredictable events (threats, opportunities, and other sources of uncertainty or missing information) that could influence outcomes</li> <li>• assess the likelihood of each event, and the consequences, including commercial, reputation, safety, health, environment, regulatory, legal, governance, and social consequences</li> <li>• devise ways to influence the likelihood and consequences to minimise costs and undesirable consequences, and maximise benefits</li> <li>• help in negotiating equitable ways to share any costs and benefits between stakeholders and the community</li> </ul>
7. Meet legal and regulatory requirements	<i>means</i> that you should be able to demonstrate an understanding of the laws, regulations, codes and other instruments which you are legally bound to apply, and apply these in your work	<ul style="list-style-type: none"> <li>• identify and comply with the codes, standards of compliance or legal instruments relevant to a particular product, project, process or system</li> <li>• draft commercial contracts that cover the procurement of services, equipment, materials, access rights or access to information</li> <li>• seek advice, rulings or opinions from time to time to ensure that your understanding of legal and regulatory requirements is up-to-date</li> <li>• practise within legal and regulatory requirements</li> <li>• negotiate appropriate approvals from regulatory authorities for <i>engineering activities</i></li> <li>• protect intellectual property</li> </ul>

## Elements of Competence – VALUE IN THE WORKPLACE

This unit of competency requires you to demonstrate:

- how you collaborate and work with others
- how you work within an organisation to provide value for stakeholders
- how you initiate, plan, lead or manage and secure financial and other material resources to support *engineering activities*
- how you apply your professional judgement

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8. Communication	<p><i>means</i> you can communicate in a variety of different ways to collaborate with other people, including accurate listening, reading and comprehension, based on dialogue when appropriate; and</p> <p><i>means</i> you can speak and write, taking into account the knowledge, expectations, requirements, interests, terminology and language of the intended audience</p>	<ul style="list-style-type: none"> <li>• respect confidentiality obligations</li> <li>• build and maintain collaborative relationships with other people, gaining their respect, trust, confidence and willing, conscientious collaboration</li> <li>• exercise informal leadership in order to coordinate the activities of diverse people who contribute to <i>engineering activities</i></li> <li>• collaborate effectively within multi-disciplinary teams including other professions in the workplace</li> <li>• lead and sustain discussion with others and, where appropriate, integrate their views to improve deliverables</li> <li>• convey new concepts and ideas to technical and non-technical stakeholders</li> <li>• deliver clear written and oral presentations on engineering problems and engineering activities in English or in a language appropriate to the engineering work.</li> </ul>

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9. Performance	<i>means</i> that you demonstrate an ability to apply appropriate tools or processes to achieve corporate objectives while accounting for personal obligations to the profession	<ul style="list-style-type: none"> <li>• build, develop and maintain relationships with product, project, process or system clients, sponsors, partners, service providers and contractors</li> <li>• dialogue with a client, sponsor, organisation, government or other social actors to jointly develop an accurate understanding of needs, opportunities and priorities</li> <li>• work with a client, sponsor, organisation, government or other social actors to develop solutions in terms of engineering possibilities</li> <li>• cultivate an attitude of engineering innovation and creativity to add value for clients or sponsors of the product, project, process or system</li> <li>• apply engineering performance requirements that create the greatest benefits or value for stakeholders, keeping in mind the tolerance for uncertainty of different stakeholders that are providing financial or other material resources in the anticipation of future benefits.</li> </ul> <p>[Performance requirements could include the need to keep to a desired schedule, long-term cost effectiveness, minimising upfront capital expense, accelerated financial returns or social or environmental benefits, technical quality, constructability, maintainability and operational reliability, among others]</p> <ul style="list-style-type: none"> <li>• collaborate within and outside educational institutions to enhance the quality and value of engineering education to students</li> <li>• question the contract or agreement that governs your work, and ensure that it allows for the possibility that you may not be able to complete the work due to circumstances beyond your control</li> </ul>

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10. Taking action	<i>means that you initiate, plan, lead or manage engineering activities</i>	<ul style="list-style-type: none"> <li>• contribute to successful proposals, bids, technical qualification and tender documents for <i>engineering activities</i></li> <li>• provide initiative and leadership in coordinating technical, commercial, social and environmental aspects of <i>engineering activities</i> implementation</li> <li>• gain sufficient confidence from stakeholders for them to provide you with financial and other resources to conduct your work independently on the understanding that you will deliver agreed results on time within a given cost target</li> <li>• apply and use appropriate formal coordination and management systems and organisational processes such as project management, quality management, production management, logistics, enterprise resource and planning systems, maintenance management, configuration management, information management</li> <li>• report progress relative to the agreed schedule, expenditure relative to the budget, provide agreed deliverables, and report on any outstanding issues</li> <li>• manage projects effectively, including scoping, procurement and integration of physical resources and people; control of cost, quality, safety, environment and risk; and monitoring of progress and finalisation of projects</li> <li>• keep financial and other records to substantiate the effective application of finance and other resources provided in support of your work, in a form that is appropriate to meet the needs of agencies that will audit the conduct of the work</li> </ul>
11. Judgement	<i>means that you exercise sound judgement in engineering activities</i>	<ul style="list-style-type: none"> <li>• deal decisively with <i>engineering activities</i> which have significant consequences and diverse or conflicting stakeholder interests</li> <li>• supervise, monitor and evaluate the progress of technical work performed by other people, diagnose performance deficiencies and negotiate appropriate remedial measures, such as providing training and assistance</li> <li>• seek appropriate advice and decide whether to proceed or suspend work when faced with unexpected obstacles, performance deficiencies, impending or actual failures</li> </ul>



## Elements of Competence – TECHNICAL PROFICIENCY

This unit of competency require you to demonstrate:

- how you use advanced engineering science
- how you make effective use of engineering knowledge provided by other people
- how you analyse problems and how you develop creative and innovative solutions
- how you evaluate the outcomes and impacts of engineering activities

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12. Advanced engineering knowledge	<i>means</i> that you comprehend and apply advanced theory-based understanding of engineering fundamentals to predict the effect of <i>engineering activities</i>	<ul style="list-style-type: none"> <li>• Develop and apply current research papers to inform and shape perceptions of engineering possibilities to meet [client] needs</li> <li>• apply advanced theory-based knowledge of engineering fundamentals and the forefront of a practice area to the delivery of engineering projects, systems and programs (including educational)</li> <li>• use mathematical, numerical and computational tools pertinent to the engineering discipline to predict technical, commercial, environmental and social performance</li> <li>• apply the principles and theories of engineering science and mathematics to help make accurate performance predictions, including predicting failure</li> <li>• apply engineering fundamentals and logic to the development and operation of complex financial, commercial or managerial systems</li> </ul>
13. Local engineering knowledge	<p><i>means</i> that you acquire and apply local engineering knowledge; and</p> <p><i>means</i> that, where appropriate, you apply engineering knowledge contributed by other people including suppliers, consultants, contractors and independent experts</p>	<ul style="list-style-type: none"> <li>• apply accepted local technical literature and engineering practices and locally applied international standards</li> <li>• take into account local environmental plans, conditions, constraints and opportunities</li> <li>• when appropriate, apply and incorporate engineering knowledge embodied in standards, design guides, product datasheets, existing products and designs in order to produce reliable and economic results in a timely manner</li> <li>• keep yourself informed about new and emerging technologies, techniques, products, materials, methods, theories and science relevant to your practice areas</li> <li>• apply Australian knowledge and practices, including unwritten engineering knowledge contributed by informed peers and experts knowledgeable in the area of engineering</li> </ul>

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14. Problem analysis	<i>means that you define, investigate and analyse engineering problems and opportunities</i>	<ul style="list-style-type: none"> <li>• accurately determine the main issues that require addressing in analysing the problem and reliably identify opportunities to improve outcomes</li> <li>• work with customer or employer to reach an agreed understanding of the expected capability or functionality of the required product, project, process or system</li> <li>• when you identify or are presented with <i>engineering problems</i>, adopt appropriate research methods to locate previously known solutions to similar problems, including seeking advice or help from informed people</li> <li>• conduct research, investigation and analysis in relation to product, project, process or system</li> <li>• adopt educational best practice and inclusive principles in the design and delivery of educational programs and courses</li> <li>• engage in dialogue with appropriate people to reach an agreed understanding of technical issues for which there are no well-understood and reliable solutions</li> </ul>
15. Creativity and innovation	<i>means that you develop creative and innovative solutions to engineering problems</i>	<ul style="list-style-type: none"> <li>• apply your knowledge of materials and physical and abstract objects to work out how to rearrange them so they perform the required function</li> <li>• develop the most effective ways to create value for sponsors, clients, end users and investors in products, projects, processes or systems that have agreed aesthetics, level of performance or properties</li> <li>• select and use fundamental principles to meet requirements economically, possibly reusing or modifying existing componentry</li> <li>• develop concepts to meet requirements and specify, document, build, test, verify, validate, measure and monitor engineering products or processes</li> <li>• review opportunities in work portfolio for enhancing products, processes, systems and services, assesses viability and initiate actions</li> <li>• apply the benefits of continuous technical change and innovation to enhance the outcomes delivered</li> <li>• apply and advance research-based education practice to course design, delivery and assessment</li> </ul>

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16. Evaluation	<i>means that you evaluate the outcomes and impacts of engineering activities</i>	<ul style="list-style-type: none"> <li>• evaluate ongoing projects, products and processes to identify and diagnose performance deficiencies, impending or actual failures, and propose remedies and solutions</li> <li>• monitor and evaluate product, project, process or system against whole of life criteria (cost, quality, safety, reliability, maintenance, aesthetics, fitness for purpose and social and environmental impact and decommissioning)</li> <li>• determine criteria for evaluating a design solution and address designer obligations for work health and safety</li> <li>• undertake and report design verification (e.g. of pressure equipment) to required standard</li> <li>• set or adopt criteria for evaluation and review and evaluate the effectiveness of engineering programs</li> <li>• evaluate product, project, process or systems outcomes against the original specification or design brief</li> <li>• diagnose performance deficiencies, conceive and design remedial measures and predict performance of modified systems</li> <li>• evaluate product, project, process or systems outcomes for constructability and maintainability as input to future design improvement</li> <li>• assess and use technical information and statistics correctly to ensure that opportunities are based on sound evidence</li> <li>• engage in periodic review and continuous improvement of educational programs and courses</li> </ul>