Appendix J

TABLE OF PRE-QUALIFIED INTEGRAL LED LAMPS & QUALIFICATION PROCESS

Appendix J: Table of Pre-Qualified Integral LED Lamps & Qualification Process (effective November 30, 2009)

The Table of Pre-Qualified Integral LED Lamps was generated under the following guidelines:

1. All lamps must be vetted through the Utility for pre-qualification. See Section J2 of this appendix for qualification process instructions and required manufacturer-provided supporting documentation.
2. Pre-qualification status of all integral lamps listed in Section J1 will expire once Energy Star's Program Requirement and Criteria take effect. Afterwards, only those integral lamps with an Energy Star label will be accepted.
3. Program and technical requirements are subject to change. An annual eligibility review of all pre-qualified integral lamps will be conducted and may affect pre-qualification status.

Please note, Utility qualification for lamps must be completed prior to application submittal.
LED lamps intended to replace linear fluorescent or high-intensity discharge (HID) lamps are not eligible for incentives at this time.
Submittals and/or questions can be sent to: Judelson.Enriquez@sce.com

J1: TABLE OF PRE-QUALIFIED INTEGRAL LED LAMPS

J2: INTEGRAL LED LAMPS QUALIFICATION PROCESS

J3: SUBMISSION SUMMARY AND CHECKLIST

J4: INTEGRAL LED LAMPS – TECHNICAL REQUIREMENTS

J5: APPENDIX OF RESOURCES

J1: TABLE OF PRE-QUALIFIED INTEGRAL LED LAMPS

MANUFACTURER	BRAND	MODEL	TYPE	APPROVED WATTAGE	DATE QUALIFIED	REVIEWED BY (IOU)
-	-	-	-	-	-	-

J2: INTEGRAL LED LAMPS QUALIFICATION PROCESS

Please note, Utility qualification for lamps must be completed prior to application submittal. LED lamps intended to replace linear fluorescent or high-intensity discharge (HID) lamps are not eligible for incentives at this time.
Submittals and/or questions can be sent to: Judelson.Enriquez@sce.com

Step 1 – See Section J4 for minimum technical requirements. Integral LED Lamps must meet the stated minimum requirements.
Step 2 – Complete and submit the checklist found in Section J3.
Step 3 – Submit the following from the **LED Lamp Manufacturer**:

1. **Manufacturer Product Specification Sheet.**
2. **LM-79-08 Test Report(s)**: Provide Independent Testing according to IES LM-79 that provides efficacy, output, color, and photometric distribution of your product. An Integrating Sphere Test will be required to provide color information. A Goniophotometer test by itself is not adequate. A sample test report is included with this document. At a minimum, the LM-79 testing report(s) should include:
    a. Electrical Data;
        i. Input voltage,
        ii. Current in (A)mperes,
        iii. Power in (W)atts
        iv. Power Factor & THD
    b. Total Light Output;
        i. Luminous Flux in Lumens
        ii. Luminous efficacy (Lm/W),
        iii. Zonal Lumen Summary
    c. Luminous Intensity Distribution;
        i. Candela Distribution
        ii. Polar Graph
        iii. Suggested additional data,
            1. Spacing Criteria,
            2. Coefficient of Utilization (CU) and
            3. isoilluminance plot
    d. Color characteristics;
        i. Color Temperature (CCT),
        ii. Color Rendering Index (CRI),
        iii. Chromaticity Coordinates
        iv. Spectral power distribution (SPD)
3. **Lifetime Determination Statement**: Provide written explanation of how L70 Lifetime of Product is determined using the LM-80 and In-situ temperature tests referenced below.
    a. **LM-80** Test: Provide LED Package Manufacturer IES LM-80 Test Report with results showing relative (%) light output over time at 55°C, 85°C and X°C (a third temperature at the manufacturer's choice).
    b. **In-Situ Temperature Test:** Provide test report indicating the Temperature of the hottest LED In-Situ in ANSI/UL 1598-04 (hardwired) or ANSI/UL 153-05 (corded) environments. This temperature measurement will be used with LM-80 data to validate lumen maintenance and useful life of product. Note that this temperature measurement should be specially requested by the manufacturer as they are getting their UL testing.

J3: SUBMISSION SUMMARY AND CHECKLIST

MANUFACTURER CONTACT INFORMATION	
Company	
Name	
Address	
Phone	
Fax	
Email	
Web Site	

ATTACHMENTS	
Item	**Included Check ☑**
1. LM 79 Test Reports	☐
2. Lifetime Determination Statement	☐
3. LM 80 Test Report	☐
4. In-situ Temperature Test Report	☐

SUBMITTED INTEGRAL LED LAMP INFORMATION			
Required Information & Test Results	**Fill In**	**Verified Table 1 Check ☑**	**Reviewer Notes For Office use Only**
□ Manufacturer Name			
□ Manufacturer Part or Catalog#			
□ Lamp Type (A, B, BR, PAR, MR, etc.)		☐	
□ Dimmable? (Y/N)		☐	
□ Operating voltage (V)		☐	
□ Operating current (mA)		☐	

□ Wattage as tested (W)		☐	
□ Total Luminous Flux (Lumens)		☐	
□ Luminous Efficacy (Lm/W)		☐	
□ Color temperature (CCT)		☐	
□ Color Rendering Index (CRI)		☐	
□ Luminous Intensity Distribution		☐	
□ LED Operating Frequency (Hz)		☐	
□ L70 Lumen Maintenance (Hours)		☐	
□ Power Factor (PF)		☐	
□ Manufacturer Warranty (Years)		☐	
□ UL File #		☐	

Submission:
This information should be submitted in electronic format to Judelson.Enriquez@sce.com

J4: INTEGRAL LED LAMPS – TECHNICAL REQUIREMENTS

The technical requirements below were derived from Energy Star's Integral LED Lamps Eligibility Criteria (Draft 3) released in September 18, 2009.

1) REQUIREMENTS FOR ALL LAMPS

These criteria are not applicable to LED lamps intended to replace linear fluorescent or high-intensity discharge (HID) lamps.

<table>
<tr><th>Criteria Item</th><th>ENERGY STAR Requirements</th><th>Reference Standard/ Test Method</th><th>Laboratory Requirements</th></tr>
<tr><td>Correlated Color Temperature (CCT) and Duv</td><td>Lamp must have one of the following designated CCTs (per ANSI C78.377-2008) consistent with the 7-step chromaticity quadrangles and Duv tolerances listed below (see Appendix A for more information).
<table>
<tr><th>Nominal CCT</th><th>Target CCT (K) and tolerance</th><th>Target Duv and tolerance</th></tr>
<tr><td>2700 K</td><td>2725 ± 145</td><td>0.000 ± 0.006</td></tr>
<tr><td>3000 K</td><td>3045 ± 175</td><td>0.000 ± 0.006</td></tr>
<tr><td>3500 K</td><td>3465 ± 245</td><td>0.000 ± 0.006</td></tr>
<tr><td>4000 K</td><td>3985 ± 275</td><td>0.001 ± 0.006</td></tr>
</table></td><td>LM-79-08
ANSI C78-377-2008</td><td>DOE CALiPER Recognized or NVLAP Accredited for LM-79</td></tr>
<tr><td>Color Maintenance</td><td>The change of chromaticity over the minimum lumen maintenance test period shall be within 0.007 on the CIE 1976 (u',v') diagram.</td><td>LM-79-08
ANSI C78.377-2008</td><td>DOE CALiPER Recognized or NVLAP Accredited for LM-79</td></tr>
<tr><td>Color Rendering Index (CRI)</td><td>Minimum CRI (Ra) of 75. In addition, the R9 value must be greater than 0.</td><td>LM-79-08
ANSI C78.377-2008
CIE 13.3-1995</td><td>DOE CALiPER Recognized or NVLAP Accredited for LM-79</td></tr>
</table>

Dimming NOTE: DOE is working with NEMA to develop a dimming standard for LED lamps and luminaires.	Lamps may be dimmable or non-dimmable. Product packaging must clearly indicate whether the lamp is dimmable or not dimmable. Manufacturers qualifying dimmable products must maintain a Web page providing dimmer compatibility information. Minimum efficacy, light output, CCT, CRI, and power factor of dimmable lamps will be confirmed with the lamp operated at full power.	n/a	n/a
Warranty	A warranty must be provided for lamps, covering material repair or replacement for a minimum of three (3) years from the date of purchase.		
Allowable Lamp Bases	Must be a lamp base listed by ANSI.	ANSI C81.61-2007	Self certification
Power Factor	For lamp power ≤5W, no minimum power factor is required For lamp power >5W, power factor must be ≥ 0.70	ANSI C82.77-2002 LM-79-08	DOE CALiPER Recognized or NVLAP Accredited for LM-79
Minimum Operating Temperature	Integral lamp shall have a minimum operating temperature of -20℃ or below.		Self certification
LED Operating Frequency	≥ 120 Hz **Note:** This performance characteristic addresses problems with visible flicker due to low frequency operation and applies to steady-state as well as dimmed operation. Dimming operation shall meet the requirement at all light output levels.		Self certification3
Electromagnetic and Radio Frequency Interference	Integral LED lamps must meet the appropriate FCC requirements for consumer use (FCC 47 CFR Part 15) and/or industrial use (FCC 47 CFR Part 18).		FCC laboratory or manufacturer's laboratory4
Audible Noise	Integral lamp shall have a Class A sound rating.		Self certification

Transient Protection	Power supply shall comply with IEEE C.62.41-1991, Class A operation. The line transient shall consist of seven strikes of a 100 kHz ring wave, 2.5 kV level, for both common mode and differential mode.	IEEE C.62.41-1991	Self certification
Operating Voltage	Lamp shall operate at 120 or 277 volts, +/- 10%.		Self certification

2) REQUIREMENTS FOR REPLACEMENT LAMPS – LAMPS INTENDED TO REPLACE EXISTING STANDARD ELECTRIC LAMPS (per ANSI C79.1-2002)

Minimum performance and dimensional criteria are provided below for omnidirectional, decorative, and directional lamp replacements.

These criteria are not applicable to LED lamps intended to replace linear fluorescent or high-intensity discharge (HID) lamps.

2A) Omnidirectional Lamps

Applicable lamp types: A, BT, P, PS, S, T (per ANSI C79.1-2002)

Criteria Item	**ENERGY STAR Requirements**	**Reference Standard/Test Procedure**	**Laboratory Requirements**
Minimum Luminous Efficacy - LED lamp power <10W - LED lamp power ≥10W	 50 lm/W 55 lm/W	LM-79-08	DOE CALiPER Recognized or NVLAP Accredited for LM-79

<table>
<tr><td>Minimum Light Output</td><td colspan="2">Lamp shall have minimum light output (total luminous flux) at least corresponding to the target wattage of the lamp to be replaced, as shown below. Target wattages between the given levels may be interpolated.</td><td>LM-79-08</td><td>DOE CALiPER Recognized or NVLAP Accredited for LM-79</td></tr>
<tr><td></td><td>Nominal wattage of lamp to be replaced (watts)</td><td>Minimum light output of LED lamp (lumens)</td><td colspan="2"></td></tr>
<tr><td></td><td>25</td><td>200</td><td colspan="2"></td></tr>
<tr><td></td><td>35</td><td>325</td><td colspan="2"></td></tr>
<tr><td></td><td>40</td><td>450</td><td colspan="2"></td></tr>
<tr><td></td><td>60</td><td>800</td><td colspan="2"></td></tr>
<tr><td></td><td>75</td><td>1,100</td><td colspan="2"></td></tr>
<tr><td></td><td>100</td><td>1,600</td><td colspan="2"></td></tr>
<tr><td></td><td>125</td><td>2,000</td><td colspan="2"></td></tr>
<tr><td></td><td>150</td><td>2,600</td><td colspan="2"></td></tr>
<tr><td>Luminous Intensity Distribution</td><td colspan="2">Products shall have less than 80% of total flux in the 0° to 60° zone and at least 20% of total flux above 90° (lamp in base-up position, with 0° at the nadir). Distribution shall be vertically symmetrical as measured in three vertical planes at 0°, 45°, and 90°. See Appendix B for illustration.</td><td>LM-79-08, Section 10</td><td>DOE CALiPER Recognized or NVLAP Accredited for LM-79</td></tr>
<tr><td>Maximum lamp diameter</td><td colspan="2">Not to exceed target lamp diameter as per ANSI C78.20-2003.</td><td>ANSI C78.20-2003</td><td>Self-certification</td></tr>
<tr><td>Maximum overall length (MOL)</td><td colspan="2">Not to exceed MOL for target lamp as per ANSI C78.20-2003.</td><td>ANSI C78.20-2003</td><td>Self-certification</td></tr>
<tr><td>Lumen Maintenance</td><td colspan="2">≥ 70% lumen maintenance (L70) at 25,000 hours of operation</td><td>LM-79-08; Elevated Temperature Test per ENERGY STAR CFL version 4.0;
LM-80-08 (for early initial qualification</td><td>DOE CALiPER Recognized or NVLAP Accredited for LM-79</td></tr>
</table>

		option)	
Rapid Cycle Stress Test	Cycle times must be 2 minutes on, 2 minutes off. Lamp will be cycled once for every two hours of required minimum L70 life.	ANSI C78.5 LM-65 (clauses 2,3,5, 6)	DOE CALiPER Recognized or NVLAP Accredited for LM-79

2B) Decorative Lamps

Applicable lamp types: B, BA, C, CA, DC, F, G (per ANSI C79.1-2002)

Criteria Item	**ENERGY STAR Requirements**	**Reference Standard/Test Procedure**	**Laboratory Requirements**
Minimum Luminous Efficacy	40 lm/W	LM-79-08	DOE CALiPER Recognized or NVLAP Accredited for LM-79
Minimum Light Output	Lamp shall have minimum light output (total luminous flux) at least corresponding to the target wattage of the lamp to be replaced, as shown below. Target wattages between the given levels may be interpolated.	LM-79-08	DOE CALiPER Recognized or NVLAP Accredited for LM-79
	Nominal wattage of lamp to be replaced (watts)	Minimum light output of LED lamp (lumens)	
	10	70	
	15	90	
	25	150	
	40	300	
	60	500	
Maximum lamp diameter	Not to exceed target lamp diameter.		Self certification

Lumen Maintenance	≥ 70% lumen maintenance (L70) at 15,000 hours of operation	LM-79-08, LM-80-08 (for early initial qualification option)	DOE CALiPER Recognized or NVLAP Accredited for LM-79
Rapid Cycle Stress Test	Cycle times must be 2 minutes on, 2 minutes off. Lamp will be cycled once for every two hours of required minimum L70 life.	ANSI C78.5 LM-65 (clauses 2,3,5, 6)	DOE CALiPER Recognized or NVLAP Accredited for LM-79

2C) Directional Lamps

Applicable lamp types BR, ER, K, MR, PAR, R (per ANSI C79.1-2002)

For MR and PAR lamps, the following lamp diameters are included at this time: MR16, PAR16, PAR20, PAR30S (short neck), PAR30L (long neck), PAR38

Criteria Item	**ENERGY STAR Requirements**	**Reference Standard/Test Procedure**	**Laboratory Requirements**
Definition	Directional lamp means a lamp having at least 80% light output within a solid angle of π sr (corresponding to a cone with angle of 120°)	EC No 244/2009; LM-79-08, Section 10	DOE CALiPER Recognized or NVLAP Accredited for LM-79
Minimum luminous efficacy - Lamp diameter ≤ 20/8 inch - Lamp diameter > 20/8 inch	 40 lm/W 45 lm/W	LM-79-08	
Color Spatial Uniformity	The variation of chromaticity within the beam angle shall be within 0.006 from the weighted average point on the CIE 1976 (u',v') diagram.	LM-79-08 ANSI C78.379-2006, section 5	DOE CALiPER Recognized or NVLAP Accredited for LM-79

Maximum lamp diameter	Not to exceed target lamp diameter	ANSI C78.21-2003	Self certification
Maximum overall length (MOL)	Not to exceed MOL for target lamp	ANSI C78.21-2003	Self certification
Minimum light output ***– BR, ER, K, and R lamps***	Lamp shall have minimum light output (total luminous flux) equal to the target wattage of the lamp to be replaced multiplied by 10.	LM-79-08	DOE CALiPER Recognized or NVLAP Accredited for LM-79
Minimum center beam intensity[1] ***– PAR and MR16 lamps***		LM-79-08, Section 10	DOE CALiPER Recognized or NVLAP Accredited for LM-79
- PAR lamps	Link to online tool at http://www.drintl.com/temp/ESIntLampCenterBeamTool_5_19.xls Enter the following information into the online tool: PAR diameter in eighths of an inch (i.e., 16, 20, 30, 38) Target lamp nominal wattage Target lamp beam angle in degrees (Note: maximum allowable beam angle = 65°.)		
- MR16 lamps	Link to online tool at http://www.drintl.com/temp/ESIntLampCenterBeamTool_5_19.xls Enter the following information into the online tool: Target lamp nominal wattage Target lamp beam angle in degrees (Note: maximum allowable beam angle = 50°.)		
Lumen Maintenance	≥ 70% lumen maintenance (L70) at 25,000 hours of operation	LM-79-08; Elevated Temperature Test per ENERGY STAR CFL version 4.0; LM-80-08 (for early initial qualification option)	DOE CALiPER Recognized or NVLAP Accredited for LM-79
Rapid Cycle Stress Test	Cycle times must be 2 minutes on, 2 minutes off. Lamp will be cycled once for every two hours of required minimum L70 life.	ANSI C78.5 LM-65 (clauses 2,3,5, 6)	DOE CALiPER Recognized or NVLAP Accredited for LM-79

[1] Models based on statistical analysis of 432 PAR and 122 MR16 lamps produced by NEMA manufacturers are used to set minimum center beam intensity requirements. For a given target lamp wattage and target beam angle, mathematical functions for each lamp type yield the minimum required center beam intensity in candelas (cd). The minimum requirement is within two standard deviations of the center beam intensity predicted by the model.

3) REQUIREMENTS FOR NON-STANDARD LAMPS – LED LAMPS OF NON-STANDARD LAMP TYPE OR FORM

In addition to the requirements above, the following performance and information requirements apply to Non-standard Lamps. **These criteria are not applicable to LED lamps intended to replace linear fluorescent or high-intensity discharge (HID) lamps.**

Criteria Item	ENERGY STAR Requirements	Reference Standard/Test Procedure	Laboratory Requirements
Minimum Luminous Efficacy - LED lamp power <10W - LED lamp power ≥10W	 50 lm/W 55 lm/W	LM-79-08	DOE CALiPER Recognized or NVLAP Accredited for LM-79
Minimum Light Output	200 lumens	LM-79-08	DOE CALiPER Recognized or NVLAP Accredited for LM-79
Luminous Intensity Distribution	No specific distribution is required. Must submit goniophotometry report showing luminous intensity distribution produced by the lamp.	LM-79-08, Section 10	DOE CALiPER Recognized or NVLAP Accredited for LM-79
Lumen Maintenance	≥ 70% lumen maintenance (L70) at 25,000 hours of operation	LM-79-08; Elevated Temperature Test per ENERGY STAR CFL version 4.0; LM-80-08 (for early initial qualification option)	DOE CALiPER Recognized or NVLAP Accredited for LM-79

Rapid Cycle Stress Test	Cycle times: 2 minutes on, 2 minutes off. Lamp cycled once for every two hours of required minimum L70 life	ANSI C78.5 LM-65 (clauses 2,3,5, 6)	

4) LUMEN MAINTENANCE TESTING AND LIFE CLAIMS

Minimum life requirement: 15,000 hours to 70% lumen maintenance (L70) for Decorative lamps (section 7B); 25,000 hours for all other lamp types. At least 6,000 hours of lumen maintenance testing is required of all lamps. Longer L70 life may be claimed based verified lumen maintenance levels after 6,000 hours of lumen maintenance testing, as follows:

6000-Hour Lumen Maintenance Thresholds		
	Minimum lumen maintenance at end of 6000 hours (% of initial lumens; -3% tolerance)	**Maximum L70 Life Claim (hours)**
Minimum for Decorative	86.7%	15,000
Optional for Decorative	89.9%	20,000
Minimum for Non-standard, Omnidirectional, and Directional	91.8%	25,000
Optional for All Lamp Types	93.1%	30,000
	94.1%	35,000
	94.8%	40,000
	95.4%	45,000
	95.8%	50,000

J5: APPENDIX OF RESOURCES

Required Testing Services

- DOE CALiPER Testing Laboratories – see below or http://www1.eere.energy.gov/buildings/ssl/test_labs.html
- National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratories - http://ts.nist.gov/standards/accreditation/index.cfm

DOE CALiPER LM-79 and LM-80 Testing Laboratories

Integrating Sphere (LM-79 Section 9.1 and 9.2)

- Independent Testing Laboratories, Inc. – Boulder, CO http://www.itlboulder.com/
- Intertek – Cortland, NY http://www.intertek-etlsemko.com/
- Luminaire Testing Laboratory, Inc. – Allentown, PA http://www.luminairetesting.com/
- Lighting Sciences, Inc. – Scottsdale, AZ http://www.lightingsciences.com/home/
- OnSpeX/CSA International – Atlanta, GA http://www.onspex.com/
- Aurora International Testing Laboratory – Aurora, OH Brochure Guide
- Orb Optronix Inc. – Kirkland, WA http://www.orboptronix.com/

Goniophotometry (LM-79 Section 9.3)

- Independent Testing Laboratories, Inc. – Boulder, CO http://www.itlboulder.com/
- Intertek – Cortland, NY http://www.intertek-etlsemko.com/
- Luminaire Testing Laboratory, Inc. – Allentown, PA http://www.luminairetesting.com/
- Lighting Sciences, Inc. – Scottsdale, AZ http://www.lightingsciences.com/home/
- OnSpeX/CSA International – Atlanta, GA http://www.onspex.com/

UL 1598 or UL 153 testing Nationally Recognized Testing Laboratories (NRTLs)

- Canadian Standards Association (CSA);
- Intertek Testing Services NA, Inc. (ITSNA);
- MET Laboratories, Inc. (MET);
- NSF International (NSF);
- SGS U.S. Testing Company, Inc. (SGSUS);
- TUV America, Inc. (TUVAM);
- TUV Product Services GmbH (TUVPSG);
- TUV Rheinland of North America, Inc. (TUV);
- Underwriters Laboratories Inc.(UL); and
- Wyle Laboratories, Inc. (WL).
- A complete and current listing of NRTLs: http://www.osha.gov/dts/otpca/nrtl/