


AUSTRALIAN ENGINEERING COMPETENCY STANDARDS

GENERAL INTRODUCTION AND STAGE 2 COMPETENCY STANDARDS FOR
PROFESSIONAL ENGINEERS • ENGINEERING TECHNOLOGISTS • ENGINEERING ASSOCIATES



**ENGINEERS
AUSTRALIA**





**“Theory and experience are of equal value to the engineer.
Theory without experience is the foundation without the superstructure.
Experience without theory is the superstructure without the foundation.
The former is useless, the latter dangerous.”**

William Charles Kernot

Australia's first Professor of Engineering, The University of Melbourne, 1883-1909

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PREFACE

Engineers Australia (the Institution of Engineers Australia) sees itself as part of a global community of professional engineering associations that reflect and contribute to world best standards in engineering education and practice. It gives expression to this aim through its active participation in international agreements on professional standards and assessment procedures, and associated professional groupings, as well as bilateral mutual recognition agreements with engineering bodies in many countries. Engineers Australia is recognised as the National Professional Engineering Competency Authority by virtue of its leadership role for the engineering profession in Australia. In this role it has assumed the responsibility for competency standards on behalf of the engineering profession, including reviewing their use and amending them as necessary to maintain their currency.

During the period 1992 to 1994, Engineers Australia developed competency standards for Stage 1 (Graduate) and Stage 2 (Experienced Practitioner) in the three occupational categories of Professional Engineer, Engineering Technologist and Engineering Officer (now known as Engineering Associate). At that time, the evolving nature of competency standards was recognised, and it was anticipated that they would be reviewed on a four to five yearly basis. The first review took place in early 1998 and a further review was conducted in 2002/2003. Both reviews took account of experience gained from using the earlier competency standards for assessment and other purposes.

The 2002/2003 review comprised think-tanks and meetings held with focus groups. Throughout the process of review, every endeavour was made to ensure representation from the three occupational categories, a spread of disciplines, the public and private sectors, members and non-members of Engineers Australia. The final draft of the competency standards was endorsed by a National Competency Reference Group encompassing the three occupational categories. Finally, the standards were approved by the Council of Engineers Australia.

To maintain currency, a further review is anticipated in 2007/2008. To assist that review, interim comment, either in the broadest sense or in detail, can be sent to the Director Education and Assessment, Engineers Australia, at any time.

While Engineers Australia takes full responsibility for the contents of these Standards, their formulation has drawn on similar standards published and administered by counterpart bodies overseas – particularly the Institution of Professional Engineers New Zealand and the Engineering Council (UK), and others. These sources are gratefully acknowledged. Furthermore the valuable contributions of a vast array of people who cannot be mentioned individually are acknowledged. They have helped ensure that this final document reflects current workplace activities and requirements in a clear and concise manner. Every endeavour has been made to present the material in as user-friendly a format as possible.

This third edition was brought together within the Education and Assessment directorate of Engineers Australia by Peter Parr *Hon FIEAust*, Dr Guy Beaubois *FIEAust CPEng* and Ron Badger *FIEAust CPEng*.

OBJECTIVES

The Australian Engineering Competency Standards are intended to be used for the following purposes:

- 1** To provide a basis for assessing and certifying the competency of engineering practitioners, for use by engineering employers, government, regulatory bodies and any other interested parties.
- 2** To provide criteria for the award of Chartered status to members of Engineers Australia.
- 3** To assist educational institutions in planning programs leading to engineering degrees and diplomas, and to provide Engineers Australia with a basis for accrediting or recognising such programs.
- 4** To assist employers and participants in planning programs of professional formation, particularly those designed to help new graduates develop and demonstrate the competencies of an experienced practitioner; and to provide the basis for Professional Development Programs endorsed or led by Engineers Australia.
- 5** To provide a reference for employers in determining job specifications and appropriate levels of employment and remuneration.
- 6** To provide the main foundation for Engineers Australia's membership of international agreements of equivalence and mobility.

GENERAL INTRODUCTION

COVERAGE OF THE PRESENT DOCUMENT

The present document comprises:

- a general introduction to the Australian Engineering Competency Standards, Stages 1 (Graduate) and 2 (Experienced Practitioner), and
- the Stage 2 Competency Standards for Professional Engineers, Engineering Technologists and Engineering Associates.

The Stage 1 Competency Standards are in an advanced stage of review and redevelopment and at present are published separately. They are available on Engineers Australia's website at www.engineersaustralia.org.au. It is expected that future editions will include both Stage 1 and Stage 2.

Competency Standards for more advanced levels of practice are also published separately.

The formulation, development and assessment of professional competencies are not simple matters, particularly in a field of activity as diverse and far-reaching as engineering. This General Introduction therefore attempts to set out the conceptual basis of the Standards, and how they may be used in assessing competency.

THE NATURE OF ENGINEERING

Engineering is both an art and a science. The science consists of the careful and knowledgeable use of scientific principles, physical materials, and disciplined design techniques to produce devices and systems, and their operating arrangements, to perform useful functions in a reliable and affordable way. These can range from wristwatches to computer networks; milk cartons to agricultural machinery; water supplies and sewage works, roads and bridges and high-rise buildings to chemical and manufacturing plants; bicycles, motor vehicles and railways to ships and aircraft; mobile telephones, broadcast networks and security systems to medical instrumentation and life-support equipment; cooking utensils and paper clips to clothing factories and credit cards. The art lies in creating new directions in human affairs by perceiving innovative applications of scientific knowledge, combining different fields of knowledge in unique ways, developing fresh technologies and managing technical resources to produce new outcomes. It lies too in achieving an expression that is satisfying in every way, and that speaks for itself to all who encounter it.

THE ENGINEERING TEAM

The engineering team includes a variety of occupations and specialisations. These standards are concerned with three occupational categories: professional engineer,

engineering technologist, and engineering associate. The titles of Chartered Professional Engineer, Chartered Engineering Technologist and Chartered Engineering Associate (Officer) are available to members of Engineers Australia who have demonstrated the competencies here set out.

Most sections in this Introduction apply in common to all three categories. This section looks at their respective roles and distinguishing features.

Engineers, technologists and associates come together in different combinations to undertake projects and programs. Their activities and competencies are often closely inter-related and it is difficult, and sometimes artificial, to say where the responsibilities of one category end and those of the next category begin. Each category has its strengths and its limitations. There are activities that could be undertaken, in different circumstances, by members of any of the three categories. Other activities are clearly the province of one category but not of another – for example, the province of a professional engineer but not an engineering associate, or vice versa. In all their activities, members of Engineers Australia are committed to act in accordance with the Code of Ethics (Appendix D) which, in particular, limits members to act only in areas of their competence.

These standards do not attempt to draw firm demarcation lines between the three categories, which would be sterile and counterproductive. Rather, they attempt to describe the distinguishing strengths of each – which may be shared in lesser degree by the others.

We also acknowledge many examples of practitioners in a particular occupational category who may, in some respects at least, be operating well beyond the strict requirements of that category. These standards are in no way intended to limit personal or professional development, or confine practitioners to particular functions. Their purpose is to make clear the *minimum* competencies relating to each category, that all Chartered members in that category may be relied upon to possess.

Some features of engineering are common to all three categories. All engineering is about the application of a distinctive body of knowledge, based on mathematics, science and technology, integrated with business and management, continually evolving in the light of new theories, new evidence and new experience, and specialising to greater or lesser extent in particular fields of application. All engineering is about developing, providing and maintaining infrastructure, goods and services for industry and the community, and about helping to identify and implement directions for the future.

All engineering practitioners have responsibilities to society, and to their employers and clients, in relation to

health and safety, legal and contractual obligations, and the ethical and environmental impacts of their work. Again, all members of Engineers Australia are bound by the Code of Ethics (Appendix D), which sets out these obligations in detail.

All three occupational categories have contributions to make to the overall capability and competence of the engineering team. All have a responsibility to recognise the contributions of other members and to call on these when appropriate. All may be called on to function independently, and to accept independent responsibility in particular circumstances. All are responsible for promoting the engineering role to the wider community.

Professional Engineers

Professional engineers are required to take responsibility for engineering projects and programs in the most far-reaching sense. This includes the reliable functioning of all materials and technologies used; their integration to form a complete and self-consistent system; and all interactions between the technical system and the environment in which it functions. The latter includes understanding the requirements of clients and of society as a whole; working to optimise social, environmental and economic outcomes over the lifetime of the product or program; interacting effectively with the other disciplines, professions and people involved; and ensuring that the engineering contribution is properly integrated into the totality of the undertaking. Professional engineers are responsible for interpreting technological possibilities to society, business and government; and for ensuring as far as possible that policy decisions are properly informed by such possibilities and consequences, and that costs, risks and limitations, as well as desirable outcomes, are properly understood.

Professional engineers at the level of Stage 2 competency are not expected to have taken full charge of major projects or interactions on this scale; but they are expected to have demonstrated a propensity to do so and to have taken every opportunity to exercise it.

The work of professional engineers is predominantly intellectual in nature. In the technical domain, they are primarily concerned with the advancement of technologies and with the development of new technologies and their applications through innovation, creativity and change. They may conduct research concerned with advancing the science of engineering and with developing new engineering principles and technologies and new interfaces with other disciplines. Alternatively, they may contribute to continual improvement in the practice of engineering, and in devising and updating the Codes and Standards that govern it.

Professional engineers have a particular responsibility for ensuring that all aspects of a project are soundly based in theory and fundamental principle, and for understanding clearly how new developments relate to established practice and experience and to other disciplines with which they may interact. One hallmark of a professional is the capacity to break new ground in an informed and responsible way.

Professional engineers may lead or manage teams appropriate to these activities, and may establish their own companies or move into senior management roles in engineering and related enterprises.

The benchmark qualification for professional engineers is the four-year Bachelor of Engineering degree.

Engineering Technologists

Engineering technologists normally operate within a relatively well-defined technical environment, and undertake a wide range of functions and responsibilities. They are typically specialists in a particular field of engineering technology and their expertise lies in familiarity with its current state of development and its most recent applications. Within their specialist field, their expertise may be at a high level, and fully equivalent to that of a professional engineer; but they are not expected to exercise the same breadth of perspective as a professional engineer, or carry the same wide-ranging responsibilities for stakeholder interactions, for system integration, and for synthesising overall approaches to complex situations and complex engineering problems.

The work of engineering technologists combines the need for a strong grasp of practical situations and applications, with the intellectual challenge of keeping abreast of leading-edge developments in their particular field. For this purpose they need a strong understanding of scientific and engineering principles and a well-developed capacity for analysis. The work of technologists is most often concerned with applying current and emerging technologies, often in new contexts; or with the application of established principles in the development of new practice. They may contribute to the advancement of particular technologies as well.

Some engineering technologist qualifications include an emphasis on technical management as well as a grounding in a particular area of technology. Technical management is seen as an appropriate field of specialisation in itself, and many technologists build their career paths in this direction. Examples of such specialisation include product development for manufacturing, manufacturing management, mine management, and management and maintenance of processing plants, complex building services, or testing laboratories.

Persons may also be recognised as engineering technologists who hold degrees in fields related to engineering, and who have developed expertise and experience in applying their knowledge in conjunction with engineering work. Examples might be in geology and geotechnics, information technology and software development, mining, biomedical technology, optical communications, renewable energy systems, agriculture, and so on.

The competencies of engineering technologists equip them to approve and certify many technical operations such as calibration and testing regimes, compliance with performance-based criteria for fire safety, and design of components and sub-systems and of installations such as building services in circumstances that do not call for significant new development. Such certification should be fully acceptable in the public domain and should not require further endorsement by other practitioners perceived to be more highly qualified.

Engineering technologists may lead or manage teams appropriate to these activities. Some may establish their own companies or may move into senior management roles in engineering and related enterprises, employing professional engineers and other specialists where appropriate.

The benchmark qualification for engineering technologists is the three-year Bachelor of Engineering Technology degree.

Engineering Associates

Engineering associates focus mainly on practical applications. They may be expert in installing, testing and monitoring equipment and systems, in the operation and maintenance of advanced plant, and in managing or supervising tradespeople in these activities. They may be expert in selecting equipment and components to meet given specifications, and in assembling these to form systems customised to particular projects.

Engineering associates are often required to be closely familiar with Standards and Codes of Practice, and to become expert in their interpretation and application to a wide variety of situations. Many develop very extensive experience of practical installations, and will be more knowledgeable than a professional engineer or technologist on detailed aspects that can contribute very greatly to safety, cost or effectiveness in operation.

In other instances, associates may develop high levels of expertise in aspects of design and development processes. These might include, for example, the use of advanced software to perform detailed design of structures, mechanical components and systems, manufacturing or process plant, electrical and electronic equipment, information and communications systems,

and so on. Other examples might be in the construction of experimental or prototype equipment. Again, experienced operators in these areas often develop detailed practical knowledge and experience complementing the broader or more theoretical knowledge of others.

Associates need a good grounding in engineering science and the principles underlying their field of expertise, to ensure that their knowledge is portable across different applications and situations. Context-specific training and experience in a particular job are not sufficient to guarantee generic competency. Given a good knowledge base, however, associates may build further on this through high levels of training in particular contexts and in relation to particular equipment. Aircraft maintenance is an excellent example.

The competencies of engineering associates equip them to certify the quality of engineering work and the condition of equipment and systems in defined circumstances, laid down in recognised standards and codes of practice. Such certification should be fully acceptable in the public domain and should not require further endorsement by other practitioners perceived to be more highly qualified.

Engineering associates may lead or manage teams appropriate to these activities. Some may establish their own companies or may move into senior management roles in engineering and related enterprises, employing professional engineers and other specialists where appropriate.

The benchmark qualification for engineering associates is the two-year Advanced Diploma of Engineering under the Australian Qualifications Framework or the Associate Degree in Engineering.

COMPETENCY AND ITS ASSESSMENT

Competency is commonly defined in Australia as *the ability to perform activities in an occupational category or function to the standard expected in employment.*

Competency is a measure of ability, regardless of how that ability has been acquired. Consequently, it is often held that the only determinant of competency is actual performance. In engineering, this is valid only if we understand in depth what constitutes dependable performance. It is not enough to say: a certain outcome has been achieved, therefore the person who achieved it must have been competent to do so.

Engineering involves highly disciplined approaches to complex matters. Engineers must be well versed in these approaches and in the knowledge that supports them. Often though, application of engineering methods is far from routine, and has to be interpreted and adapted to

circumstance. Situations encountered in practice vary widely, and those of tomorrow are not always foreseeable today. The technologies developed and used by engineers, and the environment in which engineering is practised, are continually evolving.

A satisfactory outcome in one set of circumstances may not guarantee the capacity to achieve a satisfactory outcome in another.

In assessing the competency of engineers, we need to be assured that they have not only performed well in the circumstances encountered to date, but that – on all the indications available – they have the capacity to handle situations reasonably likely to be encountered in the future. This includes the ability to apply their knowledge reliably and safely in different circumstances; to recognise the limitations of their personal expertise; and to be prepared when necessary either to extend that expertise, or to call for assistance from other sources.

Competency might be summarised as a combination of knowledge, experience, and enterprise – enterprise meaning the capacity to engage with new challenges and different circumstances. We cannot omit enterprise, and treat it as something additional and separate. Every engineer has a responsibility to engage with the new and to help shape the future: it is an integral part of their professional competence.

Assessment of competency should therefore include evaluation of how a candidate actually approaches particular situations and interacts with them, and what resources the candidate brings to bear on such interactions. The assessment methodology should say:

- Show us *what* you have been able to achieve in engineering practice;
- Show us *how* you achieved what you did, and *why* you chose to act in particular ways;
- Show us how you acquired the *knowledge* to enable you to do these things.

Inability to address any of these must cause concern that a claim of competency is not well founded.

STAGES OF COMPETENCY

In assessing competency to work autonomously, we distinguish between formal knowledge and intellectual training, and the ability to apply them in practice.

The terms *Enabling Competencies* and *Practice Competencies* are sometimes used. Enabling competencies denote awareness and critical understanding of the requisite body of knowledge, the ability to apply it to representative problems and situations, and the intellectual skills to test and continually extend it through lifelong learning in formal and informal contexts. Practice competencies are gained

through experience in applying these enabling competencies in real-world situations involving uncertainties, time and cost pressures, complex interpersonal and organisational relationships, interactions with clients and other professionals, new and unfamiliar situations, and the need to reconcile conflicting aims and requirements, select from multiple options, and assess and manage risk.

Some sources use the term *Capable* to mean a person equipped with the knowledge and skills to perform certain occupational tasks, and *Competent* to mean a person who has actually performed them satisfactorily and consistently in practice.

These Standards use the terms **Stage 1** and **Stage 2** competency.

Stage 1 is the level of competency achieved on completion of an educational qualification accredited or recognised by Engineers Australia, for entry to the profession (a degree or diploma – refer to *The Engineering Team*, above). Stage 1 is primarily concerned with the enabling competencies. The accreditation criteria for an engineering qualification also require some exposure to engineering practice and an appreciation of its demands, and the development of attributes necessary for the assumption of responsibility as an engineering professional.

Persons who are Stage 1 competent are ready for entry to practice, or practice-ready. In employment, they will typically work initially on tasks of limited scope and complexity, under the guidance of a more experienced person, while they develop practice competencies and experience.

Stage 2 competency embodies both the enabling and the practice competencies relevant to a field of engineering and an occupational category. Persons who are Stage 2 competent are *practice-experienced* and are capable of working autonomously under general direction in normal operating environments. Particularly complex, critical or innovative work might call for limited guidance while experience develops further.

It is vital to understand that Stage 2 competency includes the knowledge base and enabling skills represented by Stage 1. It is not possible to be Stage 2 competent without being Stage 1 competent.

The terms Stage 1 and Stage 2 may not be optimal but they have been retained because they are part of an established usage.

PATHWAYS TO COMPETENCY – PROFESSIONAL FORMATION

The most common sequence of professional formation comprises an educational qualification, followed by a period of formative experience in the engineering workforce. Students acquire knowledge and skills in an

educational setting; and then, as graduates, learn to apply them in real-world situations.

Other pathways can also be effective. Not everyone has the opportunity to undertake full-time study. Some study programs specifically incorporate work experience, and some occupations alternate study and work experience in a continuous progression. There is valid debate between the proponents of concentrated study and those of contextual learning. Employers have widely differing views on professional formation needs. Education and employment arrangements will continue to diversify and will include new forms of work-based learning and new educational technologies. Individuals learn in different ways, and different pathways may prove more or less effective for different participants.

Competency standards must seek to provide objective statements of the skills that are genuinely needed for effective practice, on which the community and the profession can rely. Competency-based assessment must be capable of assessing whether or not an individual actually possesses these skills, without prescribing how they should have been developed.

In a climate of such flexibility, it is all the more vital to recall the critical role of fundamental knowledge and intellectual training in an engineer's repertoire of competencies and their portability from one operating context to another.

Most of us learn from what goes on around us, and professionals must be constantly active in this regard. But unless it rests on firm foundations, such learning may be selective, impressionistic, unstructured, even counterproductive. It is essential to reflect periodically on our knowledge in a wider context, free from the constraints of particular projects or commercial imperatives. What are the basic principles involved? To what fundamental theories do they relate and on what bodies of evidence do they rest? How do they connect to other disciplines and factors? In what circumstances do they apply, and where are their limitations? Does our understanding match the experiences of others?

The prime purpose of the educational programs leading to engineering qualifications is to develop such knowledge in a comprehensive and consolidated way, together with the intellectual skills to reflect on it, test it and extend it. The general experience is that only a formal educational setting provides the opportunity to do this on a sufficient scale.

A person claiming Stage 2 competency who does not hold a recognised engineering qualification must be able to explain by what other means they have developed and consolidated such knowledge and skills; and must be able to show that Stage 1 competencies have been thoroughly demonstrated in practice. It would not be

reasonable to claim Stage 2 competency based on several years experience of work performed on an ad hoc basis, *followed* by an educational program providing more advanced knowledge and skills. If the qualification had been completed in advance, or perhaps concurrently, it would have enabled the work to be performed at a different level and from a different perspective. Persons with different levels of knowledge generally approach and respond to situations in different ways, and may learn different lessons from them.

It is acceptable for enabling and practice competencies to be developed concurrently. A person who has developed them in reverse order would not be regarded as Stage 2 competent until their Stage 1 knowledge has been demonstrated in practice.

Engineers Australia welcomes the development of professional competency by any valid means. However, it sees the accredited qualification as the benchmark for Stage 1 competency, against which other pathways should be compared for similar outcomes.

Persons who have recently completed a Stage 1 educational qualification are encouraged to undertake a Professional Development Program approved by Engineers Australia, while developing the practice competencies that will qualify them for Stage 2 assessment.

Stage 2 competency is the criterion for Chartered status within Engineers Australia. The titles Chartered Professional Engineer, Chartered Engineering Technologist and Chartered Engineering Associate are available to members who have been assessed as having demonstrated Stage 2 competency against the relevant Standard.

EVOLUTION OF THE STANDARDS TO DATE

Appendix B traces the evolution of the Standards from their inception in 1992, to the present form.

STRUCTURE OF THE PRESENT STANDARDS

The Stage 1 Standards

Stage 1 competency is the level of preparation necessary and adequate for entry to practice. A person who is Stage 1 competent has:

- a thorough understanding of the body of engineering knowledge relevant to their occupational category;
- the ability to apply this knowledge to representative problems and situations, typical of the responsibilities of practitioners in that category; and
- the attributes and skills necessary to function as a professional, and the intellectual skills to test and continually extend their knowledge through lifelong learning in formal and informal contexts.

There is a separate Stage 1 Standard for each of the three occupational categories. Each Standard comprises three **Units** or major areas of competency:

- Knowledge Base
- Engineering Ability
- Professional Attributes.

Each Unit contains a number of **Elements**, differing for the three categories. Within each Element are a series of **Indicators**, describing ways in which the Element would typically be demonstrated.

Assessment is made on a holistic basis. A candidate for assessment must demonstrate each Element of competency in an overall sense, but is not expected to meet every indicator in detail.

The Standards are the basis for accreditation or recognition of educational programs leading to the benchmark Stage 1 qualification in each category:

Professional Engineers:
four-year Bachelor of Engineering degree

Engineering Technologists:
three-year Bachelor of (Engineering) Technology degree

Engineering Associates:
two-year Advanced Diploma of Engineering or Associate Degree in Engineering.

For a program to be accredited or recognised, Engineers Australia must be satisfied that the educational institution has measures in place ensuring that all graduates of the program have developed and demonstrated the competencies set out in the relevant Standard.

Graduates of accredited or recognised educational programs have thereby demonstrated Stage 1 competency, and need not undertake further assessment. Persons who do not hold an accredited or recognised qualification may undertake individual assessment: see below.

The Stage 2 Standards

The standards described are those of engineers who have now completed their initial professional formation and are equipped to work autonomously, under general direction, in their field of expertise. This level of competence would typically be attained by an able young person holding an accredited engineering qualification followed by three to five years of good-quality experience with respected engineering employers. Clearly, not all job situations will provide equal coverage of all the relevant areas of competency. Nor can anyone, within this typical timespan, gain experience of all the activities they may be required to undertake over the next several years. Assessment of competency must therefore include an estimate of future capability as well as current achievement.

The Stage 2 Competency Standards are structured in two parts:

- **Part A** sets out the **Competencies** required of an engineering practitioner. These are common to all three occupational categories.
- **Part B** sets out the **Standards** to which the competencies must be demonstrated. There is a separate Standard for each of the three categories.

Part A: the Competencies

There are to be fourteen **Units** or major areas of competency. Three are Core Units, common to all areas of engineering practice. Eleven are Elective Units, from which candidates select two units appropriate to their particular area of practice (some are mutually exclusive, as indicated). They are:

Core Units

- C1 Engineering Practice
- C2 Engineering Planning and Design
- C3 Self Management in the Engineering Workplace

Elective Units

- E1A Engineering Business Management *or*
- E1B Engineering Project Management
- E2 Engineering Operations
- E3 Materials/Components/Systems
- E4A Environmental Management *or*
- E4B Investigation and Reporting
- E5 Research, Development and Commercialisation
- E6 Sourcing and Estimating Materials
- E7 Change and Technical Development
- E8 Technical Sales and Promotion
- E9 Engineering Education.

Each Unit contains a number of **Elements**. Within each element are a series of activities, or outcomes capable of being measured, describing ways in which the Element would typically be demonstrated. In earlier editions these were called Performance Criteria. In the present edition they are called **Defining Activities**.

For example:

Unit:	Engineering Practice.
Element:	Pursues continuing professional development.
Defining activities:	Reviews own strengths and determines areas for development; Plans for further professional development; Undertakes engineering professional development activities; Improves non-engineering knowledge and skills to assist in achieving engineering outcomes.

To demonstrate a Core Unit, candidates must demonstrate all Elements within the Unit. To demonstrate an Elective Unit, candidates must demonstrate the stipulated Elements within the Unit. To demonstrate an Element, candidates must show that they have successfully performed most or all of the Defining Activities.

Most of the Elements and Defining Activities are common to all three occupational categories, with minor variations indicated within some Units. This recognises that many engineering activities are undertaken by all members of the engineering team, in different contexts and with different emphases and different kinds of expertise.

Part B: the Standards

There is a separate Standard for each occupational category. The Standards reflect the respective role descriptions, set out in the General Introduction above and summarised as follows:

Professional Engineers are responsible for engineering projects and programs in the most far-reaching sense, for bringing knowledge to bear from multiple sources to develop solutions to complex problems and issues, for ensuring that technical and non-technical considerations are properly integrated, and for managing risk.

Engineering Technologists specialise in the theory and practice of a particular branch of engineering or engineering-related technology, and in its application, adaptation and management in a variety of contexts; and/or in technical project management.

Engineering Associates focus on the practical implementation of engineering work or the conduct of engineering operations, and in the application of recognised standards and codes of practice in familiar and unfamiliar situations.

In each category, candidates must demonstrate the Stage 2 competencies in relation to projects, activities and situations involving some or all of the characteristics detailed for that category, under the headings:

- Knowledge and understanding
- Expertise
- Responsibility for outcomes
- Management roles.

Assessment against these Standards is necessarily related to the occupational roles in which the competencies have been exercised, and to the scope offered by those roles – but is not necessarily limited to them. A candidate employed in one occupational category may well demonstrate some of the attributes of another; and different candidates may perform the same role in different ways, for example in the degree of initiative shown.

COMPETENCY-BASED ASSESSMENT

Assessment against the Stage 1 Standards

Engineers Australia sees the accredited or recognised educational qualification as the benchmark for Stage 1. Holders of accredited or recognised qualifications have thereby demonstrated Stage 1 competency, and further assessment is not necessary.

Persons holding qualifications that have not been accredited or recognised by Engineers Australia may apply for individual assessment of Stage 1 competency. Details of the method of application and of assessment are given in the publication *Assessment of Eligibility for Membership (Stage 1 Competency) for Candidates not holding an Accredited or Recognised Qualification*, available on Engineers Australia's website at www.engineersaustralia.org.au.

This publication also sets out in detail what is meant by an *accredited or recognised qualification*.

Assessment against the Stage 2 Standards

Assessment of Stage 2 competency is always undertaken on an individual basis.

The normal process is to invite candidates to apply for assessment in the occupational category that they believe appropriately reflects their qualifications, experience and occupational attainments. The components of the assessment are:

- Has the candidate demonstrated Stage 1 competency, by means of an accredited or recognised qualification, or otherwise?

This should be checked before a detailed Stage 2 application is prepared. A candidate who does not hold an accredited or recognised qualification in the category concerned, and has not otherwise formally demonstrated Stage 1 competency, should apply for individual Stage 1 assessment. In certain circumstances it may be possible to undertake Stage 1 and 2 assessments concurrently; advice should be sought.

- Has the candidate demonstrated each of the Units of Competency in Part A (the three Core Units plus two Elective Units) by performing most or all of the Defining Activities?
- Have the Units been demonstrated to the Standard set out in Part B, for the occupational category concerned?
- In the context of this occupational category, has the demonstration of each Unit been:
 - Strong
 - Satisfactory
 - Weak
 - Not acceptable (inadequate and requiring further development, or no evidence provided)?

- In the light of all these factors, a holistic assessment is reached of whether or not a candidate has demonstrated Stage 2 competency in their selected occupational category.

Details of the method of application and of assessment are given in the publications:

- *Handbook for Applicants for Chartered Professional Engineer (CPEng) and registration on the National Professional Engineers Register*
- *Handbook for Applicants for Chartered Engineering Technologist (CEngT) and registration on the National Engineering Technologists Register*
- *Handbook for Applicants for Chartered Engineering Officer (CEngO)*

available on Engineers Australia's website at www.engineersaustralia.org.au.

In assessments conducted by Engineers Australia, candidates who are judged not to have demonstrated Stage 2 competency will be offered advice on where the shortcomings are seen to lie, and on developmental action they might take to strengthen areas of weakness.

In some instances, a candidate may be advised to consider applying for assessment in a different occupational category.

ARTICULATION

Articulation is the process of transferring laterally from one occupational category to another: for example, from Engineering Technologist to Professional Engineer.

Articulation requires extension of both enabling and practice competencies – in other words, extension of both a member's knowledge base, and the nature and level of their practice experience. There can be some trade-off between these two components but it is rarely, if ever, possible to substitute one entirely for the other. Candidates for articulation cover a wide range of circumstances and individual advice is usually needed.

For example, a newly-graduated Engineering Technologist, with little or no work experience, may wish (for whatever reason) to proceed immediately to qualify as a Professional Engineer. The most appropriate path may well be to complete a Bachelor of Engineering, with credit for the qualification already gained. However, it can be difficult to arrange a program of subjects within the BE framework that properly addresses the needs of articulation without excessive duplication.

Engineers Australia actively encourages educational institutions to develop and offer programs specifically designed to assist members to articulate. Such programs typically involve well-developed approaches to

Recognition of Prior Learning, for candidates with substantial experience in their current category. Completion of a program that has been designed for articulation and accredited by Engineers Australia automatically satisfies Stage 1 competencies.

Some candidates may have practised at the leading edge of their current category for a number of years, and may have developed an extensive body of specialist knowledge and have reached a position of seniority. For such candidates there may be little value in extensive full-time study, much of which might replicate knowledge already gained in practice. However, there remains the need to ensure the breadth and depth of theoretical understanding, analytical capability, and disciplined approach to design required of a professional engineer, and the ability to apply these in both familiar and unfamiliar circumstances. This need could be more appropriately met by a personal study program expressly designed for the purpose. Such a program might not result in a further academic qualification, but could equip the candidate to undertake a combined Stage 1/Stage 2 assessment in the desired category.

Through its National Articulation Committee, Engineers Australia offers guidance and support to members wishing to articulate from one occupational category to another. Details are given in the publication *National Articulation Committee: Guidelines on Articulation*, available on the website at www.engineersaustralia.org.au.

Notwithstanding the above, members who consider that they have already achieved the full range of Stage 1 competencies for their target category by a combination of experiential learning and independent study, or otherwise, may apply directly for individual Stage 1 assessment.

BENCHMARKING AND QUALITY ASSURANCE

A number of measures operate to maintain the quality and currency of the Standards, and of the assessment system that supports them.

At Stage 1 level, Engineers Australia's Accreditation Board evaluates and (where appropriate) accredits educational programs leading to four-year engineering degrees and three-year engineering technology degrees. The accreditation system interacts continually with all Australian engineering schools and involves substantial numbers of engineers practising in industry, as well as academics. In addition to teaching, learning and assessment procedures that ensure attainment of Stage 1 competencies by all graduates, engineering schools must demonstrate effective feedback and quality improvement processes. A similar accreditation or recognition system is under development for programs leading to the Advanced Diploma of Engineering.

The accreditation system is extensively internationally benchmarked. Engineers Australia is a signatory to two international agreements of equivalence of Stage 1 accreditation standards:

- the Washington Accord, relating to the professional engineering degree; and
- the Sydney Accord, relating to the engineering technology degree.

Each of these involves detailed scrutiny of each signatory's accreditation system by the other signatories, including periodic comprehensive review visits, recommendations for improvement where appropriate, and requirements for compliance in order to retain signatory status. Regular plenary meetings and workshops share developments in best practice, arrange mentoring by existing signatories of new applicants for membership, and develop policies on new program areas and modes of delivery such as distance education.

It is hoped that membership of the corresponding agreement relating to engineering associate qualifications will follow.

All Stage 2 competency assessments are conducted on an individual basis. Engineers Australia draws on the expertise of a large number of professional interviewers who are themselves Chartered current practitioners. All interviews are arranged and facilitated by an Australia-wide team of professional Accredited Assessors, who are responsible for ensuring objective and comprehensive assessment against the Standards, for ensuring that assessment is based on demonstration of outcomes and not pathways, and for counselling candidates. The team meets regularly, and members interact constantly to share knowledge and ensure consistency and continuous improvement. Moreover, a holistic and common-sense approach is taken by assessment panels, who know the level of competency realistically expected in the 'real world'.

The Stage 2 assessment system has recently been subject to an independent Quality Assurance review, which confirmed that every endeavour is made to ensure that assessments are fair, thorough and consistent across Australia geographically, and across engineering disciplines. The review's recommendations for improvement have been adopted and implemented, and QA documentation aspects of the system have been greatly strengthened.

These quality assurance measures will progressively extend to individual Stage 1 assessments also.

Engineers Australia is an active member of two international agreements between bodies responsible for assessment and/or registration of experienced practitioners, at or beyond Stage 2 level:

- the Engineers Mobility Forum International Register
- the APEC-Engineer Register.

Like the Stage 1 Accords mentioned above, these agreements involve detailed scrutiny and periodic mutual inspection of members' standards and procedures as well as regular plenary meetings, workshops, mentoring commitments to new applicants for membership, and direct interaction with other members on practice and disciplinary issues. As part of its membership of these schemes, and separately, Engineers Australia bilateral agreements of cooperation and recognition with over sixty engineering institutions in some twenty countries.

Within Australia, the National Engineering Registration Board has adopted the Australian Engineering Competency Standards as the basis for registering independent practitioners. The Board has wide stakeholder representation from State and Territory Governments, community groups, and other engineering and engineering-related associations.

These arrangements – which are themselves continually evolving – ensure that the Competency Standards and the competency-based assessment system are constantly subject to review, development, and comparison with national and international best practice.

PART A
Competencies for Stage 2
Engineering Practitioners

Common to:
Professional Engineers
Engineering Technologists and
Engineering Associates (Officers)

PART A: Units of Competency for Stage 2

SECTION 1 – CORE UNITS OF COMPETENCY AND ASSOCIATED ELEMENTS

UNIT C1: Engineering Practice

- C1.1 Presents and develops a professional image
- C1.2 Pursues continuing professional development
- C1.3 Integrates engineering with other professional input
- C1.4 Develops engineering solutions
- C1.5 Identifies constraints on potential engineering solutions

UNIT C2: Engineering Planning and Design

- C2.1 Interprets and scopes design requirements
- C2.2 Prepares concept proposal and seeks advice on latest technology
- C2.3 Implements planning and design process
- C2.4 Reviews the design to achieve acceptance
- C2.5 Prepares and maintains documentation during the design process
- C2.6 Validates design

UNIT C3: Self Management in the Engineering Workplace

- C3.1 Manages self
- C3.2 Works effectively with people
- C3.3 Facilitates and capitalizes on change and innovation
- C3.4 Plans and manages work priorities and resources
- C3.5 Maintains customer focus and relationships with clients / stakeholders / suppliers / regulators
- C3.6 Manages information

UNIT C1: Engineering Practice

DESCRIPTOR: This Unit requires members of the engineering team to apply a professional approach to a specific area of engineering practice.

ELEMENT	DEFINING ACTIVITIES
C1.1 Presents and develops a professional image	<ol style="list-style-type: none">Practises in a field of engineering, in accordance with the Engineers Australia's Code of Ethics, as a significant part of normal work dutiesDemonstrates use of appropriate engineering techniques and toolsProduces outcomes that require innovative thought and intellectual rigourPublishes the outcomes of innovation in reports or professional papersAchieves recognition for engineering expertise from colleagues and clientsIdentifies opportunities to solve problems through applying engineering knowledgeDemonstrates an awareness of environmental / community / political issues that would benefit from an engineering input
C1.2 Pursues continuing professional development	<ol style="list-style-type: none">Reviews own strengths and determines areas for developmentPlans for further professional developmentUndertakes engineering professional development activitiesImproves non engineering knowledge and skills to assist in achieving engineering outcomes
C1.3 Integrates engineering with other professional input	<ol style="list-style-type: none">Interacts with appropriate professionals and specialists to achieve agreed outcomes and develop broader knowledgeSeeks a range of information sources to develop and strengthen present engineering focusChallenges current practices to identify opportunities for improvement through a multi disciplined, inter-cultural approach
C1.4 Develops engineering solutions	<ol style="list-style-type: none">Identifies and proposes options to achieve engineering solutionsProduces new concepts / design / solutions / methodsDemonstrates the achievement of improvements in processes and outcomesPlans and manages the development of solutionsProposes means of testing, measuring and evaluating solutionsDevelops and applies new engineering practices on a regular basis
C1.5 Identifies constraints on potential engineering solutions	<ol style="list-style-type: none">Identifies the interrelationship of social, physical, environmental, political, financial and cultural issues with the proposed engineering solutionsIdentifies professional risks, statutory responsibilities and liabilitiesImplements Occupational Health and Safety and other statutory requirementsIdentifies hazards and consequent risks, and initiates appropriate safety and disaster management measuresIdentifies long term environmental and sustainability issues associated with engineering activities

UNIT C2: Engineering Planning and Design

DESCRIPTOR: This Unit requires members of the engineering team to be involved in the interpretation of requirements, apply engineering principles, conceptualise options and apply creativity to development of plans and designs that meet the client's requirements.

ELEMENT	DEFINING ACTIVITIES
C2.1 Interprets and scopes design requirements	<ol style="list-style-type: none">Negotiates and interprets the client's requirementsBrings to the client's attention the implications for sustainability, and options for an improved environmental outcomeDocuments the requirements, negotiates and obtains agreement on acceptance criteriaAnalyses client requirements for the design criteria to ensure that all appropriate specifications are included in the design requirementsReviews the design requirements by considering the impact on the plan / design of all development and implementation factors, including constraints and risksSelects and applies engineering standards and design specifications to write functional specifications which meet the requirementsDefines and agrees the acceptance criteria with the client
C2.2 Prepares concept proposal and seeks advice on latest technology	<ol style="list-style-type: none">Applies innovative approaches to the development of possible design concepts, responding to imperatives such as sustainabilityInvestigates and analyses the possible design concepts to achieve the design requirementsSeeks advice from appropriate personnel and sources where the concept proposal has non standard engineering requirementsCollaborates with the client to adapt the plan / design brief/concept to improve outcomes and overcome possible problemsAdvises the client of the likely impacts on the communitySeeks advice on latest technologies
C2.3 Implements planning and design process	<ol style="list-style-type: none">Arranges design tasks to meet the agreed outcomes and cost structureAnalyses and selects resources/processes/systems to develop the plan or designDevelops and checks the design solution using the engineering specificationCreates (when appropriate) a demonstration model of the designEstablishes documentation management process
C2.4 Reviews the design to achieve acceptance	<ol style="list-style-type: none">Reviews the design to ensure that user's requirements are metInforms the user of the likely impact on the user's lifestyleIncorporates corrections and makes improvements to the design ensuring social responsibilities, such as sustainability are metReviews the design with the client to gain documented acceptance
C2.5 Prepares and maintains documentation during the design process	<ol style="list-style-type: none">Ensures that the supporting documentation required to implement the design is accurate, concise, complete and clearEnsures that the designed item is identified by agreed design documentation / recordsApplies the agreed documentation control process when making changes to the designEnsures that the documentation for the design remains accurate and current during the design development
C2.6 Validates design	<ol style="list-style-type: none">Prepares and implements plans to verify that completed physical work meets clients' requirementsDevelops periodic test schedules to monitor performance and enable others to take any corrective action necessarySeeks feedback from the commissioning process to facilitate corrective actions or improvementsEvaluates the performance of the design outcome in the user's environment using appropriate toolsEvaluates community reaction to the design outcome

UNIT C3: Self-Management in the Engineering Workplace

DESCRIPTOR: This Unit requires members of the engineering team to perform work competently, making judgements about work priorities and information requirements to achieve effective working relationships and engineering outcomes.

ELEMENT	DEFINING ACTIVITIES
C3.1 Manages self	<ul style="list-style-type: none">a. Manages own time and own processesb. Exercises initiative in the workplacec. Completes tasks in a competent and timely mannerd. Demonstrates professional ethics as the opportunity occurse. Copes with change
C3.2 Works effectively with people	<ul style="list-style-type: none">a. Communicates effectively with othersb. Recognises the value of cultural diversity and applies appropriate workplace practices for a viable workplace ecologyc. Develops and maintains trust and confidence of colleagues, clients and suppliers through competent performanced. Seeks and values input from internal and external sources to enhance communicatione. Mentors others in specific areas of engineering focusf. Builds and maintains network relationships that value and sustain a team ethic
C3.3 Facilitates and capitalizes on change and innovation	<ul style="list-style-type: none">a. Initiates opportunities to introduce changeb. Works with others to introduce changec. Develops creative and flexible approaches and solutionsd. Manages emerging challenges and opportunitiese. Manages in a manner to advance sustainability
C3.4 Plans and manages work priorities and resources	<ul style="list-style-type: none">a. Prioritises competing demands to achieve personal, team and the organisation's goals and objectivesb. Prepares, monitors and reviews work plans, programs and budgetsc. Plans resource use to achieve profit / productivity / sustainability /environmental impact minimisation targets
C3.5 Maintains customer focus and relationships with clients/stakeholders/suppliers/regulators	<ul style="list-style-type: none">a. Identifies client's needsb. Works in collaborative relationships with clients / suppliers in the planning and implementation of the projectc. Demonstrates commercial awarenessd. Manages the procurement processe. Negotiates to ensure that available capability meets requirementsf. Provides regular and complete progress reports
C3.6 Manages information	<ul style="list-style-type: none">a. Locates and reviews relevant informationb. Applies relevant legislation, statutory requirements, and standardsc. Manages information relating to insurances, indemnities, and commercial instrumentsd. Documents processes and outcomese. Analyses information

**SECTION 2 –
ELECTIVE UNITS OF COMPETENCY AND
ASSOCIATED ELEMENTS**

UNIT E1A: Engineering Business Management

- E1A.1 Contributes to engineering business strategies
- E1A.2 Develops client relationships
- E1A.3 Manages the implementation of engineering plan within the business
- E1A.4 Manages resources
- E1A.5 Manages people
- E1A.6 Manages suppliers
- E1A.7 Manages business information
- E1A.8 Monitors engineering business performance

OR

UNIT E1B: Engineering Project Management

- E1B.1 Develops project integration
- E1B.2 Scopes the project
- E1B.3 Manages people
- E1B.4 Manages the physical resources within the project
- E1B.5 Manages quality, safety, environment and risk
- E1B.6 Manages cost and procurement
- E1B.7 Manages time and progress
- E1B.8 Finalises the project

UNIT E2: Engineering Operations

- E2.1 Plans operations and systems
- E2.2 Manages the processes within the operation / system
- E2.3 Manages the assets within the operation / system
- E2.4 Manages people
- E2.5 Measures and documents engineering operation / system
- E2.6 Manages environmental performance

UNIT E3: Materials / Components / Systems

- E3.1 Determines engineering requirements
- E3.2 Designs/develops materials/components/systems
- E3.3 Defines processes to prepare materials / components / systems for use in the project / operation
- E3.4 Manages the uses of materials / components / systems within the project / operation
- E3.5 Manages the recovery, reuse and disposal of materials / components / systems

UNIT E4A: Environmental Management

- E4A.1 Determines the existing environmental condition
- E4A.2 Establishes stakeholders' expectations
- E4A.3 Reviews existing environmental conditions against stakeholders' expectations
- E4A.4 Develops and ranks strategies to achieve sustainable development
- E4A.5 Implements, monitors and evaluates strategies

OR

UNIT E4B: Investigation and Reporting

- E4B.1 Responds to / Identifies problems
- E4B.2 Plans the investigation
- E4B.3 Carries out the investigation
- E4B.4 Draws conclusions and makes recommendations

UNIT E5: Research and Development and Commercialisation

- E5.1 Identifies opportunities for new or improved processes and / or products
- E5.2 Identifies the resources required for the R & D
- E5.3 Initiates concept development
- E5.4 Gains commitment to the R & D proposal
- E5.5 Ensures research is undertaken
- E5.6 Collaborates in the commercialisation of research outcomes

UNIT E6: Source and Estimate Materials

- E6.1 Defines requirements and sources for materials
- E6.2 Estimates material
- E6.3 Procures material/resources
- E6.4 Prepares materials/components/systems for use in the project/operation

UNIT E7: Change and Technical Development

- E7.1 Participates in planning the introduction of technical change
- E7.2 Develops technically creative and flexible approaches and solutions
- E7.3 Manages emerging technical challenges and opportunities

UNIT E8: Technical Sales and Promotion

- E8.1 Identifies sales opportunities
- E8.2 Applies product knowledge to client requirements
- E8.3 Promotes technical capability of the product / system
- E8.4 Seeks client's feed back

UNIT E1A: Engineering Business Management

DESCRIPTOR: This Unit requires members of the engineering team to contribute to business strategies through the provision of specialist engineering knowledge and experience.

ELEMENT	DEFINING ACTIVITIES
E1A.1 Contributes to engineering business strategies	<ul style="list-style-type: none"> a. Provides engineering analysis to contribute to the development of strategic plans and sustainability b. Integrates engineering objectives into business planning c. Seeks emergent business opportunities based upon engineering initiatives to create opportunities d. Works with others to develop engineering performance targets and financial plans e. Provides advice on engineering related costs and risks f. Implements processes to monitor and adjust team performance within the organisation's continuous improvement policies g. Undertakes risk assessment within organisational guidelines h. Develops quality plans for engineering operations i. Applies whole of life costing
E1A.2 Develops client relationships	<ul style="list-style-type: none"> a. Plans to meet internal and external clients' engineering requirements b. Ensures delivery of quality engineering products and services c. Seeks client feedback on the delivery of engineering products and services d. Monitors adjusts and reports on the client service received e. Assists customers to identify sustainable options and implications
E1A.3 Manages the implementation of engineering plans within the business	<ul style="list-style-type: none"> a. Allocates roles and responsibilities to staff to achieve engineering plans b. Provides engineering leadership c. Manages performance and standards d. Contributes to the solution of engineering problems e. Monitors strategic engineering plans, goals and targets f. Manages costs g. Manages safety and quality h. Manages environmental issues i. Manages risks and contingencies
E1A.4 Manages resources	<ul style="list-style-type: none"> a. Implements resource management plans b. Procures resources c. Manages asset maintenance d. Manages disposal, waste management and recycling plans e. Provides advice on engineering costs f. Contributes to the innovative management of resources
E1A.5 Manages people	<ul style="list-style-type: none"> a. Implements people management plan b. Monitors team and individual performance targets c. Participates in the selection of staff d. Ensures the provision of skills and competencies requested to meet business targets e. Manages the workplace culture so that staff work in a continual learning environment f. Ensures the adherence to ethical, OH&S and quality standards g. Provides performance feedback
E1A.6 Manages suppliers	<ul style="list-style-type: none"> a. Participates in supplier selection b. Prepares documents for engagement of suppliers c. Plans and implements monitoring of suppliers
E1A.7 Manages business information	<ul style="list-style-type: none"> a. Identifies and complies with all statutory reporting requirements b. Uses management information systems effectively to store and retrieve data for decision making c. Prepares and presents business plans / budgets in accordance with the organisation's guidelines and requirements
E1A.8 Monitors engineering business performance	<ul style="list-style-type: none"> a. Establishes monitoring processes and feedback systems to ensures agreed targets are met b. Establishes monitoring and reporting processes to ensure statutory requirements are met c. Establishes and monitors processes so that continuous improvement is achieved at all levels of the business

UNIT E1B: Engineering Project Management

DESCRIPTOR: This Unit requires members of the engineering team scope and manage engineering projects within a program of work ensuring that time, cost, and quality are managed effectively and that progress is maintained to achieve the outcomes within and across a number of projects.

ELEMENT	DEFINING ACTIVITIES
E1B.1 Develops project integration	<ul style="list-style-type: none"> a. Integrates the project with the business directions b. Manages communication across the project with all stakeholders c. Designs / agrees upon documentation system across the project d. Manages integration of all aspects of project design e. Plans and manages the integration of the transition of each stage of the project cycle f. Relates the project to community aspirations g. Develops the Project Plan
E1B.2 Scopes the project	<ul style="list-style-type: none"> a. Collaborates with the clients / project owners and the team to define project deliverables for various phases within the project budget b. Identifies measurable outcomes to evaluate the project on completion c. Develops project scope and feasibility accessing other areas of expertise as required d. Defines parameters for the environmental management plan e. Manages the relation between project management and environmental management
E1B.3 Manages people	<ul style="list-style-type: none"> a. Implements people management plan b. Monitors team and individual performance targets c. Ensures that the project team has adequate skills and resources to achieve the project outcomes d. Participates in selection of staff e. Manages the workplace culture so that staff work in a continual learning environment f. Discusses project scope and project objectives with those involved in the project g. Delegates the achievement of outcomes to ensure cost, time and material resources are appropriately allocated and applied h. Ensures the adherence to ethical, environmental, OH&S and quality standards i. Provides performance feedback j. Informs project members of the relationship of the project to other program outcomes
E1B.4 Manages the physical resources within the project	<ul style="list-style-type: none"> a. Develops resource, material conservation, recovery and waste management plans b. Defines project resource performance parameters in consultation with others c. Develops strategies to maintain the effective performance of the resources d. Initiates training programs for staff to monitor resource condition e. Diagnoses problems and identifies requirements for appropriate testing f. Establishes environmental and sustainability criteria for procurement of materials, equipment and services
E1B.5 Manages quality, safety, environment, and risk	<ul style="list-style-type: none"> a. Initiates a quality program to ensure that outcomes are achieved to the required standard of quality specified in the contract b. Manages the reporting and documentation of quality, and controls non-conformances c. Establishes plans for management of Occupational Health & Safety and Environmental Control d. Manages hazard identification and the prevention of accidents e. Manages remedial action and reporting when accidents occur f. Identifies risks, their potential impacts, and produces a risk minimisation plan
E1B.6 Manages cost and procurement	<ul style="list-style-type: none"> a. Determines procurement requirements for the project b. Ensures that the procurement process conforms with all probity requirements c. Determines project budget, and monitors and controls project costs d. Monitors the production of deliverables to ensure that cost trend deviations from budget are quickly identified and remedied e. Specifies contract requirements to achieve the project outcomes f. Reviews requested variations against contract terms and conditions, the agreed project outcomes and variations in project requirements or conditions g. Reviews and approves matters during any defects and liability period

ELEMENT	DEFINING ACTIVITIES
E1B.7 Manages time and progress	<ul style="list-style-type: none"> a. Determines and implements project programs b. Monitors project progress against program, and initiates remedial action if necessary c. Identifies and manages potential areas of conflict at the work site and between stakeholders, customers and regulators d. Monitors contracts against outcomes e. Keeps accurate records on all aspects of project progress including environmental conditions and performance reporting f. Communicates on project progress to the project team, clients, stakeholders and regulators
E1B.8 Finalises the project	<ul style="list-style-type: none"> a. Reviews and documents the project outcomes against the project requirements b. Establishes the acceptance criteria for the project in consultation with the client c. Plans the hand-over of the project

UNIT E2: Engineering Operations

DESCRIPTOR: This Unit requires members of the engineering team to manage or coordinate ongoing engineering operations and make decisions to optimise the performance of the plant / system in a dynamic environment.

ELEMENT	DEFINING ACTIVITIES
E2.1 Plans operations and systems	<ol style="list-style-type: none">Liaises with design, development and other related groups to develop the plant / system operational planTakes a whole of life perspective when identifying future requirements and possible impacts on the plant / system / operation,Confirms that the goal of the operation meets the organisation's objectivesPlans to optimise the flexibility and productivity of the operationCommunicates engineering requirements and implications for financial planningCommunicates the plan for the operation / plant / system to those involved in implementation or adaptation
E2.2 Manages the processes within the operation / system	<ol style="list-style-type: none">Specifies, procures and allocates resources required to carry out the processesRegulates process / system to control variationImplements logistics plan to ensure spares and parts are availableInitiates corrective action to reduce variation and operational faults in the process or systemMonitors processes and modifies them to achieve optimum outcomesAnalyses the relative value of modifications to the system / processAdvocates improvements to the operation to commercial managers and other stakeholdersManages sustainable environmental practices during the operation of the process / system
E2.3 Manages the assets within the operation / system	<ol style="list-style-type: none">Defines asset performance parameters in consultation with othersDevelops maintenance strategy and maintenance implementation plansPrepares and manages whole of life costingTrains staff to implement condition monitoringDiagnoses faults and identifies requirements for appropriate technical testingDevelops logistics and costings for the resources acquisition required to support the maintenance planPlans for and implements the decommissioning and disposal of assetsDevelops an energy and resource minimisation plan
E2.4 Manages people	<ol style="list-style-type: none">Ensures that the staff are trained in the operation of the process / systemBriefs and coordinates work teams to operate the process / systemProvides system / plant / operational proceduresReviews performance and competency development of operational teamsCollaborates with and guides work teams to optimise the process / systemGuides work teams to implement all Occupational, Health and Safety practices
E2.5 Measures and documents engineering operation / system	<ol style="list-style-type: none">Reviews outcomes of the process in terms of quality, cost and time against the operational planAnalyses productivity to determine where improvements can be madeDevelops system or work procedures required to operate and improve the process
E2.6 Manages environmental performance	<ol style="list-style-type: none">Conducts regular environmental audits of processes/procedures and systemsDevises energy demand management plan and monitoringDevises waste management plan and monitoringDevises water conservation plan and monitoringDevises materials conservation plan and monitoringMonitors and manage workplace environmental conditions and risksDevises environmental reporting structure and process

UNIT E3: Materials / Components / Systems

DESCRIPTOR: This Unit requires members of the engineering team to select safe and sustainable materials, components and systems which are a part of solutions to engineering problems and meet client and community expectations.

ELEMENT	DEFINING ACTIVITIES
E3.1 Determines engineering requirements	<ol style="list-style-type: none">Determines fundamental project / operation parameters in consultation with the clientConsiders the characteristics of specific projects / operations with regard to materials, components and system requirementsDetermines and evaluates client and community expectations of the materials / components / systems usedIdentifies and evaluates factors affecting the selection of materials / components / systems including client and community expectationsDetermines a selection strategy that includes methods, costs and benefitsBrings sustainable consequences and options to the client's notice
E3.2 Designs / develops materials / components / systems	<ol style="list-style-type: none">Defines design requirements and environmental performance criteria for materials / components / systemsScopes the design and development processGains acceptance of the specifications for material/components/systemsPlans for disposal / renewal / long term storage optionsApplies engineering principles to the development of the materials / components / systemsTests the developed materials / components / systems against the design requirements and environmental performance criteria prior to integration into the project / operation
E3.3 Defines processes to prepare materials / components / systems for use in the project / operation	<ol style="list-style-type: none">Defines cost effective, sustainable and efficient methods for the preparation of materials / components / systemsSchedules the access and preparation of materials / components / systemsCarries out tests using the selected methods to ensure agreed standards are achievedDetermines interaction that may occur between materials / components / systems within the operation / projectPrepares certification reports on the characteristics and uses of materials components / systemsDefines appropriate life span profiles for materials components systems
E3.4 Manages the uses of materials / components / systems within the project / operation	<ol style="list-style-type: none">Maintains the material / components / systems according to the quality systemsReviews the performance of the material / components / systems against the required outcomes of the project / operationApplies and modifies procedures to ensure that the material / component / system is protected from deteriorationResearches new methods to improve performance and introduces new components / materials systems according to the quality systemsReviews community satisfaction with the functionality, sustainability and aesthetics, of the materials /systems used in the project / operation
E3.5 Manages the recovery, reuse and disposal of materials / components / systems	<ol style="list-style-type: none">Defines a process for recovery and reusing the maximum amount of materialDefines the process for disposal / long term storage minimising materials to landfill and the production of green house gas emissionsDefines risks in material disposalSelects the appropriate engineering methods following a consideration of optionsApplies relevant legislationDocuments the process of disposal / storage / renewal

UNIT E4A: Environmental Management

DESCRIPTOR: This Unit requires members of the engineering team to examine and determine the environmental management requirements of engineering work.

ELEMENT	DEFINING ACTIVITIES
E4A.1 Determines the existing environmental condition	<ol style="list-style-type: none">Researches and reviews sustainable imperatives and environmental values for the engineering project area through consultation and researchDevelops / responds to and initiates briefs for environmental studies which adequately reflect extent of required work.Audits existing environmental condition and identifies prioritiesScopes the environmental impact of any engineering intervention into the biophysical and socio-cultural environmentIdentifies probable environmental engineering outcomes for the specific parameters within the brief.Records / reports on the findings of the initial assessment
E4A.2 Establishes stakeholders' expectations	<ol style="list-style-type: none">Consults with all major stakeholders to establish clear and agreed sustainability goals or objectives.Determines expectations regarding each component of the environmentIntegrates environmental considerations and the imperative for sustainability with the overall outcome of the operation or project.Identifies stakeholder views on specific options for environmental improvement and development of sustainabilityRecords and reports on expectations for project / operation integration
E4A.3 Reviews existing environmental conditions against stakeholders' expectations	<ol style="list-style-type: none">Determines variations between environmental and sustainability goals and the current condition of the environmentEstablishes the possibilities and options for the ongoing minimisation of environmental impacts, environmental regeneration and the development of sustainabilityDetermines existing directions of project requirements against expectations
E4A.4 Develops and ranks strategies to achieve sustainable development	<ol style="list-style-type: none">Develops options from professional and stakeholder adviceDetermines criteria to assess the feasibility of optionsEvaluates available options against assessment criteria to identify risks and priorities.Provides an environmental reportDevelops and reports on strategies to implement the preferred options
E4A.5 Implements, monitors and evaluates strategies	<ol style="list-style-type: none">Implements strategies in consultation with appropriate stakeholders and communitiesIntegrates environmental management plan and procedures into all aspects of engineering design and application.Collects and reviews data on implementation of strategiesEvaluates progress and reviews strategiesReviews outcomes with stakeholders

UNIT E4B: Investigation and Reporting

DESCRIPTOR: This Unit requires members of the engineering team to identify and respond to opportunities for engineering investigation and to make recommendations that solve engineering problems or improve present applications.

ELEMENT	DEFINING ACTIVITIES
E4B.1 Responds to / Identifies problems	<ul style="list-style-type: none">a. Redefines problems as necessaryb. Identifies opportunities for engineering investigations and the likely stakeholdersc. Identifies sources of appropriate knowledged. Develops / acts on a brief to carry out the investigatione. Researches relevant information, seeking input from stakeholdersf. Confirms likely scope of investigation and possible engineering applications with the relevant stakeholders by developing acceptance criteria
E4B.2 Plans the investigation	<ul style="list-style-type: none">a. Assesses likely resources required for the investigationb. Costs the investigationc. Identifies and plans interaction with stakeholdersd. Provides a structure for review which may lead to recommendations for other projectse. Sets sustainability objectives and prioritiesf. Produces a program of activities for the investigationg. Determines method of approachh. Ensures that the necessary resources are availablei. Liaises with other organisations and individuals who may be affected by / or who are involved in the investigationj. Defines and agrees upon acceptance criteria and direction with stakeholders
E4B.3 Carries out the investigation	<ul style="list-style-type: none">a. Researches and analyses to isolate problemsb. Reflects on the definition of problems to ensure accurate definitionc. Identifies the technological requirements of the investigationd. Develops initial options for actione. Integrates both the engineering and possible multi-disciplinary issues into the research to achieve a sustainable solutionf. Identifies hazards and risksg. Applies scientific methodologies taking into account of legal, financial, health and environmental requirementsh. Reviews and improves the brief continuouslyi. Completes the investigation ensuring that all relevant factors have been taken into account
E4B.4 Draws conclusions and makes recommendations	<ul style="list-style-type: none">a. Synthesises information and develops creative recommendationsb. Considers all aspects of the research in developing conclusionsc. Costs the recommendationsd. Reviews the development of conclusions with stakeholderse. Seeks feedback on deliverables to ensure that the brief is satisfied

UNIT E5: Research and Development and Commercialisation

DESCRIPTOR: This Unit requires members of the engineering team to identify opportunities for Research & Development (R & D), identify commercial opportunities for the outcomes and to plan and design the research. Research is a significant aspect of the work and may involve pure research as well as applied research.

ELEMENT	DEFINING ACTIVITIES
E5.1 Identifies opportunities for new or improved processes and / or products	<ul style="list-style-type: none"> a. Identifies and documents opportunities for the engineering application or adaptation of new concepts, products or technologies b. Analyses situations or required outcomes, in consultation with potential clients and other stakeholders, to determine justification for research c. Defines the process for initial background documentation and literature review d. Identifies emerging risks of pursuing or rejecting the opportunity e. Identifies potential benefits and tangible outcomes of the research and development opportunity f. Identifies how sustainability can drive innovation and improvement in process and products
E5.2 Identifies the resources required for the R & D	<ul style="list-style-type: none"> a. Scopes the R & D concept to develop project objectives in terms of results and time lines b. Formulates and submits cost estimates of development, design, methodology, procedures, research and analysis c. Defines research deliverables in terms of specific measurable results by stages of the research d. Conducts R & D scoping under the direction of environmental management requirements
E5.3 Initiates concept development	<ul style="list-style-type: none"> a. Determines preliminary strategic objectives and priorities being addressed by the research b. Refines the research process required through a collaborative process to ensure that all parties that could have a potential interest have an opportunity to express their interest c. Identifies the extent and combination of fundamental or applied research d. Analyses the impact of emerging engineering methods, technologies, processes and hypotheses to refine the R & D concept e. Scopes the R & D concept to develop project objectives in terms of results and time-limits f. Clarifies commitment to the concept with all parties directly involved g. Develops the concept in relation to the imperatives of sustainability
E5.4 Gains commitment to the R & D proposal	<ul style="list-style-type: none"> a. Prepares formal application for research funds together with supporting documents b. Identifies commercial opportunities for R & D application
E5.5 Ensures research is undertaken	<ul style="list-style-type: none"> a. Establishes R & D project management b. Identifies a research focus, conducts tests and identifies information for general application c. Methodically measures and records research project parameters d. Communicates and monitors R & D progress e. Ensures R & D continues to provide innovative engineering applications / systems / processes f. Ensures regulatory and legal requirements are addressed g. Analyses recorded results and develops conclusions h. Reports results with analysis of their significance to the underlying engineering problem i. Prepares demonstrations (models or prototypes) of the R & D outcomes
E5.6 Collaborates in the commercialisation of research outcomes	<ul style="list-style-type: none"> a. Collaborates with others to review the costs and benefits of Research & Development b. Provides recommendations for the implementation of Research & Development based on commercial analysis c. Consults on the development of projects that are implementing Research & Development outcomes d. Provides engineering advice on specific aspects of commercialization such as regulatory and legal requirements, pricing, distribution and promotion e. Consults to transfer new technology into commercial production

UNIT E6: Source and Estimate Materials

DESCRIPTOR: This Unit requires members of the engineering team to define requirements, estimate the material required and identify appropriate sources to access the material from.

ELEMENT	DEFINING ACTIVITIES
E6.1 Defines requirements and sources for materials	<ol style="list-style-type: none">Defines the scope and parameters for the estimate following interpretation of technical informationBrings to the client's attention the sustainable implications and optionsAnalyses estimate requirements in consultation with interested partiesCompares options for materials against technical requirementsDetermines and evaluates community expectations of the aesthetics and functionality of the materials used in the project/operationIdentifies options and costs to sources materials
E6.2 Estimates material	<ol style="list-style-type: none">Carries out calculations to ensure the currency and accuracy of the figures and rates usedDefines cost effective sustainable and efficient methods for the preparation of materials/components /systemsCalculates estimates using the correct units in accordance with specification requirements and proceduresDetermines interaction that may occur between materials/components/systems within the operation/projectDocuments and present estimates to meet the initial requirements
E6.3 Procures material / resources	<ol style="list-style-type: none">Uses ordering documentation to identify materials and components for purchasingOrders materials and componentsMaintains ordering and purchasing documentation
E6.4 Prepares materials / components / systems for use in the project / operation	<ol style="list-style-type: none">Defines cost effective sustainable and efficient methods for the preparation of materialsSchedules the access and preparation of materialsCarries out tests using the selected methods to ensure agreed standards are achievedDetermines interaction that may occur between materials within the operation / projectPrepares certification reports on the characteristics and uses of materialsAccepts or rejects materials

UNIT E7: Change and Technical Development

DESCRIPTOR: This Unit requires members of the engineering team to implement technical developments and act as a catalyst in the implementation of technical innovation so that improvements in products and services are achieved.

ELEMENT	DEFINING ACTIVITIES
E7.1 Participates in planning the introduction of technical change	<ul style="list-style-type: none">a. Contributes effectively in the product / service planning processes to introduce technical improvements / changeb. Identifies opportunities for technical improvements in products and systemsc. Consults with designated individuals/groups to introduce technical and operational improvements / changed. Explains the business objectives and plans to justify technical change to products/services /systems
E7.2 Develops technically creative and flexible approaches and solutions	<ul style="list-style-type: none">a. Identifies and analyses alternative approaches to managing technical problemsb. Assesses risks and ensures an environmentally sustainable position is taken to achieve technical improvements with a recognised benefit or advantage to the organisationc. Participates in the workplace by promoting the development of innovative approaches to achieve technical outcomesd. Reviews resource management to improve productivity and / or reduce costs
E7.3 Manages emerging technical challenges and opportunities	<ul style="list-style-type: none">a. Responds to the changing technical needs of customers/stakeholdersb. Keeps individuals / teams informed of progress in the implementation of technical changec. Negotiates and implements recommendations for improving the methods / techniques to manage technical change

UNIT E8: Technical Sales and Promotion

DESCRIPTOR: This Unit requires members of the engineering team to identify opportunities for the sale of technical products / systems and provide technical product information to internal and external clients.

ELEMENT	DEFINING ACTIVITIES
E8.1 Identifies sales opportunities	<ol style="list-style-type: none">Identifies potential clientsEstablishes contact with clients through providing information on technical products related to their processes/productSeeks information on potential clients concerns or awareness of shortcomings in present processesResearches to identify future technical and market trendsIdentifies opportunities to present the features and the benefits of the technical product/process
E8.2 Applies product knowledge to client requirements	<ol style="list-style-type: none">Analyses the clients process/service/product to identify areas for improvementAssists the client to specify their requirementsProvides information on the technical product/process to meet the clients acknowledged requirements or likely future requirementsPromotes the environmental and energy factors of the productTrains clients in applying technical products
E8.3 Promotes technical capability of the product / system	<ol style="list-style-type: none">Provides internal sales staff with information on the technical capability of the product /systemDevelops and presents product/system promotional informationAttends and contributes to industry conferences in the area of product/system specialisation
E8.4 Seeks client's feed back	<ol style="list-style-type: none">Contacts clients to establish satisfaction with the productReviews and acts on feedbackCommunicates with other staff to review process and improve service where requiredProvides ongoing client support as required

PART B

**Standards to which
Stage 2 Competencies
must be demonstrated**

PROFESSIONAL ENGINEERS

Professional Engineers are responsible for engineering projects and programs in the most far-reaching sense, for bringing knowledge to bear from multiple sources to develop solutions to complex problems and issues, for ensuring that technical and non-technical considerations are properly integrated, and for managing risk.

Professional Engineers must demonstrate Stage 2 competencies in relation to projects, activities and situations that involve some or all of the following:

KNOWLEDGE AND UNDERSTANDING

A knowledge background equivalent to an accredited four-year Bachelor of Engineering degree or recognised alternative, with in-depth knowledge across one or more broad fields of engineering.

Ability to tackle technically challenging problems and work from first principles to make reliable predictions of outcomes.

Ability to ensure that all aspects of a project are soundly based in theory and fundamental principles and to recognise results, calculations, or proposals that may be ill-founded, identify the source and nature of the problem and take appropriate action.

Understanding how new developments relate to established theory and practice and to other disciplines with which they may interact.

EXPERTISE

Ability to address issues and problems that have no obvious solution and require originality in analysis.

Addressing infrequently encountered issues and problems, outside those encompassed by standards and codes of practice for professional engineering.

Development of new engineering principles and technologies including use of new materials, techniques or processes or of existing materials, techniques or processes in innovative ways.

Innovation, creativity, and change, and capacity to break new ground in an informed and responsible way.

Engagement with wide-ranging or conflicting technical, engineering and other issues, and resolution of significant problems arising from interactions between such issues.

Interaction with diverse groups of stakeholders with widely varying needs.

Use of diverse resources including people, money, equipment, materials and technologies.

Integration of all functional elements to form a complete and self-consistent system.

Disciplined, holistic approach to complex situations and problems and to the conduct of complex activities.

Disciplined and systematic approach to design and synthesis on a substantial scale.

Ability to conceptualise alternative approaches, comprehend and define the risks and benefits of each, use informed professional judgement to select an optimum that is deliverable in practice, justify and defend selection.

Participation in research or research-and-development teams.

RESPONSIBILITY FOR OUTCOMES

Significant consequences in a range of contexts.

Interactions between the technical system and the environment in which it operates, and integration of social, environmental, and economic outcomes over the lifetime of the product or program.

Interacting effectively with other disciplines and professions and ensuring that the engineering contribution is properly integrated into the totality of the project or enterprise.

Interpreting technological possibilities to society, business, and government, and ensuring that policy decisions are properly informed by technological considerations.

Working with clients or non-technical stakeholders to ensure that their objectives are properly reflected in a technical brief or specification.

MANAGEMENT ROLES

Professional engineers may lead or manage teams appropriate to these activities and may move into senior management roles in engineering and related enterprises. In these management roles, Professional Engineers should clearly conceptualise risk across all facets of engineering, i.e:

Identifying, assessing and managing risk, both of a technical kind and in relation to clients, users, the community and the environment.

Ensuring that technological costs, risks and limitations are properly understood as well as desirable outcomes.

Recognising limits to own knowledge and seeking advice, or undertaking research, to supplement own knowledge and experience.

ENGINEERING TECHNOLOGISTS

Engineering Technologists specialise in the theory and practice of a particular branch of engineering technology or engineering-related technology, and in its application, adaptation and management in a variety of contexts.

Engineering Technologists must demonstrate Stage 2 competencies in relation to projects, activities and situations that involve some or all of the following:

KNOWLEDGE AND UNDERSTANDING

A knowledge background equivalent to an accredited three-year Bachelor of Engineering Technology degree or recognised alternative.

Thorough understanding of the theoretical and/or experimental basis of the technology sufficient to keep pace with or actively contribute to its advancement.

Understanding of engineering and technical principles sufficient to manage interactions between the technology and other parts of an overall technical system.

EXPERTISE

Application of the technology in a variety of situations and contexts.

Adaptation of the technology to varied or new applications or situations.

Familiarity with standards and codes of practice relating to the technology, and ability to contribute to their progressive improvement based on understanding of both theoretical and practical factors.

Design of equipment or installations utilising the particular technology.

Management of a range of technical functions and personnel on a significant scale in an engineering or engineering-related context such as manufacturing, software development, mining, construction, building services, precision testing, plant operation etc.

Knowledge and competence in a scientific or technological field other than engineering, together with well-developed expertise in its application in close conjunction with engineering work.

Exercise of ingenuity, originality and innovation in adapting the technology to new applications and developing new practices for its use. Contribution to the advancement of relevant codes and standards.

Participation in research or research-and-development teams concerned with advancing the technology or developing new technologies that relate to it.

RESPONSIBILITY FOR OUTCOMES

Inspection, approval and certification of designs, tests, installations or engineering work utilising the technology, in circumstances where the technology is agreed to be suitable for the purpose in question.

Certification of compliance with performance-based criteria by equipment or installations utilising the technology.

Ability to communicate the significance of the technology and its use in a particular context to other technical and non-technical stakeholders in a project.

Ability to recognise fundamental properties and limitations of the technology, identify circumstances that suggest a significant problem, and take appropriate action.

Assessment, communication and management of technical risk associated with equipment or installations utilising the technology.

Recognising limits to own knowledge and seeking advice to supplement own knowledge and experience.

MANAGEMENT ROLES

Engineering Technologists may lead or manage teams appropriate to these activities. Some may move into senior management roles in engineering and related enterprises, employing professional engineers and other specialists where appropriate.

ENGINEERING ASSOCIATES

Engineering Associates focus on the practical implementation of engineering work or the conduct of engineering operations, and in the application of recognised standards and codes of practice in familiar and unfamiliar situations.

Engineering Associates must demonstrate Stage 2 competencies in relation to projects, activities and situations that involve some or all of the following:

KNOWLEDGE AND UNDERSTANDING

A knowledge background equivalent to a two-year Advanced Diploma of Engineering or Associate Degree in Engineering.

Theoretical knowledge sufficient to appreciate the detailed functioning of plant and equipment, its practical scope and limitations, and the salient features of its interaction with the operating environment.

Detailed understanding of performance of equipment and components against technical specifications.

Analytical skills sufficient to quantify familiar and unfamiliar operating situations and to recognise when accepted methods of solution are likely to prove inadequate in a given situation.

EXPERTISE

Close familiarity with standards and codes of practice relating to a recognised field of engineering and expertise in their interpretation and application to a wide variety of situations.

Specifying the components, equipment or system required to meet a given objective in compliance with the relevant standards and codes.

Selecting and combining available components to form systems meeting given specifications.

Installing, commissioning, maintaining, repairing and modifying plant and equipment to given specifications and/or in accordance with recognised standards and codes.

Testing and fault diagnosis in complex plant and systems in accordance with accepted procedures.

Utilising advanced software or other design aids to perform detailed design of critical elements and/or complex systems.

High levels of training, and periodic updates and upgrades, in specific plant, equipment, systems or techniques.

Contribution to the advancement of technologies, practices, codes and standards in the light of practical experience and theoretical understanding.

Participation in research or R&D teams, as experts in the construction of research equipment or otherwise.

RESPONSIBILITY FOR OUTCOMES

Supervision of tradespeople in appropriate aspects of the above functions.

Responsibility for the safe operation of complex plant under agreed guidelines.

Inspection and certification of work in compliance with recognised standards and codes.

Exercise of engineering judgement within the limits of accepted practice, and knowledge of when and how to seek or employ additional advice or expertise.

Understanding of risk associated with normal engineering operations. Recognition of limits of applicability, detection of unlikely results and appropriate corrective action.

Recognising limits to own knowledge and calling in other expertise as necessary.

MANAGEMENT ROLES

Engineering Associates may lead or manage teams conducting these activities. Some may move into senior management roles in engineering and related enterprises, employing professional engineers and other specialists where appropriate.

APPENDIX A

GLOSSARY OF TERMS

Accredited Course: a structured program of education and training, typically comprising a three year full time equivalent engineering technology course or a four year full time equivalent professional engineering course, which meet the criteria laid down by Engineers Australia in its accreditation policies. The accreditation process involves an actual visit to the academic institution, and subsequent audits.

Articulation: is the process of transferring from one occupational category to another through a program of competency enhancement. This may be achieved by a combination of formal academic and experiential formation of additional competencies.

Competency: the ability to perform activities within an occupation category or function to the standard expected in employment.

Continuing Professional Development (CPD): the development of knowledge, skills, and expertise through a professional career.

Contribute: indicates a level of responsibility less than collaborate, but a higher level than participate, requiring the application of some expertise in the performance of tasks, within the same occupational category.

Defining Activities: subdivisions of an Element of Competency that are observable in the workplace.

Discipline: a branch or sub-division of engineering / technological knowledge, instruction or learning.

Element of Competency: subdivision of a Unit of Competency that is observable in the workplace.

Enabling Competencies: the underpinning knowledge required in order to be able to perform activities to the standard expected in the workplace.

Engineering Team: a group which consists of a combination of members of the suite of occupational categories including Professional Engineers, Engineering Technologists, and Engineering Associates.

Field: an area of engineering knowledge and practice forming part of an engineering discipline.

Formation: the process by which a member of the engineering team on completion of undergraduate education acquires the competencies of an experienced practitioner and can undertake normal work under general direction, or more complex work under the limited guidance of a more experienced practitioner.

General Direction: a condition of relative independence in the approach to the performance of work, within a managerial framework that provides general oversight of effort, objectives, methodology and resource allocation.

General Guidance: broad instructions, with occasional detailed guidance, allowing the exercise of some initiative and judgment. Work assessed in broad terms and reviewed on completion.

Generic: relevant to all disciplines of engineering.

Guidance: receiving instructions normally from an experienced engineering practitioner on work required, methods of approach and unusual or difficult features, and subject to progress checks and assessment on completion.

Judgement: the ability to allocate comparative value to subjective criteria, demonstrated by the application of the knowledge, expertise and conceptual thinking necessary to make correct decisions appropriate to the occupational level. In the case of Professional Engineers, the exercise of choice to solve problems otherwise intractable to analysis.

Limited Guidance: instructions in the form of clear statements of objectives normally from immediate superior, with occasional guidance but an expectation of initiative and judgment, and with outcomes measured against achievement of objectives.

Normal: a characteristic of regular work carried out in the engineering workforce, involving the exercise of customary and conventional knowledge and skill in the application of traditional practices, methods and standards appropriate to a particular occupational category, but excluding work that is complex.

Participate: indicates a level of responsibility generally limited to an interaction with others and providing specific help on request, within the same employment category.

Recognised Course: a course which Engineers Australia accepts as meeting the basic requirements for a grade of membership.

Unit of Competency: major segment or broad area of professional performance, typically representing major functions or roles of a profession.

APPENDIX B

THE COMPETENCY STANDARDS TO DATE

This section sketches the evolution of the Standards to date, and may assist readers familiar with previous editions to appreciate the changes introduced in the present edition. It may be omitted by those reading the Standards for the first time.

The first two editions (1992 and 1999) defined Stage 2 competencies in the form of Units of Competency. In the 1999 edition there are three Core Units, and a number of Elective Units from which a candidate must select two. This arrangement has worked well in practice. With some changes, it is retained in the present edition, but is complemented by important new material.

The 1999 edition was entitled *National Generic Competency Standards for Stage 2 Professional Engineers, Engineering Technologists and Engineering Associates and the Advanced Stage Engineer*. It set out the full array of Stage 2 Units, Elements, and Performance Criteria separately for each of the three occupational categories. Each Unit in each category was supplemented by detailed Range Statements, Evidence Guides, and Considerations, to assist in its interpretation. These supplementary statements attempted to compare and contrast the roles of practitioners in the three categories. However, many of the statements appeared closely similar. Differences were in the fine detail, requiring considerable practice in using the Standards before clear distinctions could be drawn.

This 2003 edition, therefore, does away with the detailed range statements, evidence guides and considerations. Instead, it attempts to provide direct statements of the distinguishing characteristics and strengths of the three categories, each in its own right, allowing the Standards to be used with greater confidence to assist in locating a person's current category of competence.

In earlier editions, Stage 1 competencies were not explicitly described but were treated as an implicit subset of Stage 2. In the 1993-1994 editions, discrimination between Stages 1 and 2 was achieved by either defining a direct limit to responsibility for Stage 1, or indicating a level of exposure/responsibility in work by means of defined words. The 1999 edition said "Whilst the wording for Stage 1 is the same as for Stage 2, the assessment process for those seeking competency based entrance to an occupational category recognises that candidates have not undergone a formation process with its accompanying increase in knowledge, understanding, problem solving and practice skills".

Stage 1 competency standards have been explicitly formulated for the first time in 2003, and linked to the accreditation criteria for programs leading to engineering qualifications. The Stage 1 Standards are published separately at present, but it is expected that future editions will incorporate both Stage 1 and Stage 2.

APPENDIX C

INDICATIVE RANGE STATEMENTS FOR ENGINEERING DISCIPLINES

PREAMBLE

This Appendix provides a guide to assist in recognising engineering disciplines. The method employed has been to indicate, but not prescribe, the principal specific areas of expertise which characterize the engineering disciplines covered by engineering courses offered by Australian universities and accredited by Engineers Australia. The principal engineering disciplines are shown in alphabetical order. Each discipline draws upon enabling competencies, some of which are general in their application, eg, Mathematics, Computing, Physics and Chemistry. Other enabling competencies, such as those listed below, are specific to certain disciplines.

- Control Theory
- Ecoscience
- Electrical Theory
- Electronic Theory
- Fluid Mechanics
- Geology
- Geomechanics
- Materials
- Solid Mechanics
- Thermodynamics

Disciplines covered are those in which professional engineers normally practise. Areas of practice for engineering technologists and engineering associates may cover similar disciplines, or may be more closely focussed as fields within one or more disciplines. The exercise of professional judgment will be required to determine the appropriate categorisation.

AERONAUTICAL ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, aircraft, applied in the structural aspects of airframes, aircraft controls and flight stability, and aircraft capability and safety under operational conditions. Specific expertise areas include:

- Aeronautical Engineering Practices
- Aircraft Structures and Wings
- Aircraft Airframes Engineering
- Aircraft Systems Engineering
- Aircraft Control Theory & Systems
- Avionics Engineering
- Aircraft Dynamics Engineering
- Engineering Aerodynamics
- Aircraft Maintenance Engineering
- Engineering Aeronautics
- Aircraft Mechanisms Engineering
- Fatigue and Fracture Mechanics

- Aircraft Operations
- Structural Mechanics
- Aircraft Propulsion Engineering
- Aircraft Stores

Other areas of specific expertise relevant to the practice of Aeronautical Engineering are found within the disciplines of Electronic Engineering, Communications Engineering, Computer Systems Engineering, Electrical Power Engineering, Instrumentation and Control Engineering, Mechanical Engineering, Mechatronic Engineering, Software Engineering, Space Engineering and Structural Engineering.

AGRICULTURAL ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, engineering work related to the use and development of agricultural land, buildings, machinery and equipment. Agricultural engineering is applied in irrigation, drainage, flood and water control systems, design and manufacture of farm buildings, agricultural machinery plant and systems for crops, animals and animal products. Specific expertise areas include:

- Agricultural Economics
- Agricultural Engineering Practices
- Agricultural Machines Engineering
- Agricultural Materials Engineering
- Agricultural Structures Engineering
- Agriculture
- Engineering Hydrology
- Engineering Surveying
- Water & Waste Water Engineering

BIOMEDICAL ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of medical devices, facilities and equipment designed to support and enhance human life and help individuals to overcome physical disabilities. Specific expertise areas include:

- Biomedical Electronics Engineering
- Biological Signal Processing
- Medical Image Processing
- Mass Transfer
- Fluid Mechanics
- Structural Analysis
- Materials Engineering
- Technology Management
- Computer Principles
- Physiology
- Cardiovascular
- Dynamics Anatomy
- Biomechanics
- Pharmacokinetics

BUILDING ENGINEERING

The engineering discipline concerned with research, design, development, construction, and management of the structure of buildings. Specific expertise areas include:

- Building Construction Engineering
- Building Engineering Practices
- Construction Engineering Practices
- Construction Management
- Structural Mechanics
- Building Structures

BUILDING SERVICES ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, maintenance and management of plant and equipment used for building services. Specific expertise areas include:

- Building Services Engineering Principles
- Building Lifts Operation Systems
- Building Services Engineering Practices
- Power Electronics
- Building Illumination Engineering
- Communication Systems Engineering
- Building Air Conditioning
- Building LAN
- Building Electrical Systems Engineering
- Building Electrical Distribution Systems

Other areas of specific expertise relevant to the practice of Building Services Engineering are found within the disciplines of Electronic Engineering, Communication Engineering and Instrumentation and Control Engineering.

CERAMIC ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of products based upon, ceramic materials. Specific expertise areas include:

- Ceramic Engineering Processes
- Ceramics (Electrical, Physical)
- Chemical Ceramics Engineering
- Fuel Engineering
- Materials Physics
- Materials Thermodynamics
- Mineralogy
- Mineral Process Engineering
- X-Ray Diffraction Microscopy

CHEMICAL ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, commercial scale chemical plants and process systems, industrial processing and fabrication of products undergoing chemical and/or physical changes. Specific expertise areas include:

- Chemical Process Engineering
- Petroleum Process Engineering
- Mineral Process Engineering
- Process Plant Design
- Environmental Engineering
- Biochemical Process Engineering
- Process Design and Development
- Project Engineering & Management
- Process Control and Optimization
- Emission Control and Treatment
- Process Operation & Management
- Safety Engineering

CIVIL ENGINEERING

The engineering discipline concerned with materials such as steel, concrete, earth and rock, and with their application in the research, design, development, manufacture, construction, operation, maintenance and management of hydraulic, structural, environmental and systems aspects of infrastructure works and services such as water, sewerage, transport, urban development and municipal services, and with building and construction for other infrastructure industries. Specific expertise areas include:

- Civil Engineering Practices
- Concrete Engineering
- Construction Engineering Management
- Construction Engineering Practices
- Engineering Hydrology
- Engineering Surveying
- Environmental Engineering
- Geotechnical Engineering
- Urban and Regional Planning
- Municipal Engineering
- Road, Transport & Traffic Engineering
- Structural Engineering
- Coastal and Ocean Engineering
- Water & Waste Water Engineering
- Underground Construction & Tunnelling
- Hydraulic Engineering

COMMUNICATIONS ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, plant and equipment, transmission media and systems used for communication. Specific expertise areas include:

- Communication Engineering Principles
- Communication Switching
- Communication Systems Engineering
- Electromagnetic Power Devices
- Electronic Coding
- Electronic Digital Signal Systems
- Navigation Aids and Radar
- Optical Communications
- Opto-Electronics
- Radio Communication
- Satellite Communication
- Wave Propagation

COMPUTER SYSTEMS ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, computing systems. Computer systems engineering requires specialized application of digital electronic engineering in the effective integration of the hardware and software components of computing systems. Specific expertise areas:

- Communication Engineering Principles
- Computer Engineering Practices
- Computer Graphics
- Computer Network Engineering
- Local Area Network Engineering
- Computer Programming, Advanced
- Software Engineering
- Electronic Digital Signal Systems
- Microprocessor Engineering
- Wave Propagation Engineering
- Computer Principles & Operating Systems
- Electronic Analogue & Digital Engineering

CONSTRUCTION ENGINEERING

The engineering discipline concerned with construction of civil engineering works. Specific expertise areas:

- Building Construction
- Construction Engineering Management
- Construction Engineering Practice
- Environmental Engineering
- Geotechnical Engineering
- Hydraulic Engineering
- Municipal Engineering
- Road Engineering
- Structural Mechanics
- Structural Engineering
- Underground Engineering & Tunnelling

ELECTRICAL ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, equipment, plant and systems applied in electrical power generation, transmission, and distribution and in industry and utilised in control of computer systems. Specific expertise areas include:

- Electrical Engineering Principles
- Plant & Switchgear Engineering
- Industrial Machine Practice
- Plant Protection Systems
- Electrical Systems Engineering
- Electromagnetic Compatibility (EMC)
- Electrical Machines and Drives Engineering
- Electrical Safety
- Industrial Electronics
- Computer Network Engineering
- Transformers Engineering
- Computer-aided Design & Manufacturing
- Electromagnetic Power Devices
- Transducers & Actuator Engineering
- Computer Principles
- Signal Processing
- Industrial Electrical Engineering

Other areas of specific expertise relevant to the practice of Electrical Engineering are found within the disciplines of Electrical Power Engineering and Mechatronic Engineering.

ELECTRICAL POWER ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, maintenance and management of electronic equipment, machines, plant and systems associated with the generation, transmission, distribution utilisation and control of electric power. Specific expertise areas include:

- Electrical Engineering Practice
- Power Electronics Engineering
- Electric Power Generation
- High Voltage Engineering
- Electric Power System Protection
- Plant & Switchgear Engineering
- Electric Power System Analysis
- Electric Substations Engineering
- Electric Power System Operation
- Power Electronics
- Electrical Machines and Drives
- Energy Conversion
- Computer Principles
- Safety and Environmental Engineering
- Optical Current and Voltage Transformers
- Transformers Engineering
- Electric Power Transmission & Distribution

Other areas of specific expertise relevant to the practice of Electrical Power Engineering are found within the disciplines of Electrical Engineering and Instrumentation and Control Engineering.

ELECTRONICS ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, electronic equipment, instrumentation and systems for industrial control, communication, navigation, data processing and entertainment. Specific expertise areas include:

- Audio Engineering
- Communication Engineering Principles
- Electromagnetic Power Devices
- Electronic Digital Signal Systems
- Electronic Image Processing
- Radio Communication Engineering
- Wave Propagation Engineering
- Biomedical Electronics Engineering
- Computer Principles
- Opto-Electronics
- Electronic Engineering Practices
- Transducers & Actuator Engineering
- Electronic Analogue and Digital Engineering

ENVIRONMENTAL ENGINEERING

The engineering discipline which includes appropriate biological and chemical knowledge, and is concerned with the application of physical, chemical and biological processes occurring in the natural, urban and industrial environments. It is concerned with sustainability issues through minimization of resource use, such as land, water, energy, and minimization of waste production. It is further concerned with mitigation of pollution and minimization of adverse effects of engineering works on the environment. It is multidisciplinary, having substantial relationships with the chemical, civil, mechanical and mining disciplines. Specific expertise areas include:

- Biological Science & Engineering
- Coastal Engineering
- Ecology
- Engineering Hydrology
- Environmental Economics
- Erosion Control Engineering
- Environmental Law and Policy
- Hydraulic Engineering
- Environmental Management Systems
- Cleaner Production
- Hazardous Waste Treatment Engineering
- Water and Waste Water Engineering

GEOLOGICAL ENGINEERING

The engineering discipline concerned with geology and geophysics in its application to works involving earth and rock, energy and mineral resources and mining. Specific expertise areas include:

- Civil Engineering Practices
- Construction Management
- Construction Engineering Practices
- Engineering Geology
- Engineering Hydrology
- Engineering Surveying
- Geological Engineering
- Geophysical Prospecting
- Geotechnical Engineering
- Mineralogy
- Mining Geology
- Petroleum Reservoir Fluids

GEOMATIC ENGINEERING

Geomatic Engineering is an activity based on information technology which is concerned with collecting spatial information by measurement, and the analysis, management and manipulation of this data as part of scientific, administrative, legal and technical operations. These activities include:

- Cartography
- Land Surveying
- Digital Mapping
- Geodesy
- Geographic Information Systems
- Hydrography
- Land Information Management
- Cadastral Operations
- Photogrammetry
- Remote Sensing
- Land Information Systems
- Engineering and Mining Surveying
- Metrology
- Spatial Data Infrastructure

INDUSTRIAL ENGINEERING

The engineering discipline concerned with the planning, organizing and operation of industrial facilities and processes for the economic, safe and effective use of physical and human resources. Industrial engineering is applied in design for the integration of material, human and financial resources, and of production sequences and methods, optimum flows and layouts, and of work methods and procedures, labour organization, and in economic evaluation of facilities, processes or techniques. Specific expertise areas include:

- Industrial Engineering Practices
- Manufacturing Process Engineering
- Materials Handling Engineering
- Methods Engineering
- Operations Research
- Quality Assurance and Control
- Safety and Environmental Engineering

INSTRUMENTATION AND CONTROL ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, implementation, maintenance and management of automatic control and data acquisition systems including services such as lifts, air conditioning and humans centred controlled environments. Specific expertise areas include:

- Control Systems Engineering Principles
- Process Plant
- Information Coding & Transmission
- Digital Signal Processing
- Artificial Intelligence & Expert Systems
- Transducers & Actuator Engineering
- Mathematical Modelling
- Software Techniques
- Instrumentation Systems
- Local Area Network Engineering
- Communication Systems Engineering
- Measurements Techniques
- Human-Computer Interface Engineering
- Computer Principles
- Computer Systems Engineering
- Embedded & Real-time Systems
- Power Electronics
- Information Coding & Transmission
- Real-Time Data Acquisition

Other areas of specific expertise relevant to the practice of Instrumentation and Control Engineering are found within the disciplines of Biomedical Engineering, Communications Engineering, Computer Systems Engineering, Electronics Engineering, Software Engineering and Mechatronics Engineering.

MANUFACTURING ENGINEERING AND PRODUCTION ENGINEERING

The related engineering disciplines concerned with the planning, organizing and operation of manufacturing methods, processes, facilities and systems for economic, safe and effective use of physical and human resources. Manufacturing engineering is applied in the selection and design of tooling for machining, pressing, welding, hardening, plating, assembly and other processes, in design, selection and development of manufacturing processes and systems, using new or existing machinery and equipment, and in production planning and control and the management of production functions. Specific expertise areas include:

- Computer-aided Design & Manufacturing
- Engineering Ergonomics
- Engineering Tribology
- Industrial Engineering Practices
- Manufacturing Engineering Practices
- Manufacturing Process Engineering
- Manufacturing Systems Engineering
- Quality Assurance and Control
- Robotics Engineering

MATERIALS ENGINEERING

The engineering discipline concerned with research, development and investigations into the properties, production, utilization and management in the application of metallic, ceramic, polymers, rubbers and other materials. Specific expertise areas include:

- Ceramic Engineering Practices
- Foundry Practice Engineering
- Metallurgy
- Materials Handling Engineering
- Polymer Engineering
- Engineering Tribology
- Metallurgical Analysis & Engineering
- Mechanical Engineering
- Materials Engineering & Engineering Practices

MARITIME ENGINEERING

The engineering discipline concerned with the operation of ships and other maritime facilities. Specific expertise areas include:

- Manufacturing Process Engineering
- Marine Acoustics Engineering
- Maritime Engineering Administration
- Ocean Science and Engineering
- Ship Structural Engineering
- Ship Propulsion Engineering
- Operations Research
- Ship Systems Engineering
- Ship Hydrostatic & Hydrodynamic Engineering

MECHANICAL ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, machines, machine and thermodynamic processes, and manufacturing and materials handling plants and systems. Mechanical engineering is applied in manufacturing, transport, electricity generation, and in works and services using machine systems, including the environment of building interiors. Specific expertise areas include:

Automotive Engineering
 Engineering Tribology
 Fuel Engineering
 Marine Engineering
 Quality Control and Assurance
 Robotics Engineering
 Environmental Engineering
 Applied Mechanics
 Fluids Engineering
 Production Engineering
 Design Engineering
 Systems Engineering
 Hydraulic Engineering
 Engineering Ergonomics
 Fatigue and Fracture Mechanics
 Metal Forming Engineering
 Mass Transfer
 Refrigeration Engineering
 Vibration Analysis and Noise Control
 Materials Engineering
 Manufacturing Engineering Practices
 Heat Transfer
 Internal Combustion Engineering
 Maintenance Engineering
 Pressure Vessels
 Biomechanical Engineering
 Computer-aided Design & Manufacturing
 Mechanical Machines Engineering
 Machine Tool & Manufg. Processes
 Aeronautical & Aerospace Engineering

MECHATRONIC ENGINEERING

The engineering discipline concerned with the design and implementation of engineered products that require the integration of electronics and computer technology with the traditional aspects of electromechanical systems.

Modern Video camcorders for example illustrate such an engineered product, which requires expertise in the related areas of:

Dynamics
 Mechanical Design
 Control Systems
 Materials Engineering
 Instrumentation
 Transducers and Measurement
 Computer Engineering
 Electromagnetic Power Devices

METALLURGICAL ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, plant and processes for the smelting, electrolytic, flotation and other means of extracting metals from their ores, for production of iron and steel, refinement of gold, silver, zinc, copper, nickel and other metals. Specific expertise areas include:

Materials Engineering
 Metallurgical Analysis
 Metallurgical Engineering
 Metallurgical Engineering Design
 Metallurgical Engineering Practices
 Metallurgy
 Extractive Metallurgy
 Mineral Process Engineering
 Mineralogy

MINING ENGINEERING

The engineering discipline concerned with the research, exploration, design, development, installation, operation, maintenance and management of underground and open pit mines for the extraction and treatment of minerals. Mining engineering is applied in the economic evaluation of mineral deposits, mine design and production systems, ore handling systems, mineral processing plant, mine infrastructure services, and environmental and safety considerations. Specific expertise areas include:

Environmental Engineering
 Engineering Geology
 Geophysical Prospecting
 Explosive Technology
 Mineral process engineering
 Geotechnical Engineering
 Mechanical Machines Engineering
 Mine Management & Regulations
 Mine Process Control Engineering
 Mine Process Engineering
 Mine Surveying
 Mineralogy
 Mining Engineering Practices
 Mining Geology
 Mining Structural Engineering
 Mining Technology and Methods
 Electrical Power Engineering in Mines
 Operations Research

NAVAL ARCHITECTURE

The engineering discipline concerned with research, design, development, manufacture, installation, operation, maintenance and management of, marine vessels and floating structures, applied, for example, in design and construction of ships, and their economic evaluation, performance evaluation and seagoing trials. Specific expertise areas include:

- Manufacturing Process Engineering
- Mechanical Engineering Practices
- Ship Propulsion Engineering
- Ship Management Economics
- Ship Systems Engineering
- Ship Structural Engineering
- Ship Hydrodynamic & Hydrostatic Engineering
- Vibration Analysis Engineering

PETROLEUM ENGINEERING

The engineering discipline concerned with research, exploration, design, development, installation, operation, maintenance and management of, petroleum and natural gas extraction plant and systems. Petroleum engineering is applied in land and seabed drilling, control of gas and oil from wells, well production, and planning and management of such operations. Specific expertise areas include:

- Environmental Engineering
- Natural Gas Engineering
- Oil and Gas Law and Regulation
- Petroleum Formation Evaluation
- Petroleum Geology
- Petroleum Production Economics
- Petroleum Process Control & Plant
- Fluids Engineering
- Petroleum Reservoir Rock Properties
- Petroleum Well Drilling Engineering

SOFTWARE ENGINEERING

The engineering discipline concerned with research, specification, design, development, deployment, testing, maintenance, and management of software systems. Specific expertise areas include:

- Computer Programming Techniques
- Requirements Analysis
- Software Engineering Principles
- Software Engineering Practices
- Software Testing
- Software Engineering Tools
- Software Metrics
- Human-Computer Interface Engineering
- Algorithms and Data Structures
- Computer Systems Security

- Software Development Process Modelling
- Software Reliability
- Software Project Management & Planning Estimation

SPACE ENGINEERING

The engineering discipline concerned with research, design, development, manufacture, implementation, maintenance and management of spacecraft, airframes structures, spacecraft controls and communications, flight stability and spacecraft operation and safety systems. Specific expertise areas include:

- Spacecraft Engineering Principles
- Real-time Data Acquisition
- Spacecraft Airframes Engineering
- Spacecraft Operation Systems Engineering
- Spacecraft Systems Engineering
- Spacecraft Safety Systems Engineering
- Spacecraft Control Systems
- Aerodynamics Engineering
- Spacecraft Instrumentation
- Spacecraft Structure Engineering
- Spacecraft Communications Systems

Other areas of specific expertise relevant to the practice of Space Engineering are found within the disciplines of Instrumentation and Control Engineering, Communications Engineering, Computer Systems Engineering, Electronics Engineering, Software Engineering, Aeronautical Engineering and Structural Engineering.

STRUCTURAL ENGINEERING

The engineering discipline concerned with the design and erection of structures for buildings and other civil engineering works. Specific expertise areas include:

- Civil Engineering Practices
- Concrete Engineering
- Construction Engineering Practices
- Construction Management
- Engineering Surveying
- Structural Engineering
- Structural Engineering Practices
- Structural Mechanics
- Engineering Geology & Geo-technical Engineering
- Timber Engineering

APPENDIX D ENGINEERS AUSTRALIA CODE OF ETHICS

The members of Engineers Australia are committed to the Cardinal Principles of the Code:

- to respect the inherent dignity of the individual
 - to act on the basis of a well informed conscience, and
 - to act in the interest of the community
- and to uphold its Tenets.



The Tenets of the Code of Ethics are:

- 1** Members shall place their responsibility for the welfare, health and safety of the community before their responsibility to sectional or private interests, or to other members;
- 2** Members shall act with honour, integrity and dignity in order to merit the trust of the community and the profession;
- 3** Members shall act only in areas of their competence and in a careful and diligent manner;
- 4** Members shall act with honesty, good faith and equity and without discrimination towards all in the community;
- 5** Members shall apply their skill and knowledge in the interest of their employer or client for whom they shall act with integrity without compromising any other obligation to these Tenets;
- 6** Members shall, where relevant, take reasonable steps to inform themselves, their clients and employers, of the social, environmental, economic and other possible consequences which may arise from their actions;
- 7** Members shall express opinions, make statements or give evidence with fairness and honesty and only on the basis of adequate knowledge;
- 8** Members shall continue to develop relevant knowledge, skill and expertise throughout their careers and shall actively assist and encourage those with whom they are associated, to do likewise;
- 9** Members shall not assist in or induce a breach of these Tenets and shall support those who seek to uphold them if called upon or in a position to do so.