Standardized Specification Sheet Guidelines
Version 1.0

December 15, 2010

Introductory Remarks: These Standardized Product Specification Guidelines are provided to assist manufacturers in creating a standard "Spec Sheet" for their off-grid lighting products. The Guidelines outline a framework for providing clear information to buyers (particularly wholesale distributors and other bulk purchasers) and enable fair comparisons to be made between different products. In developing the metrics, we have focused on specifications for system level performance (as opposed to component performance) wherever possible. We have also strived to keep the list as short as possible while still providing key information to buyers. The procedures associated with evaluating the respective metrics draw from test procedures that were developed for Lighting Africa by the Fraunhofer Institute for Solar Energy Systems (FISE) titled "**Stand-Alone LED Lighting Systems Quality Screening.**" This document is necessary to complete these Specifications and will be referred to as the **Lighting Africa Quality Test Method (LA-QTM)**.

Only results from laboratories in the Lighting Africa Test Laboratory Network who are qualified to conduct the full LA-QTM will be accepted for specifications sheets. A description of how laboratories can qualify for the Network is available in a separate document.[1]

Section 1: Specification Guidelines summary and example

The Specification Sheet is divided in to eight sections:

0) Overall Performance

1) General Information

2) Run Time

3) Lighting System Specifications

4) Charging System Specifications

5) Energy Storage Specifications

6) Special Features

7) Sample Procurement Date

These subject areas are outlined in Table 1 below. Following that is an example specification sheet for a hypothetical product; it provides an example of the suggested format for the specification sheet. Detailed explanations of each topic, including the methods used to test and verify, are given in Section 2.

[1] For details on the Lighting Africa Test Lab Network, email qualityassurance@lightingafrica.org or ask your Lighting Africa contact person.

Table 1. *Off-Grid Light Specifications "Short" List Summary Table*

Sec.	Topic	Listing	Notes, test method, etc.
0	**Overall Performance**	In sentence form, list the light output and run time for up to two settings.	
1	**General Information**	Manufacturer Co. name, contact info, website, brief summary of guarantees offered (duration and coverage in general)	Detailed guarantee/warranty information should be provided separately.
2	**Autonomous Run Time**	Number of hours the product can be used on a full battery at each light level setting	**LA-QTM** Section 4.1.6 "Run Time" (Autonomous Time)
	Lighting Hours per solar day (PV only)	Run Time per solar day (5 kWh/m²/day)	**Appendix A:** Photovoltaic Specification Methods (below) **LA-QTM** Section 4.1.9.1, Appendix 6.6.1
3	**Lamp Technology**	Lamp Type	LED, CFL, fluorescent tube, etc.
	Light Output: Initial	Lumens	Measured with integrating sphere or goniophotometer
	Light Output: 2000 hr.	Lumens	**LA-QTM** Section 4.1.13
	Light Quality	Angular distribution type (categorized by Full width-half max (FWHM) angle) Color Rendering and Appearance (CRI, Color temperature description)	See Section 2.
4	**Charging system type(s)**	Solar, external AC charger, internal AC charger, dynamo	More than 1 may apply
	AC systems	- Rated power input specifications (e.g., 230 VAC, 50 Hz vs. 120 VAC, 60 Hz, etc. - Time to charge a fully discharged battery	**LA-QTM** Section 4.1.9.4
	Crank Charging Systems	Time to charge a fully discharged battery if the crank is turned at 120 revolutions per minute. Can also be reported in terms of lighting duration per duration of cranking (e.g., minutes/minute)	**LA-QTM** Section 4.1.9.3; updated crank charging test method forthcoming.
5	**Energy Storage System Type**	Battery, capacitor etc.	
	Capacitor Systems	Capacitance rating	
	Battery Systems	Battery chemistry type	NiCad, NiMH, alkaline, sealed lead acid, Li-ion etc.
	Battery Systems	Specify battery nominal voltage and capacity (mAh or Ah) at the following discharge rates: SLA: 20 hr discharge rate (C/20) NiCd/NiMH/Li-ion: 5 hr discharge rate (C/5) Specify type of protection (LVD/ HVD)	**LA-QTM** Section 4.1.4
6	**Additional Information / Special Features**	Must note primary Lamp Housing Material; Note any auxiliary power output jacks, electrical output type (DC vs. AC), outlet style (e.g. mini-USB, 3 mm barrel, etc.), nominal voltage, current output Note certifications of factory, product, etc. that are verified by LA (e.g. ISO9000).	Jacks for applications (mobile telephone charging, radios, etc)
7	**Sample Procurement Date**	Date (month/year) when samples were procured for testing.	Retesting is required every 2 years (minimum) to maintain

			specification sheet.

Table 2: *Specifications Sheet for a hypothetical product (not representing any real lamp).*

Sunshine Lamp	Verify specs at: **www.lightingafrica.org/specs/SLC01**
Overall Performance	
"High" setting: 100 lumens for 2.4 hours after one day of solar charging **"Medium" setting**: 50 lumens for 4.8 hours after one day of solar charging	[include thumbnail photo for quick product ID here]
General Information	
Manufacturer	Sirius Lighting Corporation
Product Name	Sunshine Lamp
Model Number	SL-42
Contact	help@slc.com
Website	www.slc.com
Warranty	2 years (covers defects in manufacture under typical use); see detailed terms for more information.
Run Time	
Autonomous Run Time (full battery)	6 hours "high" 12 hours "medium"
Lighting hours per solar day (PV only)	2.4 hr/day "high" 4.8 hr/day "medium"
Lighting System	
Lamp type	LED
Light output	100 lumens "high" 50 lumens "medium"
Light output at 2000 hours	70 lumens "high"
Light Distribution: Wide 	Color Appearance: Warm (more red) — Daylight — Cool (more blue) Color Rendering: (50%) — (100%) CRI: 85
Charging System	
Charge type(s)	PV and AC Grid
Charge Time (AC Grid)	6.5 hours (AC input = 230 VAC, 50 Hz)
AC Input Power Range	110-230 volts AC, 50-60 Hz
Storage System	
Storage Type	Rechargeable NiMH (6 x AA in package)
Nominal Battery Voltage	3.6 volts DC
Battery Capacity	3600 milliamp hours
Battery Protection	Active HVD and LVD
Easily Replaceable Battery?	Yes
Additional Information & Special Features	
Lamp Housing	Polycarbonate / ABS
[Standard feature] Auxiliary power for mobile phone charging (120 mA at 4.2 VDC, mini-USB connector) **[Optional feature]** FM radio that attaches via the mobile charging port, will operate for approximately 4 hours on a full charge. **Factory Certification**: ISO9000:2000	

Date of Sample Procurement for Testing	August, 2009
	Revision 200908.01

Section 2: Detailed explanation of Specification listings

0. Overall Performance

This section is a description of the key performance indicators – brightness and run time – for up to two settings. For each of the settings listed, the lumen output and hours of run time should be described using plain language phrasing. The run time should be "on a full battery charge" for AC charged or central charging model products, "after one day of solar charging" for solar-charged products and "after XX minutes/hours of cranking" for mechanically charged products.

1. General Information

- Manufacturer company name, contact information, and website address
- Product brand name and model number
- Guarantees or warranties offered by the manufacturer to wholesale and/or retail buyers

2. Run Time

Autonomous Run Time

- Number of hours the product can be used on a full battery **at the highest setting, lowest setting, and any additional settings for which lighting levels are reported (lumen output)**. Note: hours of use are defined by the time that it takes the light output to drop to 70% of its initial value where "initial" is defined as the light level 20 minutes after the test has started.
- For disposable batteries: report test results as specified above with a specified disposable battery (give size, brand, and model). Run at least four tests (using a new set of batteries each time) and report the average.
- Definitions for Autonomous Run Time can be found in the **LA-QTM** section 4.1.6 "Run Time" (Autonomous Time) and section 4.1.4 Battery Capacity

Lighting hours per solar day

- Number of lighting hours available from 1 solar day
  (= Autonomous Run Time ÷ Full charge time)
- *Full charge time* definition follows in Charging System Specifications below

3. Lighting System Specifications

Lamp source technology (i.e., LED, CFL, fluorescent tube, etc.)

- List the lamp technology type. For systems with more than one lamp technology, list all types.

Lumen output

- Average lumen output during a discharge cycle is estimated based on initial lumen output and the average relative illuminance during a discharge cycle. **Initial** lumen output is measured in an integrating sphere or goniophotometer. The entire luminaire **must** be tested, including any lenses, reflectors, and all parts that are normally included with the product that may affect light output. The tests should be performed with a power supply set to the nominal battery voltage in place of the battery after a 20 minute warm-up period. The initial lumen output is multiplied by the fractional value that represents the average lumen output relative to the initial during a full discharge cycle to estimate the average lumen output during discharge.

- Lighting Africa requires a lumen output listing for the highest light setting and any additional settings for which run time is specified. In cases where the manufacturer tests for lower light settings, **the highest light setting is always tested first.** Subsequent tests at lower light settings can directly follow the high output test as long as the light remains continuously ON. If the light is turned off at any point in the test, a new 20 minute warm-up period must be performed.
- Lumen output at **2000 hours** may be measured by an integrating sphere or goniophotometer as explained above. An alternate method may also be used to measure the relative loss in light output over time, as explained in the **LA-QTM** Section 4.1.13. Note, however, that an **initial** lumen test in an integrating sphere or goniophotometer must still be performed.

Color Rendering should be reported according to the Color Rendering Index (CRI) – R_a – and should be included in the Color graphic (see Figure 1). Move the arrow to match the CRI.

Color Appearance Description should be included in the Color graphic (see Figure 1) according to the correlated color temperature (CCT). Move the arrow to match the CCT. The Warm dot is 2700 K, Daylight is 5600 K and Cool is 7500 K. If the CCT is off the scale, put the arrow on the farthest appropriate edge (e.g., if CCT is 10,000 put the arrow on the "cool" dot).

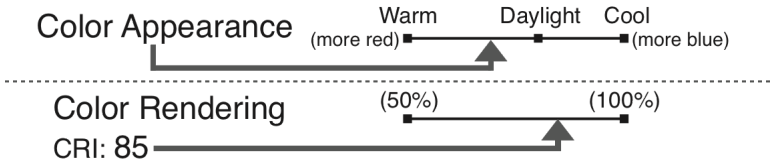

Figure 1: *Color Appearance and Rendering Graphic. Move the arrow to match measured CCT and CRI (details on arrow placement available if base graphic file is opened in vector graphics editor).*

Lighting Distribution should be reported in terms of the full-width half max (FWHM) angle category (i.e., reporting the numerical value of FWHM angle is not required). The angle is defined in terms of a two dimensional "slice" of the lighting distribution that includes the peak and is bounded by illuminance levels equal to half the peak (i.e., the FWHM angular slice must be continuous). The FWHM angle is allowed to be discontinuous if the discontinuity is caused by expected interference from the casework of the product (e.g., support "beams" in a typical lantern form factor). The FWHM angle can be measured in any orientation; however, if the average of the FWHM angle in the orientation in which it is reported and the perpendicular orientation FWHM angle is less than 50% of the reported angle, the average must be reported instead. Based on the angle, choose the appropriate category from the list below and include the correct graphic. Lights with multiple modes or optics that have different categories should report each of them and show each appropriate graphic with clear indication of which mode(s) correspond to which graphic.

- **Narrow (spot):** **$0° < FWHM < 15°$**
- **Wide:** **$15° < FWHM < 180°$**
- **Omni** **$FWHM \geq 180°$**

The appropriate graphic(s) should be placed next to the Light Distribution Specification:

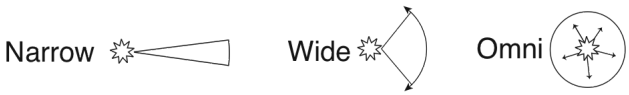

Figure 2: *Light Distribution Graphic (crop to leave only the intended symbol and label).*

Notes:

- Include any additional information about the lighting system (driver type, etc.) that has been verified by testing.

4. Charging System Specifications (list all of the following that apply)

Charging system type (e.g., solar, external AC charger, internal AC charger, dynamo) Note that more than one may apply

PV

- **Full charge time** = number of days to charge a fully discharged battery with a solar input of 5 kWh/m²/day
- Manufacturer must know the module power, efficiency, and battery capacity
- See **Appendix A: Photovoltaic Specification Methods** (below) and **LA-QTM** section 4.1.9.1 and appendix 6.6.1.

AC

- **Rated power input specifications** (e.g., 230 VAC, 50 Hz or 120 VAC, 60 Hz, etc.)
- **Time to charge a fully discharged battery**

Crank

- Time to charge a fully discharged battery if the crank is turned at 120 revolutions per minute

5. Energy Storage Specifications

Energy storage system type (e.g., battery, capacitor)

Capacitor storage

- Specify capacitance rating in uF or F

Battery storage

- Battery chemistry types
- Battery nominal voltage
- Battery package type (AAA, AA, battery pack etc)
- Capacity (in mAh or Ah) at 5 hour discharge rate (C/5)
- Presence of battery protection (low and high, active or passive)
- Ease of replaceability (yes or no) – This metric is based on the LA-QTM (method for determining ease of battery replacement under development).[2]

6. Additional Information & Special Features

- Main materials used for lamp housing

Note any additional special features included in the product, and note if they are standard or optional.

- Auxiliary power output (if applicable)
- Note any auxiliary power output jacks for applications such as mobile telephone charging, radios, etc. Note electrical output type (DC vs. AC), outlet style (e.g. mini-USB, 3 mm barrel, etc.), nominal voltage, and typical current output associated with each auxiliary jack. Note any connectors that are included for modifying the outlet style

Note any certifications for the product or factory certifications.

- e.g., ISO9000

[2] In general, if battery replacement can be achieved with only a screwdriver and without needing to remove or replace any circuit boards or other components, the battery is considered easily replaceable.

7. Date

- Note the month and year of sample procurement for the most recent test results – this determines the validity of the test results.
- The revision number of the specification sheet should be included on the final line, below the sample procurement date, and should be eight digits long. The first six digits are the year and month of sample procurement. The last two digits, separated from the first six by a decimal point, are the chronological revision number for the specification sheet. Revision 01 is the first version – based on the original round of testing after sample procurement. Any modification to the spec sheet – regardless of whether additional testing is required (short of completing a full retest) – should be labeled with a new revision number.

Section 3: Details on Specification Sheet Regulation

Precision of Reporting

The qualitative parts of the specification sheet (warranty, manufacturer name, lighting type, etc.) should always be accurate and updated.

Quantitative parts of the specification sheet that are reported on a continuous scale can be rounded for ease of interpretation. The rounded specification must be based on the most recently available LA-QTM result and be reported to the nearest number that meets the precision guidelines presented in the Table below. The guidelines are in terms of significant figures of reporting (s.f.). If one is rounding to the maximum precision, the rounding should be according to standard conventions ($\geq 0.5 = 1$; $< 0.5 = 0$). Alternatively, one can round further (to fewer significant figures than the maximum) but any further rounding must be in the "Allowable direction" as defined in the table, starting from the original measured value (i.e. the standard rounding convention does not apply in that case). Lighting Africa personnel will work with manufacturers to resolve questions about the degree of rounding in each category.

Table 3: *Precision requirements for metrics on a continuous scale*

Metric	Maximum Precision of Reporting	Allowable direction for add'tl rounding	Example(s)
Run time (autonomous or from standard charging cycle) [hours]	2 s.f.*	Down	4.33 hr → 4.3 hours or 4 hours 36.6 hr → 37 hours or 30 hours
Light output [lumens]	2 s.f.	Down	19.2 lm → 19 lm or 10 lm
Color rendering (CRI) [R_a]	2 s.f.	Down	83.2 → 83 or 80
Color Temperature (CCT) [K]	2 s.f.	Up	4678 K → 4700 K or 5000 K
Light Distribution (FWHM)	2 s.f.	Down	87°→87° 178°→180°
Charge time	2 s.f.	Up	2.49 days → 2.5 days or 3

[days or hours]			days 8.65 hr → 8.7 hr or 9 hr
Battery Capacity [mAh]	2 s.f.	Down	1432 mAh → 1400 mAh or 1000 mAh
Other information	2 s.f.	Varies	n/a

* s.f. = "significant figures"

Maintenance of Specification Sheet and Re-testing

Manufacturers will be expected to update their specification sheet to reflect the current version of their products.

Retesting is required every two years at a minimum to maintain a "current" specification sheet. The two-year period is defined by the procurement month for samples. In addition, certain changes in specified performance will trigger re-testing:

Changes to a "qualitative" part of the specification sheet (e.g., the product warranty or IP class) will require verification of the change by an independent lab or agent. For "quantitative" specification changes (e.g., battery capacity or lumen depreciation), a change smaller than 10% will not trigger retesting. If the change to a quantitative specification represents a performance decline greater than 10%, retesting will be automatic. Reported improvements in performance by greater than 10% will require action by the specifications sheet governing body (e.g., Lighting Africa personnel at this point), who will decide if retesting is required.

Component-level design changes can manifest themselves in system level performance specifications (e.g., autonomous run time). If a manufacturer reports a set of specification sheet changes that do not make logical sense (e.g., a decreased battery capacity by 50% and no change to the autonomous run time or lighting level), Lighting Africa personnel may take action, including clarifying the change with the manufacturer and potentially requiring retesting, if appropriate.

About Lighting Africa

Lighting Africa, a joint World Bank and IFC program, seeks to accelerate the development of markets for modern off-grid lighting products in Sub-Saharan Africa where an estimated 10 to 30 percent of household incomes are spent on hazardous and low quality fuel-based lighting products. The goal is to mobilize and provide support to the private sector to supply quality, affordable, clean and safe lighting to 2.5 million people by facilitating the sale of 500,000 off-grid lighting units by 2012 while, at the same time, creating a sustainable commercial platform that will realize the vision of providing 250 million people with modern off-grid lighting products by 2030. This platform will provide an avenue for social, health and economic development, especially for households and small businesses that will realize significant cost savings and increases in productivity.

Lighting Africa is implemented in partnership with:

The Africa Renewable Energy and Access Grants Program (AFREA), the Asia Sustainable and Alternative Energy Program (ASTAE), the Energy Sector Management Assistance Program (ESMAP), the Global Environment Facility (GEF), Good Energies Inc., Italy, Luxembourg, the Netherlands, Norway, the Public-Private Infrastructure Advisory Facility (PPIAF), the Renewable Energy & Energy Efficiency Partnership (REEEP). For more information: www.lightingafrica.org