"This first article will raise more questions than it answers, but the aim is to generate a general awareness of what effects a torches beam of light, and carry out a little myth busting as we go along. Following articles in this series should go some way to answering any questions raised here and will certainly give far more details."

When purchasing a torch for hunting there will be curtain requirements of the torch and its accessories. Most of these will be obvious, such as the type of mount it uses or the size and weight of the torch, but probably the most critical information required, will be the torches "**beam pattern**".

The "**beam pattern**" is how the torches beam appears to light the area in front of you; how wide it is, where the brightest and dimmest parts of the beam are, and how far it throws the light (how far it enables you to see). This is what you need to know, but the only information available is the manufacturer's description and whichever power ratings they choose to use.

This information is often ill informed, inaccurate, misleading and won't help you understand how the torch actually performs.

Below is a brief list of information manufacturers usually offer you, and a simplified explanation of what it does and doesn't mean.

- **LED (Light Emitting Diode):** This, for all intents and purposes, is the type of bulb used in the torch, and is what I will be looking at in this and subsequent articles. It needs no warm up time, uses small amounts of power, is extremely robust and can lasts a life time.
- **Lumens:** Lumens, or 'out of the front' (OTF) Lumens (a slightly more realistic measurement), are measurements of all the visible light coming out of the torch in any direction. This does not tell you anything about the "**beam pattern**". The traditional home 60 watt light bulb would emit nearly 1000 Lumen of light, but imagine that attached to your gun!
- **Candlepower:** An outdated measurement of the intensity at which the light burns, but not what light you can see coming out of the torch or what the beam pattern is like.
- **Watts:** This shows how much energy is used to power the LED, but nothing at all about the light coming out of the torch. An inefficient torch will convert larger amounts of this energy into heat rather than light.
- **Q5/R2/T6 etc:** This is ***not*** the type of LED, but the LED manufacturers way of dividing LED's into what they call 'Bins'. These 'bins' give an indication of potential brightness and efficiency of the LED, but the same bin number could be applied to different types of LED's with different characteristics. This only gives a vague idea of brightness as each bin number allows for variances and the human eye can't detect small differences between bins anyway. The bins give no indication of beam pattern.

The two things which would best indicate how the torch will perform and how the "**beam pattern**" will appear in use, are the type of LED used in the torch and which lens or reflector the torch uses.

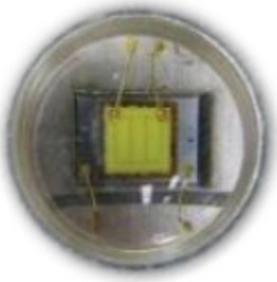
From this information you could determine the approximate width and length (the throw) of the beam and would have an idea of brightness.

"*At this point I will clarify that nothing will compare to actually using the torch in the environment it is intended to be used in, only then can you be certain of how the torch will perform*."

The LED

Every type of LED has its own characteristics and for the purpose of throwing a narrow beam of light a long way, the LED needs to produce the most intense light as is possible over as small a surface area as is possible and then project this light at a tight forward angle.
Highly efficient low wattage LED's will generate less heat than inefficient or higher wattage LED's. Heat has the most damaging effect on an LED, the more heat the LED generates the larger the aluminium body is required, to conduct the heat away from the LED. A low wattage LED can have advantages for a gun mounted torch as it will generally reduce the size and weight of the torch.

CREE, a leading LED manufacturer in the USA, make the 7090 XR-E LED. This is widely regarded as the most suitable LED for the application of throwing a narrow beam of light a long distance. Torches using this LED are not capable of emitting much more than around 250 Lumens and often much less, but if used with the appropriate lens or reflector, can achieve an extremely tight "**beam pattern**" with good throw.
There are torches which contain this LED advertised as being 600 Lumens, but this is totally impossible. Many companies which claim to be the manufacturers of torches are completely unaware of which components their torches contain, so I'm afraid a little detective work may be necessary.

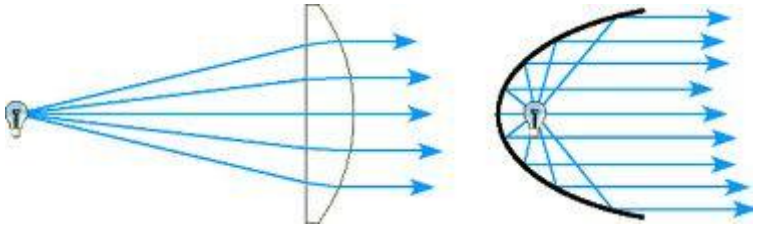


This is a close up of a CREE XR-E LED. It is extremely small, but can be identified by the metal ring around the LED and if you look closely has 3 yellow bands and 2 central bond wires. (These can just be made out within the yellow square) There are 2 types of XR-E, the EZ1000 which has a $1mm^2$ die (the yellow square) and the EZ900 which has a $0.9mm^2$ die. The EZ900 is the better one for this purpose.

The Lens/Reflector

Torches use Lenses and reflectors to gather the light emitted by the LED and manipulate it into the desired beam pattern, in this case a tight beam of light which will give a long throw.

The **Parabolic reflector** is the most common type and is the usual cup shaped reflector, and normally gives a wide general purpose beam. The wider and deeper the reflector is, the less light escapes and the more light is thrown forwards reducing the width of the beam and increasing the light intensity and distance of throw. A correctly set up polished (SMO) reflector tends to throw the light further than a rippled (OP) reflector, but has a less smooth beam pattern.
The **Aspherical lens**, which works best with the CREE XR-E LED produces the most tightly focused beam and ultimately produces a square image, which is the inverted image of the LED. The LED can also be moved backwards and forwards to alter the width and length of the beam.



The first diagram depicts an Aspherical lens, which is a domed lens but the surface is not a perfect sphere shape. The second diagram is the more common cup shaped Parabolic reflector

A graphic summary
The simplest way to summarise the information in this article is to imagine this: A hosepipe with one end connected to a water tower and the other end connected to a choice of two attachments, one a jet nozzle the other a rose (shower head).

The water tower represents the battery, the pressurised water (the amount flowing out) is representing "**Lumens**", the hosepipe (in various diameters) represents the "**LED**" and the jet nozzle or rose (shower head) represents the Lens or Reflector.

The scene is set.

Scenario 1.
Tap on full with lots of water flowing down the hosepipe, with a shower head attachment at the end.

Scenario 1 Outcome.
The high water pressure could possibly create the system to fail unless added precautions are applied (e.g. using beefed up jubilee clips). The water will spray out covering a large area up to around 10 metres. It is very hard to adjust the spread of the water.
Waters large area close to you.

Scenario 2.
Tap on two thirds power flowing down a short narrow hosepipe, with a jet nozzle at the end.

Scenario 2 Outcome.
The water is running at a lower pressure, using less water and creating less stress on the system. The water offers virtually no spread, but throws the water out in a tight stream around 20 Meters. It is quite easy to manipulate the water to give it a wider or narrower spread.
Waters very small area a long way away.

This is exactly the same for torches. It is not the amount of light produced which gives the throw, but what is done with it. It takes four times as much light to throw twice as far, so it is far easier to manipulate a smaller amount of light efficiently than to simply produce more light and all the problems that causes, such as more power required and a solution to drawing the increased heat away from the LED.