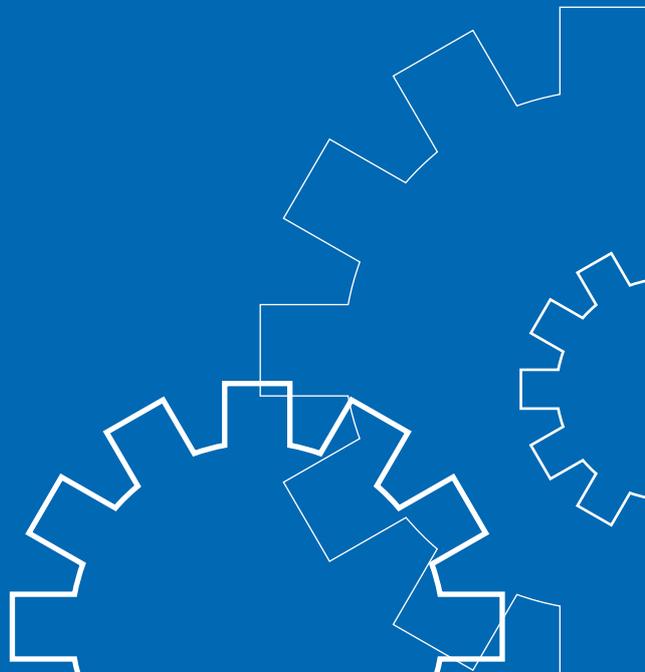
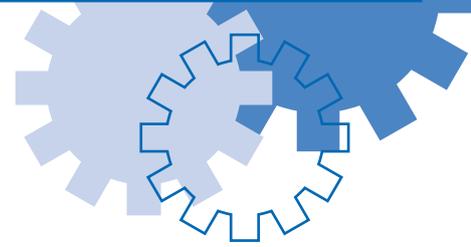




REHABILITATION ENGINEERING

*Working together to optimise the skills of
people living with disabilities*





What is ‘rehabilitation engineering’?

‘Rehabilitation engineering is the application of science and technology to improving the quality of life for people with disabilities.’

James Reswick, Former Director Division of Rehabilitation Sciences
National Institute of Disability and Rehabilitation Research, USA.

As defined by the *Rehabilitation Act of 1973, Amended 1998*

Rehabilitation engineering is the systematic application of engineering sciences to design, develop, adapt, test, evaluate, apply, and distribute technological solutions to problems confronted by individuals with disabilities in functional areas, such as mobility, communications, hearing, vision, and cognition, and in activities associated with employment, independent living, education, and integration into the community.

Rehabilitation engineers are key to the development and delivery of ‘assistive technology’, a term which refers to technologies and principles that meet the needs of and address the barriers confronted by individuals with disabilities in a range of life areas. Assistive technology is often associated with education, rehabilitation, employment, transportation, independent living, and recreation.

What is the role of rehabilitation engineering?

The role of a rehabilitation engineer may include:

- research to develop new technology, but also to make it more effective
- suggesting commercially available devices
- modification of existing devices
- fabrication of a custom device or design a modification
- testing of equipment for safety and compliance to Australian and International Standards
- assistance with job development
- suggesting work site modifications.

What training or background does a rehabilitation engineer have?

Rehabilitation engineers are professional engineers who are eligible for membership of the College of Biomedical Engineers, Engineers Australia. They normally have a four year university engineering degree, formal training in the life sciences and at least three years relevant professional experience.

The teaching of rehabilitation engineering includes study of the following topics:

- people with disabilities
- biomechanics of normal human walking
- lower limb orthotics and prosthetics
- upper limb orthotics and prosthetics
- seating and wheeled mobility
- standards for rehabilitation equipment
- access to the built environment
- functional electrical stimulation
- biofeedback
- voice output communication devices
- computer access techniques
- technology for vision impairments
- technology for hearing impairments
- control of the home environment
- service delivery
- the rehabilitation team
- Universal Design education.



What unique skills does a rehabilitation engineer bring to a multidisciplinary team?

Rehabilitation engineers complement the work of other professionals, such as physiotherapists, occupational therapists and speech pathologists, among other health professionals, to enhance an individual's ability to work and live as normally as possible.

The rehabilitation engineer, in conjunction with other clinical experts, will assess the functional capabilities of the client, and listen to what the client wants to be able to do. Their goal is to give technical assistance, and an engineering perspective to problem solving, providing assistance with technical systems and solutions that commonly fall beyond the experience of the average clinician.

Working together to optimise the skills of people living with disabilities

**Client names have been substituted in the following case studies.*

Promoting independence

Brett* normally relies on his carer to operate his wheelchair for mobility and therefore required a solution that would allow him to independently operate his wheelchair with a single, foot operated switch. As a result of a consultation between Brett, his carer, a rehabilitation engineer, physiotherapist, occupational therapist and technician, Brett decided to trial the *ClickToGo* integrated wheelchair control system.

The rehabilitation engineer provided technical recommendations regarding the selection and implementation of an appropriate system, arranged a trial of the device and performed the necessary programming of the wheelchair controller. During the trial, Brett immediately understood the operation of the device and was able to independently drive and negotiate obstacles.



Tailoring a mobility device

A specialised wheelchair was designed, developed and commissioned by the Rehabilitation Engineering Centre at Royal Perth Hospital for a woman with complete amelia. The wheelchair, shown here under construction, had a complexity that was beyond the capabilities of local wheelchair manufacturers. The wheelchair has the following features:

- raise-lower through 600mm
- seat tilt between -5° and $+90^{\circ}$
- rotation (slew) on the base $\pm 60^{\circ}$
- swing away control stem
- cruise control
- actuator redundancy override
- restraint systems that allow safe transportation
- gimballed cup holder.

Subsequent additions included an 'on-board' toileting system and a mobile phone mount.



Taking control

Sarah* has sustained a complete spinal cord injury at the T9 level, which has resulted in impaired sensation and compromised skin integrity. Until recently, Sarah used a manual wheelchair for mobility. However, after switching to a powered wheelchair, Sarah suffered recurrent skin breakdowns (pressure ulcers) under her ischial tuberosities, despite using the same pressure-redistributing cushion.

The rehabilitation engineering team used pressure mapping systems to demonstrate how the distribution of Sarah's body weight over the pressure-redistributing cushion changed when the cushion was transferred between the two wheelchairs. Using principles of seating biomechanics, the team modified the powered wheelchair to improve the efficiency of her pressure-redistributing cushion and specifically reduce the contact pressures under the ischial tuberosities to acceptable levels.

The modifications included:

- fabricating a 'wrapped' seat board surface (to replicate the slung manual wheelchair upholstery)
- optimising the footplate height and angle (to distribute more body weight along the femurs)
- altering the backrest shape (to correct pelvic obliquity and improve lateral stability).

The rehabilitation engineering team also used the pressure mapping system as an educational tool, showing Sarah, her carer and community therapist the benefits of various pressure-relieving manoeuvres such as tilting backwards, shifting from side to side or leaning forwards.



Standards testing

Rehabilitation engineers apply their knowledge and training from fields such as biomedical, mechanical and electrical engineering, to the area of International Standards testing and development for medical equipment.

Working within a multi-disciplinary team that develops and drafts Standards, rehabilitation engineers provide input on the engineering and technical aspects of the testing regime. This includes expertise when it comes to how a particular test is conducted, how fatigue limits are determined and which equipment should be used.

The engineer is involved at all stages of assessment of a product to a given Standard, including physical testing, failure analysis and formal reporting. Engineers working within the field of Standards testing are usually accredited by an independent testing authority, such as the National Association of Testing Authorities in Australia.

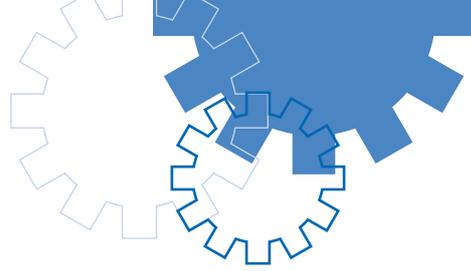
VPAP power supply units

Two types of wheelchair-mounted modular power supply systems have been developed by the Rehabilitation Engineering Centre at the Royal Perth Hospital to provide mobility for variable positive airway pressure (VPAP) ventilator users. These systems are used by clients with end-stage respiratory failure. The type shown may be also used as a standby unit to provide power in the event of a blackout. The alternative unit provides power from the wheelchair batteries.

Both systems have contingencies for failure, where they can convert alternative power supplies from automotive or mains sources in the event of a system failure, which ensures the operation of the VPAP ventilator is not compromised.

Contact details for rehabilitation engineering centres around Australia





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The National Committee on Rehabilitation Engineering of Engineers Australia coordinates professional activity in this area in Australia.



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