OF BULBS AND BATTERIES

BY JERRY REIMER

A crash awakens you from sleep, you reach for the bedside flashlight, snap the switch on, and command a brilliant beam adequate to illuminate and identify any potential adversary. Blinded by the light, the intruder freezes in his tracks--the cat, again. Third time this week. Off goes the beam, and the flashlight is returned to the recharger stand to await its next nocturnal call to duty. And you return to bed, trying to sleep, dreaming of feline homicide.

Or...

It's the third day on the trail. After fourteen miles, camp is chosen, meals prepared, and then consumed as night falls. Weary hikers, heavy forest, and a new moon. No campfire lounging tonight, only sleep. The familiar pain of a too full bladder awakens you.

You grab the lightweight flashlight as you exit the tent and use it to guide your journey deeper into the woods. On the return trip, you note the beam's diminished brilliance. Only a pale yellow glow remains when you reach the tent.

How can the new batteries be dead after only three nights? you wonder as you doze off again.

Clearly, the demands placed on the two flashlights are significantly different. Yet seldom are the demands of the flashlight considered when a failed bulb is replaced. Or perhaps the bulb has been replaced with a new krypton bulb (that "rivals the sun," they claim).

What are some of the technical specifications surrounding flashlight bulbs and how do bulbs affect battery life?

Not all bulbs are created equal.

Flashlight bulbs are described by their mounting base style; usually threaded or flanged. They are rated by the voltage (V) needed to operate them and by how much current (milliAmperes) they use while operating.

Listed below are the specifications of the more common flashlight bulbs.

Threaded Voltage Current

222	2.25	250 mA
243	2.33	270 mA
14	2.47	300 mA
40	6.30	150 mA
46	6.30	250 mA

Flanged	Voltage	Current
PR4	2.33	270 mA
PR2	2.38	500 mA
PR6	2.47	300 mA
PR3	3.57	500 mA
PR12	5.95	500 mA
PR13	4.75	500 mA
PR15	4.75	500 mA

Krypton	Voltage	Current
K-1	2.40	600 mA
K-2	2.40	830 mA
K-3	3.60	800 mA

Flashlight batteries are constructed in specific sizes-- the familiar AA, C, and D--and are available in either single use or rechargeable (ni-cad) types. The single-use cells, of carbon-zinc, alkaline, or whatever, all deliver 1.5 volts each. Stack two together to get 3 volts, three deliver 4.5 volts, etc.

Ni-cad batteries provide around 1.2 volts each. Two together make 2.4 volts, three, 3.6 volts, etc. Obviously, the bulb voltage needs must be met by the batteries.

All batteries are rated according to their capacity: how much energy they store. Large batteries are rated for the number of hours they can deliver 1 ampere (ampere hours). Smaller batteries are rated in milliampere (1/1000 ampere) hours (mAH).

Obtaining the mAH ratings from the various manufacturers is difficult, despite their universal claims of outlasting all the others! The mAH ratings for ni-cad batteries are more widely published, and typical ratings are as follows:

Battery	Volts	Current
AA	1.2 V	500 mAH
C	1.2 V	1200 mAH
D	1.2 V	4000 mAH

By dividing the mAH rating by the current used by a bulb, an estimate of battery life can be made. (For example: 1200 mAH C battery divided by 300 mA bulb equals 4 hours of battery life.)

When all these ratings are considered, the importance of selecting the proper bulb can be realized. Generally, for a given voltage, the bulb with the highest current will produce the greatest light, but for the least amount of time.

Thus, any bulb that uses twice the current of another bulb will only operate for half as long on the same batteries. (For example: two AA ni-cads have 1.2 V x 2 for a total of 2.4 volts at 500 mAH; paired with a PR4 bulb rated at 2.33 V and 270 mA, we have 500 mAH divided by 270 mA for a time of 1 hour, 51 minutes. Of course, using long-life alkaline cells will provide light longer than the ni-cad example indicates.)

Installing a high current bulb in a rechargeable flashlight that's used around the home is probably a good choice, based on the need for bright light for relatively short periods of time. In the field situation described at the beginning of this article, a little light goes a long way and inadvertently using the wrong bulb can result in no light surprisingly quickly.

As with all equipment, choose what you purchase based on knowledge and individual needs--even when it's as "insignificant" as a flashlight bulb.
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