



*NEMA Lighting Systems Division
& American Lighting Association
Joint Document: LSD 51-2009*

Solid State Lighting—Definitions for Functional and Decorative Applications

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Contents

- 1 Background 3
- 2 Scope 4
- 3 References 4
- 4 Terminology 4
- 5 Classification: Type of Luminaire 4
- 6 Major Characteristics and Metrics for Evaluations 6
- 7 Summary 8

1 Background

The growth of white-light LED light sources for general lighting applications (known also as solid state lighting or SSL) continues at a rapid pace driven by the unique characteristics of LEDs and their energy saving potential. A wide range of lighting products is being developed, including products that permit the retrofit of existing luminaires with LEDs.

Traditionally, and especially in residential lighting, all luminaires for general illumination purposes can be classified into two types: functional and decorative. Often, there is overlap—decorative lighting, for example, may also fulfill functional needs for visibility. The point is that there are no established metrics that clearly differentiate functional and decorative luminaires. Both types use electrical energy to produce light and must meet product safety requirements such as those developed by Underwriters Laboratories (UL).

LEDs, just as other light sources, are now being used in both functional and decorative luminaires and, increasingly, the advantage of energy savings with LED sources is being recognized. Now, it may be important to define the differences between the two types of luminaires because of the way the luminaires are used and the differences in the way their energy use can be evaluated.

For functional luminaires, one agreed upon metric—luminaire efficacy (luminaire light output per input watt or lumens/watt) and its measurement method—have been established. Both U.S. federal government agencies as well as many state governments are now implementing the luminaire efficacy metric to recognize LED functional luminaire energy saving benefits. For instance, the voluntary DOE ENERGY STAR[®] Program recognizes products that comply with luminaire efficacy (and other) performance specifications.

For LEDs used in decorative luminaires, the metric of luminaire efficacy may not appropriately address the product advantages and market acceptability because of the wide range of appearance and aesthetic factors that characterize LED decorative lighting applications. However, both manufacturers and consumers recognize that energy efficiency is also an important factor in LED decorative lighting.

Therefore, the essential purposes of this joint NEMA Lighting Division and ALA document are to: (1) illustrate and clarify the differences between functional and decorative luminaire products, and (2) define the metrics needed to evaluate decorative luminaire performance using simple, feasible approaches. The methodology is designed to provide useful information to the public and it may assist the government and others in their SSL specification development.

2 Scope

This document provides definitions of functional and decorative solid state lighting luminaires (lighting fixtures) designed for general lighting applications for residential and non-residential areas. The document further provides guidelines for the specification of the major characteristics, performance criteria, and evaluation process needed for these luminaires.

3 References

ANSI/IESNA RP-16, *Nomenclature and Definitions for Illuminating Engineering*

IESNA LM-79-08, *Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products*

IESNA LM-80-08, *Approved Method: Measuring Lumen Maintenance of LED Light Sources*

4 Terminology

4.1 Functional Luminaires

Luminaires physically, electrically, and optically designed to illuminate specific visual tasks or areas with a quantifiable amount of illumination.

4.2 Decorative Luminaires

Luminaires primarily designed for their lighted as well as their unlighted appearance and aesthetic contribution to the space. Such luminaires are typically intended for use where a decorative accent or an aesthetic appearance, not a specified amount of luminaire light output, is desired. The light output of decorative luminaires is typically not intended to independently illuminate a space or a task.






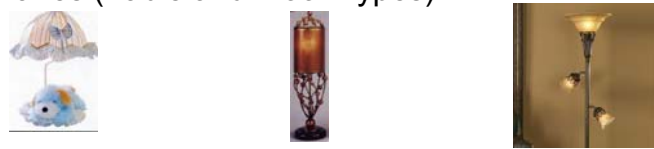



5 Classification: Type of Luminaire

Table 1 shows general classifications for functional and decorative luminaires based on product type or grouping.

- F—functional
- D—decorative
- B—both functional and decorative

It is recognized that the above classification is not completely definitive. In some cases, the same luminaire sold through different distribution channels, e.g., residential versus commercial applications, may be classified differently. For example, a wall sconce sold for residential lighting may be classified as “D,” while for commercial lighting it may be a “B.” However, the generality of the statements in Sections 6.2 and 6.3 shall remain effective.

Table 1

Luminaire Description or Style	Type
<p>Chandeliers</p> 	<p>B</p>
<p>Recessed Down-Lights</p> 	<p>F</p>
<p>Wall Sconces</p> 	<p>D</p>
<p>Surface Mount</p> 	<p>B</p>
<p>Hanging Pendants</p> 	<p>B</p>
<p>Portable Luminaires (Table and Floor Types)</p> 	<p>B</p>
<p>Track</p> 	<p>F</p>
<p>Task</p> 	<p>F</p>
<p>Accent</p> 	<p>D</p>

6 Major Characteristics and Metrics for Evaluations

6.1 Functional Luminaires

For all SSL functional lighting luminaires, regardless of application, Illuminating Engineering Society (IES) defined characteristics and corresponding metrics for evaluation and performance apply. Characteristics include, but are not limited to:

- a) Luminous flux
- b) Luminous intensity (angular) distribution
- c) Beam spread angle
- d) Illuminance and uniformity
- e) Glare
- f) Chromaticity and Color Rendering Index (CRI)
- g) Luminaire efficacy

For functional lighting, the existing IES standards (publication types including Design Guidelines, Recommended Practices, Light Measurements, Technical Memorandums, and Lighting Efficiency Managements), which include testing methods, are applicable for the performance evaluation. For the government energy saving recognition programs such as ENERGY STAR, luminaire efficacy and other performance requirements are specified. It is recommended that the DOE Quality Advocates “Lighting Facts” label be used for the luminaire.

6.2 Decorative Luminaires

There are two ways in which solid state lighting is applied to decorative luminaires:

- a) LED lamps (with the driver integrated or not integrated into the lamp assembly): An LED lamp (equipped with an ANSI-defined base) is intended to be used as a direct replacement for a conventional lamp and serves as an end-use device. There are no secondary optical or mechanical elements that further modify the LED lamp light output behavior.
- b) LED light engine: LED light sources are integrated into the luminaire where secondary optical elements such as lenses, shades, diffusers, filters, and reflectors, as well as mechanical elements, are used to modify the light output from the LED light engine.

For either of the above light source types, the performance characteristics as defined by the IES for the luminaire may not apply since the direction or quantity of light (lumens) is not of interest. Rather, the lighted appearance of the luminaire is evaluated and judged with subjective aesthetic measures such as “homogeneity,” “uniqueness,” “sparkle,” etc. These characteristics cannot be measured by instruments. They are evaluated only by human observers.

For decorative lighting, including luminaires that utilize replacement LED lamps, the suggested approach is therefore to measure the power use and light output at the light

source level for either the LED lamp or the LED light engine, rather than the entire luminaire. For example, if the device is constructed with ENERGY STAR in mind, that specification may require the LED lamp or LED light engine to have a certain efficacy (lumens/watt).

Because the performance of decorative luminaires is defined at the light source level, luminaire manufacturers seeking an ENERGY STAR qualification should utilize ENERGY STAR qualified LED light engines and label in accordance with ENERGY STAR guidelines. It is recommended that the DOE Quality Advocates “Lighting Facts” label be used for the LED light engine. Note that ENERGY STAR, at this time, does not apply to luminaires that accept standard lamp form factors.

Also, for decorative luminaires, other performance criteria listed below might be measured at the source level, if required, rather than the luminaire level, including:

- a) Luminous intensity (angular) distribution
- b) Beam spread angle
- c) Illuminance and uniformity
- d) Glare
- e) Chromaticity and CRI

6.3 Luminaires that Serve Both Functional and Decorative Purposes

To avoid confusion, this category is limited to the maximum wattage specified by the product category for the luminaire to receive ENERGY STAR markings. When the wattage exceeds the stated limit, the luminaire defaults to the functional category.

6.3.1 Luminaires using LED Lamps (Screw Base)

If LED lamps are used in luminaires such as chandeliers, hanging pendant lamps, and others, where the LED lamps are to be used to replace existing lamps (incandescent or integral CFL), the efficacy should also be measured at the light source, e.g., LED lamp level. To ensure efficiency and desired appearance of the luminaire, the following performance metrics are recommended for LED lamps intended to be direct replacements for incandescent or integral CFL lamps:

- a) Efficacy
- b) Equivalent lumen output
- c) Similar light distribution
- d) Similar color (chromaticity and CRI)
- e) Similar physical size

It is recommended that the DOE Quality Advocates “Lighting Facts” label be used for the LED lamp.

6.3.2 Luminaires using LED Light Engines

In general, an LED light engine is designed for specific luminaire(s). Because of the decorative purpose being added to the functionality, some devices that cause extra system level losses may be added to the luminaire, such as decorated glass, shades, baffles, patterned diffusing, or colored or artistic designs. The following performance criteria are therefore unimportant for the intended use of the luminaires:

- a) Beam spread angle
- b) Illuminance and uniformity
- c) Glare
- d) Chromaticity and CRI

If an LED light engine is designed and included as part of the luminaire, but can be removed from the luminaire, its performance should be evaluated as stated in Section 6.3.1. However, because the thermal and mechanical design of the luminaire will affect the LED light engine performance, the overall design of the luminaire, including thermal management and mechanical structures, should be considered and the LED light engine should be labeled with the maximum case temperature and provided with a method to verify that the combined engine and luminaire system does not exceed the thermal limit.

If the LED light engine cannot be removed from the luminaire, LED case temperature in situ should be measured, and the corresponding LED performance at the case temperature specified.

7 Summary

SSL technology is growing rapidly. There are unique opportunities to utilize LEDs in ways that will result in performance and appearance benefits as well as energy savings. Indeed, it may be some years before all of the benefits are recognized since they might involve health, productivity, or other broad societal effects.

At the current stage of development, any specifications for the metrics of evaluating SSL performance may be limited because of current knowledge and practice. Thus, there is no reason that NEMA Lighting Division or ALA should establish any guidelines that inhibit technology growth. NEMA and ALA recognize and support the need to develop and promote energy saving products and at the same time benefit consumers and allow for rapid SSL commercialization.

It is responsibility of NEMA and ALA to provide the public and government with the objective information that reflects the industry's best practices. The information listed in this document is based on this principle and should be considered as the overall industry position.