## **Design Mods to Improve LED Light Output efficiency**

## A Note to the LED Light production industry to do better and This is all doable with existing LEDs in a primitive environment

Most white 12 Volt LED light strips or bulbs use 3 LEDs in series with a resistor to limit the current for voltage fluctuations. In a 12 v dc system this allows the light to work when the battery is charging at 15v without harming or over driving the LEDs. These LEDs come on dimly at around 7-8VDC and get brighter as voltage increases. The resistor in this case is high in value and waists power that could be used to produce light. If 4 LEDs in series and a resistor is used then the LEDs starts to light at 10-11v DC.

However in this configuration a resistor would be chosen to limit the current in the LEDs when charging at 15 V DC. So as a result at 12 volts a lower current would result. Running a LED at lower than max improves light output efficiency of the LED and makes it last a whole lot longer. In a string of 4 LEDs in series, there is one more LED producing light from the same current so the lumen/watt or light producing efficiency goes way up. I have not seen this used in the past production designs. Yet my testing shows one can get approximately about 60% more lumen/watt running at about 20% of the original power with a 4 LED and a 22 ohm resistor instead of 3 LEDs in series with a 470 ohm resistor.

Another factor in this is that the lower the current that flows in the LED the higher the light efficient output per power input (Lumen/watt). I have found that if one uses about 1/6 to 1/10 the current of normal operation that a LED is more light output efficient. One benefit for survival needs is the LEDs last a whole lot longer than 100,000 hrs.

The above concepts would be used in a primitive environment. However, there is such a thing a PollySwitch or PollyFuse that is becoming more and more available. It is a resettable fuse that basically is a resistor that acts like a resistor at low currents. At higher currents it begins to trigger into high and higher resistance as it heats up. At high voltage it becomes a high resistance and the current drops to a safe lower level thus acting like a fuse or switch. It has a trigger current point that for high voltage Polyswitches is more gradual resistance change than for lower voltage PolySwitches.

Thus if one matches the trigger point resistance curve to the power limits of the 4 series LED's then one can use this effectively to improve LED Light output at 12 volts. The result of a properly tuned PollySwitch in series with 4 LEDs is to produce more light a lower voltage. This is because the resistance is lower at the lower voltage.

So for the optimum low power highly efficient survival lighting. I see if eventually these Polyswitches will find there way in to LED bulb and string production but for now, find the best-most efficient individual LEDs and make your own. Use a resistor for now and a Polyfuse only if you can find one to match the current and voltage needed. The most efficient LEDs that I have found to date are "3W 280LM LED Beads" from ebay. I run them at about 50-70ma where they run cool and most efficient at lumen/watt.