Miles's Homemade Cree Q5 LED Super Caplamp!

At the time of writing, the newly released Cree Q5 LED is the brightest LED ever made. When consuming about 3.7 watts of power, it produces around 230 lumens of light. Compare this to the traditional halogen Oldham caplamp bulb, which consumes 4 watts of power and produces only 48 lumens of light. A rather uneven yellow light at that. Even the now positively outdated Luxeon III LED yields only 90 Lumens from 3 watts of power consumption - so the new Q5 really is streets ahead.

Yet there are no headlamps available yet based on this new emitter, so I decided to build my own. It wasn't particularly difficult or expensive to do and the results are impressive, please read on to follow my project….

The Base Lamp

There is no point reinventing the wheel trying to make a lighting head from scratch, so I opted for a traditional mining caplamp to be the host for my project. Originally thinking of an Oldham head, I abandoned it instead for a Youle head of around 1950's vintage. They are larger than the Oldham heads so have more space inside for the wiring and circuitry, and the reflector is made of metal rather than the Oldhams plastic. This therefore can act as a useful heatsink for the mighty Q5 LED, which gets hot!

The Battery

The battery I made myself. I took an ABS plastic enclosure and inserted into it a 4.5ah 6v Sealed Lead Acid battery. This yields 27 watt-hours, so on full whack the Q5 should light for around 7 hours on this. I could have made a bigger one but I like the small enclosure and the light weight. I could have made a very small box with six or eight 18650 Lithium Ion cells but that would have put the project cost up. I could also have used a traditional Oldham battery (4v is fine) but charging it would have been the problem as the Youle head doesn't fit an Oldham charger.

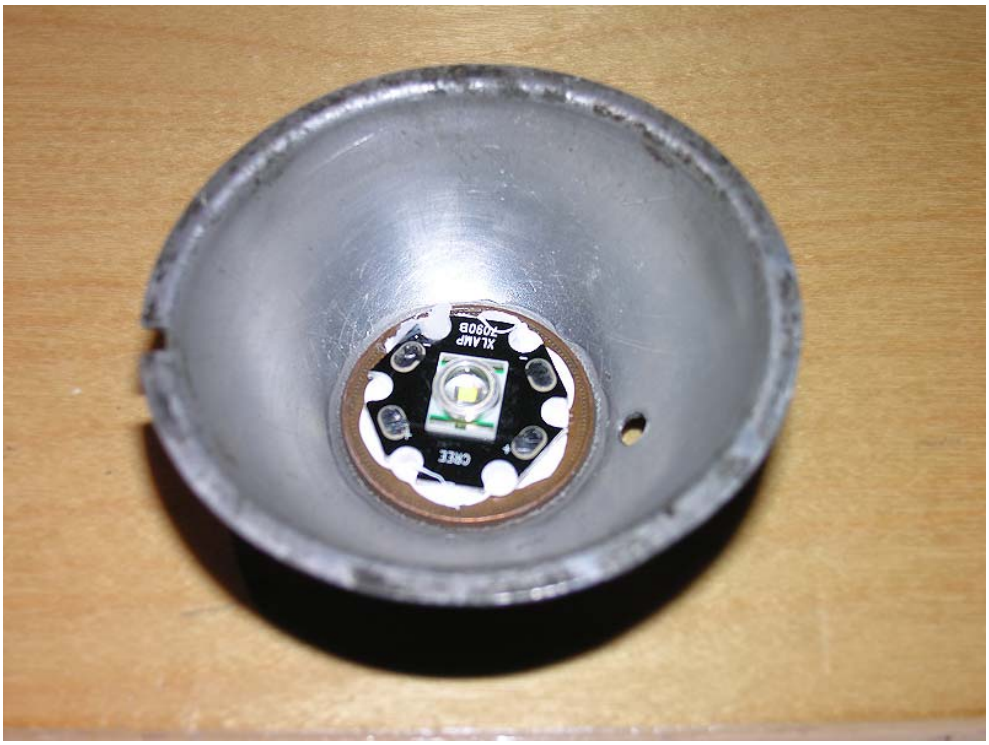
On top of the battery box I bolted a steel 2-pin plug for the charger to connect to. In order to be able to belt-mount the battery, I riveted a length of cut seat-belt type material down one side so a belt can slide through. This holds it pretty tough, but if I wanted it super tough I could have used a length of sheet metal with washers as spacers, bolted to the battery box. This setup was fine though for me.

The cable exit point was via a tough strain-relief grommet, which is very strong. As the armoured cable is securely anchored at the light end also, separating the battery and head by accident would be very hard to do! With the Youle head being unbreakable, I was confident the setup was up to tough treatment.

The Build

Stage 1 was to dismantle the Youle head and replace the aged internal wiring with some new stuff, then clear out the coal dust from whatever colliery it's been used in for probably 30-40 years. The old 3w bulb came out, and the metal reflector removed and ready for working on.

With the metal reflector out, I needed a firm base on which to mount the Q5. This would have to be flat and able to let heat move out and away as efficiently as possible. I opted to glue down a 2p coin, as it's round, copper (good heat conductivity) and just the right size. I used superglue just to hold it in place then plastered it in thermal paste to allow heat to pass from the coin to the reflector smoothly. Not a small heatsink by any means!



The next stage was to install the Q5 emitter with lots of thermal paste. I also drilled a small hold in the side of the reflector to allow the wires to pass through from the rear to the Q5.

Now you can't drive a LED like this straight from the battery, you need a regulator circuit to make sure the LED is receiving the exact power it needs to operate at full efficiency without burning out. I opted for a small cheap regulator that was designed to go in a torch, therefore it was very small. It will accept any incoming voltage from 3v to 9v, and from this output a smooth pure 3.7 volts at 1 amp, which is exactly what the Q5 needs to work at its maximum power output. It needed the wires soldering on which was a bit messy as I'm not good at soldering. It went fine though (note the extra 1p for more heatsinking!)

I was worried the wiring would come apart on the regulator when I pushed it all into the head, and also worried it could short out. So I wrapped it in heat-shrink and put a cable-tie around it to give it more strength. I also put insulated crimp-terminals on the wires connecting it to the head so it could be removed easily at a later date.

At this point I wasn't convinced all the wiring and the regulator would fit in the Youle head, but fortunately it did. On the front of the Q5 I stuck a plastic lens to give it a good beam. This funnel-shaped attachment came to the exact height of the surrounding reflector, so the front glass would sit just nice on top of it. Plastic optics like this are notorious for leaking light out of the side, which is usually a waste. Not so with this lamp – the old reflector would redirect it back out the front as a nice diffused spill light.

Only thing left to do is gently push all the wiring back into the head, screw on the front glass and bezel and turn it on!

Wow it works! And flippin ‘eck it’s bright! The regulator clearly driving it at maximum output, it wasn’t hard to believe there was 230 Lumens coming out of this caplamp. Time to wander out into the night for a test!

The Q5 Caplamp in use

Absolutely stunning. Not only is this lamp just utterly bonkers on sheer light output, it has a very good balance of spot and spill.

The spot (very centre of the light pattern) is critical for being able to see a long way underground, for route finding and staring down long tunnels to see if they ‘go’. The centre of this light travels an unbelievable distance, hundreds of feet in fact.

The spill (wide shining diffused light) is also very important for allowing your brain to interpret the terrain (low roof and rocky floor etc). If the light doesn’t have the spill right you can find yourself stumbling and banging into things a lot. I must admit I wasn’t expecting this light to have a very good spill but it sure does, very wide and even. Just perfect.

I thought I’d do some comparison photos with another lamp to show the light output.

Comparison with Stenlight S7 Headlamp

The Sten is considered by many (including me) to be leading LED based lamp, and the two Luxeon III emitters in it should be a good comparison. The Luxeon III's yield around 90 lumens each, so that's 180 in total from about 6 watts of power consumption. This new Q5 based lamp *should* theoretically be brighter even with just one emitter, whilst also consuming less than 4 watts of power.

Stenlight S7 (fitted with standard optics, set to full power): Very bright in the midrange, with a weak spill. Pretty good on range though, a nice lamp to use.

Homemade Q5 Caplamp: "Holy Boat Anchors, Batman!" The centre spot is much brighter, travelling far further. The spill is also far wider meaning it's going to be nicer to walk with. Absolutely stunning output.

Technical info on comparison: Camera on tripod set to 8 second exposure, ISO200, f2.6 for both shots. Lights held in same position (just next to camera) and shined targeted for the distant tree hanging over road.

Conclusion

Very pleased indeed – a really nice lamp. Actually the nicest lamp I've ever used, the combination of spill, spot, clear light and sheer output muscle go together to make a light with astounding performance. All wrapped up in a battery and head that's pretty tough, practical and ready for work. The comparison photos don't do it justice, this light is utterly spectacular to see with!

Project Cost

Youle Head and Cable: £5 second hand off eBay
ABS Battery Box Enclosure: £4 Maplins
2-Pin Charger Socket: £2 Maplins
Cable Exit Grommet: £2.50 Maplins
6V 4.5AH Battery: £5 Maplins
Q5 LED: £5 from Hong Kong
1A Regulator: £4 from Hong Kong
Optics: £1 from Hong Kong

Total: £28.50

Other bits used which didn't really cost anything as I had them kicking about anyway were a bit of old seatbelt, some rivets, some glue, thermal paste, crimping terminals, heat-shrink, and a 6V SLA battery charger. The latter item can be had from eBay for about five pounds plus delivery.

Build time was about two hours.

Further Notes

Although the battery box hadn't let me down I felt it was the weak link in the chain. I decided the following week to replace it with something far tougher.

For those who don't know, Coal Miners in recent years carried small stainless-steel canisters on their belts containing "Self-Rescuers", which were like simple gas-masks for use in a fire. These belt-mounted canisters were incredibly tough and had a very strong belt-mount on the side. With the self-rescuer removed, these canisters represent pretty much the toughest thing you can put on a belt, and the 6V battery fitted nicely into it, packed with holding-foam so it doesn't move about. A 16mm hole was drilled in the top to hold the cable-exit grommet, which holds the cable with a vice-like grip. Now the battery box really is ultra tough, there is no accidentally breaking this battery! Tougher now than even an Oldham battery, it's certainly ready to take any abuse that can be thrown at it.

I forgot to mention also that the regulator I used has five selectable power levels, which can be scrolled through by flipping the power switch off then on quickly. Even the lowest power mode is still really quite bright, and should provide many, many hours continuous light between recharges.

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