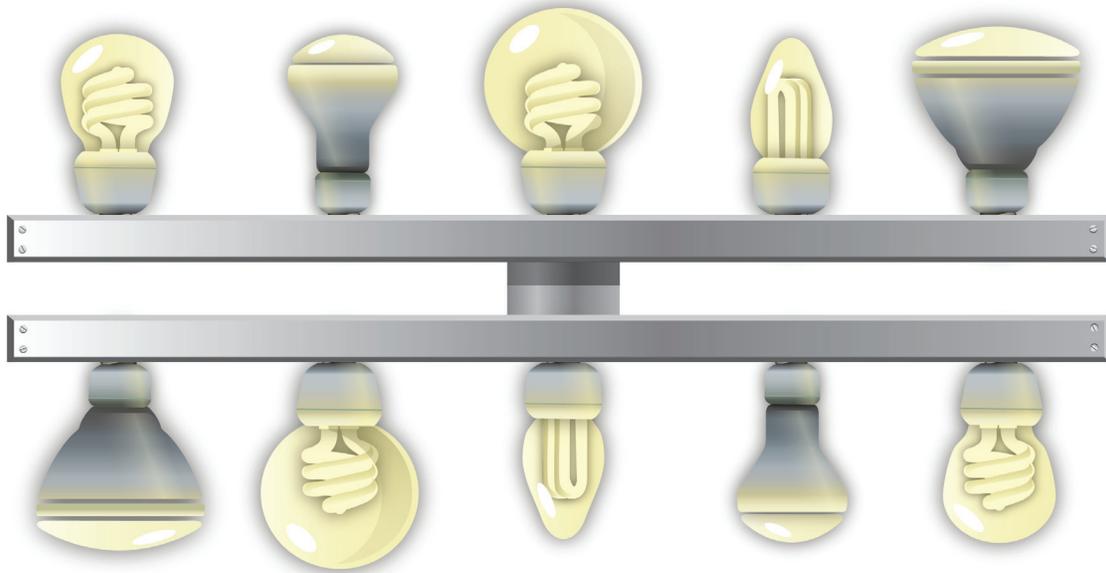


# ENERGY STAR<sup>®</sup> CFL THIRD PARTY TESTING AND VERIFICATION



## Cycle 1: Results



May 2011



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# ENERGY STAR® CFL THIRD PARTY TESTING

## Final Report: Cycle 1

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### **Submitted to the**

U.S. Environmental Protection Agency

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## EXECUTIVE SUMMARY

The ENERGY STAR CFL Third Party Testing and Verification Program exists to support the U.S. Environmental Protection Agency in ensuring that compact fluorescent lamps (CFLs) qualified and labeled as ENERGY STAR continue to meet all ENERGY STAR CFL qualification criteria. This report contains the results of all products tested by the program as of February 5, 2011.

This report reflects performance testing of 68 products purchased in the second half of 2009 and first quarter of 2010. This testing data indicates no statistically significant difference in performance between tested samples of randomly selected products and tested samples of nominated products.

More than 90 percent of products tested passed seven of the 10 required tests. The final passing results for the remaining three tests—the Rapid Cycle Stress Test, the Chromaticity Test, and the Interim Life Test—will be known once the marginal failure retests<sup>1</sup> are completed.

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<sup>1</sup> A marginal failure is defined as a tested unit with one less sample passing a test than required. For example, a product that failed the Rapid Cycle Stress Test with 4/6 samples passing instead of the required 5/6 is scored as a marginal failure. Products that have one or more marginal failures but no other failures must undergo a re-test.

## SUMMARY RESULTS

	Passing Criteria	Results		Failures				Passing	
		Mean	Median	Full		Marginal		Total	Percentage
				Number	Percentage	Number	Percentage		
<b>Rapid Cycle Stress Test</b>	5/6 survive to half of rated life	5.44	6	4	6%	7	10%	57	84%
<b>Interim Life</b>	9/10 survive to 40% of rated life	9.21	10	5	8%	6	9%	55	83%
<b>40% Life Lumen Maintenance</b>	> 80%	85%	86%	7	11%			59	89%
<b>1,000 Hour Lumen Maintenance</b>	> 90%	93%	94%	7	10%			61	90%
<b>Chromaticity</b>	All coordinates inside ellipse	9.47	10	3	4%	3	4%	62	91%
<b>Run-Up Time</b>	< 60 or <180 seconds	47.8	32.5	4	6%			64	94%
<b>Starting Time</b>	< 1000 milliseconds	360	270	3	4%			65	96%
<b>Power Factor</b>	> 0.5	0.59	0.56	3	4%			65	96%
<b>Efficacy</b>	Varies by type	65.3	67.82	1	1%			67	99%
<b>Color Rendering Index</b>	> 80	82.7	82.4	0	0%			68	100%
<b>Total</b>				21	31%	8	12%	39	57%

## BACKGROUND

The ENERGY STAR CFL Third Party Testing and Verification Program was established in version 4.0 of the ENERGY STAR CFL Criteria, effective December 2, 2008, to test off-the-shelf versions of all ENERGY STAR qualified CFLs at least once every 5 years. The program is administered by D&R International, an independent consulting firm. Intertek Laboratories, a National Voluntary Laboratory Accreditation Program (NVLAP)-accredited third party laboratory, conducts all testing for this program.

This verification testing program replaced the Program for the Evaluation and Analysis of Residential Lighting (PEARL), which operated from 1999 to 2009 and evaluated 194 unique CFLs over nine testing cycles. The ENERGY STAR program differs from PEARL in four principle respects:

1. In the ENERGY STAR program, half of all products are randomly selected and half are nominated by utilities and ENERGY STAR partners; in PEARL, all products were nominated.
2. In the ENERGY STAR program, testing cycles occur twice a year; in PEARL, they occurred once a year.
3. PEARL provided assurance on a small sample of products in a given cycle. This program ensures that *all* qualified CFL products receive quality assurance testing.
4. This program is manufacturer-funded. PEARL was funded by DOE, EPA, and energy efficiency program sponsors.

Product testing under the ENERGY STAR CFL Third Party Testing and Verification Program is the same as for ENERGY STAR product qualification, except that product qualification requires full life testing. Products are tested for efficacy, starting time, run-up time, power factor, 1,000-hour lumen maintenance, 40% life lumen maintenance, stress endurance, interim life, color rendering, and correlated color temperature (CCT).

This report, prepared and submitted to the U.S. Environmental Protection Agency (EPA), contains the final results of the first testing cycle, Cycle 1. Product testing began in May 2009. Some products in Cycle 1 started testing significantly later due to procurement issues. This report covers all products that completed testing by February 5, 2011.

## PRODUCT SELECTION

- The ENERGY STAR CFL criteria require annual testing of 20 percent of products. Because there are two cycles of testing each year, a target of 10 percent of the unique products was selected for Cycle 1<sup>2</sup>.
- This cycle included 46 products nominated by EPA and participating ENERGY STAR partners<sup>3</sup> (i.e., utilities, manufacturers, states, efficiency program sponsors, and other government entities) and 22 randomly selected products.

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<sup>2</sup> Since products were selected in April 2009, the target number was 10% of all ENERGY STAR qualified CFLs listed at that time.

- No more than three products of any single manufacturer were selected for testing for this cycle.<sup>4</sup>

Of the 68 products reported here,<sup>5</sup> 59 are from Cycle 1 and nine are from Cycle 2 testing completed between April 2009 and February 2011. Many products are privately labeled and sold under multiple brand names, so the 68 products represent a total of 675 qualified products or 13.7 percent of the total qualified product list.

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<sup>3</sup> Manufacturers are limited to two nominations per competitor. Other types of partners may nominate as many products as they wish.

<sup>4</sup> Under the CFL Criteria v.4.2, No more than six models from a single manufacturer may be tested in any given fiscal year. A manufacturer is defined as a CFL partner with qualified products.

<sup>5</sup> Slightly fewer than 68 products were actually unique; six are duplicates. Some OEM products were tested multiple times under different privately labeled model numbers due to a glitch in internal records. In cases where the outcomes between two identical products differed, the two results were averaged as if they were a double sample. For example, if eight out of 10 samples passed the Interim Life Test in one case but 10 out of 10 samples passed in the other, the products was scored as 18/20 (the same as 9/10) and marked as passing for both products.

## PRODUCT PROCUREMENT

For each CFL model number selected, Intertek purchased 18 samples:

- 10 samples for photometric testing
- Six samples for the Rapid Cycle Stress Test (RCST)
- Two backup samples in case of breakage

Product selection protocol calls for purchasing products from at least two and preferably four different geographic locations and from at least three different retail or commercial outlets. For Cycle 1, Intertek reported in eight cases that it was able to locate retail outlets only in a single state.

Product testing lasted 12 months. The laboratory had difficulty locating and purchasing several products. Difficulties arose from inaccuracies in the information some manufacturers provided about retail outlets, as some products are only available wholesale and others had been retired or had not yet shipped.

## PRODUCT TESTING AND RESULTS

Intertek performs and reports on all CFL testing in accordance with ENERGY STAR Criteria Version 4.2, published on March 7, 2008 and effective beginning December 2, 2008. D&R International compiles the test results. Full test results are available in the table on page 26 of this document. Summary statistics broken down by model type are available on page 31 of this document.

Ten samples were tested for each product. Five were measured base up and five were measured base down unless specified otherwise in the text below. Reflectors are measured in the base up position only.

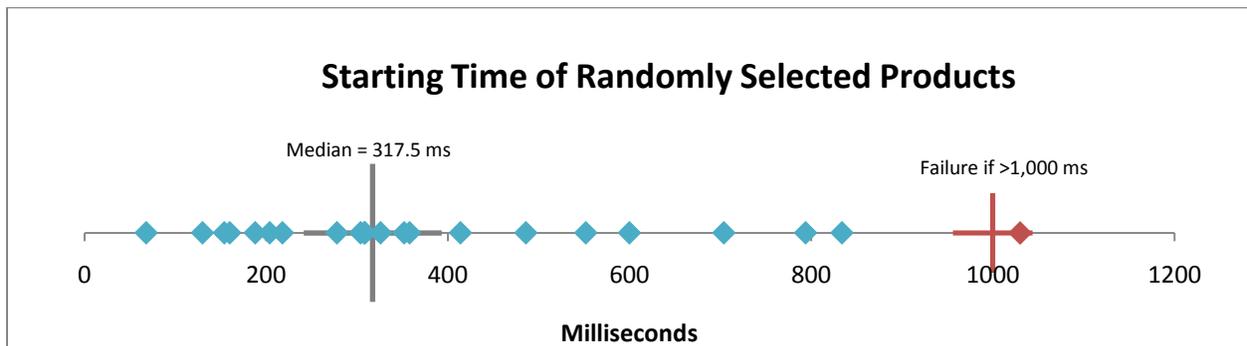
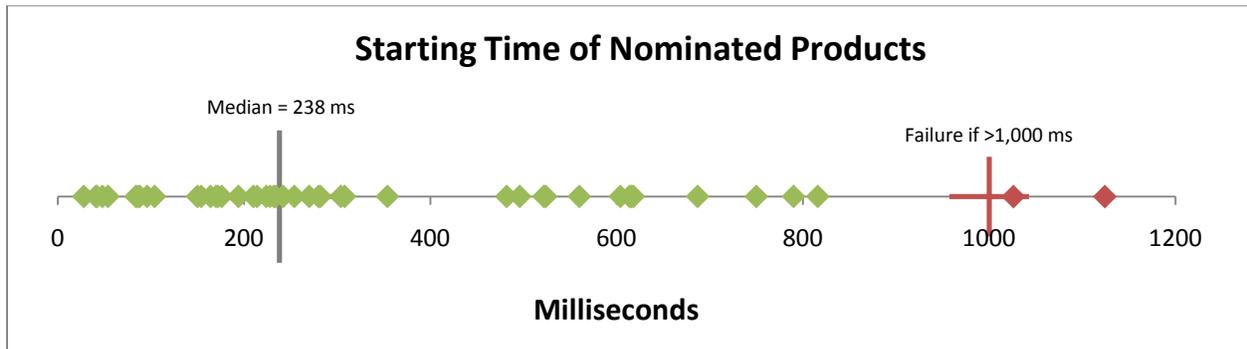
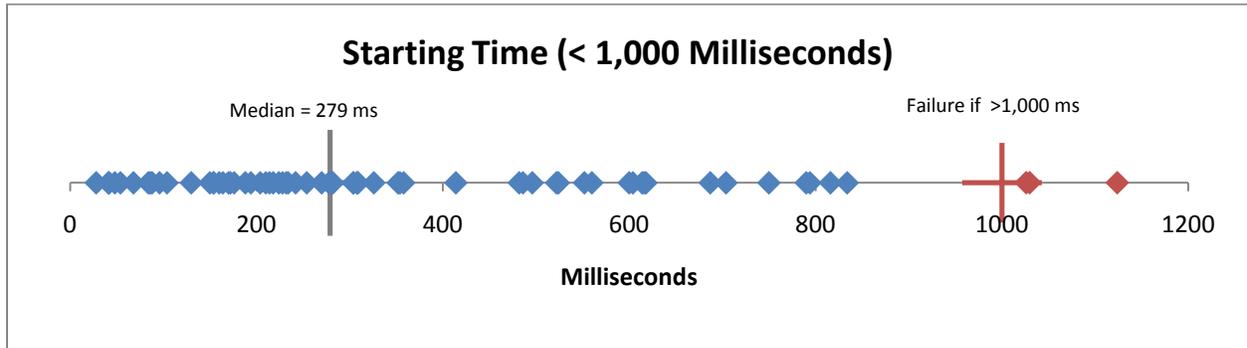
The following sections show the outcome of each test. In the figures each diamond represents the average of all samples tested for a single product. Red diamonds represent products that failed the test. Blue and green diamonds represent products that passed the test with light blue denoting randomly selected products and green denoting nominated products.

## TESTING SCOPE – PARAMETERS AND TEST METHODS

- Starting time
- Run-up time
- Power factor
- 1,000-hour lumen maintenance
- Lumen maintenance at 40 percent of rated life
- Luminous efficacy
- Rapid Cycle Stress Test
- Interim Life Test
- Color rendering index (CRI)
- Correlated color temperature

## STARTING TIME

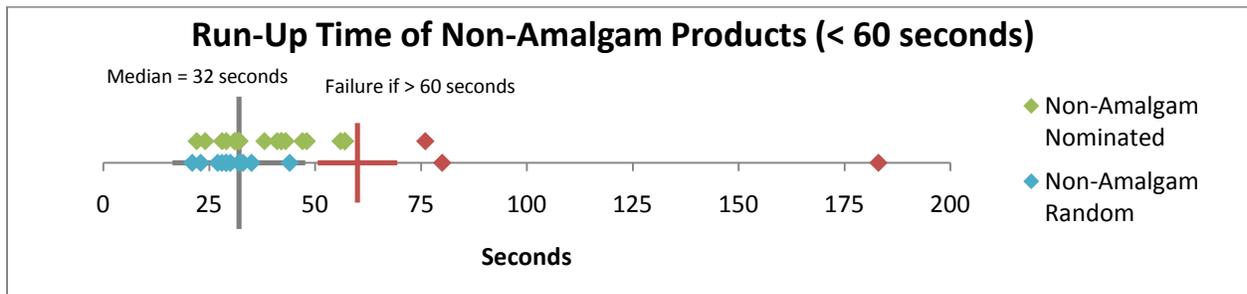
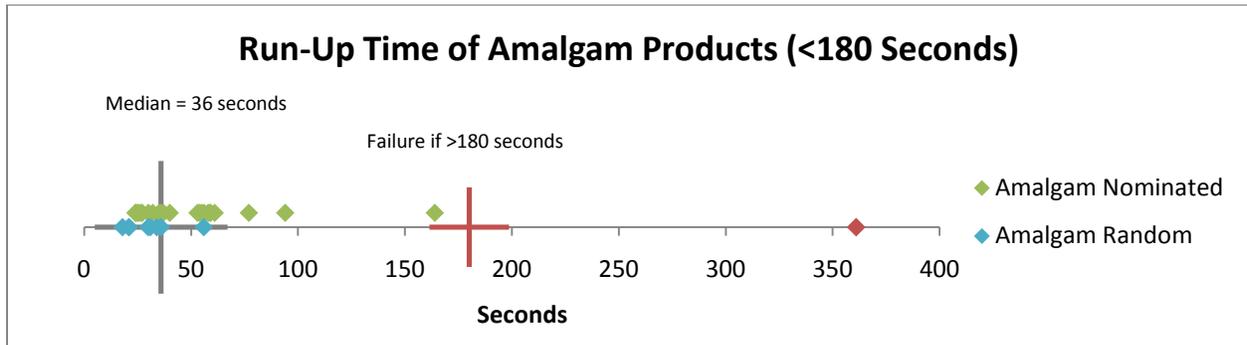
Starting time is the time needed after switching the CFL on for it to start fully and remain lighted. Products with start-up time measurements of <1,000 milliseconds pass the test.



Starting Time						
	Total		Nominated		Randomly Selected	
	#	%	#	%	#	%
Failed	3	4	2	4	1	4.5
Marginal Failure (Retest)	N/A	N/A	N/A	N/A	N/A	N/A
Passed Initial Test	65	96	44	96	21	95.5
<b>Median</b>	<b>279</b>		<b>238</b>		<b>317</b>	
<b>Total Tested</b>	<b>68</b>		<b>46</b>		<b>22</b>	
Starting time delay is measured in milliseconds. Products must have a starting time delay of 1,000 milliseconds or less. There are no marginal failure criteria for this test.						

## RUN-UP TIME

Run-up time is the time it takes the CFL to reach full brightness. Amalgam mercury products with run-up times less than 180 seconds and non-amalgam mercury products with run-up times less than 60 seconds pass the test. Below, nominated and randomly selected products are broken out by color for amalgam and non-amalgam samples.



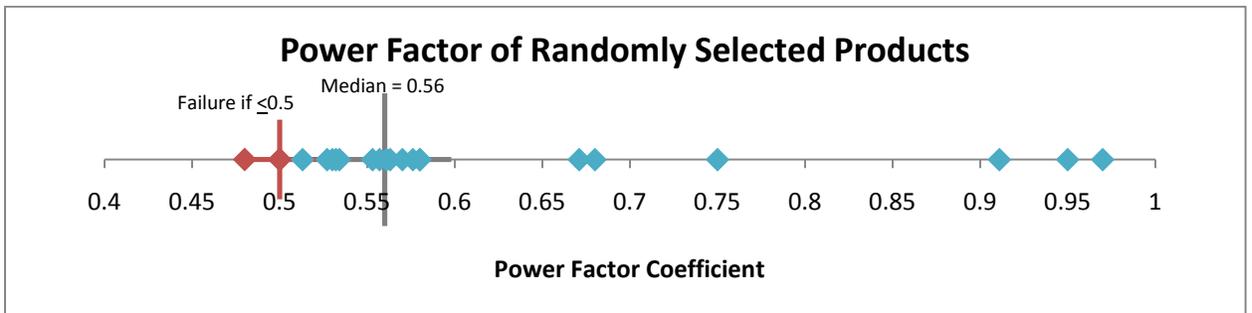
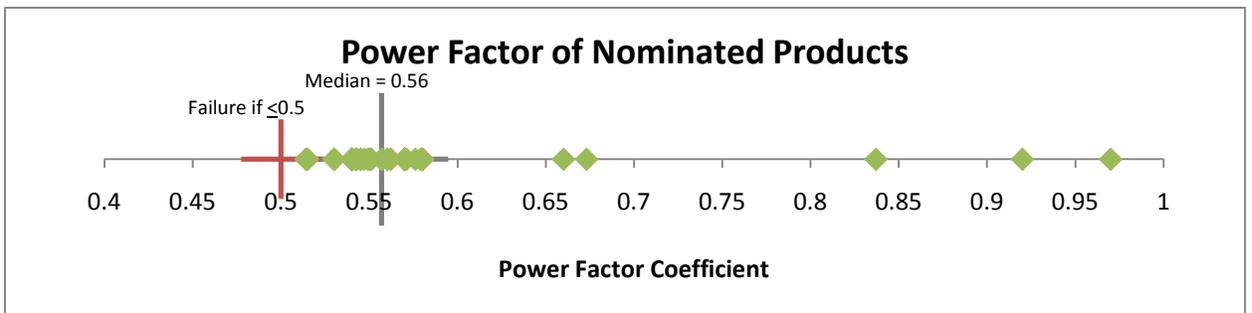
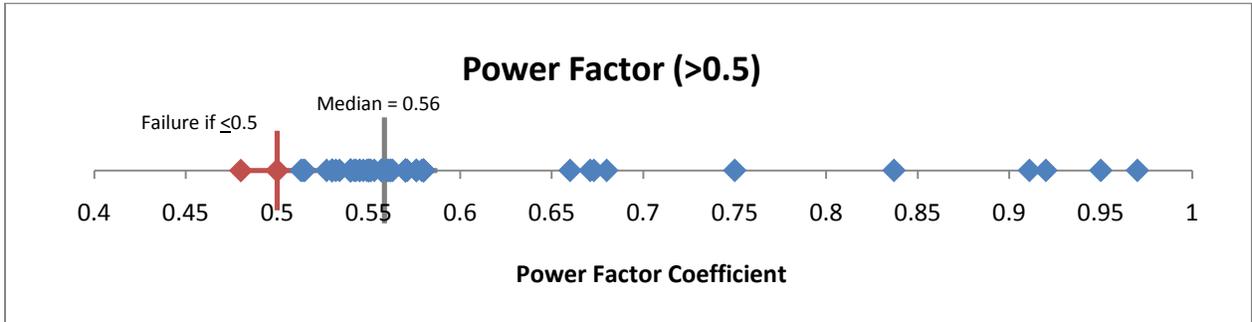
Run-Up Time						
	Total		Amalgam		Non-Amalgam	
	#	%	#	%	#	%
Failed	4	6	1	3	3	3
Marginal Failure (Retest)	N/A	N/A	N/A	N/A	N/A	N/A
Passed Initial Test	64	94	32	97	32	91
<b>Median</b>	<b>33.5</b>		<b>36</b>		<b>32</b>	
<b>Total Tested</b>	<b>68</b>		<b>33</b>		<b>35</b>	

Run-up time is measured in seconds. Products with non-amalgam mercury must be a measurement of less than 60 seconds. Products with amalgam mercury must have a measurement of less than 180 seconds. There are no marginal failure criteria for this test.

## POWER FACTOR

Power factor is the active power of the CFL divided by the apparent power.

Products with a power factor greater than 0.5 pass the test.

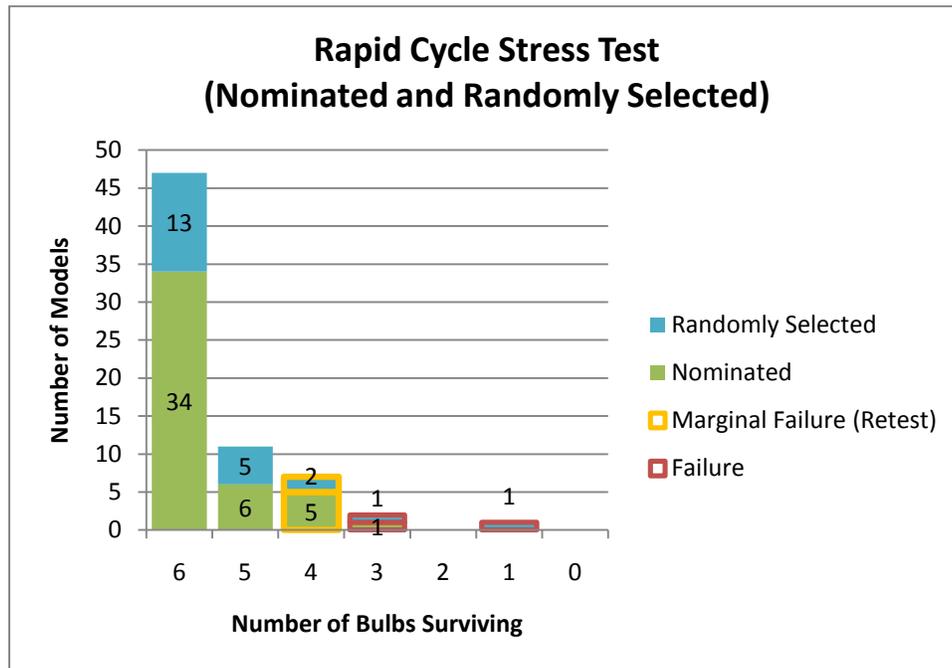


Power Factor						
	Total		Nominated		Randomly Selected	
	#	%	#	%	#	%
Failed	3	4	0	0	3	14
Marginal Failure (Retest)	N/A	N/A	N/A	N/A	N/A	N/A
Passed Initial Test	65	96	46	100	19	86
<b>Median</b>	<b>0.56</b>		<b>0.56</b>		<b>0.56</b>	
<b>Total Tested</b>	<b>68</b>		<b>46</b>		<b>22</b>	
The power factor must be greater than 0.5 to pass. There are no marginal failure criteria for this test.						

## RAPID CYCLE STRESS TEST

The RCST tests how many on/off cycles a product can endure without failing.

Six samples are tested. If zero or one sample fails to endure the test for a number of cycles equal to half the product's rated life, this product passes. If two samples fail before enduring the required number of cycles, the product scores as a marginal failure. If three or more samples fail, the product fails the test.



Rapid Cycle Stress Test						
	Total		Nominated		Randomly Selected	
	#	%	#	%	#	%
Failed	3	4	1	2	2	9
Marginal Failure (Retest)	7	10	5	11	2	9
Passed Initial Test	58	85	40	87	18	82
<b>Average</b>	<b>6</b>		<b>6</b>		<b>6</b>	
<b>Total Tested</b>	<b>68</b>		<b>46</b>		<b>22</b>	
The Rapid Cycle Stress Test requires that five of six samples pass. Marginal failure is defined as four out of six samples passing.						

## LUMEN MAINTENANCE TESTS

Lumen maintenance measures a product's lumen maintenance over time compared to the 100-hour output. Lumen measurements are taken at 100 hours, 1,000 hours, and 40 percent of rated life. Samples are burned on racks, 3 hours on, 20 minutes off, until they reach each of the chronological thresholds at which point the laboratory makes the test measurements. Lumen maintenance is evaluated on two metrics: lumen maintenance at 1,000 hours and lumen maintenance at 40 percent of the product's rated life.

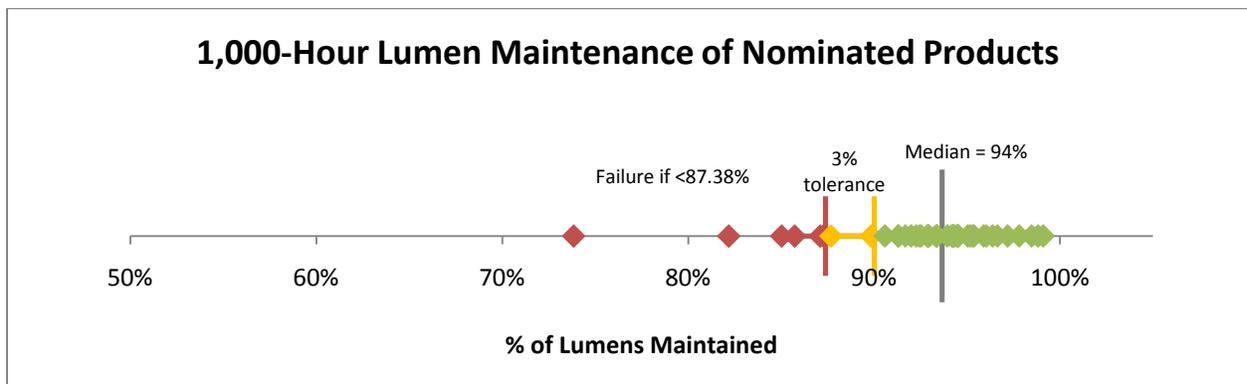
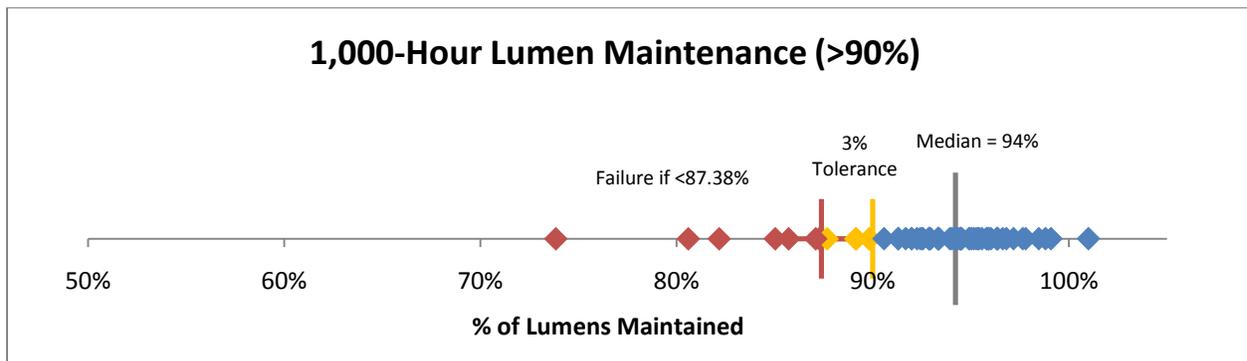
Products pass the 1,000-hour lumen maintenance and 40 percent lumen maintenance tests if light output meets the specified requirement plus a tolerance of 3 percent.

Histograms are included for these tests to better illustrate the densely clustered data points for passing products.

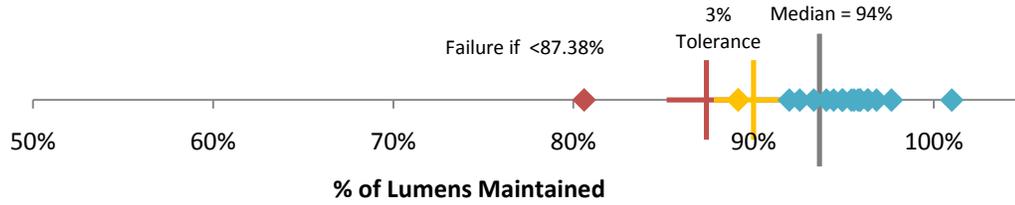
### 1,000-HOUR LUMEN MAINTENANCE TEST

The 1,000-hour Lumen Maintenance Test is an initial measurement of how well a product maintains its light output level over time.

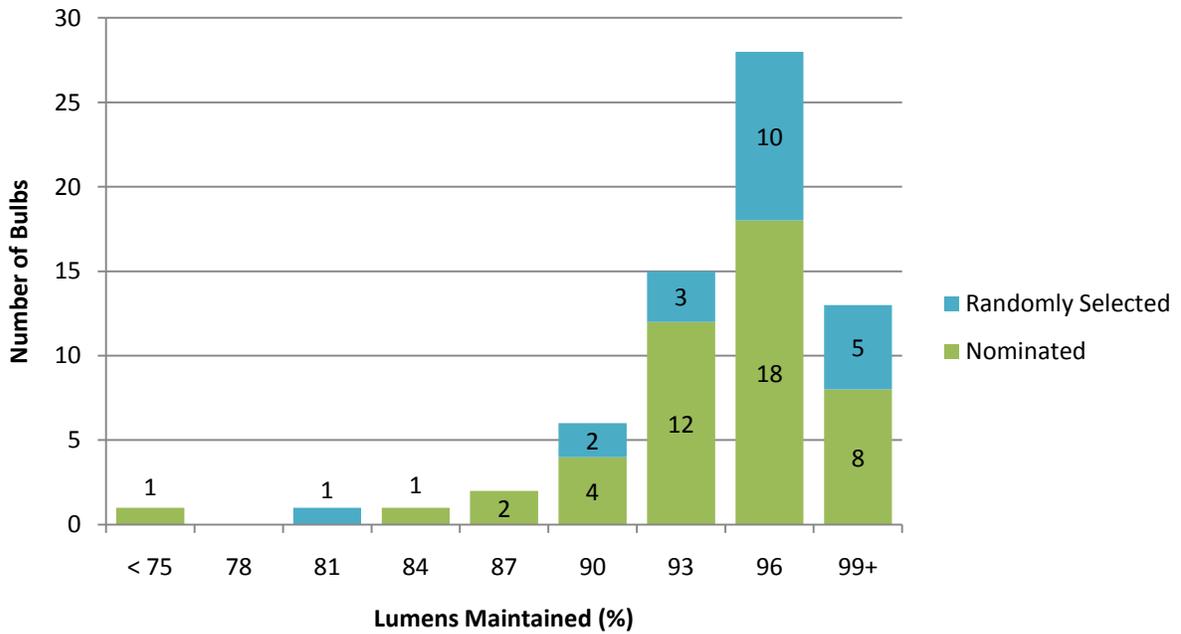
Products with a lumen measurement at 1,000 hours that is greater than 90 percent of the 100-hour measurement pass the test.



### 1,000-Hour Lumen Maintenance of Randomly Selected Products



### 1,000-Hour Lumen Maintenance Histogram (Nominated and Randomly Selected Products)



1,000-Hour Lumen Maintenance						
	Total		Nominated		Randomly Selected	
	#	%	#	%	#	%
Failed	7	10	6	13	1	4.5
Marginal Failure (Retest)	N/A	N/A	N/A	N/A	N/A	N/A
Passed Initial Test	61	90	40	87	20	95.5
<b>Median</b>	<b>94%</b>		<b>94%</b>		<b>94%</b>	
<b>Total Tested</b>	<b>68</b>		<b>46</b>		<b>21*</b>	

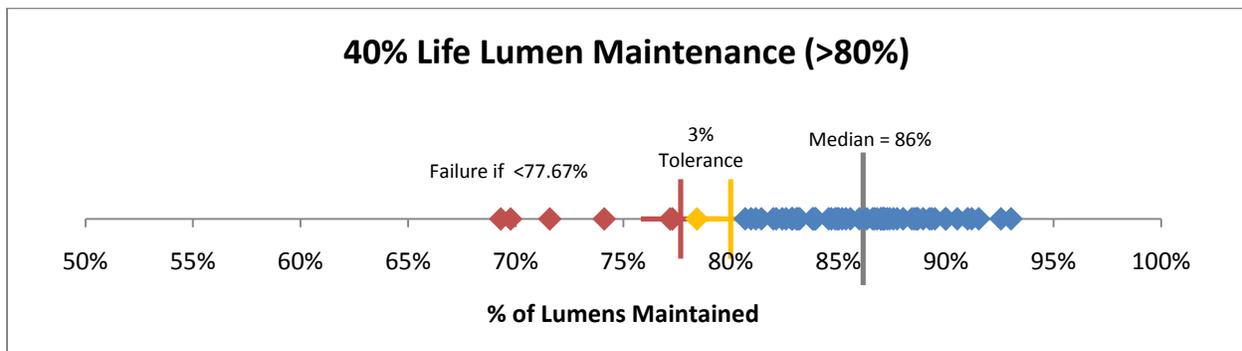
If a product's lumen measurement at 1,000 hours is greater than 90 percent of the lumen measurement at 100 hours, it passes the test. A 3 percent tolerance is allowed for each product. There are no marginal failure criteria for this test.

\* A lab error led to one missed measurement for this test. No other products or tests were affected.

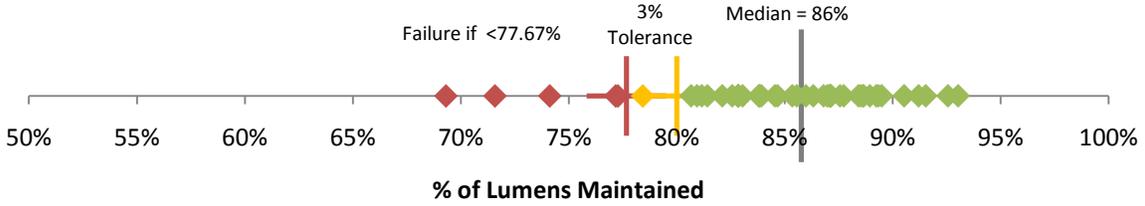
#### LUMEN MAINTENANCE AT 40 PERCENT OF RATED LIFE

Another lumen measurement is taken after 40 percent of the product's rated life has passed.

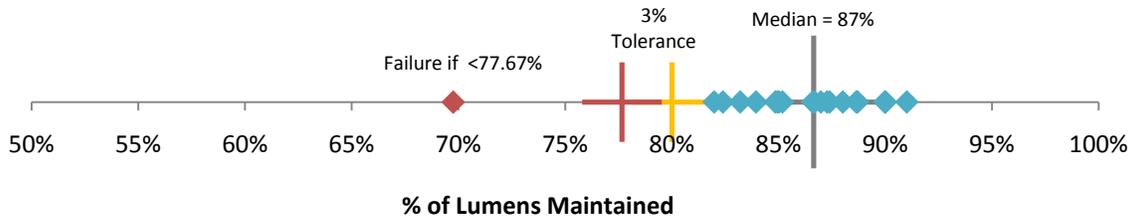
Products with a lumen measurement at the 40 percent life threshold that is greater than 80 percent of the 100-hour measurement pass the test.



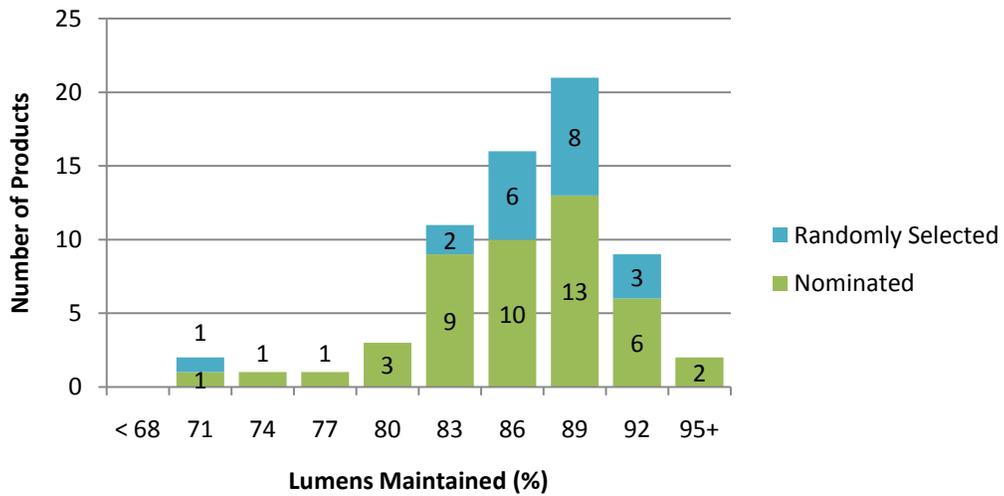
### 40% Life Lumen Maintenance of Nominated Products



### 40% Life Lumen Maintenance of Randomly Selected Products



### 40% Lumen Maintenance Histogram (Nominated and Randomly Selected)

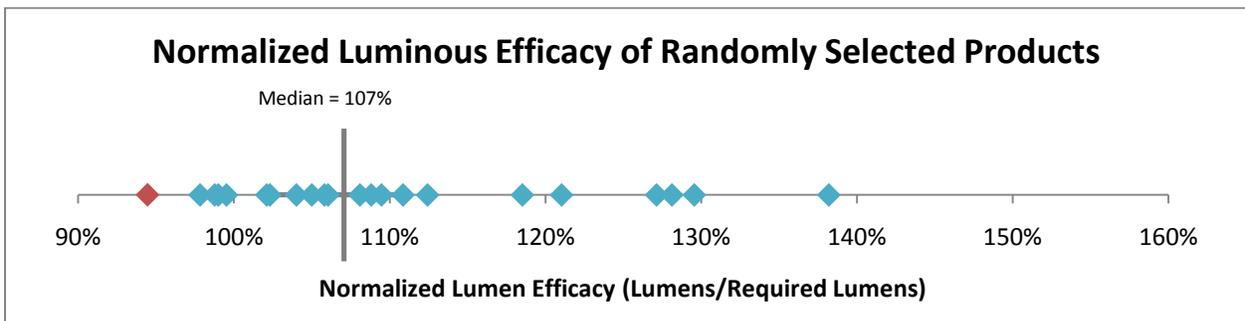
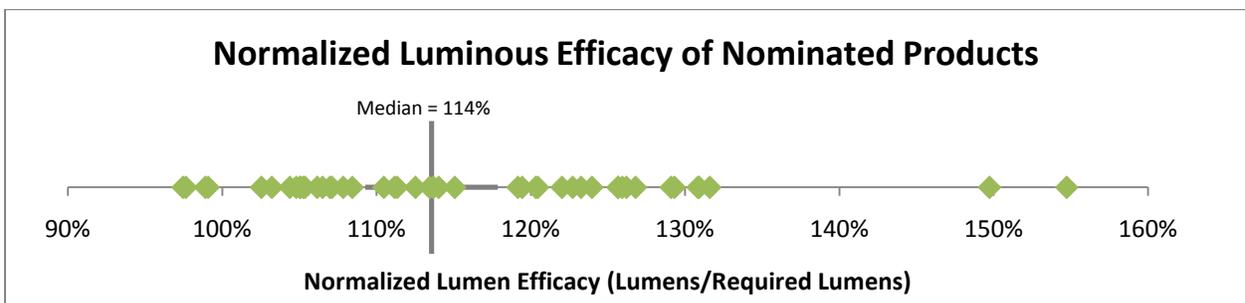
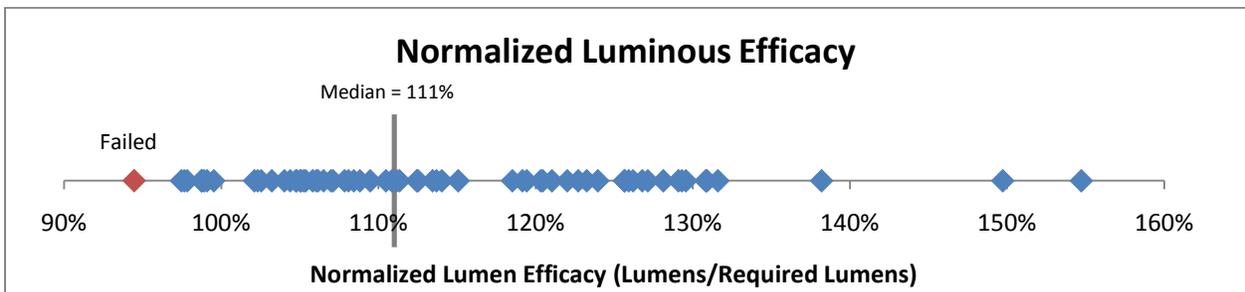
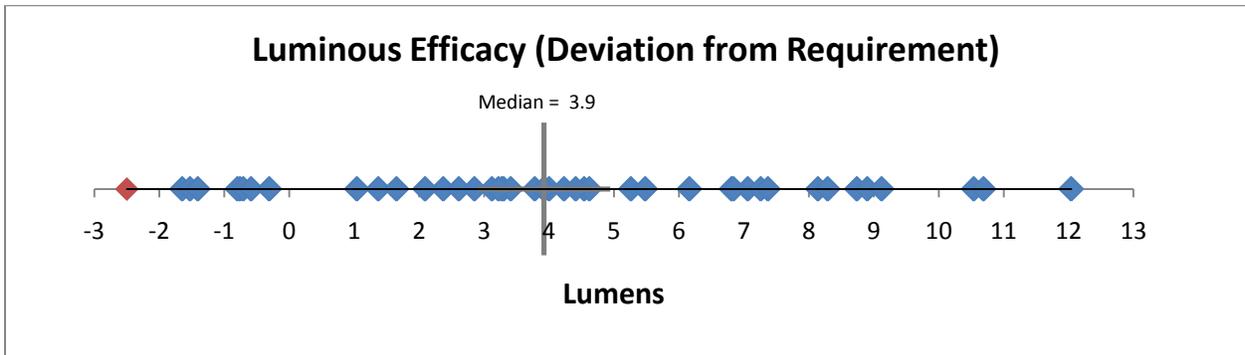


40 Percent Lumen Maintenance						
	Total		Nominated		Randomly Selected	
	#	%	#	%	#	%
Failed	6	9	5	11	1	5
Marginal Failure (Retest)	N/A	N/A	N/A	N/A	N/A	N/A
Passed Initial Test	62	91	41	89	20	95.5
<b>Median</b>	<b>86%</b>		<b>87%</b>		<b>86%</b>	
<b>Total Tested</b>	<b>68</b>		<b>46</b>		<b>20*</b>	
<p>If a product's lumen measurement at 40 percent of rated life is greater than 80 percent of the lumen measurement at 100 hours, it passes the test. A 3 percent tolerance is allowed for each product. No marginal failure criteria are defined for this test.</p> <p>* Two randomly selected products did not complete testing, and the 40% Life Lumen Maintenance Test is not included for either one.</p>						

## LUMINOUS EFFICACY

Efficacy is light output divided by energy used and is measured in lumens per watt.

A product passes the Luminous Efficacy Test if it is greater than or equal to the specific ENERGY STAR efficacy requirement for that model type plus a tolerance of 3 percent. Normalized results are included because different model types have different efficacy requirements, and normalizing the data points by dividing the actual efficacy by the required efficacy shows how far each product is from its required result.

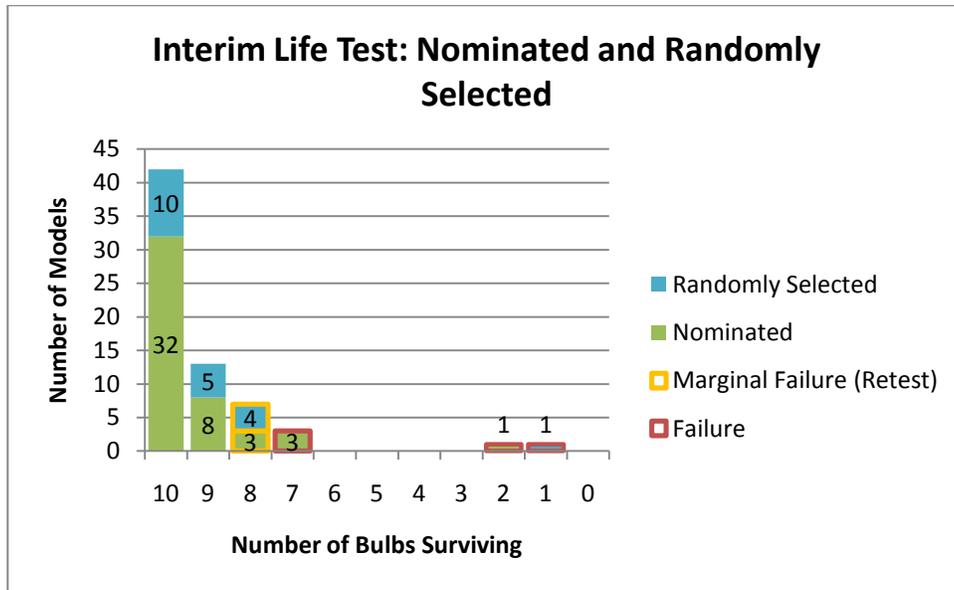


Luminous Efficacy						
	Total		Nominated		Randomly Selected	
	#	%	#	%	#	%
Failed	1	1.5	0	0	1	4.5
Marginal Failure (Retest)	N/A	N/A	N/A	N/A	N/A	N/A
Passed Initial Test	67	99	46	100	21	95
<b>Median</b>	<b>65</b>		<b>65</b>		<b>64</b>	
<b>Total Tested</b>	<b>68</b>		<b>46</b>		<b>22</b>	
<p>Luminous efficacy is measured differently for different wattages and model types. Requirements range from 30 to 65 lumens per watt. Consult ENERGY STAR Criteria Version 4.0 for a detailed description of requirements for each wattage and model type. A 3 percent tolerance is allowed for each product. There are no marginal failure criteria for this test.</p>						

## INTERIM LIFE TEST

The Interim Life Test measures how many of the 10 samples are still lit at 40 percent of the CFL's rated life.

If the number of failures (samples that did not stay on) is zero or one, then the product passes. If the number of failures is two, it scores as a marginal failure. If the number of failures is three or greater, then the product fails the test.



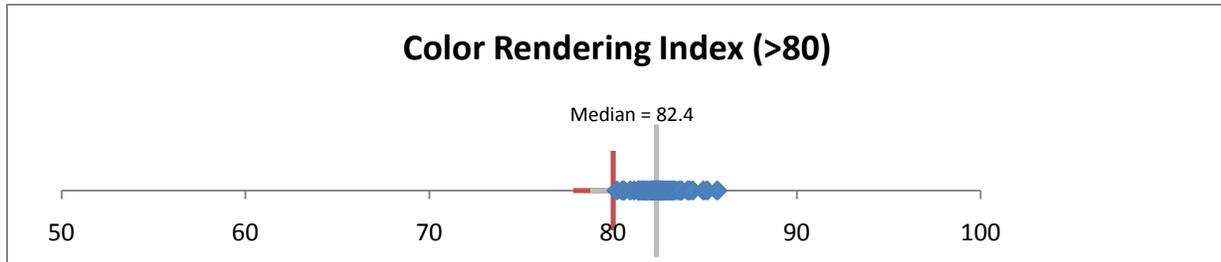
Interim Life Test						
	Total		Nominated		Randomly Selected	
	#	%	#	%	#	%
Failed	5	7	4	9	1	5
Marginal Failure (Retest)	7	10	3	6.5	1	5
Passed Initial Test	56	82	39	85	20	90
<b>Median</b>	<b>10</b>		<b>10</b>		<b>9.5</b>	
<b>Total Tested</b>	<b>68</b>		<b>46</b>		<b>20*</b>	

The Interim Life Test requires that 9 of 10 samples survive to 40 percent of the product's rated lifetime. Marginal failure is defined as 8 of 10 samples passing.

\* Two randomly selected products did not complete testing; the 40% Life Lumen Maintenance Test is not included for either one.

## COLOR RENDERING INDEX

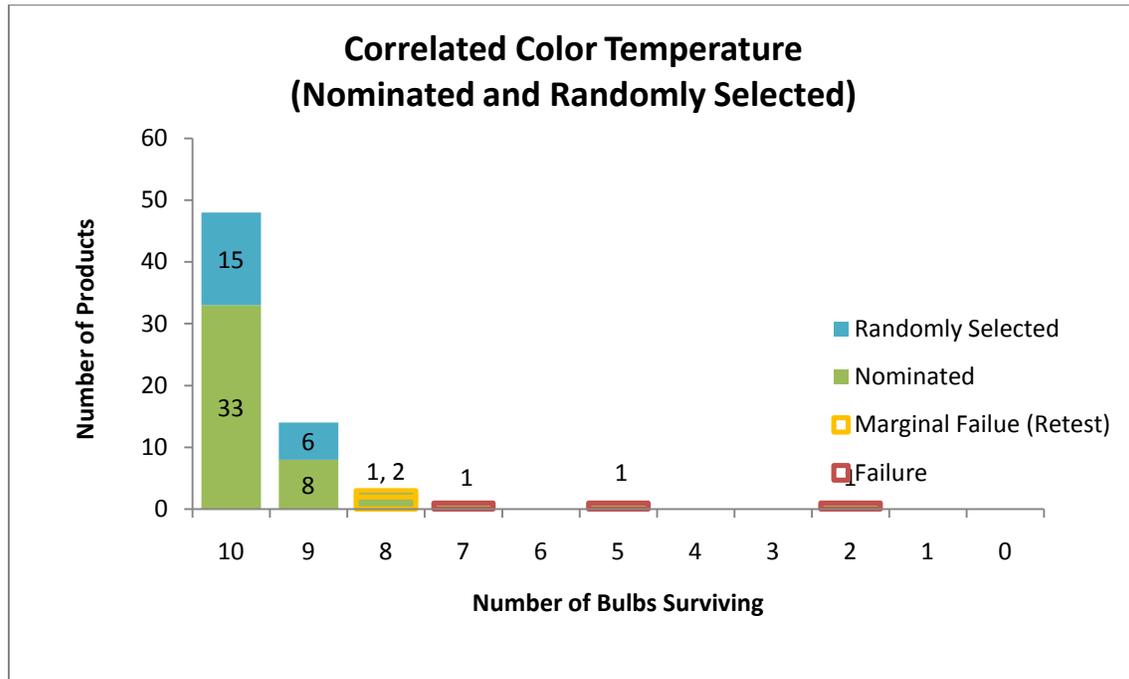
The Color Rendering Index (CRI) is a measure of the ability of a light source to accurately render the color of illuminated objects. The CRI is defined according to the Commission Internationale de l'Eclairage's Publication No.13.3 1995. Products with a CRI greater than 80 pass the test.



Color Rendering Index						
	Total		Nominated		Randomly Selected	
	#	%	#	%	#	%
Failed	0	0	0	0	0	0
Marginal Failure (Retest)	N/A	N/A	N/A	N/A	N/A	N/A
Passed Initial Test	68	100	46	100	22	100
<b>Average</b>	<b>83</b>		<b>83</b>		<b>83</b>	
<b>Total Tested</b>	<b>68</b>		<b>46</b>		<b>22</b>	
The Color Rendering Index Test requires that the average of all samples have an index of 80 or greater. There are no marginal failure criteria for this test.						

## CORRELATED COLOR TEMPERATURE

Correlated Color Temperature (CCT) is a measure of the color appearance of a CFL, measured in Kelvin. CCT is scored based on the American National Standards Institute (ANSI) ellipses for the manufacturer's specified color temperature. Products with zero or one samples falling outside the ANSI ellipse pass. Products with two samples falling outside the ANSI ellipse score as marginal failures.



Correlated Color Temperature						
	Total		Nominated		Randomly Selected	
	#	%	#	%	#	%
Failed	3	4	3	6.5	0	0
Marginal Failure (Retest)	3	4	1	2	1	4.5
Passed Initial Test	62	91	41	89	21	95.5
<b>Average</b>	<b>10</b>		<b>10</b>		<b>10</b>	
<b>Total Tested</b>	<b>68</b>		<b>46</b>		<b>22</b>	

The Correlated Color Temperature Test requires that 9 of 10 samples fall within the ANSI ellipse for a specified color temperature. Marginal failure is defined as 8 of 10 samples passing.

## OBSERVATIONS

The table below shows a breakdown of product failures. An unusually high number of products marginally failed the Rapid Cycle Stress Test. Seven of the eight marginal failures came from the Rapid Cycle Stress Test.

Criteria	Number	Total Tested	Percentage of Total Tested
<i>Failed at Least 1 Test</i>	21	68	31%
Bare Products	17	61	23%
Covered Products	4	7	57%
Failed 1 Test	12	68	18%
Failed 2 Tests	5	68	7%
Failed 3 Tests	3	68	4%
Failed 4 Tests	1	68	1%
Marginally Failed (4 currently retesting)	8	68	12%
Marginally Failed Rapid Cycle Stress Test (4 currently retesting)	7	68	10%
<i>Significantly Underperforming Products<sup>6</sup></i>	14	68	21%
Bare Products	8	61	13%
Covered Products	6	7	86%

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<sup>6</sup> For the purposes of quantifying a “noticeable” failure, D&R defines a significantly underperforming product as one with one or more failures that are two or more standard deviations from the average of the test failed.

ALL RESULTS FOR CYCLE 1 PRODUCT TESTS RECEIVED AS OF FEBRUARY 5TH, 2011

KEY	
*	The product has been retired or discontinued since testing began.
(?)	The product could not be positively identified because its model number corresponds to multiple qualified products.
Failed	The product failed testing.
Significantly Underperforming	The product failed at least one test by more than two standard deviations
Marginal Failure	The product was a marginal failure, meaning that only one less sample than required passed (e.g., if 9 out of 10 are required, only 8 out of 10 passed).
3% Applied	The product passed the Efficacy and/or Lumen Maintenance Test with performance between 97% and 99.9% of the minimum requirement.
Nominated	The product was nominated for testing.
p	The product passed the test

Model Type	Efficacy	Starting Time	Run-Up Time	Power Factor	1,000-Hour Lumen Maintenance	40 Percent Lumen Maintenance	Color Rendering Index	Chromaticity Coordinates	Rapid Cycle Stress Test	Interim Life Test
	See CFL Criteria Version 4.2	<1,000	Amalgam <180; non-amalgam <60	>0.5	>90%	>80%	>80	9/10	5/6	9/10
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	4	1
Bare-spiral	p	p	p	p	P	p	p	p	p	7
Bare-spiral	p	p	p	p	P	p	p	p	4	p
Bare-spiral	p	p	p	p	P	p	p	p	p	8
Bare-spiral	64.20	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	85.72%	74.12%	p	p	3	p
Bare-spiral	p	1124	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	4	p
Bare-spiral	p	p	p	p	P	p	p	p	4	p
Bare-spiral	p	p	p	p	P	p	p	p	4	p
Bare-spiral	p	p	p	p	89.83%	77.28%	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	85.03%	74.12%	p	p	3	8
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	8
Bare-spiral	p	p	p	p	P	p	p	5	4	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	73.84%	71.59%	p	8	p	2

Model Type	Efficacy	Starting Time	Run-Up Time	Power Factor	1,000-Hour Lumen Maintenance	40 Percent Lumen Maintenance	Color Rendering Index	Chromaticity Coordinates	Rapid Cycle Stress Test	Interim Life Test
	See CFL Criteria Version 4.2	<1,000	Amalgam <180; non-amalgam <60	>0.5	>90%	>80%	>80	9/10	5/6	9/10
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	8	p	7
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	2	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	1030	80	p	89.13%	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	78.43%	p	p	p	p
Bare-spiral	p	p	P	p	P	p	p	p	p	8
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	8	3	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	80.60%	69.76%	p	p	1	8
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral	p	p	p	p	P	p	p	p	p	p
Bare-spiral (3-way)	p	p	p	.48	P	p	p	p	p	p
Bare-spiral (3-way)	p	p	p	.50	P	p	p	p	p	p
Bare-spiral	p	p	76	p	87.27%	69.31%	p	p	p	7

Model Type	Efficacy	Starting Time	Run-Up Time	Power Factor	1,000-Hour Lumen Maintenance	40 Percent Lumen Maintenance	Color Rendering Index	Chromaticity Coordinates	Rapid Cycle Stress Test	Interim Life Test
	See CFL Criteria Version 4.2	<1,000	Amalgam <180; non-amalgam <60	>0.5	>90%	>80%	>80	9/10	5/6	9/10
(3-way)										
Bare-spiral (Dimmable)	p	p	p	p	p	p	p	p	p	8
Bare-spiral (dimmable)	p	p	p	p	P	p	p	p	p	p
Bare-spiral (Dimmable)	p	p	p	p	P	p	p	p	p	p
Bare-spiral (Dimmable)	p	p	p	p	P	p	p	p	p	p
Bare-spiral (Dimmable)	p	p	p	p	87.10%	p	p	7	p	p
Covered-A-line	42.5; Requires 45	p	361	p	89.16%	cancelled	p	p	p	cancelled
Covered-A-line	p	p	p	p	P	p	p	p	p	p
Covered-A-line	p	p	p	p	P	p	p	p	p	p
Covered-A-line	p	1026	p	p	P	p	p	p	p	p
Covered-reflector	p	p	p	p	87.67%	p	p	p	p	p
Covered-reflector	p	p	p	p	P	p	p	p	p	p
Covered-reflector	p	p	183	0.5	P	p	p	p	p	p
Covered-reflector (dimmable)	p	p	p	p	P	cancelled	p	p	p	cancelled
Covered-reflector (dimmable)	p	p	p	p	P	p	p	p	p	p

Model Type	Efficacy	Starting Time	Run-Up Time	Power Factor	1,000-Hour Lumen Maintenance	40 Percent Lumen Maintenance	Color Rendering Index	Chromaticity Coordinates	Rapid Cycle Stress Test	Interim Life Test
	See CFL Criteria Version 4.2	<1,000	Amalgam <180; non-amalgam <60	>0.5	>90%	>80%	>80	9/10	5/6	9/10
Covered-reflector (Dimmable)	p	p	p	p	82.18%	77.18%	p	p	4	p

**SUMMARY STATISTICS FOR ALL PRODUCTS TESTED**

	Efficacy: Minimum 33-60, depending on W and Model Type	Starting Time: <1,000 ms	Run-Up Time <60 sec (non-amalgam), <180 sec (amalgam)	Power Factor >0.5	1,000-Hour Lumen Maintenance: Must be >90%	40 Percent Lumen Maintenance: >80% of 100-hour lumen average	Color Rendering Index >80	Chromaticity Coordinates: 9/10 coordinates must fall inside ellipse	Rapid Cycle Stress Test: 5/6 samples must meet (rated lifetime)/2 cycles	Interim Life Test: 9/10 samples must last 40% of rated life	Total Tests	Total Models
<b>Nominated</b>												<b>46</b>
<b>Mean</b>	<b>66.03</b>	<b>341.65</b>	<b>44.57</b>	<b>0.58</b>	<b>92.71%</b>	<b>84.78%</b>	<b>82.44</b>	<b>9.39</b>	<b>5.59</b>	<b>9.33</b>		
<b>Median</b>	<b>68.15</b>	<b>238.0</b>	<b>37.50</b>	<b>0.56</b>	<b>93.66%</b>	<b>85.77%</b>	<b>82.39</b>	<b>10.00</b>	<b>6.00</b>	<b>10.00</b>		
Total Failures	0	2	1	0	6	5	0	3	1	4	22	13
Bare Models	0	2	0	0	2	2	0	3	1	2	12	9
Covered Models	0	0	1	0	4	3	0	0	0	2	10	4
Marginal Failures								2	5	3	10	5
Bare Models								1	4	3	8	5
Covered Models								1	1	0	2	0
% Full Failure	0.0%	4.3%	2.2%	0.0%	13.0%	10.9%	0.0%	6.5%	2.2%	8.7%		28.3%
% Passing Test	100.0%	95.7%	97.8%	100.0%	87.0%	89.1%	100.0%	89.1%	87.0%	84.8%		60.9%
<b>Randomly Selected</b>												<b>22</b>
<b>Mean</b>	<b>63.91</b>	<b>398.68</b>	<b>56.38</b>	<b>0.62</b>	<b>94.03%</b>	<b>85.63%</b>	<b>83.10</b>	<b>9.64</b>	<b>5.23</b>	<b>8.90</b>		
<b>Median</b>	<b>65.53</b>	<b>317.50</b>	<b>31.00</b>	<b>0.56</b>	<b>94.95%</b>	<b>86.64%</b>	<b>82.37</b>	<b>10.00</b>	<b>6.00</b>	<b>9.50</b>		
Failures	1	1	3	3	1	1	0	0	2	1	13	8
Bare Models	0	0	0	2	1	1	0	0	2	1	7	5
Covered Models	1	1	3	1	0	0	0	0	0	0	6	3
Marginal Failures								1	2	4	7	3

	Efficacy: Minimum 33-60, depending on W and Model Type	Starting Time: <1,000 ms	Run-Up Time <60 sec (non-amalgam), <180 sec (amalgam)	Power Factor >0.5	1,000-Hour Lumen Maintenance: Must be >90%	40 Percent Lumen Maintenance: >80% of 100-hour lumen average	Color Rendering Index >80	Chromaticity Coordinates: 9/10 coordinates must fall inside ellipse	Rapid Cycle Stress Test: 5/6 samples must meet (rated lifetime)/2 cycles	Interim Life Test: 9/10 samples must last 40% of rated life	Total Tests	Total Models
Bare Models								1	2	3	6	3
Covered Models								0	0	1	1	0
% Full Failure	4.5%	4.5%	13.6%	13.6%	4.5%	4.5%	0.0%	0.0%	9.1%	4.5%		36.4%
% Passing Test	95.5%	95.5%	86.4%	86.4%	95.5%	95.5%	100.0%	95.5%	81.8%	77.3%		50.0%
<b>All</b>												<b>68</b>
<b>Mean</b>	<b>65.34</b>	<b>360.10</b>	<b>48.27</b>	<b>0.59</b>	<b>93.12%</b>	<b>85.04%</b>	<b>82.65</b>	<b>9.47</b>	<b>5.47</b>	<b>9.20</b>		
<b>Median</b>	<b>67.82</b>	<b>279.00</b>	<b>34.00</b>	<b>0.56</b>	<b>94.21%</b>	<b>86.15%</b>	<b>82.38</b>	<b>10.00</b>	<b>6.00</b>	<b>10.00</b>		
Total Full Failures	1	3	4	3	7	6	0	3	3	5	35	21
Bare Models	0	2	0	2	3	3	0	3	3	3	19	14
Covered Models	1	1	4	1	4	3	0	0	0	2	16	7
Total Marginal Failures								3	7	7	17	8
Bare Models								2	6	6	14	8
Covered Models								1	1	1	3	0
% Failing Test	1.5%	4.4%	5.9%	4.4%	10.3%	8.8%	0.0%	8.8%	14.7%	17.6%		42.6%
% Full Failure	1.5%	4.4%	5.9%	4.4%	10.3%	8.8%	0.0%	4.4%	4.4%	7.4%		30.9%
Total Passing Test	67	65	64	65	61	62	68	62	58	59		39
Bare Models	58	56	58	56	55	55	58	53	49	49		36
Covered Models	9	9	6	9	6	7	10	9	9	7		3
<b>% Passing Test</b>	<b>98.5%</b>	<b>95.6%</b>	<b>94.1%</b>	<b>95.6%</b>	<b>89.7%</b>	<b>91.2%</b>	<b>100.0%</b>	<b>91.2%</b>	<b>85.3%</b>	<b>82.4%</b>		<b>57.4%</b>