

From the editor

* Although being involved with OzHPV for quite a few years, especially editing HUFF I've not offered much as to where my interests lie. Building/designing HPV's would have to be my main focus but I've been interested in powering bikes for a long time now and have been surprised how much thought needs to go into the design to get it functional. The amount of articles submitted in HUFF has dropped off of late so I thought I'd put finger to keyboard and present a little of my thoughts. The following article is the first of several submissions on the subject I could possibly do so if you want to shut me up you know what to do – give me other material to print. ;-) There are quite a few Internet links included in this article for further reading with the hope this increases your knowledge of the subject and is helpful.

* You may like to get your hands on a new book just out by Andrew and Joanne Hooker riding Logo Recumbents around Australia. See info at http://www.poseidonbooks.com/ants_dust_and_flies.htm

* As a member of RACV for an extra \$20 a year you can get free transport home should you get a puncture on your bike!?? This is a new road service product called Bike Assist. It's for cyclists who experience difficulties and require roadside assistance. If a puncture cannot be repaired at the roadside or the bicycle cannot be ridden due to a mechanical problem such as a broken chain, a taxi will be dispatched to transport the bicycle and the rider to their home address or chosen destination. Some interesting info...particularly if you are planning a long trip!
<http://motoring.racv.com.au/racvm/Peacemind/membership/bikeassist.cfm>

* Greenspeed may soon have 16" Tioga Comp tyres. Ian Sims said recently '... the order for the samples has been placed. No ETA as yet.

Timothy Smith - tas@ozhvp.org.au

Get up your fellow HPV'ers nose - put a motor on your HPV

I have a reasoning that recumbents are a natural progression from upright bikes for many commuting tasks and assisting these cycles yet another progression for many. Saying that, I also have to acknowledge a strong opposition to any sort of assistance on a bike, often from the HPV community, this I believe is usually because of ignorance. If nothing else I would argue that's it's better to have someone using an electric assisted bike than driving their car to run around town. I would also argue that assistance on a bike isn't just for the mobility of the disabled. (although this is an excellent choice) Assistance give the rider the choice of commuting to work without needing to have a shower at the end of the trip and can allow a person to commute far more distance than they would normally consider. Hills are a killer for most and a well set up assist can be configured to handle the steepest hills.

I have health issues that prevent me from participating in the majority of riding over any distance but took my electric powered trike to the last OzHPV rally held in Canberra knowing I could be involved. It was a bit of a game for some spotting when I turned on the motor (as the batteries just would not last if I used it continuously all day) but I found it ideally suited to this activity and am constantly impressed with my electric US Pro Drive kit.

The law (and most people) only want a power assisted HPV but some go what I believe a little too far and fully power them. The Internet has several jet powered bikes (<http://www.outsideconnection.com/gallant/hpv/vision/>) and I saw a 12hp motor the other day on a bike. (http://www.greenspeed.us/jackal_electric_bicycle.htm)

Monash Uni has been doing a study on power assist in Australia and you can read their report at <http://www.cyclingpromotion.com/Power Assisted Bicycles Monash Final report.pdf>

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With that out of the way - Where can I get one?

I'd like to offer some power assist options that I have been involved with and I believe work quite well. There are several other OzHPV members who are probably more qualified to talk about such matters than I – Chris Curtis and Giles Puckett were (and still may be) involved in Solar races of some sort and there may be others so feel free to shout me down where I get it wrong.

There are many commercial add-on units for sale in Australia and abroad and also one could put together something workable with a few ideas and a workshop. I'm not as positive about petrol powered units as electric so this will show up in what I present here but several petrol units are available in Australia. I find that for riding around town, electric is better suited because they are quiet, can be turned on/off so much easier (you don't have to prime then pull start the thing) and (only) appear to be more legal to uninformed members of the public.

See this (ageing) web site for a broad Aussie assist options: <http://www.ihpva.org/people/tstrike/powerassist.htm>

Most of the HPV manufacturers in Australia have at one time played around with powering their machines. Greenspeed appear to sell mainly Heinzmann hub motors on their trikes but have also had Honda 'roller on the tyre' units, Martin Arnold



A Pedal Ezy with 4 stroke Honda 'roller on the tyre' unit.

from Logo trikes once produced a Honda 4 stroke powered trike and just a few days ago Wayne Kotzur emailed me to say he is building a Honda assisted low rider. Why Honda you might say. Well Honda have 3 very small, low polluting, quiet and beautiful 4 stroke motors possibly used for wipper snippers, 31cc, 22cc and now a 25cc. See <http://www.honda-engines.com/gx25.htm> They are not the only small 4 stroke manufacturers though as the Robin and Stihl 4 stroke motors appear excellent units.

Darryl Shelswell (shelco@optusnet.com.au) purchased a small gearbox of about 5:1 ratio for about \$100 from a Qld scooter shop that mates perfectly with the Honda motors.



The rubber roller is geared down by a toothed rubber belt.

So what is the legality of motors on a bike? I'm not going to go right into this right now but I can't see how any standard petrol motor (without some sort of power limiting device) could be legal in Australia on a bike. For example, even the smallest of the Honda motors mentioned above has 1.2 HP and although most States differ, 1/4HP is common as an approximate legal limit. (200w to be precise)

It's hard to know with electric either as there isn't even a clear idea of where the measurement is taken. EG Is it from the wheel? I am aware of many commercial electric units that say they comply but appear to be way over the limit if you take their stated power output into account.

3 commercial electric units I would suggest are:

Crystalyte: This would have to be the cheapest hub motors I've seen. Dale Monger is importing these and a lot of positive comment is said on the power assist internet mailing list about them. Dale said recently - "All the motor kits will be the same price, i.e - AUS \$550. For more information you can view the Crystalyte site at www.crystalyte.com. If you have any specific questions feel free to E-mail me. dale_monger@yahoo.com.au I have ordered three front hub motors and two rear hub motors (with base for cassette cluster + integrated disk), but the order has yet to be shipped. All kits are for a 26 inch wheel. If you had a specific requirement, I may be able to get the order changed.

US Pro drive motor geared down to drive the cranks using a toothed rubber belt.



I also have a number of prismatic NIMH batteries and Lithium Polymer batteries that I am currently testing and intend to sell.”

US Pro Drive: Not as cheap as the Crystalyte but an excellent unit. See <http://www.curriotech.com.au/bicycle-electric.htm>

Heinzmann: As mentioned earlier Greenspeed have these excellent motors and though not as cheap as the others, get very good reports from owners. <http://www.heinzmann.de/e/index.htm>

Build you own

There are many pitfalls building from scratch, especially in the electric area. The biggest mistake made is using equipment, especially motors and batteries not designed for the application. For example, car starter motors are an obvious for some but have proved to be nothing but troublesome in the ones I've seen. They are terribly inefficient, get hot, strip bike drive



Robin 2 stroke engine connected to the pedals through a 50:1 gearbox. Rider has to pedal when the motor is driving the cranks.

systems and are not physically made to run for periods of time. Electric model cars or aircraft motors are high powered too but I believe they are less than suitable because of their high revs (gearing is a problem) and lack of motor mass leading to difficulty in dissipating the heat generated.

If you don't have experience with electrical equipment I'd suggest using a unit out of an electric wheel chair. These can be a little heavy but are made for a similar application so should function acceptable. I have purchased through the post several motors and batteries from Alan Strang of Astec Equipment Services, a business that repairs and sells spare (new and old) parts for electric powered wheel chairs. 1213b Sturt St, Ballarat 3350, Ph 03 53324098, Mobile 019 433846, astec@vic.australis.com.au.

Alan is an electrical engineer and part of a HPV team in the World Solar Cycle Challenge so knows this area very well.

Alternatively Oatley Electronics has several motors and speed controllers for this application as well for September a complete electric bike for \$300.

<http://www.oatleyelectronics.com/bcorner.html#SC300>

Also the Australian Currie webpages have a new 450W brushed motor for \$219, 450W brushed motor kit with controller and twist throttle. For \$299.95 at http://www.curriotech.com.au/currie_scooter_spare_parts_asteroid.htm

So how can I do it?

The biggest issue I find is getting the high revs of the motor geared down to a usable drive on a bike. Below are a few suggestions but there are so many alternative ways depending on your engineering skill.

Drive roller

Petrol motors have high rev ranges so many connect the motor to a drive roller that pushes down on the tyre. This way isn't considered very efficient, can cause excessive tyre wear unless you're careful and can have slip in wet weather. Saying that it is probably the easiest method of attachment and if power loss isn't an issue (EG petrol engines) many have gone down this path. Why not have the roller drive a toothed rubber belt of which wraps around the bike tyre increasing surface area and producing less tyre wear. <http://www.ihpva.org/people/tstrike/zeta/zeta.htm>

I find this hard to get my head around but changing the size of the bike wheel being driven makes no difference to the speed when the motor is connected.



Zeta roller +belt on the tyre electric unit. Belt wraps around the tyre producing less slippage and wear.

To me this isn't so obvious as I see the drive wheel and bike wheel it runs on as a gearing ratio (like 2 cogs together) but a motor can go on any size bike wheel and the speed will be the same. It's as if the drive roller is running along the road rather than on the bike wheel as a cog pair. http://www.aerochute.com.au/Pedal_Ezy/pedal_ezy.html

Powering the cranks

For many years I resisted the idea of using a motor to power the cranks. I'm not sure why I had such strong views but I guess it was because I expect it would be hard to make the setup so one could pedal without the motor as well as power the bike without pedalling. A local Tasmanian farmer here showed me several such designs all with the motor driving the cranks so the rider has to pedal when the motor was on. They worked so well I decided to do my own and am very impressed with this method. If nothing else one has the use of all the bike gears for the motor drive as well as for pedalling. I don't have a problem having to pedal when the motor is on as I believe it looks too obvious (especially to the police) that the machine is more than human



Ex electric wheel chair motor driving the cranks.

powered which could well draw unwanted attention. When riding it's just a matter of switching off the motor when changing gears to save too much strain on the drive system. I also found I needed to build a soft start (circuit with minimal components at <http://www.ihpva.org/people/tstrike/electrike2/softstr2.gif>) to lessen the start up pressure on the bike gears, a fully variable speed control would be optimal. Cranks that have a built in ratchet are obtainable (http://www.hostelshoppe.com/atp_archives/ips_instructions.pdf) which would allow the motor to run without the rider pedalling. The key to this system is to gear the motor to the cranks in a way that produces optimal motor revolutions allowing optimal cadence for the rider. On hills the motor slows down as the trike slows (of course) drawing more current and therefore extracting more power out of the drive system. This is exactly opposite to what the rider would want as it's best to spin the cranks to save knees so gearing needs to be thought through.

Note you use a right crank and pedal on the left side too with this setup so 2 right hand thread pedals are also required and this left pedal had the possibility of unscrewing because it is mounted backwards. (although I have not experienced this yet)



A hub motor can be quite suitable to drive the cranks if mounted so the body of the motor can spin - these are designed to turn at a similar speed to cranks. See <http://todd.cleverchimp.com/bike/cp/>

Direct drive

Many (homebuilt) recumbents have in place a BB (bottom bracket, where the pedal cranks mount) in place somewhere under the seat when an old bike frame is used for the back end. This BB or a free mounted BB could be used to connect the motor to the drive wheel. For example:

- * The biggest cog on the gear cluster could be used (but I found a spacer would be needed between the 2 biggest cogs so the chains don't clash) for the drive motor and the rest of the gears on the cluster available for the rider.
- * Use a disk brake rear hub and mount a cog onto the disk mount. Alternatively purchase a disk brake adaptor for non-disk brake hubs.
- See http://nsmb.com/gear/first_principles_07_02.php or <http://www.phantomcycles.com.au/>
- * Make a spoke clamp adaptor like the Currie/US Pro drive kit. Pics at <http://www.ihpva.org/people/tstrike/uspdp/uspdp.htm>
- * Buy a Currie/US Pro drive hub (normally sold with complete bikes) that has the normal thread on the right but some sort of mount on the left.
- * Drive the front wheel on a bike.

Powered trailer

If all the power assist drive system was built into a trailer this payload can be easily disconnected leaving the bike as it originally intended. There are some beautiful examples of this on the Internet, EG Bob trailer with hub motor as the drive wheel. (<http://www.thunderstruck-ev.com/motobob.htm>)

A trailer could have a 3 speed internal hub on the wheel with an electric motor connecting to this by chain giving gears to extend the suitability. I suggest a gear cluster is less suitable, particularly



Robin 2 stroke engine driving a pancake generator. An electric motor drives the cranks from small gel batteries charged by this unit.

if the motor has just 1 speed as shifting needs to be achieved with the motor on possibly damaging the gearing as shifting would be under load.

I've had one attempt at a trailer - more info at: <http://www.ihpva.org/people/tstrike/electrailer.htm>

IC/Electric

Using a small battery, have a petrol motor drive a generator to keep the battery charged with an electric motor driving the bike. <http://www.ihpva.org/people/tstrike/electrike2/badcock.htm>

I have also come across (but getting ridiculous at the end)

* A rear hub with enough meat on the left side bearing area to cut a thread that a screw-on ratchet cog could mount so the drive to the wheel from the motor is on the left. Or, Use a flip-flop hub with a threads both sides of the hub so the drive to the wheel from the motor is on the left. Note the cog would unscrew without further attention.

* Modify a 3x7 hub so the 3 internal gears are available for the motor and the cluster gears available for the rider. <http://homepages.ihug.com.au/~aegidius/pandora.htm>

* On a trike have 2 back wheels, one for the rider and one for the motor.

* John Doubleday, an OzHPV member close to me is planning on using a mid drive US Pro drive motor and gearbox driving the rear wheel through the existing chain. This is configured so the rider can use the motor without pedalling or pedal without the motor on but have all the rear gears available for the motor. <http://www.ecospeed.net/>

* Fit a hub motor on both the front and the back. One is configured for climbing and the other for fast riding on the flat.

* Mount the motor on a backpack with a large propeller pushing the rider along. http://www.jollylox.com/cgi-local/yellowbike/pics.pl?gallery=no_gallery_yet_gallery&id=12

What sort of batteries

To keep costs down many use cheap sealed lead acid batteries. (including some/most of the commercial units) These batteries need looking after if they are to survive including:

* Keep them as charged up as possible.

* Don't run them down any lower in voltage than you can help it and definitely don't run them completely flat. Some say don't flatten them much more than 1/2 way.

* Their AH rating is a measurement taken at a much lower current draw than a power assist would take. For example a 12Ah battery may supply a small current for a long time but draw 12 amps and they probably won't last anything like 1 hour.

* These batteries don't last as long in a session if you continuously draw a lot of current out of them. In other words, allow the battery to recover a little when in use by periodically resting from use.

* Use a charger designed for the battery type. EG don't put in more current than is optimal, don't over charge and use a constant voltage charger for lead acid batteries.



US Pro drive 24 volt kit - battery incl fuse and switch under the seat.

More exotic batteries can be purchased but cost considerably more. Most systems are 24v or higher as the higher (some 72V+) the voltage the lower the current. This can translate into smaller diameter wiring possible and less resistance.

How do SLA, NiZn, Li-ion, and NIMH batteries compare? See <http://www.evdeals.com/BatteryComparison.htm>

Application

For safety I suggest including in the design a fuse or some sort of circuit breaker just in case anything goes wrong. A master key switch is also very useful so the bike can be disarmed, especially when near children or in public.

Conclusion

Putting this article together shows me the enormous information available on assist cycles as this article really only skims the topic.

If you want to find out more, on the Internet it is well worth joining these mailing lists. After joining look through the photos and files at the site as there's many hours viewing available.

Motor incl speed controller + planetary gearbox clamps to the spokes.





Ex electric wheel chair motor on a detachable trailer.

<http://www.power-assist.org/>
<http://sports.groups.yahoo.com/group/e-bents/>
<http://uk.groups.yahoo.com/group/electricbikes/>

Further reference:

www.staton-inc.com
<http://www.geocities.com/Yosemite/Gorge/9546/bikev/bikev.htm>
<http://www.ihpva.org/people/tstrike/building/powerast.htm>

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Cruzbike

I'd like to announce a new recumbent bike design being available.

Its a front wheel drive conversion kit to be applied to a dual suspension mountain bike of the kind you can get from K-mart or Toys-r-us. By taking that approach you can get a dual suspension recumbent bicycle for way, way below the usual cost. You can piggy back on low cost high volume manufacture.

Everyone's been telling me it looks great, but check for yourself: there's a small web site: www.cruzbike.com. I'm taking orders now for the conversion kit, which will cost about \$400 plus postage & packing in Australia and includes everything you need to bolt on the conversion. I'm just starting to the price kind of depends on how many orders come in.

The fully made up bike will be available in Perth later in the year. The conversion is reversible, by the way, so you can go back to the mountain bike style anytime you like. The seat that comes with the conversion kit is pressed aluminium featuring a compound curve design for comfort and strength. The seat really adds to the look of the bike.

The killer thing about this front wheel drive is that both wheels are the same size - so they look more like a regular bike than most recumbents do. Other points, you are up quite high, so plenty of confidence for riding through town. And you can ride no-hands, since its front wheel drive.

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Canberra Mob - Come and Try

Recently the OzHPV Canberra Mob held one of it's "Come and Try Recumbent" afternoons. It was organised in conjunction with Pedal Power ACT, the local cycle advocacy/commuting/recreational cycling mob.

Even though it was a cool afternoon (temperature not hip) there was a very good turn out. There were at least 20 recumbents available for people to ride and look at. This number included 8 trikes 12 bikes and 1 bent tandem.

The must have been 30 non Mob people present during the 2 & 1/2 hours we were out there and they all showed a lot of interest.

Ian Humphries (Flying Furniture Cycles) brought along parts of his fleet and was very busy answering questions and adjusting bikes for various riders. For the come and try events we use a concrete soccer (Futsal) court about 100m x 50m and so long as everybody goes the same direction, there is enough room for over 10 cyclists to circulate.

The Mob will try and run this type of event again some time later in the year. There's talk of a demonstration trike race and a come and try at the Big Canberra Bike Show to be held in September.

Come and try's are an effective way for people to see all the different types of recumbents available and also to promote OzHPV membership and maybe other state groups might like to give it a try?

The Victorians would have a walk up start having the various trike manufacturers on call, who I am sure would support such events. All you need to do is find a suitable car park or open area and advertise it in the local cycle advocacy group newsletter.

Peter Heal - heal@cyberone.com.au

Cadence on a cheap bike computer

There has been some discussion on the Internet forums recently regarding how to measure pedal speed using a standard bike computer (with no cadence function) by entering in a certain wheel size and adding magnets to the front cranks. You may have an old one lying around and want to give this a try.

Here's the formula:

$$\text{km/hr} = \text{diameter(mm)} * \text{"cadence"} * 60 / 1,000,000$$

The 60 factor converts between hours and minutes, the 1,000,000 factor between mm and km.

Synchro-pull braking mechanism

The rules for Pedal Prix racing in this country demand that both front brakes be linked to a single lever, as many of the early trikes were built without centre point steering. Plus we have had a number of customers who have only had the use of one hand, e.g. due to a stroke.

At first we modified brake levers to take two cables, and then we found a lever designed for BMXs to take two cables. However the problem was that not only did these levers need frequent adjustment, but the braking capacity was much reduced due to being able to only use one hand!

Then we came across a "magic" design. The most amazing thing about this design, was that the braking power increased with this lever over the use of separate levers! Not a large increase, but it definitely had a slight edge on the independent set up, instead of having the large reduction in braking force, that we were getting with the normal 2 into 1 levers.

Why? Dunno. We were never really able to find out.

One of the major features of the design is that it incorporates a balance bar, to balance the braking on the front two wheels. It also incorporates "Stirrups" which reduce friction at the cable ends. Strangely this ingenious design was not in production, possibly due to the fact it would NOT be a good idea to use it on an upright bike! So we have been getting them specially made, and have had them available for a couple of years.

For a photo and price, please see our Parts and Accessories page. <http://www.greenspeed.com.au/accessories.htm>

Ian Sims, Greenspeed - ian@greenspeed.com.au

You want km/hr = "cadence", therefore diameter = $1,000,000 / 60$

$$\text{Wheel diameter} = 16666.6$$

Which probably wont be accepted by your computer, so will need to use 1667 and read 8.5 km/hr as a cadence of 85.

Alternatively put 3 magnets spaced equally around, divide your circ measurement = $16666.6\text{mm} / 3 = 5555.6\text{mm}$ and that should work!! If this doesn't explain it also have a look at:

<http://www.wisil.recumbents.com/mars/pages/proj/misc/computertip.html>

Timothy Smith - tas@ozhvp.org.au

Canberra OzHPV Rally

12th, 13th & 14th November 2004

The Canberra OzHPV Mob invites all OzHPV members to Canberra for a weekend of recumbent cycling fun and activities.

This will be the second OzHPV Rally held in Canberra. The first was held in 2003 and attracted many interstate and local recumbent enthusiasts.

Cycling in Canberra comes alive during October and November with many different cycling events, such as the Mont 24 hour MTB race, the Urban Polaris, the Tour de Femme as well as various smaller rides and events, which come together to be promoted as the Canberra Festival of Cycling.

The Canberra OzHPV Mob tries to put on a major event each year during the Festival period. In previous years we have run the Canberra OzHPV Challenge, but this has been run earlier in the year in Victoria for the past two years. The Canberra Rally is intended to provide a non-competitive event for all recumbent riders to get together, ride bikes, eat food, meet other enthusiasts and generally have a good time.



The program for the 2004 event is being finalised at present and will include the following over the three days:

- Longer rides of around 40km
- Leisurely sight-seeing rides of Canberra's tourist spots
- Participation in the "non-bloke" Tour de Femme bike race
- Come and try sessions where "Joe Public" and participants can try out the many types of recumbents
- A restaurant dinner and socialising
- Workshops on various recumbent technical subjects such as carbon fibre, corflute, bike design etc.

- Demonstration of Human powered boat
- Trike racing around a city car park
- Night rides

The Rally will also be the venue for the OzHPV AGM which will take place on the Saturday night.

How much is all this going to cost? Well, unlike last year, there will be no entry fee to participate in any event (except perhaps the trike racing). We won't be hiring a special hall for the duration of the weekend.

Accommodation is up to the participant to arrange, however we are negotiating a special rate at the Canberra Youth Hostel at O'Connor <http://www.yha.com.au/hostels/details.cfm?HostelID=15> and for those wishing to camp there are several caravan parks in the same area. Canberra Motor Village, Kuznea Street, O'Connor 02 62475466

For those "non-blokes" wishing to take part in the Tour de Femme mass participation bike race, you will need to enter prior to the weekend. An OzHPV team will be taking part which other "Non-Blokes" are welcome to participate in. See following site for details: <http://www.pedalpower.org.au/events/details.asp?IntContId=200>

Please register your interest by sending an email to Peter Heal heal@cyberone.com.au or by phone 0422103139

IHPVA Human Power Archive

OzHPV members can obtain a CD of this very informative magazine. The articles date from 1977 to present day and cover every aspect of Human powered vehicles, bikes, boats and aircraft.

There's a lot of very technical articles with complicated formulas etc but it's all really good stuff.

If you are interested in building anything to do with Human Powered Vehicles, you need to have one of these CDs.

As stated the archive has been made available as the authors are establishing a web based archive and member organisations of the IHPVA such as OzHPV have been given the Cds to copy and sell to their members.

\$20 donation to OzHPV will get you a copy of the CD.

Contact me if you want one.

Peter Heal - heal@cyberone.com.au

A 3 Watt LED Bike Light

Want a really bright light that runs for days on a tiny battery? Well, technology can't deliver on that just yet, but advances Light Emitting Diode (LED) technology are bringing us ever closer to this goal.

A LED is a solid-state semiconductor component that uses electricity to make light. The concept of getting a semiconductor to emit light was originally demonstrated in 1907, but did not reach practical application until the 1970's. Since then the quest has been to develop LED's of different colours and greater brightness. LEDs that produce white light similar to that put out by a 5 Watt halogen bulb are now commercially available, and are starting to appear in commercial products.

Why use LED's? Compared to incandescent lights, LEDs are more efficient at producing light, and have lives so long that they basically don't burn out.

The appeal of using LEDs for cycle lighting is that you can get away with using a lower capacity (hence lighter) battery, and they make extremely robust and reliable lighting systems.

One of the more prominent high power LED manufacturers is Lumileds (www.lumileds.com). They make, amongst other things, 1 Watt, 3 Watt and 5 Watt white LEDs - they call them Luxeon Stars. They are available in Australia from a number of sources, such as the Alternative Technology Association (<http://shops.bizarsoftware.com.au/ATAShop>) and Oatley Electronics (<http://www.oatleyelectronics.com>).

A bare Luxeon Star LED is shown in Figure 1. It is about the size of a 10c piece. The back of the device is aluminium. The LED does get hot in operation and need some additional material to draw the heat away - in electronics parlance, a heatsink is required (see figure 2). The ability of the heatsink to keep the LED's temperature down determines to a large degree the lifetime of the LED. Keep it cool and it should last around 50 000 hours!



Adequately heatsinking the LED is important. The heatsink must have access to the open air to be able to dissipate the heat from the LED. Of about half a dozen of the homebrew LED lights I've seen only one that had adequate heatsinking.



A lens assembly is shown in Figure 3. They are available in various beamwidths: the spot beam version, with a beamwidth of about 10-12 degrees is probably the best for most bike applications.

The power for an electrical device consists of a voltage (Volts) and a current (Amps). Most devices operate at a fixed

voltage, and draw a certain amount of current at that voltage. LED's are best driven at constant current. If you drive one with constant voltage the current will tend to increase as the LED heats up, potentially destroying it. The 3 Watt LED operates well at about 0.85 Amps of current. At that current they have a voltage of 3.7 Volts.



Oatley Electronics sells a kit built specifically to power the 1 Watt and 3 Watt Luxeon LEDs. It limits the current to the LED, thus protecting it.

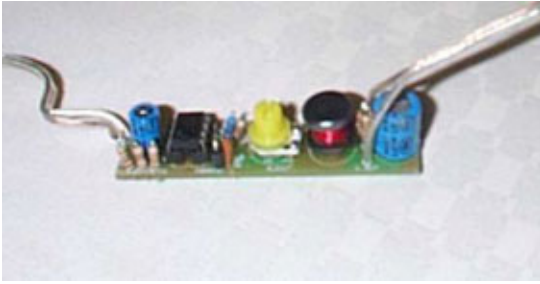
The kit also has the benefit of running off a range of input voltages. I have used battery packs with voltages between 7.2 Volts and 12 Volts without a problem with this kit.

If building up a little box of electronics is not your cup of tea then the LED can be powered with just a battery pack, and a resistor to limit the current. This approach has the advantage of simplicity, but a small amount of power will be lost in the resistor. A battery pack consisting of 3 alkaline C-cells connected end-to-end in combination with a resistor of about 0.5 Ohms does the trick. See Michael Carden's write-up of his LED light at <http://www.michaelcarden.net/luxeon/luxeon3.php> for an excellent description of how he made his lighting system.

Construction

This is how I made up my light. The lens assembly fits inside a 1 1/4" steel tube, cut from an old BMX bike. The heatsink is a cut-down CPU heatsink, as used in 486 style computer CPU's (they are available at Oatley Electronics for \$1.00). The LED is best mounted onto the heatsink with nylon nuts and bolts to avoid shorting out the LED power connections.

I used good old hot melt glue to stick the LED / heatsink assembly onto the tube, and



then positioned the lens, before sticking it in place. A bracket from a reflector serves as a mount. Hot melt glue is not all that strong, but it seems to be quite strong enough for this application.

In Use

The completed 3 Watt light puts out a similar amount of light to the 5 Watt halogen I have previously used, but it's hard to compare the two as the LED produces much whiter light, and its reflector throws the light into a broader beam. In use I've found it similar in effectiveness to the 5 Watt halogen. The advantage is that it uses less power, and provided the electronics doesn't fail, the light should be more reliable than the halogen.



Technical Stuff.

The efficiency of the Oatley Electronics power supply was measured at 74% for a 7.2 volt input. It seems this is pretty typical of such devices. For a 3 Watt load, this means the input draws about 4 Watts. The LED light, at 4 Watts is then 20% lower in power consumption for a light of similar effectiveness to the halogen.

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Corflute Vs Carbon-fibre revisited

I was not quite sure on reading Ian's article Corflute versus carbon-fibre (ED last editon of HUFF) whether the article should have carried the heading (Advertisement). While it is clearly true that Ian is a very fit, keen and competitive rider, and the M5 is perfect for him, it is less demonstrated that they are what most hpv riders are looking for.

In my experience of building recumbents since the 1980's, most of my customers refer to comfort and safety and cost as their principal concerns, as well as a smattering of injured racers and mountain bikers who cannot ride anything else. The

vast majority are happy with their bikes and trikes and show absolutely no interest in the small aero advantage they may gain. Especially in dirt touring where low speeds and mounds of luggage make the most of a recumbent ability to centralise weight distribution, provide comfortable seating ,and an unstressed hand position

While I have had some customers extremely concerned about weight (how much does the paint weigh? for instance) and aerodynamics

one must always remember that as a first approximation the rider contributes almost all the mass and almost all the drag. While the designer can set the position to some extent, it is up to the rider to make the hpv go fast.

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