

## **Amending the definition of Power Assisted Pedal Cycles to allow more powerful, yet safer versions, be used in Australia**

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### **Abstract**

In May 2012, the federal Department of Infrastructure and Transport amended the definition for power assisted pedal cycles (PAPCs) in the Australian Design Rules to allow for pedalecs, which are a form of electric bicycle that complies with the European Standard EN 15194. All jurisdictions have either already changed their legislation to accommodate pedalecs or are in the process of doing so. The amendment was in response to public demand for better, 'greener' vehicles, and was informed by a technical paper produced by Transport for NSW which involved desk-top and practical research, and extensive stakeholder consultation. This indicated that more modern and powerful power assisted pedal cycles can be introduced into the Australian road network without compromising road user safety. The Paper explains the source of the amendment, the methodologies used in researching the subject and the reasons for the key criteria incorporated in the definition.

### **Scope**

The scope of the project was explicitly limited to PAPCs, and excluded electric cycles without pedals, other types of alternative vehicles and powered mobility devices. The scope also required aligning PAPCs as far as possible with the physical and the performance characteristics of standard pedal cycles, and retaining the distinction between PAPCs and larger, more powerful mopeds.

### **Background**

In 2005, the then Roads and Traffic Authority (RTA) did a review of the licence and registration requirements for power assisted pedal cycles (PAPCs). This was in response to the burgeoning demand for smaller, more environmentally-friendly vehicles. In 2008, an issues paper was developed and circulated for public comment. A workshop was convened in June 2008, and all other jurisdictions, the federal Department of Infrastructure and Transport (DIT), the National Transport Commission (NTC) and other key stakeholders – such as Australia Post, and NSW Police – were invited to send representatives. The main findings were to retain the licensing and registration status quo for PAPCs, but to update the technical standards that apply to them. The NSW Centre for Road Safety, then part of the RTA, offered to do this work.

The definition of PAPC appears in the Australian Design Rules (ADRs), which are safety and performance standards that apply to all vehicles used in Australia, and which are administered by the DIT. The ADRs classify PAPCs as an 'AB-category vehicle', and define them as: "A pedal cycle to which is attached one or more auxiliary propulsion motors having a combined maximum power output not exceeding 200 watts". The definition had not changed since it was first introduced in 1984, which, given the time it takes to formulate ADRs, suggests it was formed even earlier, in the late '70s.

This definition is used as the basis for all legislation relating to motorised bicycles, including the definition for *bicycle* in the Australian Road Rules, administered by the NTC, and all jurisdictions' version of the road rules, and in each jurisdiction's registration and licensing legislation. All jurisdictions across Australia have similar rules for bona fide PAPCs, viz:

- they do not require registration;
- their riders do not require a licence; and
- they are deemed to be a *bicycle* for the purposes of the road rules.

The demand for smaller, cheaper and more environmentally-friendly vehicles saw an increase in the range of vehicles that were being offered as PAPCs. Many of these were not PAPCs, but motorised bicycles or mopeds, and the people using them were effectively in breach of the registration regulations, licensing regulations and the road rules.

All this helped establish the key goals of the project – to devise a standard that clearly and unambiguously defined a PAPC while maintaining the legislative status quo.

In the period up to May 2009, the Centre for Road Safety carried out extensive desk-top research, backed by modelling, to determine the characteristics that best defined PAPCs. These were assessed in a series of practical tests on prototype PAPCs made available for the purpose. A second paper was issued for public comment, and another workshop convened to review the comment and finalise the proposed updated definition.

The proposed definition was submitted to the DIT and the NTC in March 2010, accompanied by a report titled *Technical support for the proposed new definition for power-assisted pedal cycle in Australia* that detailed the research processes and findings. An extract from the report is included at Annex 1.

## **Methodology**

### ***General***

The project commenced with extensive desktop research that examined how other countries defined PAPCs and their equivalent; the different types of motors that could be used to generate the power; how the power can be measured; and to compare levels of risk created by different types of models with different power and performances.

### ***Risks***

The risk posed by a moving object can be determined by its kinetic energy, which is a function of its mass ( $m$ ) and its speed ( $v$ ), and its ability to control this energy. The equation is expressed as  $KE = \frac{1}{2} mv^2$ . To retain the allowances granted to PAPCs under the different legislation, the risk posed by PAPCs should be no greater than that posed by conventional bicycles. This means the speed they can travel and their mass must be similar, and the braking capability compatible with them.

It is anticipated that amending the definition of PAPC to allow for better models will increase the number of cyclists on the road, and many of these will be commuters either travelling to and from work or a main transport hub. Data show that 87% of crashes involving cyclists also involve motor vehicles. However, research indicates that rather than exposing the new PAPC users to risk, an increase in the number of cyclists actually reduces the crash rate for cyclists. Various studies found that a motorist is less likely to collide with a person walking and cycling if more people walk or cycle. Studies also found that policies that increase the numbers of people walking and cycling appear to be an effective route to improving the safety of people walking and cycling.

Crash data show that the incidences of pedestrians being struck by cyclists is very small compared with pedestrians being struck by other vehicles. An analysis of crash data from NSW between 1997 and 2007 shows that three pedestrians were killed and another 334 were injured following a

collision involving a cyclist but no motor vehicle, which represents 0.29% of pedestrians killed and 1.16% of pedestrians injured in all crashes during the same period. Other studies suggest the risk is lower. On the occasions when there was a crash between a pedestrian and cyclist, the cyclist is usually the cause of the crash, and the pedestrian usually suffers the more severe injury. These are further reasons why the revised definition of PAPC needs to align with standard bicycles and how they are used.

### *Speed*

A key element in aligning the performance of PAPC with standard bicycles, was ensuring their assisted speed did not exceed the speed that a typical cyclist could generate. For this exercise, it was decided to limit the speed of a PAPC to the average speed a standard club cyclist could maintain over a prolonged period. To determine this value, a detailed assessment of the speeds generated by cyclists was carried out. This used fixed values for the weight of the rider, wind resistance and friction; and a number of variables, namely gradient, rider profile and weight of the bicycle.

The results found that 25km/h was a reasonable speed an average club cyclist or daily commuter could be expected to maintain. From this, it was determined that the maximum assisted speed should be limited to 25km/h. Whereas greater speeds can be achieved, this is by more elite club cyclists on lighter bicycles in a crouched position. The motor should cut out once the PAPC reached a higher speed; if a rider can cycle faster than 25km/h, they should not gain assistance from the motor.

Vehicles that did not meet these specifications fall into the moped category and must comply with the applicable vehicle standards, be issued an Identification Plate by the DIT, be registered and, in NSW, their riders must hold a motorcycle licence and adhere to the road rules that apply to motorcycles.

### *The relationship between power and speed*

Once the preferred maximum assisted speed was established, the research looked at the amount of power necessary to generate the speed for the assumed 'typical' PAPC user. The basic rule for power and speed is the more power generated, the greater the speed capability of the device. Whereas smaller motors can generate high speeds, they cannot maintain them for prolonged periods without damaging the motor. The research showed that a 250 watt motor was capable of generating sufficient power to propel a PAPC and typical rider at 25km/h for prolonged periods. Although this may affect its ability to power heavier riders at 25km/h, increasing the power available has the potential to allow the PAPC to travel at higher speeds. Allowing a more powerful motor but limiting the speed it could generate to 25km/h was not considered an option as limiters can be easily bypassed. The 250 watts also aligned with the European and Japanese standards, which also share other technical specifications being proposed for the standard and definition.

### *Measuring power*

Another consideration when assessing these is the different ways used for describing the power, and this had a bearing on the maximum power allowed. For example, although there appears to be a large disparity between the maximum 750 watts power permitted in the USA and the 250 watts permitted in Europe, it is not stated how the value is measured for the USA model, while the European is specified as 'continuous' power, which can equate to considerably more bursts of 'instantaneous', or 'peak' power, which can be gained by a vigorous application of the controls, such as when pulling away at traffic lights or starting up a hill.

The research indicated that the power output from the auxiliary motor should be measured at the PAPC's driven wheel. This is seen to have a number of benefits. Most particularly, for certification and enforcement purposes, measuring the power at the wheel is the simplest method as it can be applied regardless of the power source and of the vehicle configuration, and it can be measured using chassis dynamometers, which are readily available. This will provide a slight underestimation of the power at the motor because the power losses in the drivetrain are not measured, which means that if the driven wheel(s) power exceeds the limit, then the motor power will also exceed the limit.

### *The need to pedal to obtain assistance from the motor*

One of the fundamental characteristics of standard bicycles is that the motive power is from the rider. This is reflected in the definition in the ADRs; indeed, the term used is pedal cycle, and it is defined as "A vehicle designed to be propelled through a mechanism solely by human power".

Substituting this into the definition for PAPC, it reads:

A [vehicle designed to be propelled through a mechanism solely by human power] to which is attached one or more auxiliary propulsion motors having a combined maximum power output not exceeding 200 watts

This emphasises that the primary source of power must be from the cyclist, and the motor is an auxiliary power source to assist the rider, such as when cycling uphill or into a strong wind, or if they are simply not fit enough to maintain a reasonable pace.

Despite this, as the definition did not explicitly state the bicycle cannot be operated without pedalling, in response to the demand for smaller, more environmentally friendly vehicles, a whole market for motorised bicycles opened up. Many of these were not bona fide PAPCs but were used, either deliberately or otherwise, to circumvent the registration and licensing laws. Typically, these faux PAPCs were fitted with non-functioning or even fixed pedals (in some models there were no pedals or they could be removed); and the motor could power the vehicle without pedalling.

These motorised bicycles continued to be supplied and used as there were difficulties in enforcing the definition outlined above, despite a number of legal cases that support the interpretation. For example, in NSW, in *Matheson v Director of Public Prosecutions (NSW)* [2008] NSWSC 550, a person's conviction for riding a registrable motor vehicle rather than a power assisted pedal cycle was upheld on appeal because, in the magistrate's words, "The motor is the primary and most often if not on all occasions, the sole means of propulsion." In another case in New Zealand, a judge found in favour of the prosecution and included in the summary: "On the facts of this case, the [electric bicycle] is a pedal assisted powered cycle not a power assisted pedal cycle, because the primary mode of power is its electric motor and not pedal power". (Reference: Judge Rollo in *Police V Herbert* [2009] DCR 898.)

To provide clarity, remove ambiguity and ensure alignment with standard bicycles, it was decided that one of the key criterion for the revised definition was to explicitly require the rider to pedal, and to continue pedalling, the PAPC for the motor to operate.

Notwithstanding this, research showed safety benefits of a low-speed start up whereby the motor is activated without pedalling at a speed of up to 6km/h, a moderate walking pace. This feature is intended to help a rider when starting up in traffic; in delivering items; and in pushing the PAPC in the event of a puncture or other malfunction. A further benefit can be gained as it has been shown that PAPC riders are more likely to obey stop signs if the vehicle is easier to start again with low speed assistance. Based on this evidence, it was decided that the PAPC may incorporate an optional low-speed start up feature.

### ***Ergonomics and performance***

For a PAPC to be considered a form of pedal cycle, it must be capable of being ridden solely by the rider, without assistance from the motor. To achieve this, PAPCs must be designed to function as a standard bicycle, with due consideration to some basic ergonomic principles. In particular, the saddle height and position relative to the handlebars and bottom bracket must be adjustable; the bottom bracket must not be so wide that the pedals are too far apart to facilitate smooth and efficient pedalling; the bicycle cannot be too heavy to use; and the gearing must be appropriate for the size of the wheels and the weight of the bicycle. Indeed, in this regard, PAPCs are included in the scope of the Australian Standard AS/NZS 1927: 2010 *Pedal bicycles – Safety requirements*, which sets safety standards for the design, assembly and performance of bicycles, and it is expected that PAPCs supplied to the Australian market should comply with this standard.

Note: Many of the non bona fide PAPCs supplied to the market did not meet some or all of these criteria.

### ***Power sources***

Research on motors pointed to electric motors being the only real practicable option. Petrol motors limited to 250 watts would have a cylinder of approximate 4cc capacity, roughly the size of a standard medical syringe. A number of suppliers claim to provide petrol motors that produce 200 watts, but these would have to be governed to limit their power output to 250 watts. This was considered inappropriate as a person buying such a motor could easily tamper with it and increase its power output. Petrol motors are also incongruous with the environmental benefits of PAPCs as they produce exhaust emissions (generally increasing with age and use), and can generate considerable amount of noise, especially given the small exhaust system they use. They are also considerably heavier than electric motors, which means they generate more kinetic energy for a given speed. Apart from posing an increased risk to pedestrians on shared paths, stopping the heavier PAPC will require higher grade brakes, and this important modification may not be done if a petrol motor is retrofitted to a standard bicycle.

Nevertheless, it was decided not to make any recommendation on the power source for the revised definition on the basis that it would stifle innovation, although it will be technologically self limiting; and the type of motor used would be driven by consumer demand for lighter, 'greener' vehicles.

### ***Practical tests***

The desk-top research was supported by a range of on-road tests using a number of electric PAPCs loaned by a prospective supplier. A range of practical tests were done at the Roads and Maritime Services Crashlab facility, and along the bike lane that runs adjacent to the M7 Motorway in Sydney's northwest (the research team had to issue themselves an exemption to use the 250 watt PAPCs). The PAPCs were also tested on a dynamometer. These tests confirmed that they provided slightly less than 250 watts continuous power measured at the wheel (which is consistent to producing 250 watts at the motor), but they could produce up to 650 watts of peak power when the controls were vigorously applied.

### **Conclusions**

From the research, it was recommended that the definition for PAPCs in the ADRs be revised to incorporate the following characteristics:

- The maximum continuous power output of the motor must be limited to 250 watts.

- The power is measured at the wheel.
- The rider must pedal for the motor to activate.
- The motor must cut out when the vehicle reaches 25km/h or sooner if the rider stops pedalling.
- The PAPC may incorporate a low-speed start up whereby the motor is activated without pedalling at a speed of up to 6km/h.

### **EN 15194**

It was found that the above points aligned with the European Standard, EN 15194:2009 *Cycles - Electrically power assisted cycles - EPAC Bicycles*. This had additional benefits as it meant that models intended for the European market could be sold without restrictions in Australia. It also meant that such models would have the conformity marking required by the EU, and enable the DIT to readily assess them for import approval. Conversely, Australian companies manufacturing for the home market could also sell their product into Europe. From this, it was recommended that the European Standard EN 15194 be afforded deem-to-comply status by the DIT.

An additional benefit in aligning the definition with EN 15194 is that PAPCs that comply with this standard tend to weigh less than the more conventional types of PAPC covered by the existing definition, typically 20kg compared to weights up to 35kg. This means the kinetic energy generated by a person riding a PAPC that complies with the European standard would be almost half that generated by the same person travelling at the same speed on an older type of PAPC.

EN 15194 varies from the proposed definition as the European specifications refer to the power generated by motor itself, not the power measured at the wheel. This is not seen to be a problem as PAPCs that meet the European power limit will comply with the proposed definition as the power losses in the drivetrain mean that the power measured at the wheel cannot be greater than at the motor.

As a result of this research, it was recommended that PAPCs that comply with EN 15194 be deemed to comply with the proposed definition.

### **Enforcement**

Although primarily concerned with establishing a standard and associated definition for PAPC, the matter of practicable enforcement could not be ignored. In essence, there is no use in introducing a standard if occurrences of non-compliance cannot be enforced. Adopting the proposed definition has a number of benefits for enforcement, namely:

- The need to pedal to activate the motor is unambiguous – if a person is not pedalling but the motor is operating the vehicle is not a pedalec.
- The continuous power output at the wheel can be measured reasonably easily by a dynamometer;
- PAPCs that comply with the EN 15194 and are imported from Europe will be marked with a label indicating that they have been subjected to the conformity assessment process and they comply with the standard.

### **Finalising the proposal**

The preliminary findings were published in another paper *Technical support for the proposed new definition for power-assisted pedal cycle in Australia* and released for public comment in May 2009. A workshop was convened in August 2009, with representation from key stakeholders – federal agencies other jurisdictions, police, councils; supplier, retailers and associations.

After the workshop, the proposed definition was finalised and submitted in March 2010, along with research finding, to the DIT and the NTC for consideration for inclusion in the ADRs and the Australian Road Rules (ARR) respectively. The NTC agreed to amend the ARR, but that could only happen after the ADRs were amended. Amending the ADR turned out to be more difficult than anticipated. The DIT decided that replacing the existing definition would be considered as introducing a more stringent standard which would require full public scrutiny involving a regulatory impact statement, so it decided to retain the existing definition and include the proposal as an alternative. It also decided not to use the wording proposed but the more simple option of allowing bicycles that complied with EN 15194 as an alternative type of PAPC.

## **Current status**

### ***Australian Design Rules***

In May 2012, the ADRs were amended to incorporate the new definition of *power assisted pedal cycle*, which is:

A pedal cycle to which is attached one or more auxiliary propulsion motors having a combined maximum power output not exceeding 200 watts; or a 'Pedalec';

and *Pedalec* is, in turn, is defined as:

A vehicle meeting European Committee for Standardization EN 15194:2009 or EN 15194:2009+A1:2011 Cycles - Electrically power assisted cycles - EPAC Bicycles.

Note: Although internal combustion engines are excluded from the definition of *pedalec*, they can still meet the original definition of PAPCs.

### ***Australian Road Rules***

The NTC has included an amendment to the definition of *bicycle* to explicitly include this definition in the proposed tenth amendment to the ARR.

### ***State and Territory legislation***

Victoria and NSW amended their legislation in 2012 to accommodate the new definition, with Queensland and the ACT following earlier this year; other jurisdictions are in the process of amending their respective laws.

## **Future Directions**

### ***Definition***

The development of the new definition of PAPCs and how it is incorporated into jurisdictions' legislation is being used by the Austroads Registration and Licensing Task Force as a prototype for developing the policy framework for other lightweight 'alternative' vehicles. This is the first in four phases that will eventually see the old definition phased out, the others stages are: establishing testing and certifying requirements for Australian manufactured PAPCs already operating in the market to improve enforcement and compliance activities; developing an operating framework for the future management of PAPCs; and investigating the safety case to remove current PAPC definition (200 watt limit) from ADRs, Australian Road Rules and all relevant state based legislation.

### ***Design standards***

The Australian Standards Bicycles Committee has commenced a project to adopt EN 15194 as an Australian Standard. This will enable local manufacturers, suppliers and users have input into the standard and, ultimately, into the definition for PAPCs.

### ***Status under Consumer Law***

The Australian Standard AS/NZS 1927: 2010 *bicycles – Safety requirements*,, and this standard is called up under the *Trade Practices Act 1974 - Consumer Protection Notice No. 6 of 2004 - Consumer Product Safety Standard: Pedal Bicycles: Safety Requirements* (CPN 6), which means that bicycles supplied to the Australian market must comply with this standard. Although PAPCs are covered by the scope of the standard, they are not included in CPN 6, meaning PAPCs supplied to the market do not have to comply with the standard. The *Trade Practices Act* is administered by the Australian Competition and Consumer Commission (ACCC), and the ACCC has been approached to remove this anomaly and to include PAPCs in CPN 6. Similarly, it is anticipated that when the Australian version of EN 15194 is published, it will be referenced in CPN 6 or another ACCC CPN as a mandatory standard.

### ***Sales***

At the time of writing, there are no data on how the sale of PAPCs has been affected in the jurisdictions that have applied the new definition. It is anticipated that some figures will be available shortly and can be incorporated in the presentation at the Road Safety Policing and Education.