

**California Energy Commission
Voluntary LED specification**

**VOLUNTARY CALIFORNIA QUALITY
LIGHT-EMITTING DIODE (LED) LAMP
SPECIFICATION**

A Voluntary Minimum Specification for “California
Quality” LED Lamps



CALIFORNIA
ENERGY COMMISSION
Edmund G. Brown Jr., Governor

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Voluntary California Quality LED Lamp Specification Version 2.0¹

The *Voluntary California Quality LED Lamp Specification* is intended to represent a level of “ENERGY STAR plus,” that is, the specification refers to the ENERGY STAR requirements when those are sufficient for the California Specification. However, in some cases, alternative or additional requirements (or no requirements) are made. These requirements are consistent with the ENERGY STAR standards as much as possible; that is, they draw on the same test data or use similar metrics.

In terms of their equivalent requirements in ENERGY STAR, the California Specification includes the following three categories:

- A) The California requirement is based on the same test procedures as the ENERGY STAR requirement, but requires a different level of performance.
- B) The California requirement is the same as the ENERGY STAR Product Specification for Lamps.
- C) There is no California requirement for that performance metric.

Eligible Lamp Bases and Lamp Shapes²

LED lamps must be classified as either “omnidirectional”, “floodlamps,” or “spotlights”; the California Specification does not recognize any other types of lamp.

Figure 5 shows which combinations of LED lamp bases and lamp shapes are eligible for this specification. Each cell of the table shows which light distribution(s) are allowed for that particular combination of lamp base and shape.

¹ This section can be found in the original *Voluntary California Lamp Specification* in Chapter 3, page 20

² This section can be found in the original *Voluntary California Lamp Specification* in Chapter 3, pages 20-21

Figure 1 5: Eligible Lamp Bases and Lamp Shapes

		Lamp shape						
		A, B,BA,C,CA, F	G,	B,BA,C,CA, FF,	MR	PAR16, R16, PAR20, R20, BR20BR20,	PAR30, R30, BR30, PAR38. R40, BR40	JC Bi-pin, wedge, t
Lamp base	E12, E17,	X	Omnidirectional	Omnidirectional	X	X	X	X
	E26, GU-24 (120V)	Omnidirectional		X	X	Spotlight	Spotlight or Floodlamp	X
	GU-10 (120V)	X	X	X	Spotlight	Spotlight	X	X
	GX5.3 (12V)	X	X	X	Spotlight	X	X	X
	G8, G9 (120V)	X	X	X	Spotlight	X	X	Omnidirectional

Also, integrated LED lamps that include trims and are designed to be retrofitted within existing recessed can housings, and which contain one of the lamp bases listed above, are eligible as floodlamps.

Glossary³

Lighting industry terms are used in this report for which some readers may not be familiar. Lighting terminology used in this report includes the following:

“ANSI” is the American National Standards Institute. ANSI is a nonprofit organization that oversees the development (by others) of voluntary standards in the United States. It coordinates with international bodies such as the International Electrotechnical Commission (IEC) and Commission International de l’Eclairage (CIE).

“ANSI Standard Shapes” are the standard lamp (light bulb) envelope shapes defined by ANSI standards. These standards ensure that lamps from many different manufacturers will physically fit within luminaires.

“Directional lamp” refers to an LED lamp having at least 80 percent light output within a solid angle of π (pi) steradians (corresponding to a cone with an angle of 120 degrees) and intended

³ This section can be found in the original *Voluntary California Lamp Specification* in Chapter 3, page 27-28

to function as a direct replacement for reflector lamps, including ANSI Standard Shapes classified as R, BR, ER, and PAR. LED spotlights and recessed cans are usually “directional” lamps.

Steradian is a measure of solid angle, that is, an angle in three dimensions. For small solid angles, the solid angle subtended by a surface from a given point is equal to the area of the surface divided by the square of the distance between the surface and the point. A complete sphere subtends 4π steradians.

“**Efficacy**” for lamps is defined as how many lumens (quantity of light) are delivered for each watt of electricity that is consumed. This is analogous to miles per gallon for a car.

“**General service lamp**” refers to lamps used to satisfy a wide range of nonspecialized, primarily residential lighting applications that have traditionally been serviced by general service incandescent lamps. The Federal Energy Information and Security Act of 2007 defines general service lamps as typically designed for a light output between 310 and 2600 lumens and capable of operating at a voltage range at least partially within 110 and 130 volts. Examples include incandescent A-lamps, compact fluorescent lamps, and screw-based LED lamps.

“**Goniophotometer**” refers to a device used for measurement of the light emitted from an object at different angles. The use of goniophotometers has been increasing in recent years with the introduction of LED-light sources, which are mostly directed light sources, where the spatial distribution of light is not homogeneous.

“**Integrated lamp**,” when used for LED lamps, refers to an LED device with an integrated driver and a standardized base that is designed to connect to the electrical branch circuit via a standardized lampholder/socket. For example, replacement of incandescent lamps with screw-base LED lamps. Integrated LED lamps can be designed for a variety of input voltages, but the California Specification covers only those lamps designed to work at line voltage (120V).

“**Lamp**” refers to the source that creates optical radiation, also known as a “light bulb”.

“**Luminaire**” refers to the housing within which the lamp is held, which provides mechanical support and electrical power to the lamp, and reflects or diffuses the light. This is also referred to as a “light fixture” in commercial applications. Many consumers refer to luminaires as “lamps”, such as “floor lamps” or “desk lamps”.

“**Macadam ellipse**” refers to the region on a chromaticity diagram that contains all colors that are indistinguishable to the average human eye, from the color at the center of the ellipse. The contour of the ellipse. Therefore, represents the just noticeable differences of chromaticity.

“Omnidirectional lamp,” when used for LED lamps, refers to a lamp intended to function with isotropic light distribution (that is, to distribute light evenly in all directions) and intended to function as a direct replacement for incandescent A-lamps, including ANSI Standard Shapes classified as A, B, C, F, G, P, PS, S, and T.

“Planckian Locus” refers to the path or locus that the color of an incandescent black body would take in a particular chromaticity space as the black body temperature changes. It goes from deep red at low temperatures through orange, yellowish white, white, and finally bluish white at very high temperatures.

“Solid-state lighting (SSL)” is used by ENERGY STAR to mean LED. As used by ENERGY STAR, the term “solid-state” refers to the fact that the light is produced by solid-state electroluminescence, (that is, as a direct result of the passage of electricity through a semiconductor). This differs from fluorescence (used in fluorescent lamps) and incandescence (used in incandescent lamps).

California Quality LED Lamp Specification⁴

The headings below show the detailed requirements of the *Voluntary California Quality LED Lamp Specification*. For easy comparability, the headings are ordered according to the structure of the ENERGY STAR Product Specification for Lamps .

Effective Date

November 21, 2014. After this date, only products complying with version 2.0 will be considered as having met the Voluntary California Quality LED Lamp Specification.

Products that met the original version of the California Quality LED Lamp Specification and where manufactured prior to November 21, 2014 are considered to still be qualified as meeting the specification after the version 2.0 changes have become effective.

Future Specification Revisions

The California Energy Commission reserves the right to change the Voluntary California Quality LED Lamp Specification, including adopting additional selected provisions from later versions of the ENERGY STAR specification.

Definitions

Same as ENERGY STAR Product Specification for Lamps 1.1.

Test Criteria

Same as ENERGY STAR Product Specification for Lamps 1.1.

Product Qualification

Same as ENERGY STAR Product Specification for Lamps 1.1.

Methods of Measurement and Reference Documents

Same as ENERGY STAR Product Specification for Lamps 1.1.

Luminous Efficacy Requirements—All Lamps

The California Specification does not include a requirement for luminous efficacy.

⁴ This section can be found in the original *Voluntary California Lamp Specification* in Appendix A in pages 29-46. The “ENERGY STAR Version 1.0 Draft 2” language has been removed in this draft and only changes made to the “California Quality LED Lamps” portion are shown.

Elevated Temperature Light Output Requirements—All Lamps

The California Specification does not include any requirement for light output ratio at elevated temperature.

Center Beam Intensity Requirement—PAR and MR Shapes

The California Quality Specification refers to the PAR and MR lamp center-beam intensity distribution requirements in ENERGY STAR as the “spotlight” photometric distribution.

Center beam intensity requirements for “Spotlights” are the same as the center-beam intensity requirements for PAR and MR lamps in ENERGY STAR Product Specification for Lamps 1.1

Luminous Intensity Distribution Requirements—Omnidirectional Lamps

Luminous Intensity Distribution Requirements for Omnidirectional Lamps are the same as ENERGY STAR Product Specification for Lamps 1.1.

Luminous Intensity Distribution Requirements—PAR and MR lamps

The California Quality Specification refers to the PAR and MR lamp luminous intensity distribution requirements as the “spotlight” photometric distribution.

Luminous intensity distribution requirements for “Spotlights” are the same as the luminous intensity distribution requirements for PAR and MR lamps in ENERGY STAR Draft 2.

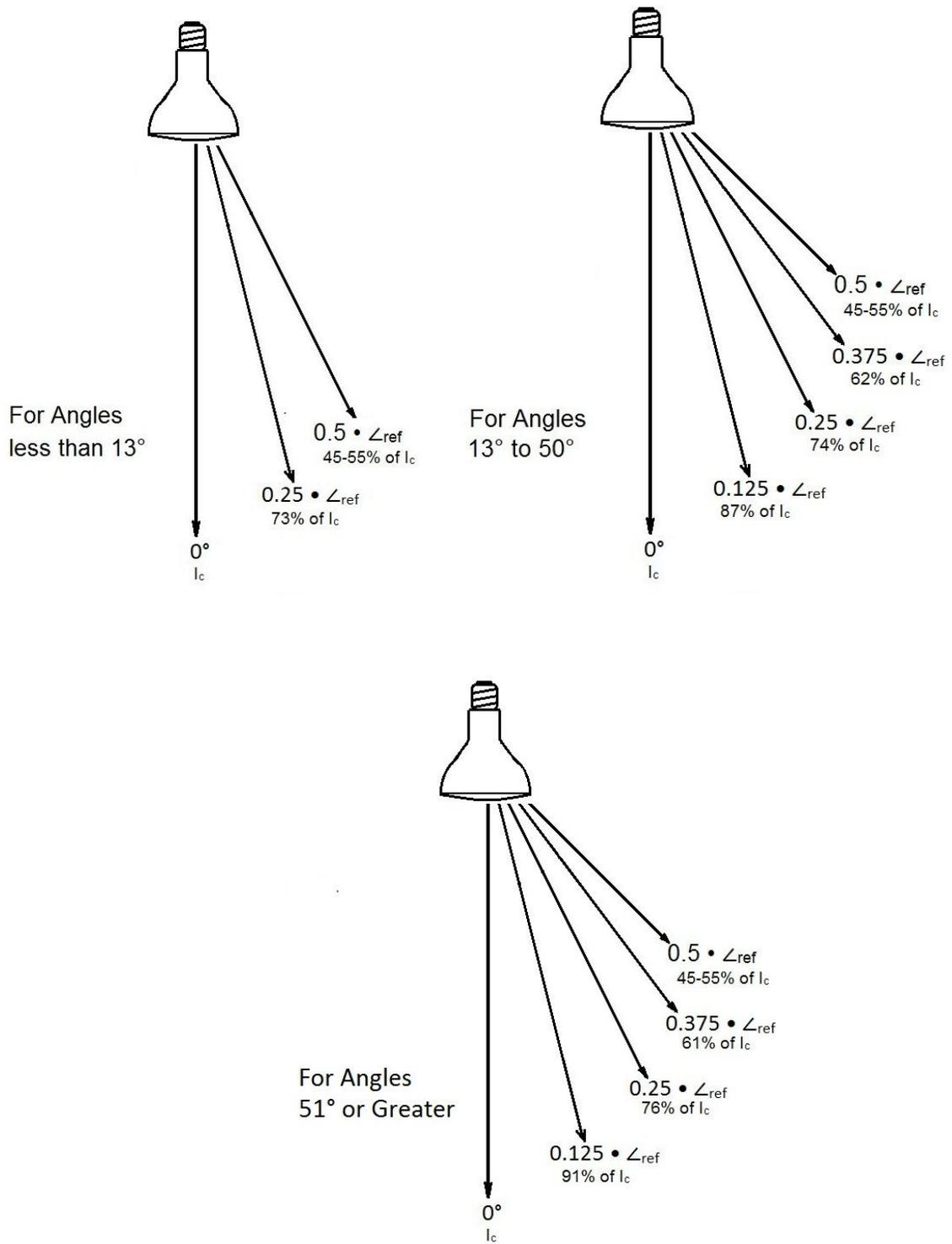
Also, the California Specification recognizes “floodlamp”-style lamps. Floodlamps complying with the Voluntary California Quality LED Lamp Specification must meet the following requirements:

- Luminous intensity shall not increase from any given angle of elevation to the next, over the range 0° to 90°, for each of the azimuthal planes.
- Beam angle shall be between 45° and 110°. Beam angle is defined as two times the elevation angle at which the intensity falls to half the peak (center-beam) intensity.
- At least 10 percent of the total flux (lumens) must be emitted in the 60°-90° zone.
- Distribution shall be vertically symmetrical as measured in three vertical planes at 0°, 45°, and 90°.

Luminous Intensity Distribution Requirements—Recessed Can Housing Retrofit Kits

Recessed can housing retrofit kits must comply with the luminaire zonal lumen density requirements for commercial and residential recessed downlight luminaires.

ENERGY STAR Draft 2 Luminous Intensity Distribution Diagrams for Directional Lamps



Correlated Color Temperature (CCT) Requirements—All Lamps

Correlated Color Temperature (CCT) requirements and test methods same as ENERGY STAR Product Specification for Lamps 1.1 with the following modifications:

Lamps must have correlated color temperatures of 2700K or 3000K. Lamps must fall within a 4-step MacAdam ellipse from the designated CCT.

Color Rendering Requirements—All Lamps

Correlated Color Temperature (CCT) requirements and test methods same as ENERGY STAR Product Specification for Lamps 1.1 with the following modification:

Lamps shall have a color rendering index ≥ 90 , and a $R_9 > 50$.

Color Maintenance Requirements—All Lamps

Color maintenance requirements same as ENERGY STAR Product Specification for Lamps 1.1.

Color Angular Uniformity Requirements—Spotlights Only

Color Angular Uniformity Requirements are the same as ENERGY STAR Product Specification for Lamps 1.1.

Lumen Maintenance and Rated Life Requirements

The California Specification does not include a requirement for lumen maintenance.

Rated Life Requirements—All Lamps

Rated Life Requirements same as ENERGY STAR Draft 2 for SSL.

Rapid Cycle Stress Test—All Lamps

The California Specification does not include a requirement for rapid cycle stress testing.

Electrical Safety Requirements—All Lamps

The California Specification does not include a requirement for electrical safety.

Power Factor Requirements—All Lamps

All California Quality LED lamps shall have a power factor ≥ 0.9 .

Operating Frequency Requirements—All Lamps

The California Specification does not include a requirement for operating frequency.

Start Time Requirements—All Lamps

The California Specification does not include a requirement for start time.

Dimming Requirements--All Lamps

All California Quality LED lamps shall be capable of continuous dimming, flicker and noise free, from 10-100 percent. For these lamps, the specification uses the dimmability requirements in the ENERGY STAR Product Specification for Lamps, Version 1.1.

The test procedures (e.g., for flicker and noise) used in the California Specification shall be those contained within ENERGY STAR Product Specification for Lamps 1.1. However, the California Specification still requires dimming down to 10%.

Transient Protection Requirement—All Lamps

The California Specification does not include a requirement for transient protection.

Noise Requirements—All Lamps

All LED lamps shall be free of noise over the full range of operation from 10%-100% output.

Lamp Toxics Reduction Requirements—All Lamps

The California Specification requires that the lamp be manufactured in compliance with all applicable California law regarding toxic material content and recyclability.

Lamp Shape Dimensional Requirements—All Lamps

All ANSI Standard Lamps are the same as ENERGY STAR Product Specification for Lamps 1.1 for those products within the scope of the California Quality LED Lamp Specification. Recessed can housing retrofit kits do not need to meet this shape requirement.

Lamp Thermal Requirements—All Lamps

The California Specification does not include a thermal requirement.

Lamp Labeling, Packaging, and Warranty Requirements—All Lamps

Lamp Labeling Requirements are the same as ENERGY STAR Product Specification for Lamps 1.1.

Lamp Packaging Requirements are the same as ENERGY STAR Product Specification for Lamps 1.1 with the following modifications:

To meet the specification, lamps must also include information about dimmer compatibility on their packaging. This information may be a URL or QR code that links to a regularly updated list of compatible dimmers.

Lamps must also include information about their luminous intensity distribution on their packaging. One of the following three descriptions must be printed on the exterior of the packaging, in => 8 point type:

- “Omnidirectional”
- “Floodlamp, [beam angle]° beam angle”
- “Spotlight, [beam angle] ° beam angle”

As an alternative to the luminous intensity descriptions above, for floodlamps and spotlights, the exterior of the lamp packaging may carry the “non-standard light output diagram” from the lamp labeling requirements of ENERGY STAR Product Specification for Lamps, Version 1.0, DRAFT 2.

Warranty Requirements

All California Quality LED Lamps shall be backed by a minimum five-year warranty, from date of purchase.

Lamp packaging shall state: “Warranty: This lamp has a [warranty term]-year, free replacement warranty”, and a phone number or website address for consumer complaint resolution. The complete written warranty shall be printed on the exterior of the packaging and be included within the lamp packaging.

The manufacturer of the lamp is solely responsible for honoring this warranty; intermediate parties (e.g. showrooms, electrical distributors, retailers) are not responsible for honoring this warranty requirement.