Framework for Testing Product Component Families

This document presents a parallel quality assurance method to IEC TS 62257-9-5 for testing interchangeable product components that may be individually sold but are intended to be used together.

Version 1
July 2014

Introduction

Historically, the most widely-used business model that modern off-grid lighting manufacturers use is to sell their product as a complete kit (i.e., including one or more batteries, solar modules, and light sources). In some cases the product is a single unit with an integrated battery, solar module, and light source, and in other cases the solar module and/or light source(s) are external to the battery, intended to be connected via a cable. For both of these product configurations, manufacturers have traditionally sold the complete product as a single, defined unit. Verifying the quality of these preconfigured kits was the original goal for Lighting Global Quality Assurance (QA).

Recently, Lighting Global has observed an increasing trend in manufacturers selling "product families"—a set of interchangeable components sold on a component-level basis or as "mix-and-match" kits. A benefit of selling products at the component-level is that users are able to tailor a complete system to their budget and lighting needs. In principle it is also less costly to scale-up these systems by purchasing extra components, rather than another complete (larger) product kit that is incompatible with the original one.

This document provides details of the Lighting Global framework for component-level testing and associated programmatic support for "product families" that are considered to have met the Lighting Global Minimum Quality Standards. The intention of this framework is to provide a low-cost, timely product verification alternative for manufacturers that sell "product families."

Because of the potentially dozens of combinations that are possible from the same "family" of interchangeable components it would be prohibitively expensive to use a QA framework that required testing of each unique set. The market drive toward flexible families of products and this incompatibility with the original framework is what drives the development of the new policy that is presented here.

Product Family Testing Framework

The following is a set of testing rules for "product families":

Product Family Testing Rules:

1. **Interchangeability:** Product family testing is intended for products that are sold as individual components or as "mix-and-match" kits in which some or all of the components within the product family may be used interchangeably.
2. **Random Sampling:** All tested components must be randomly-selected according to the guidelines in IEC TS 62257-9-5, and all tests will use a sample size of 6.
3. **System-level Testing:** At least one fully-configured system "kit" must be tested according to the Quality Test Method. The organization seeking testing may recommend the arrangement of components to have tested as a complete kit, but if there is public advertising of any specific kits, one of those advertised kits must be selected for testing. It is allowed, of course, to select more than one complete kit to have tested, if desired. Though the organization may recommend a kit for testing, Lighting Global has the discretion to select which kit combination(s) will be tested and may require testing more than one kit.
4. **Coverage:** At least half (rounding down) of the models of each product component (PV module, battery/control unit, light point, etc.) must be tested. Lighting Global has the discretion to test more than half if deemed necessary.
    a. The smallest/dimmest and largest/brightest models the test lab is capable of testing must be tested, at a minimum.
    b. The other model(s) will be selected by Lighting Global.
5. **Test Plans:** Lighting Global will develop a custom test plan for each product family. The timeline and pricing of testing will be based on this custom test plan and be agreed upon in advance of testing.

Component-level testing may take place according to Rule 4. The Lighting Global Quality Test Method in IEC TS 62257-9-5 provides a framework for rigorously testing various product components:

- **Battery/energy storage characteristics**
    - Battery capacity
    - Appropriate charge control*
- **Photometric characteristics**
    - Light intensity*
    - Light distribution*
- **Lumen maintenance**
- **Photovoltaic module performance**
- **Durability, usability, and safety**
    - IP class estimate
    - Drop, switch/connector, gooseneck, and strain relief tests
- **Electrical quality inspection**

Of the tests listed above, only the three tests with an asterisk (*) currently require system-level information or other system components to carry out the test. Table 1 provides an explanation of

how this framework for testing "product families" will be implemented in the case of tests that normally require system-level information to carry out:

Table 1 List of tests that require system-level information to carry out according to the methods in IEC TS 62257-9-5 and how the testing will be conducted on a component-level basis.

Test	Information or Other Component(s) Required by IEC TS 62257-9-5	Test Plan for Component-Level Test
Appropriate charge control	Load and charging system information is required. For NiMH batteries in particular, charging system information is required to check for passive overvoltage protection.	1. Verify appropriate charge control protection in the tested kit(s) with n = 6. 2. Verify overvoltage protection for family using a) the smallest battery and largest charging source (with n = 3) and b) the largest battery and smallest charging source (with n = 3). 3. Verify deep discharge protection for family using a) the smallest battery and largest light load (with n = 3) and b) the largest battery and smallest light load (with n = 3).[1]
Light intensity	The light source is driven at the voltage corresponding to the average light output over the full-battery run time.	Drive the light load at the voltage corresponding to the average light output over the full-battery run time for the tested kit(s) with n = 6. If more than one kit is tested, the average of the voltages obtained during the full-battery run time test will be used.
Light distribution	The light source is driven at the average voltage through the full-battery run time.	Not required.

[1] The scenarios (a and b) outlined in steps 2 and 3 are subject to safety constraints that are required to be published by the manufacturer for the component family (e.g., "With battery X, only connect up to Y watts of PV module"). Lighting Global will determine if the published safety constraints are adequate.

The other testing in the bulleted list above will be conducted as normal (i.e., according to the IEC TS 62257-9-5 QTM methods) on each component tested, as applicable to the component itself. For all component-level and kit-level tests performed on the "product family", a measurement tolerance of 15% will be allowable for truth-in-advertising judgments (i.e., the average measured value across all samples can be up to 15% lower than the advertised value).

Product Family Program Support Framework

The Lighting Global Quality Assurance team will support quality-verified "product families" according to the following guidelines:

Lighting Global Program Support Guidelines:

1. **Standards:** All complete kits that are tested according to the Quality Test Method must meet the Lighting Global Minimum Quality Standards. Additionally, all individually-tested components must meet the applicable Lighting Global Minimum Quality Standards. If any kits or components fail to meet the Minimum Quality Standards, re-testing or other measures may be required for the product family to pass at the discretion of Lighting Global.

2. **Market Check Testing:** All components and complete kits, whether initially tested or not, are subject to market check testing. If any component or configuration fails a market check test, the status of all product configurations that utilize that component or which relied on results associated with the failed configuration may be revoked as described in the Market Check Test Policy.

3. **Communicating Quality:** Test results for product families with verified quality will be available on the Lighting Global Products web page in a "Spec Book" that includes test results that apply to the family of products (see below for details on the Spec Book contents). Additionally, each fully tested system configuration will be included in a separate, stand-alone Standardized Specification Sheet (SSS) along with the current ones.

Spec Books:

For "product families" that meet the Minimum Quality Standards—both kits and components—a "Spec Book" will be generated that provides information about all of the configurations within the family and the associated components. In addition, each fully-tested kit will receive a separate Standardized Specification Sheet (SSS). Both the Spec Book and the individual product SSS will be listed on the Lighting Global website (see http://www.lightingglobal.org/products/ for examples of standard SSS). The Spec Book will contain the following (in order):

1. A title page indicating the manufacturer name, name of the "product family," and the expiration date of the test results.
2. One or more system-level SSS (based on how many complete kits are tested) with a clear disclaimer indicating that other system configurations (i.e., kits) will perform differently.
3. A component-level SSS page indicating the component type, component name or model number, component rating, and measured performance. For components that did not undergo testing, they will be clearly labeled as not being quality-tested, but text on the page will state that based on the verified quality of the other tested components in the family, the components that did not undergo testing are considered to be quality-verified as well.

An example Spec Book is provided below.

Lighting Global
Standardized Specifications Book

Manufacturer: Sunshine Co., Ltd.

Component Family Name: Sunshine Plug-N-Play

Date of Standardized Specifications Book Expiration: July 2016

This Lighting Global Standardized Specifications Book contains at least two distinct Standardized Specifications Sheets: 1) **One or more system-level Standardized Specifications Sheets** based on Lighting Global Quality Test Method results for complete system(s) defined using components in the component family, and 2) **A component-level Standardized Specifications Sheet** listing the available components in the component family by component type, each individual component's performance rating, and performance results for each component tested according to the Quality Test Method (QTM) in IEC 62257-9-5.

NOTICE: Other kits developed using components from the component family will perform differently than the kit(s) shown in the system-level SSS.

System-Level Standardized Specifications Sheet

SunShine Basic Kit

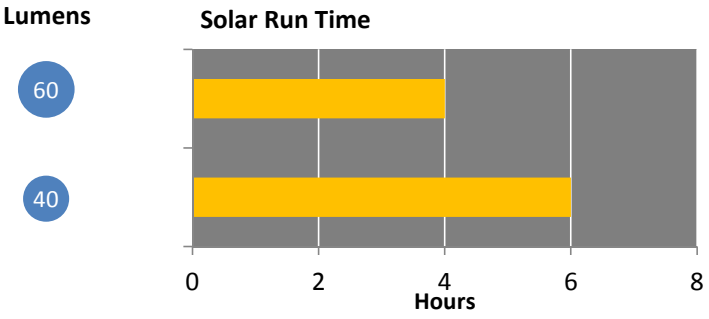
Sunshine Co., Ltd.

Included Components:

BB-2, PV-2, LS-60-a, LS-60-b

Verify Online: http://www.lightingglobal.org/products/ss-basickit

Valid Until: July 2016



Meets Lighting Global Minimum Quality Standards

Mobile Charging

2 **Light Points**

PRODUCT PHOTOGRAPH

Warranty Information

All parts are protected from manufacturing defect or failure under normal use for a period of one year.

Performance Details

	Brightness Setting***	
Performance Measure	**Both High**	**Both Low**
Full battery run time* (hours)	8	12
Run time per day of solar charging* (hours)	4	6
Total light output (lumens)	60	40
Total area with illumination > 25 lux** (m^2)	0.4	0.25
Total lighting service (lumen-hours / solar-day)	240	240

* Run time estimates do not account for mobile phone charging or other auxiliary loads; the run time is defined as the time until the output is 70% of the initial, stabilized output.

** Total area with illumination > 25 lux is determined by the maximum area with adequate illumination at a 0.75 m distance and at the distance from which the product would normally provide task lighting service.

*** Additional brightness settings (not tested):

Lighting Details

Lamp type	LED
Description of light points	Both light points contain 10 LEDs.
Colour characteristics	CRI 85 CCT "Cool" (5000-7000 K)
Distribution type	Wide
Lumen maintenance	95% of the original output remains after 2,000 hours run time

Special Features	
Mobile charging	Includes 5 mobile phone adapter "tips"
Battery/control box housing	ABS body

Durability	
Overall durability and workmanship	Pass
Durability tests passed	Drop test, switch and connector cycling, strain relief test, physical ingress protection test, and protection from occassional rain

Solar Details	
PV module type	Polycrystalline silicon
PV maximum power point	2 watts

Battery Details	
Battery replaceability	Easily replaceable with common tools
Battery chemistry	Lithium iron phosphate
Battery package type	2x 1865 package
Battery capacity	2000 mAh
Battery nominal voltage	3.2 V
Appropriate battery protection circuit	Pass

Marks and Certifications	
Factory certification	ISO 9001:2008
Safety certification	UL
Other certification	CE

Product Details	
Manufacturer name	Sunshine Co., Ltd.
Product name	SunShine Basic Kit
Product model / ID number	SS-BK1
Contact information	sunny-info@sunshine.com
Website	www.sunshine.com/sunshine-basic-kit

SSS Information	
Specs sheet expiration date	July 2016
Minimum Quality Standards Framework Version	2014
Revision	2014.04

Component-Level Standardized Specifications Sheet

Sunshine Co., Ltd. Sunshine Plug-N-Play Family

Battery/Control Box

Name / Model Number	Battery Capacity Rating (mAh)	Measured Battery Capacity (mAh)
BB-2	2000	2100
BB-4	4000	Not Tested
BB-6	6000	6000

PV Module

Name / Model Number	Peak Power at STC Rating (W)	Measured Peak Power at STC (W)
PV-2	2	2.1
PV-5	5	Not Tested
PV-10	10	9.9

Light Sources

Name / Model Number	Luminous Flux Rating (lm)		Measured Luminous Flux (lm)		Measured Lamp Efficacy (lm/W)	
	High	Low	High	Low	High	Low
LS-60-a	60	40	63	41	95	97
LS-60-b	60	40	Not Tested		Not Tested	
LS-100-a	100	60	99	63	91	92
LS-100-b	100	60	Not Tested		Not Tested	
LS-200-a	200	100	Not Tested		Not Tested	
LS-200-b	200	100	200	100	89	90

NOTICE: Not all components listed on this page were tested according to the Quality Test Method (QTM) in IEC 62257-9-5. However, based on the satisfactory performance of the tested components in the family, the components that were not tested are regarded to have passed the applicable Lighting Global Minimum Quality Standards. In addition, all tested components passed an internal inspection, the full array of *applicable* QTM durability tests, as well as ingress protection testing (where applicable).