Proposed Standards for Measuring Flashlight Output
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This is a proposal for a new standard for the flashlight industry. The standard is intended to provide useful information to a potential customer that can be use to compare flashlights and to eliminate the non-productive claims common in advertising. It is envisioned that this standard will be administered by a flashlight trade association. The idea for some kind of standard and a flashlight trade association was put forward by Brad Penny, president of Streamlight at the February 2003 Shot Show in Florida.

A flashlight is used to illuminate a surface. Therefore, we are looking for a way to describe how the flashlight will illuminate a surface in a way that it can be used to meaningfully compare individual flashlights. Further, the ability of the flashlight to maintain constant output while the state of the battery is changing from fully charged to fully discharged directly affects the surface illumination and useful runtime.

Units of measure:

> The metric system will be used. Distances will be in meters. Luminous flux will be in lumens. Illumination will be in lux. Time will be in hours. Angles will be in degrees. Temperatures are in degrees C.

Samples used for measuring light output:

> Light output shall be measured from fully assembled standard production units. The test units shall be selected at random from production batches. The units shall accurately represent what the customer will purchase.
>
> A minimum of 5 sample units shall be tested. If possible, sample units from multiple production batches should be tested.
>
> Batteries used for the test shall be typical of what a customer can easily purchase or what is shipped with the product, whichever results in the lower output. If there is a significant difference between these two figures, it is acceptable to prominently specify on the packaging and in the manual that specific batteries are required to obtain the rated performance and that use of other batteries will reduce performance.

Temperature:

> Tests shall be performed at 25 degrees C.
>
> If the light is designed to be hand held or otherwise mounted to improve the heat transfer during operation, it is acceptable to provide a comparable thermal path during testing.

Result values:

The results shall be an average of all tested sample units. If the ratio between the best and worst sample unit is greater than 10%, the results shall also include a standard deviation. However, if the sample size is greater that 10 and a single sample deviates significantly from the data cluster, that single sample may be discarded if it can be demonstrated that the sample was defective.

It is acceptable to understate (de-rate) performance results if the understatement is uniformly applied to all corresponding results. If the understatement is less than or equal to the worst performing sample, no standard deviation is required.

Measuring solid angles:

Many measurements in this standard require an origin for measuring solid angles. The origin for angular measurement is the center of the light emitting surface or optical focal point - whichever provides more accurate results. The axis of the solid angle aligns to the beam axis.

Measuring distances:

Distances are measured between the exterior surface of the sample unit lens and the exterior surface of the light meter lens. If either surface is not flat and perpendicular to the axis, the points on either lens that results is the greatest distance between the test unit and the light meter shall be used. If the measurement is at an angle, the point on the lens where the angle intersects the lens may be used instead of using the center of the lens.

Flux output:

Flux output is defined as the flux emitted from the flashlight in lumens.

The light output measurement shall be taken between 0.3rt and 1.0rt, where rt is the rated runtime of the light. The light output measurement must be taken at same time as the beam center brightness measurement.

Beam center brightness:

Beam center brightness is defined as the average surface illumination of a surface perpendicular to the beam axis intersected by a 10 degree solid angle in lux at 1 meter.

If a distance other than 1 meter is chosen, the data shall be normalized to 1 meter using the inverse square law. The distance chosen must allow the light meter to provide 3 significant digits of data.

The brightness measurement shall be taken between 0.3rt and 1.0rt, where rt is the rated runtime of the light. The beam center brightness measurement must be taken at same time as the light output measurement.

Beam center reach:

Beam center reach is defined as the distance in meters at which all parts of a surface

perpendicular to the beam axis intersected by a 10 degree solid angle can be illuminated to 10 lux.

Runtime:

Runtime is defined as the length of time the light output is greater than or equal to -3dB of the rated total light output.

Beam angle:

Beam angle is defined as the solid angle within which the light intensity is greater than or equal to -3dB of the rated brightness.

Beam pattern:

Beam pattern is a graph of angle versus distance where a point will receive 10 lux of illumination.

The graph shall be constructed with angle lines every 10 degrees starting with the beam axis. The beam axis shall be 0 degrees. Angle lines shall meet at either the bottom or left side of the graph and be centered on that axis.

A set of shadow lines shall denote the angle at which 100% of the light emitter is occluded by the housing. The area beyond the shadow lines may be left blank.

Beam pattern symmetry:

The beam pattern is normally symmetrical about the beam axis. However, if the beam pattern is not symmetrical, measurements should be made with the beam in the normal orientation of use. Definitions can be expanded to allow elliptic surface areas instead of circular surface areas when appropriate as long as the results state the axis dimensions and orientations. An additional graph shall be provided for each additional axis.

The graph uses a linear scale for distance, where the Beam center reach is defined as 100%. The graph should provide a 100% distance arc and a 50% distance arc.

Packaging and literature:

The following items shall be provided as a group on packaging and in literature:

* Flux output (e.g., Flux output: 15 lumens)
* Beam center brightness (e.g., Beam center brightness: 300 lux at 1 meter)
* Beam center reach (e.g., Beam center reach: 5.4 meters (17.7 feet) at 10 lux)
* Run time (e.g., Run time: 2.3 hours)
* Beam angle (e.g., Beam angle: 16 degrees at -3dB)
* Beam pattern graph (e.g., graph labeled: Beam pattern)

The unit of measure and condition are considered part of the value and should always be specified. It is permissible to add a 1 lux distance following the 10 lux distance (e.g., Beam center reach: 5.4 meters (17.7 feet) at 10 lux, 17 meters (55.7 feet) at 1 lux).

However, no other variations are permitted.

Note that values should be truncated instead of rounded. This prevents values from being accidentally overstated. Add another significant digit if you need to.

Background information:

10 lux provides good color recognition and good visual acuity. The eyes can quickly and easily adapt to this level of light when moving from a bright office environment (200 lux) to a dark environment.

At 1 lux, you can easily see and identify shapes at 3 times the distance provided by 10 lux, however color recognition deteriorates to identifying only limited colors. Visual acuity is deteriorating rapidly. Adapting to this level of light takes much longer than adapting to 10 lux.

Below this level of illumination all remaining color vision quickly disappears and visual acuity continues to deteriorate.