California Investor Owned Utilities (IOUs) LED Report Submittal Procedures

Rev. 6-30-2015

The Voluntary California Quality Light-Emitting Diode (Led) Lamp Specification

If you are a participating manufacturer, you may be asked to submit test reports and product samples according to these procedures. Make sure your reports cover all the feasible aspects required by the California Energy Commission (CEC) published Voluntary California Quality LED Lamp Specifications (the CEC Specifications). The CEC Specifications are not to be confused with the Title 24 specifications, which are for new construction.

The CEC Specifications at present are a combination of two documents found at the CEC website. This is because the first version was published in December 2012, then later a section was revised and adopted in January 2015. It only replaced one section of the first version, specifically Chapter 3. The other sections are still valid. So it is important to understand both documents. No new document was issued that includes both the new text and the still relevant older text. If anything in the new version contradicts the older version, the new version shall prevail.

The documents can be found at these addresses:

New revision: http://www.energy.ca.gov/appliances/led_lamp_spec/documents/

Older version: http://www.energy.ca.gov/2012publications/CEC-400-2012-016/CEC-400-2012-016-SF.pdf

If you cannot find them, request the documents from negraeber@ucdavis.edu or Richard.greenburg@sce.com.

Nicole Graeber of the California Lighting Technology Center at University of California, Davis (CLTC) is the contact for all reviews of both products and reports pertaining to compliance with the CEC Specs. Richard Greenburg is the California Investor Owned Utility (IOU) Statewide Lighting Lead. Your contacts for PG&E and SDG&E, the other IOUs, regarding these issues have not changed. The IOU Program Managers are the final decision makers in granting fund reservations and allocations to manufacturers for the Primary Lighting Program.

Selecting Models for Participation

For each model you would like to see participate, first check with the three California IOU Program Managers about whether it is a good fit for each of their programs in order to concentrate your time into providing reports for only those that are. To save you time and expense, please do not submit unsolicited reports or samples.

When an IOU Program Manager notifies the CLTC of a manufacturer of interest, with specific model numbers requiring report review, that triggers the CLTC to send you this document and associated form(s).

For each model that is found to be a good fit for at least one utility, submit the reports and samples to the IOU's Reviewer (currently Richard Greenburg of SCE) as explained later in this document. The Reviewer's task will be to organize findings and send them to the IOU Program Managers, not give pass/fail ratings. Each IOU will make its own determination of product fit for their program. Therefore, this is not a process for a product to become qualified or certified. Our findings will not be definitive for manufacturers to use for promotional purposes.

To expedite our review process, we prefer that manufacturers do not send scanned versions of the test reports, or pdfs that do not allow copying of the text, but versions from which we can copy and paste. Submit all reports and files as specified below.

All LED lamps for Upstream programs (Primary Lighting / Residential Lighting Incentive Program) must meet all testable aspects of the CEC Specifications and pass observational dimming review. A high level recap of the CEC Specs include:

CRI of 90 or >; PF of .9 or >; R9 of > 50; nominal CCT of 2,700 or 3,000, X and Y color coordinates must fall within the 4 Step MacAdam ellipse around the ANSI SSL center point; A-lamp must be omnidirectional according to ENERGY STAR® v 1.1 Program Requirements; to be called a flood lamp a product must have a minimum 45 degree beam angle meeting applicable ENERGY STAR non-PAR directional lamp requirements and stricter CEC lamp requirements stated in the applicable section below; Min. 5 year free replacement warranty must be printed on package in entirety with a phone number or web address to contact for warranty replacement; the beam angle must be printed on the package except for omnidirectional lamps. The package text must include either "Floodlamp", "Spotlight" or "Omnidirectional". The package must include minimum starting temperature. If a PAR or MR lamp, the beam angle must be printed on the lamp itself in lieu of lumen output; must dim smoothly without visible flicker or audible noise down to 10% of light output.

Lamps must meet or exceed all current applicable specifications in the ENERGY STAR Program Requirements for Lamps. Recessed retrofit kits must meet or exceed all current applicable specifications in the ENERGY STAR Program Requirements for Luminaires. In addition, they must meet all aspects of the CEC Specifications.

The observational dimming review by, or on behalf of, the utilities checks for flicker and noise, as well as dimmer compatibility over a variety of dimmer types. Flicker test results for ENERGY STAR must be submitted and indicate percent flicker at 30% or less at maximum and minimum light output tested. Noise test results for ENERGY STAR must also be submitted and meet the ENERGY STAR requirements including a maximum noise level of 24dBA at 1 meter or less for at least 80% of lamps tested.

LM-79 Report

The LM-79 Report must be a full report, not a synopsis, summary or abbreviated version. It must show laboratory accreditations, authorizations, or memberships indicating its credentials. The test typically should report, as applicable, the nominal and measured standard electrical and photometric data. It should also include a photograph of the product. It must record chromaticity coordinates X, Y, U' and V' as well as Duv. R-9 must be reported. A preference would be to include a Color Rendering Index Detail chart (somewhat similar to the one below

Color Rendering Index Detail								
R1	R2	R3	R4	R5	R6	R7	R8	Ra (CRI)
81.1	87.7	91.7	80.2	79.4	82.0	86.5	67.6	82.0

Color Rendering Index Detail (Expanded)								
R9	R10	R11	R12	R13	R14			
23.7	69.4	76.5	63.6	82.2	94.6			

These charts are common in LM-79 reports. However, if it is not practical for a manufacturer, it will be acceptable to include the measured R9 value in the list of criteria and findings of the LM-79 or ZERO Hour Report, and that will suffice for this requirement. Some accredited testing labs will customize the LM-79 report to address CEC Specifications, such as the 4-step MacAdam Ellipse. Reports that are inclusive of CEC requirements are appreciated as long as they also

serve the purposes of complete LM-79 reports. It is permissible to label them CEC Specification Reports. All reports must be from a laboratory that meets the ENERGY STAR requirements for accreditation.

ENERGY STAR beam distribution standards will apply to Directional Lamps. The CEC Specifications for **flood lamps** contain the following additional, more stringent beam distribution requirements for these products than ENERGY STAR:

- 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°.

Other Directional lamps like PARs and MRs must meet the ENERGY STAR beam distribution standards. No extra requirements of that type are found in the CEC Specifications for PARs and MRs. Recessed can housing retrofit kits must comply with the luminaire zonal lumen density requirements for commercial and residential recessed downlight luminaires, such as are found in the ENERGY STAR luminaire program requirements.

Make sure the LM-79 report has a Candela Tabulation Measurements chart similar to the example below. The table need not be exactly the same, but must be thorough enough to satisfy the ENERGY STAR and CEC Specifications candela tabulation reporting requirements.

These are the ENERGY STAR candela tabulation requirements for omnidirectional lamps:

> Lamp luminous intensity shall be measured about the lamp (polar) axis, in maximum increments of 22.5° from 0° to 180° about the polar axis. Within each vertical plane luminous intensity measurements shall be taken from 0° to 135° at 5° vertical angle increments (maximum).

For the California review process, the table can cover X Axis values up to 180 degrees, or up to the full 360 degrees if preferred. On the Y Axis, the table can cover values up to 135 degrees, or up to 180 degrees if preferred.

Below is a sample candela table using 180 degrees for both X and Y axes.

Candela Tabulation

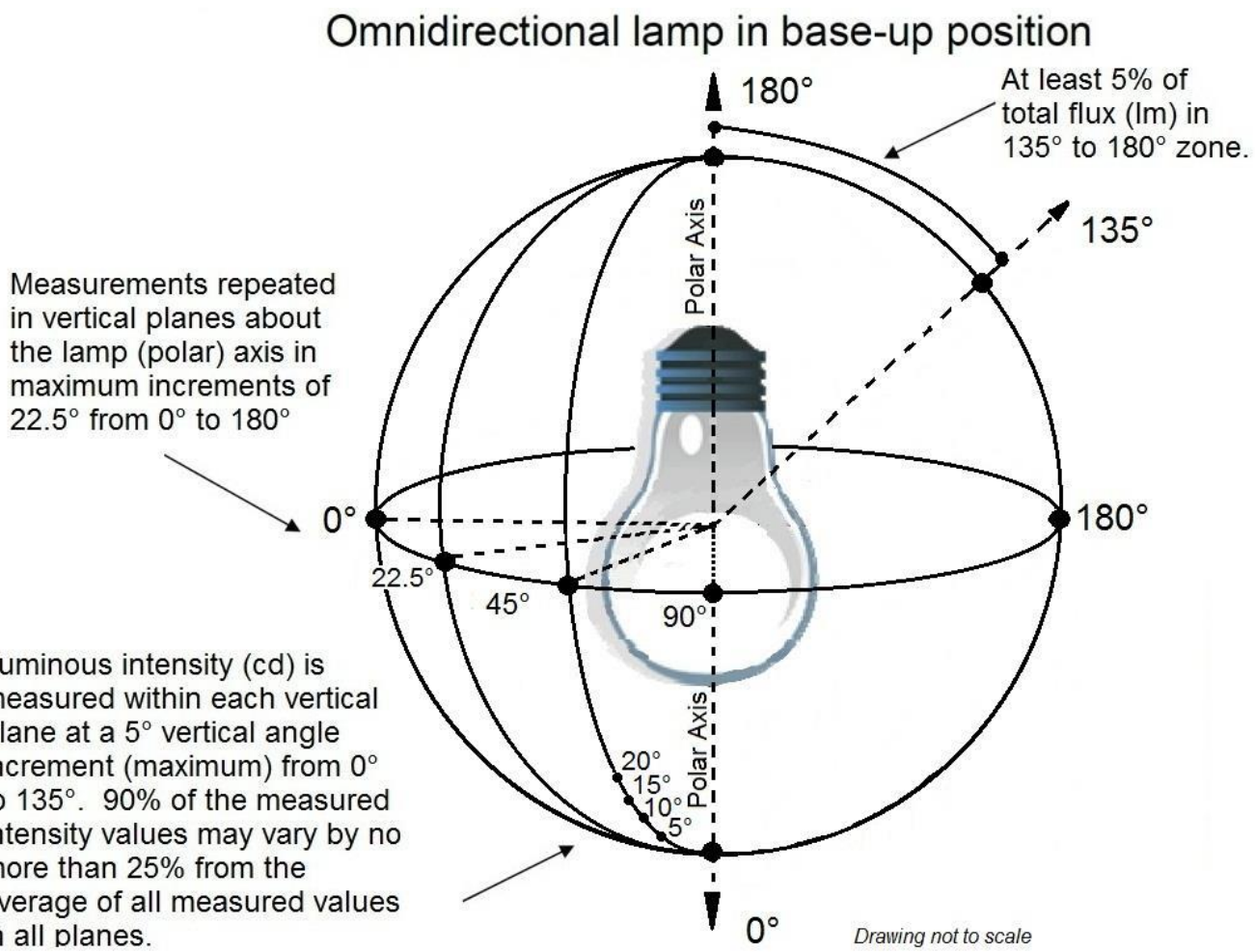
Degrees	**0**	**22.5**	**45**	**67.5**	**90**	**112.5**	**135**	**157.5**	**180**
0	56.1	56.6	56.3	56.4	56.7	56.2	56.6	56.7	56.4
5	57.4	57.4	57.7	57.9	57.8	57.5	57.4	56.9	56.9
10	57.9	57.1	57.9	57.2	57.1	57.7	57.9	57.6	56.2
15	58.2	58.4	58.6	58.3	57.4	57.8	57.2	57.4	57.3
20	59.3	59.9	59.4	59.7	58.9	58.1	58.5	58.9	58.7
25	60.7	60.2	60.1	60.9	60.2	60.4	59.7	59.2	59.9
30	62.9	62.3	62.4	61.6	61.3	61.9	60.8	60.5	60.6
35	64.6	64.7	64.9	63.4	63.7	62.2	62.1	61.7	61.4
40	66.4	66.9	66.2	65.1	65.9	64.3	63.4	63.8	63.9
45	68.9	68.6	68.3	68.4	67.6	66.7	65.9	64.1	64.2
50	70.2	71.4	71.7	70.9	69.4	68.9	67.2	66.4	66.5
55	73.5	73.9	73.9	72.2	70.4	70.6	59.3	67.9	67.7
60	74.7	75.2	75.6	74.3	72.9	71.4	70.7	69.2	68.8
65	76.8	77.5	77.4	75.7	73.2	72.4	71.9	70.3	69.1
70	77.1	78.7	78.9	76.9	74.3	73.9	72.6	70.7	69.4

75	78.4	79.8	79.2	77.6	75.7	74.2	73.4	71.9	70.9
80	78.9	79.1	80.5	77.4	75.9	74.3	73.4	71.6	70.7
85	78.2	79.4	80.7	77.9	75.6	74.7	73.9	71.1	70.9
90	78.3	79.9	80.8	78.2	75.4	74.9	74.2	71.4	70.6
95	77.7	79.2	80.1	78.5	75.9	75.6	74.3	72.9	71.4
100	77.9	78.3	79.4	77.7	75.2	75.4	74.7	72.2	74.3
105	76.6	77.7	78.9	77.8	73.5	74.9	73.9	71.3	70.1
110	75.4	76.9	76.2	75.1	71.7	73.2	72.6	70.7	70.4
115	73.9	74.6	74.3	73.4	69.8	71.5	70.4	69.9	68.9
120	70.2	71.4	71.7	70.9	66.1	69.7	68.9	67.6	66.2
125	67.5	68.9	68.9	67.2	62.4	66.8	65.2	64.4	63.3
130	63.7	64.2	64.6	63.3	62.9	62.1	62.5	61.9	60.7
135	59.8	59.5	60.4	59.7	58.2	58.4	58.7	57.2	56.9
140	54.1	55.7	55.9	54.9	54.3	53.9	53.8	53.5	52.6
145	49.4	50.8	50.2	49.6	48.7	48.2	48.1	48.7	57.4
150	44.9	44.1	44.5	44.4	43.9	43.3	43.4	43.8	52.9
155	38.2	39.4	39.7	38.9	38.6	38.7	38.9	37.1	37.2
160	33.3	33.9	33.8	33.2	32.4	32.9	32.2	32.4	32.5
165	28.7	28.2	28.1	28.5	28.9	27.6	28.3	28.9	27.7
170	21.9	21.3	22.4	21.7	20.2	19.4	21.7	19.2	18.8
175	5.6	5.7	5.9	4.8	4.5	4.9	3.9	2.3	1.1
180	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Pertaining to light distribution measured through Candela Tabulation, the ENERGY STAR and CEC Specification omnidirectional tolerances are:

> 90% of the luminous intensity measured values (candelas) shall vary by no more than 25% from the average of all measured values. All measured values (candelas) shall vary by no more than 50% from the average of all measured values.

The illustration below, taken from the ENERGY STAR specifications, characterizes these tolerances visually.



If the product is omnidirectional, make sure the LM-79 report includes a Zonal Lumen Summary chart similar to the one below. It need not be exactly the same. Our preference would be to report at 5 degree increments, rather than 10 degree. This chart is also required for other lamp types if the Beam Angle is not stated explicitly in the LM-79 report.

Zonal Lumen Summary

Zone	Lumens
0-10	11.47
10-20	33.54
20-30	53.12
30-40	68.81
40-50	79.54
50-60	84.79
60-70	84.77
70-80	80.28
80-90	72.51
90-100	62.68
100-110	51.89
110-120	41.15
120-130	31.19
130-140	22.50
140-150	15.37
150-160	9.84
160-170	5.37
170-180	0.24

The CEC Specification requires conformity to the ENERGY STAR Draft zonal lumen tolerances which for omnidirectional lamps are:

> No less than 5% of total flux (zonal lumens) shall be emitted in the 135° to 180° zone."

Below is an example of the spreadsheet used to evaluate the omnidirectional tolerances by the Reviewer. It is provided to give a graphic mathematical display of this part of the review process. Values are input from candela and zonal lumen tables you provide. If data in your pdf cannot be copied and pasted, it would be very helpful to the Reviewer if you provide a spreadsheet with the same values that can be copied and pasted as shown below.

Candala Table

Degrees	0	22.5	45	67.5	90	112.5	135	157.5	180	Pass - at least 5% in 135-180 zone **Are at least 5% of values in the Zonal Lumen Summary in the 135 to 180 degree zones?**	Pass **Percent of cells in 0-135 degree zones within 25% of average. Must be 90% or more.**	Pass - All values within 50% **Are all values within 50% of average?**
0	56.10	56.60	56.30	56.40	56.70	56.20	56.60	56.70	56.40	0	100%	Yes
5	57.40	57.40	57.70	57.90	57.80	57.50	57.40	56.90	56.90	1.819		
10	57.90	57.10	57.90	57.20	57.10	57.70	57.90	57.60	56.20	5.439		
15	58.20	58.40	58.60	58.30	57.40	57.80	57.20	57.40	57.30	9.037		
20	59.30	59.90	59.40	59.70	58.90	58.10	58.50	58.90	58.70	12.617		
25	60.70	60.20	60.10	60.90	60.20	60.40	59.70	59.20	59.90	16.197		
30	62.90	62.30	62.40	61.60	61.30	61.90	60.80	60.50	60.60	19.779		
35	64.60	64.70	64.90	63.40	63.70	62.20	62.10	61.70	61.40	23.344		
40	66.40	66.90	66.20	65.10	65.90	64.30	63.40	63.80	63.90	26.833		
45	68.90	68.60	68.30	68.40	67.60	66.70	65.90	64.10	64.20	30.177		
50	70.20	71.40	71.70	70.90	69.40	68.90	67.20	66.40	66.50	33.294		
55	73.50	73.90	73.90	72.20	70.40	70.60	59.30	67.90	67.70	36.103		
60	74.70	75.20	75.60	74.30	72.90	71.40	70.70	69.20	68.80	38.524		
65	76.80	77.50	77.40	75.70	73.20	72.40	71.90	70.30	69.10	40.483		
70	77.10	78.70	78.90	76.90	74.30	73.90	72.60	70.70	69.40	41.931		
75	78.40	79.80	79.20	77.60	75.70	74.20	73.40	71.90	70.90	42.843		
80	78.90	79.10	80.50	77.40	75.90	74.30	73.40	71.60	70.70	43.208		
85	78.20	79.40	80.70	77.90	75.60	74.70	73.90	71.10	70.90	43.038		
90	78.30	79.90	80.80	78.20	75.40	74.90	74.20	71.40	70.60	42.357		
95	77.70	79.20	80.10	78.50	75.90	75.60	74.30	72.90	71.40	41.205		
100	77.90	78.30	79.40	77.70	75.20	75.40	74.70	72.20	74.30	39.628		
105	76.60	77.70	78.90	77.80	73.50	74.90	73.90	71.30	70.10	37.644		
110	75.40	76.90	76.20	75.10	71.70	73.20	72.60	70.70	70.40	35.291		
115	73.90	74.60	74.30	73.40	69.80	71.50	70.40	69.90	68.90	32.625		
120	70.20	71.40	71.70	70.90	66.10	69.70	68.90	67.60	66.20	29.704		
125	67.50	68.90	68.90	67.20	62.40	66.80	65.20	64.40	63.30	26.598		
130	63.70	64.20	64.60	63.30	62.90	62.10	62.50	61.90	60.70	23.388		
135	59.80	59.50	60.40	59.70	58.20	58.40	58.70	57.20	56.90	20.159		
140	54.10	55.70	55.90	54.90	54.30	53.90	53.80	53.50	52.60	16.996		
145	49.40	50.80	50.20	49.60	48.70	48.20	48.10	48.70	57.40	13.981		
150	44.90	44.10	44.50	44.40	43.90	43.30	43.40	43.80	52.90	11.18		
155	38.20	39.40	39.70	38.90	38.60	38.70	38.90	37.10	37.20	8.638		
160	33.30	33.90	33.80	33.20	32.40	32.90	32.20	32.40	32.50	6.323		
165	28.70	28.20	28.10	28.50	28.90	27.60	28.30	28.90	27.70	4.021		
170	21.90	21.30	22.40	21.70	20.20	19.40	21.70	19.20	18.80	1.626		
175	5.60	5.70	5.90	4.80	4.50	4.90	3.90	2.30	1.10	0.196		
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.001		

Spotlights

ENERGY STAR requires that for all directional LEDs (like BRs, PARs, and MRs), the Color Angular Uniformity must meet these requirements:

> Variation of chromaticity across the beam angle of the lamp shall be within a total distance of 0.006 from the weighted average point on the CIE 1976 (u'v') diagram.

The color uniformity table must be provided, either in the LM-79 or in the ENERGY STAR Zero Hour Test Report. It is also known as the Color Spatial Uniformity table. It should look similar to the table below.

4.7 Color Spatial Uniformity

Beam Angle	0° Vertical Plane (u')	Deviation (≤0.006)	0° Vertical Plane (v')	Deviation (≤0.006)	90° Vertical Plane(u')	Deviation (≤0.006)	90° Vertical Plane(v')	Deviation (≤0.006)
-40	0.2494	0.0013	0.5214	0.0014	0.2502	0.0001	0.5222	0.0002
-35	0.2493	0.0014	0.5209	0.0019	0.2498	0.0005	0.5212	0.0012
-30	0.2496	0.0011	0.5210	0.0018	0.2499	0.0004	0.5212	0.0012
-25	0.2499	0.0008	0.5218	0.0010	0.2503	0.0000	0.5220	0.0004
-20	0.2504	0.0003	0.5226	0.0002	0.2506	0.0003	0.5229	0.0005
-15	0.2502	0.0005	0.5230	0.0002	0.2504	0.0001	0.5233	0.0009
-10	0.2500	0.0007	0.5231	0.0003	0.2500	0.0003	0.5232	0.0008
-5	0.2505	0.0002	0.5234	0.0006	0.2501	0.0002	0.5231	0.0007
0	0.2509	0.0002	0.5233	0.0005	0.2505	0.0002	0.5230	0.0006
5	0.2508	0.0001	0.5226	0.0002	0.2499	0.0004	0.5221	0.0003
10	0.2504	0.0003	0.5217	0.0011	0.2499	0.0004	0.5214	0.0010
15	0.2501	0.0006	0.5214	0.0014	0.2497	0.0006	0.5212	0.0012
20	0.2504	0.0003	0.5222	0.0006	0.2494	0.0009	0.5213	0.0011
25	0.2514	0.0007	0.5234	0.0006	0.2505	0.0002	0.5225	0.0001
30	0.2524	0.0017	0.5243	0.0015	0.2509	0.0006	0.5230	0.0006
35	0.2529	0.0022	0.5252	0.0024	0.2509	0.0006	0.5234	0.0010
40	0.2538	0.0031	0.5260	0.0032	0.2515	0.0012	0.5241	0.0017
Average	0.2507	/	0.5228	/	0.2503	/	0.5224	/

The LM-79 may include many other elements, but the data specified herein is most important to help determine whether the lamp complies with the CEC Specifications.

For spotlights and flood lamps, the beam angle requirement refers to the total of the two sides of the beam, not just one side. For example, your LM-79 might print the beam angle as 40 degrees, but that is just one angle. Both sides summed would be 80 degrees, so it is a flood lamp, not a spotlight. When filling in the submittal form, please input the total beam angle, not just one side.

Retrofit Kits

The CEC Specifications include clip & rim type decorative recessed screw-in retrofits as part of the Floodlamp category. In the new revision, the CEC Specifications associate the requirements with those in the ENERGY STAR Luminaire program requirements, and no longer with the Lamp requirements. Therefore, the mismatches of beam distribution, dimensions, and other characteristics have been removed. No life testing is required for retrofit kits. All standard requirements of the CEC Specifications still apply, such as CRI, chromaticity, and power factor.

The full ENERGY STAR Fixture Test Report must be submitted with the submittal form and other documents for the retrofit kits. Do not send abbreviated versions. If an LM-79 test was performed on a retrofit kit, include it in the submittal. If the full ENERGY STAR Fixture Test Report and LM-79 do not address one or more criteria of the CEC Specifications, send other lab testing reports to corroborate your claims for meeting the Specifications. They will be accepted at the discretion of the Reviewer. If the reports do not pass Reviewer discretion, the manufacturer may be asked to provide documentation that is more acceptable.

Package Text for retrofit kits must comply with the CEC requirements and the ENERGY STAR luminaire requirements.

4 Step MacAdam Ellipse

The CEC Specifications require each product's color appearance to be measured and its coordinates must fall within a 4-Step MacAdam Ellipse. This binning protocol is used to ensure color consistency of every lamp that bears the same model number from a manufacturer. But it also helps prevent color differences if customers mix brands or models in a room. The ENERGY STAR specification for Solid State Lighting uses a 7-Step MacAdam ellipse, around the center point coordinates stated below. The CEC Specifications assume the same center points must be used to measure conformity to the 4 Step Ellipse, a more stringent standard. The 4 Step MacAdam Ellipse used for program decisions will be based around a center point intended for Solid State Lighting, reflected in ANSI standard: ANSI_ANSLG C78 377-2011, Table A1 (referenced in ENERGY STAR Draft Specifications). The 2700 and 3000 Kelvin center points are stated therein as:

2700 K - x = 0.45766 y = 0.40983
3000 K - x = 0.43387 y = 0.40319

ANSI 4 Step MacAdam Ellipse Based on <u>Solid State Lighting</u> Center Points

The center points for the 4 Step MacAdam Ellipse based on Solid State Lighting are presented in table A1 of the current ANSI specification and are shown in the diagrams below. These drawings used calculated ellipses, not published ellipses. Quadrangles are shown in the graphics below, but only the ellipses are relevant for meeting the CEC Specifications. Figure A below shows an ellipse for 2700 K, and on the next page Figure B shows the ellipse for 3000 K. The IOUs do not purport these drawings to be perfect. They are printed to give a general idea of the ellipses under determination. In Figures A and B the term "OBJECTIVE" means "Coordinates for the Center Point".

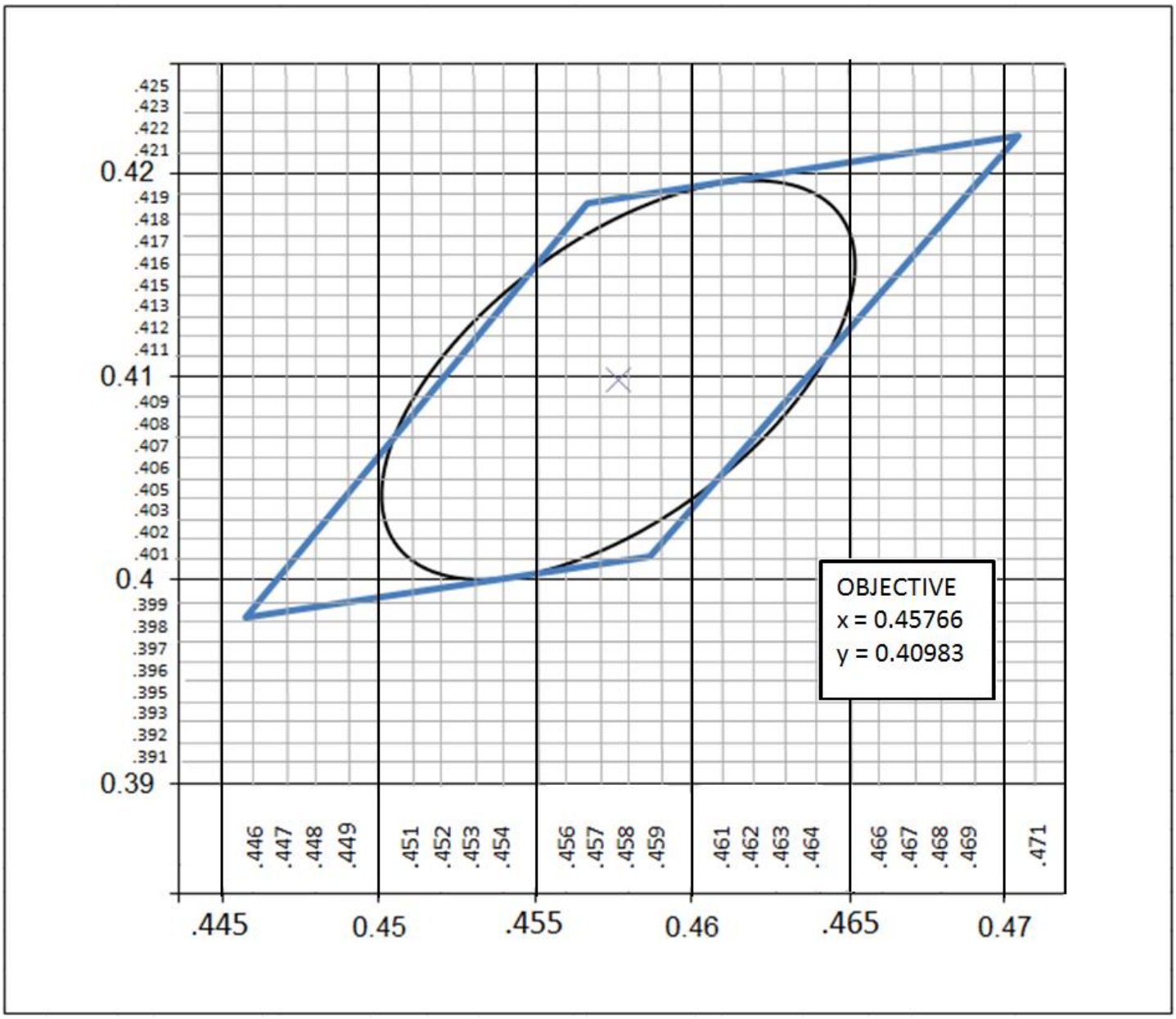


Figure A – SSL 2700K/Warm White Chromaticity Limits (4 MacAdam Color Steps)

Based on Solid State Lighting Center Points

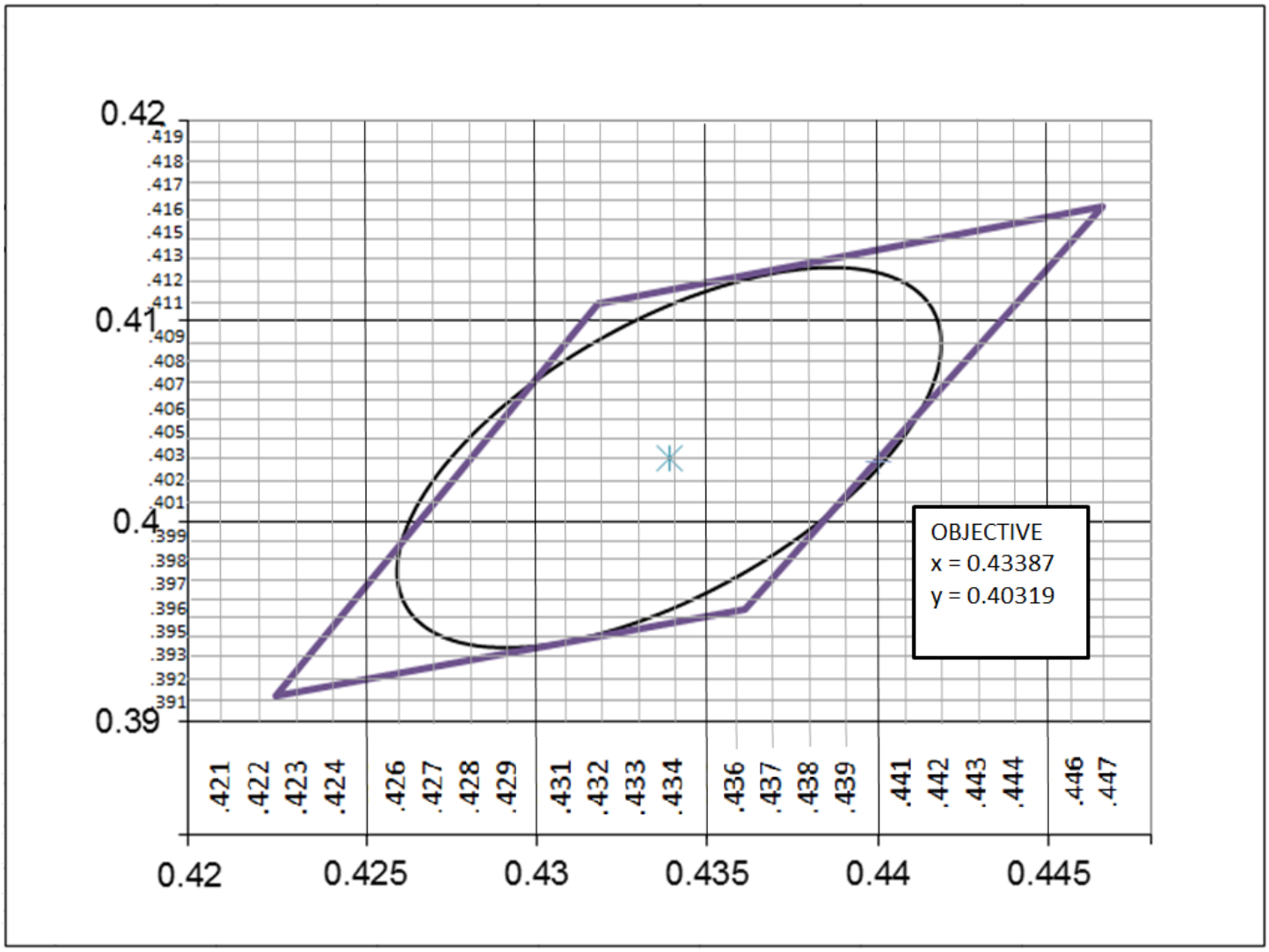


Figure B – SSL 3000K/Warm White Chromaticity Limits (4 MacAdam Color Steps)

Based on Solid State Lighting Center Points

Why These Ellipses Were Considered the Standard

Manufacturers, factories, and labs have asked why we use a 4 Step ellipse based around the SSL centerpoints of ANSI C78 377-2011 (or the original MacAdam ellipse), and based on the quadrangles of that ANSI standard, rather than the CFL or fluorescent centerpoints found in ANSI C78-C76-2001 and their corresponding ellipses.

We made this decision for these primary reasons: For the 3000K CCT, the ENERGY STAR CFL ellipse is extremely far away from the SSL ellipse and the original Macadam ellipse—there is only approximately 50% overlap. This means that lamps could be thought to comply that are, in reality, eight steps from the SSL 3000K centerpoint. For the 2700K ellipse, the CFL ellipse is almost exactly coincident with the SSL ellipse, so lamps at 2700K are not at issue. The ANSI C78-C76-2001 standard was not designed for SSL, but for fluorescent. Therefore, it is not as applicable as the SSL standard for LEDs. The ANSI C78-277-2011 7 Step SSL quadrangles are employed worldwide. So it's much easier for LED manufacturers to meet a specification based on a 4 Step MacAdam ellipse around the same centerpoints as for the 7 Step ellipse. They are the same centerpoints as for the ENERGY STAR SSL specification. Our products must pass both the 4 Step requirement for the CEC spec, and the 7 Step requirement for ENERGY STAR. Doing so based on the same centerpoints makes it convenient for manufacturers. Those asked have unanimously expressed this preference.

The ANSI C78. 377 quadrangles do not have a defined center. The Standard defines the edges but not the center. Therefore, the center is assumed to be at the centroid of the four corner points of the quadrangle.

Manufacturers should make sure they are designing and testing according to the SSL centerpoints. Products not meeting the 4-Step MacAcam ellipse requirement will not pass the report review. In the past a number of products have been rejected on that basis. The centerpoints assume the standard planckian locus (black body curve). A product designed based on a proposed alternate curve is not eligible for incentives, such as a modified spectrum lamp.

Other Required Reports and Information

If your LED product has already passed ENERGY STAR life testing and is listed as Qualified Product, please submit the full ENERGY STAR testing report. If any requirements of the CEC Specifications are not covered in the LM-79 and the full ENERGY STAR report, include additional test reports to address those requirements as applicable. For example, if the ENERGY STAR report does not indicate the level of R9, send the CRI table from the LM-79 showing the R-9 and other R values.

If your LED product *has not* already passed ENERGY STAR life testing and is not listed as a Qualified Product, please submit the three reports listed below.

ENERGY STAR Zero Hour Test Report

This test report has some similarities to the LM-79 report, but is conducted according to the ENERGY STAR Test Method. The IOUs will be reviewing the report for final product characteristics. The primary goal will be to verify the Maximum Measured Source Temperature and other information that will be used by the manufacturer in the TM-21 Calculator for In Situ Findings. It is needed if the manufacturer wishes to participate with LED products early, before ENERGY STAR life testing is complete. Please specify to the testing laboratory to include both the In Situ temperature and the measured Drive Current of the finished product.

LM-80 Test Report

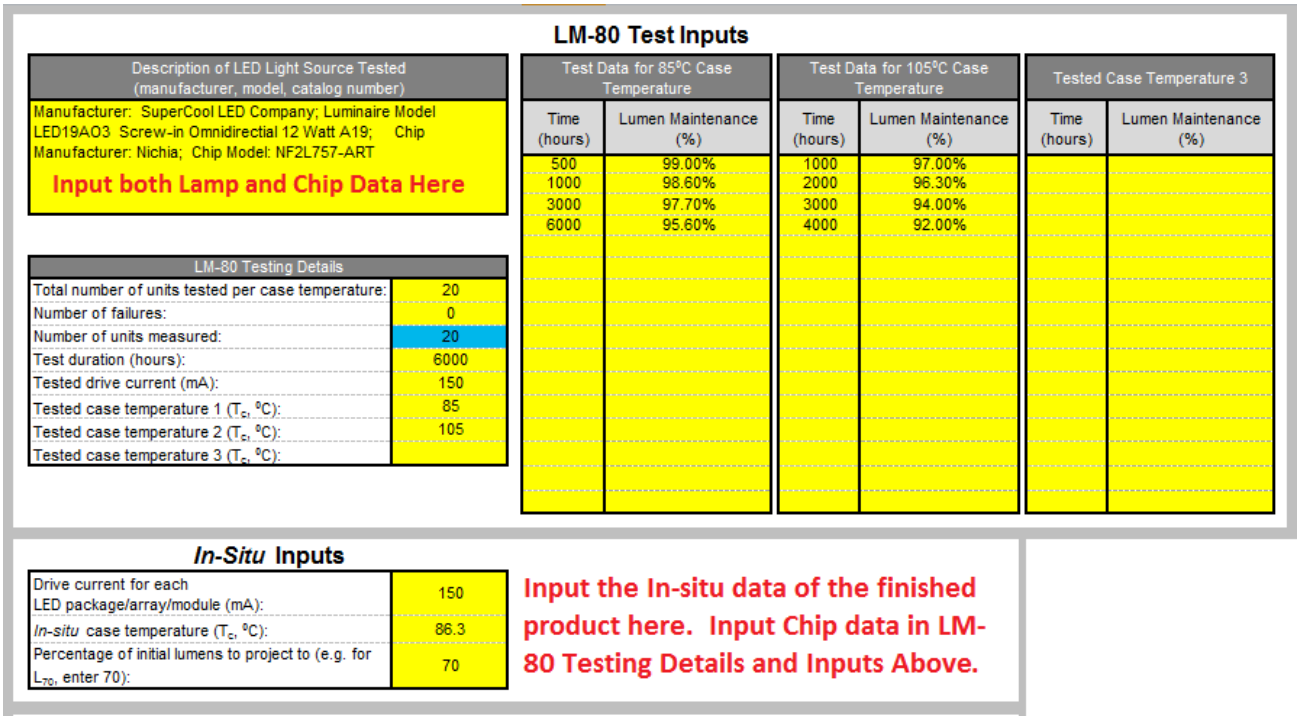
Send the LM-80 for the specific LEDs used in the finished product. The IOUs will be reviewing the report to see chip characteristics. The IOUs will have the primary goal of determining the Actual Case Temperature (Ts) most applicable to comparison with the In-situ temperature test for the Zero Hour Energy Star report, along with verifying the L-70 data in the LM-80 hour projections for the LED. It is needed for early participation prior to ENERGY STAR life testing completion.

TM-21 Calculator for In Situ Findings

The manufacturer will use and submit the same TM-21 calculator, available on the ENERGY STAR website at http://www.energystar.gov/TM-21calculator normally used to determine rated life for LED chips, and apply the data from measuring the final product's TMPled to determine its L-70 useful life in hours. For this requirement, the inputs are to be taken from the In-situ Maximum Measured Source Temperature and other data from the ENERGY STAR Zero Hour Test Report. The Drive Current from the Zero Hour Report is to be input to the Drive Current field in the TM-21 as well. This provides life-time hours we will compare to those in the LM-80. It is

needed for early participation prior to ENERGY STAR life testing completion. The graphic below shows what it should look like.

Additionally, the manufacturer shoulld also submit the original TM-21 used for the LM-80 testing that shows the inputs used to determine L-70 by the chip manufacturer. So two TM-21 MS Excel files would be sent, one for in-situ and one for the chip package. When submitting both files, please use file names that clearly distinguish the two.



LM-80 Test Inputs

Description of LED Light Source Tested (manufacturer, model, catalog number)
Manufacturer: SuperCool LED Company; Luminaire Model LED19AO3 Screw-in Omnidirectial 12 Watt A19; Chip Manufacturer: Nichia; Chip Model: NF2L757-ART
Input both Lamp and Chip Data Here

Test Data for 85°C Case Temperature		Test Data for 105°C Case Temperature		Tested Case Temperature 3	
Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)	Time (hours)	Lumen Maintenance (%)
500	99.00%	1000	97.00%		
1000	98.60%	2000	96.30%		
3000	97.70%	3000	94.00%		
6000	95.60%	4000	92.00%		

LM-80 Testing Details	
Total number of units tested per case temperature:	20
Number of failures:	0
Number of units measured:	20
Test duration (hours):	6000
Tested drive current (mA):	150
Tested case temperature 1 (T_c, °C):	85
Tested case temperature 2 (T_c, °C):	105
Tested case temperature 3 (T_c, °C):	

***In-Situ* Inputs**

Drive current for each LED package/array/module (mA):	150
In-situ case temperature (T_c, °C):	86.3
Percentage of initial lumens to project to (e.g. for L_{70}, enter 70):	70

Input the In-situ data of the finished product here. Input Chip data in LM-80 Testing Details and Inputs Above.

Additional Reports

The only additional reports or attachments that should be submitted are those that help indicate compliance with the CEC Specifications in ways other than shown in the required reports. For example, if you have performed audible noise testing, flicker index testing, or other dimming performance testing, please include those reports, with explanation on how to interpret them. For flicker testing according to the ENERGY STAR Test Method, please make sure light is visibly being emitted when flicker index and percent flicker readings at the "MinLo" minimum light output are taken. If possible, choose a MinLO of 10% or less of MaxLO to prove compliance with the CEC Specification requirement that the lamp must be able to dim to 10% or less without visible flicker. For example, if the ENERGY STAR test method requires using 20% of MaxLO, then test and record findings at 20%, but also request an additional step of dimming to 10% and repeating the method, recording findings at 10% as well in order to prove the product meets the CEC Specifications for dimming and flicker at 10%. It is not required to report to ENERGY STAR the 10% test findings, but it should be reported to the Reviewer for any future product testing. Products that have already undergone flicker testing prior to the receipt of these procedures need not be retested. If this 10% measurement proves to be infeasible in any instance, please contact the Reviewer immediately to discuss.

The test procedures (e.g., for flicker and noise) used in the California Specification is that of the most current ENERGY STAR dimming test method associated with the lamp specification, currently version 1.1 along with the 10% step explained above. It will update in line with future versions. However, the California Specification still requires flicker-free dimming down to 10% and this will not be updated with each successive ENERGY STAR specification and test method document.

Please do not submit product cut sheets, unrequested reports, news about other products, or extraneous information that could be a source of confusion.

LED Product Package and Lamp Art or Text

Specifications both from ENERGY STAR and the CEC require a number of specific messages with prescribed wording. As part of the submittal, manufacturers are to include either readable package art, or proposed package text that addresses all the package requirements in the ENERGY STAR and CEC Specifications. Many requirements are listed. The most commonly overlooked requirements found so far are:

- The warranty language on the package does not use the required phrase "Warranty: This lamp has a ___- year free replacement warranty". If it is a multi-pack, it can state "Warranty: These lamps each have a ___- year free replacement warranty". . [If multi-pack, it can start with "These lamps have . . .". If retrofit kit, "This product has . . ."]
- The warranty language does not include a statement of the phone number or website to use for product complaints and warranty claims with language to that effect.
- The warranty language has catches, loopholes, or ways for the manufacturer not to fulfill legitimate claims.
- The package text does not include the minimum starting temperature.
- The package text does not include the beam angle.
- The package text displays unreasonable incandescent equivalent wattage or percent savings claims.
- The package text does not include a dimmer compatibility statement and a QR Code or web address to find the list of compatible dimmers.
- The <u>lamp itself</u> does not include the beam angle (if a PAR or MR).

Some of these are new requirements, so they are different than previous ENERGY STAR requirements. All other packaging and lamp text requirements in the newest (version 1.1) ENERGY STAR Specifications still apply.

One clarification to the CEC Specifications in terms of package text is this. The original language required that the warranty language be printed twice, once on the outside of the package, and a second time to be inserted into the package. This has been clarified as a wording error. Now the complete warranty language need only appear printed on the outside of the package.

Here is one example of warranty language that would be permissible, among others of the manufacturer's design:

> "Limited Warranty: This lamp has a 5 year, free replacement warranty. If this product does not operate for 5 years from the date of purchase with normal use, return the product to [manufacturer name], whose sole warranty obligation is to send you a replacement or at the option of [manufacturer's name] to refund the original purchase price. Incidental and consequential damages are excluded. Visit [manufacturer's web address] or call [manufacturer's phone number] to submit warranty claims or request consumer complaint resolution."

Proof of ENERGY STAR Progress

If the product is a recessed retrofit screw-in of the clip & rim (trim) variety, send proof of ENERGY STAR certification, such as the letter or certification document from ENERGY STAR, or a screen print of the ENERGY STAR website showing the model and certification date. If the product is a screw-in lamp of another variety (eg. A-lamp, Globe, BR, or PAR), and is not yet ENERGY STAR certified, send proof from an accredited third party laboratory that the model is in 6,000

hour life testing for ENERGY STAR submission, and the laboratory's indication of how many hours of testing have elapsed to date.

The Manufacturer LED Report Submittal Form

The manufacturer should have received a form in MS Excel format to fill in and submit, which is usually sent along with this document. That form asks for pertinent data in order to put it all in one place for use in an internal database used by the California Utilities. Please fill in ALL applicable fields. If you did not receive the form, please request one. The form has addressed all or most of the CEC requirements, as well as others that are of interest to the IOUs, such as UL Rating, Lighting Facts Listing, and ENERGY STAR testing dates. Reports that are received without an accompanying LED Report Submittal Form for each model will not trigger a review. The same is true for any submission without all the required documentation. You will be told what you did wrong and what else needs to be provided. Manufacturers who consistently send fewer documents and data points than required, or who demonstrate high error rates will be given lower priority for prompt review than manufacturers who are accurate and complete in their submissions. Use the submittal form like a check list to make sure you cover everything. Do not leave any field blank. If you don't understand anything, call the CLTC Contact. Pay extra attention to the Submittal Instructions section at the end and cover all its points. Here is a recap:

> "Submit **this completed Form** in an MS Excel file. This form should accompany ALL the required reports submitted in compliance with the full text of the most recent Procedures document provided by the California Residential Lighting Incentive Program for LED test report submittal. **Submit package and lamp art or text**. If the product is not yet ENERGY STAR listed, **submit the LM80**, and **ENERGY STAR Zero Hour (or greater) Test Report** for this product, **proof of ENERGY STAR life teting progress (if not a recessed retrofit kit)**, as well as **a TM-21 file based on the in situ case temperature and drive current from the Zero Hour report**. Also send the original chip TM-21. If ENERGY STAR listed, send **full report**. If you have **dimming, flicker, and/or noise reports** from testing performed according to the Test Method of ENERGY STAR 2014 ver. 1, include it as well. Send all documents, via email, to negraeber@ucdavis.edu. **Failure to submit all documents in full compliance will result in delays. "**

The Submittal Email

It is requested that files for the reports, the form, the TM-21 calculator, and the package art or text are sent in one email where possible. If size constraints are encountered, a MS Windows zip compressed folder or file may be attached (but not a rar compressed file). If a compressed file is also to large and undeliverable, contact the Reviewer for other options such as alternative file transfer protocols.

Assuming the file sizes are not a problem, do not send some of the required documents in one email and others in a follow-up email. Wait until you have them all before sending any.

If you want to send the reports for multiple models in one email, make sure all files contain the model numbers in the file name.

Whenever sending reports, if filenames are cryptic or hard to decipher change the filenames to include understandable words like "ENERGY STAR Test Report", or "LM-79". Many files have been received that are not clearly named and even the body of the document does not identify what it is or where it came from. Please make sure all documents clearly communicate their authenticity and purpose.

Submittal of Sample Products

In the event that you are requested by the Reviewer to send product samples, please be prepared to do so one week after submitting the reports. Do not send samples unless you are requested to do so. Reports will be reviewed and then if the product complies with CEC Specifications and has not yet been reviewed for dimming observation you will be asked to send samples.

The samples are used to help determine if the LED dims to at most 10% of full light output with continual, flicker free, and noise free dimming operation. The lamps will be energized on multiple different dimmer switches. They will be observed with a combination of lamps energized. For example 1 amp on, 5 lamps, on and 8 lamps on. If the observational review reveals problems with a particular dimmer model or lamp configuration, the manufacturer will be notified of the details for their edification and prospective product improvement. Dimmer switches for the IOUs' observational review were selected based on the ENERGY STAR Draft 4 criteria for testing dimming performance, including dimmers from each category listed in that draft specification. The subsequent final draft of ENERGY STAR removed this list of dimmer types, and allows manufacturers to choose dimmer controls more freely. Ours is an observation, not a test, of compatibility. The findings can help manufacturers understand their products better and meet the CEC Specifications with greater reliability. If the manufacturer knows that obvious flicker exists or the product does not dim continuously down to 10% of light output, the manufacturer is encouraged not to request allocations for the product, submit reports, or send samples. Otherwise, please submit 8 samples of each model when so requested.

Upon request by the Reviewer, Richard Greenburg, please send the sample products addressed to:

CLTC
633 Pena Drive
Davis, CA 95618

Ref: IOU CQS Evaluation Program

If you have a need to receive any of the sample products back after being reviewed or if you have questions please contact negraeber@usdavis.edu to discuss.

Other Preliminary Requirements and Considerations

Each LED product for which a manufacturer requests allocations must be listed on the DOE's Lighting Facts database. However, if they are not listed at the time reports and samples are submitted, they must be listed before allocations are granted. Please sign into the website: www.lightingfacts.com. Click the "Manufacturers" button. Download and read the following pdf file:

LF_PartnerParticipationManual_V4[1].pdf

Follow the instructions to submit products. Be sure to check the database and make sure your applicable product specifications are all appearing. Having your product in the Lighting Facts database does not qualify it for participation in the California program. However, all LEDs in the program must be listed in the Lighting Facts database. If your product is not yet listed, please make haste to list it.

Read the CEC Specifications carefully, particularly Chapter 3, starting on page 20. Most manufacturers easily see the requirements for 90+ CRI and 0.9+ Power Factor. But here are some items that are easily missed. Please consider them before submitting reports or samples.

- LED lamps must be classified as either "omnidirectional", "floodlamps," or "spotlights". This means any type of LED other than omnidirectional or reflectorized-style are ineligible. Any clip & rim type decorative recessed fixture retrofit either with integral or remote wired screw-base, is classified as a floodlamp style lamp according to the CEC Specifications to fall into one of the three categories.
- The CEC Specifications have specific requirements both for labeling lamps and packages, including specific minimum font sizes and correct lamp classification by beam angle. Therefore, before a new product is granted allocations, the manufacturer must submit the package, package art, or package art text to the Reviewer and it must comply in every respect with the requirements in the Reviewer's estimation.
- A 5 year minimum free replacement warranty is required. It must offer a free replacement, but may include the option of a full refund at the manufacturer's discretion. Limited warranties are acceptable, but limitation language must not provide the possibility of not fulfilling legitimate warranty claims based on product performance failure.
- R9 must be **51** or greater
- Products must be free of visible flicker and audible noise

Product characteristics not included in the Specification are still of interest to the IOUs, such as efficacy and rated life and may affect program participation. Meeting the CEC Specifications may make a product eligible for program participation, but it does not guarantee the product will be granted participation in the program.

Results of the Review

The IOUs do not provide a service to manufacturers telling them whether their products pass, qualify, or are approved as meeting the CEC Specifications. The screening process is for the benefit of the utilities not the manufacturers. We do not certify or list products as meeting the CEC Specifications. Additionally, we do not fail products, disqualify them, or keep a list of ineligible products. The best official evidence that the product meets the CEC Specification to the satisfaction of an IOU, is an approved and confirmed allocation, although lack of an allocation does not indicate the product failed the CEC Specifications.

A review report is provided to each utility program manager indicating a pass/fail, yes/no, value, or comments for each area of the Specifications based on the reports and documents submitted. Each utility program manager will determine if the product meets the CEC Specifications to their satisfaction. The PM will grant allocations based on the organization's business needs. The Reviewer may inform the manufacturer that the review is complete and findings have been passed on to the IOU Program Manager. This is an indication that the reports and observations tend to show coherence with the CEC Specifications.

Manufacturers usually know before they submit reports that their product's tests, documentation, and product samples will indicate it meets the specifications. The Reviewer will inform them if any problems are encountered. If the manufacturer is asked for corrections and the Reviewer does not receive them, the manufacturers can conclude that the product will not receive allocations until the matter is rectified.

Frequently Asked Questions

Q. Can the product be in the utility programs if it is consistent with the CEC Specification, but has not yet received ENERGY STAR certification?

A. If it is a screw-in clip and trim type recessed retrofit kit, it takes very little time and expense beyond that required to meet the CEC Specifications, in order to get ENERGY STAR Certification. Therefore, it is required that all manufacturers applying for allocations under this category will have ENERGY STAR certification prior to submitting reports and requesting allocations. However, if the product is merely a screw-in lamp, it is possible for the product to receive allocations prior to ENERGY STAR certification. But it MUST it be in ENERGY STAR life testing at an accredited third party testing lab at the time. Send proof of this when submitting reports. The product must receive ENERGY STAR certification within nine months of the first allocation date, or else future allocations will be canceled. If the product fails to meet 3,000 Hour testing, the manufacturer must notify the utility and the program manager will make a determination as to whether to cancel future allocations or not, depending on circumstances. Similarly, if it passes 3,000 hour testing but fails prior to 6,000 hours, the manufacturer must notify the program manager.

Q. If the product performance passes all the CEC Specs, will it be considered to qualify?

A. Not necessarily. The product and lamp packaging must also meet every non-performance aspect of the CEC and ENERGY STAR specifications as well, such as package art, product dimensions, and lamp text requirements.

Q. How long into the future will these procedures be valid?

A. These procedures are subject to change at any time and revised versions will not automatically be sent to all manufacturers. If you have a new product to submit reports for, please request that the most recent version of these procedures and the newest submittal form be sent first.