

Call for Comments on Proposed Integration of Quality Assurance Frameworks for Pico-solar Products and SHS Kits

Lighting Global Stakeholder Outreach Memo

May 2016

Over the past two years, the Lighting Global team has worked to extend the quality assurance program to cover plug-and-play solar home system (SHS) kits up to 100 watts (W) by developing new test methods and an additional set of Quality Standards.¹ The methods developed to assess SHS kits are similar to the existing framework used to assess pico-solar products, but include some modifications and new test procedures.

Currently, the dividing line between whether a product is tested as a pico-product or an SHS kit is based on wattage. Pico-solar products (products with peak power rating of less than 15 W) are tested according to the latest version of IEC/TS 62257-9-5. Solar home system kits, which for the purposes of Lighting Global are products with peak power ratings between 10 W - 100 W, are tested according to the Lighting Global Solar Home System Kit Quality Assurance Protocols.² For products with peak power ratings between 10 W and 15 W, manufacturers may choose which methods they would prefer be used.

In the process of developing these new methods, it became clear that many of the new methods are appropriate for pico-solar products as well, and that the blurred dividing line (10 W – 15 W) between the two quality assurance frameworks is confusing and imperfect. Some key issues include:

- Products that are smaller than 10 W now often include radios and other appliances and advertise run times for the lights and appliances in combination. Testing according to the current version of IEC/TS 62257-9-5 requires conducting a number of full-battery and solar run time tests, while the energy service calculations described in Annex R of the Lighting Global Solar Home System Kit Quality Assurance Protocols² would enable test labs to conduct a single run time test and calculate the remaining run time estimates. Additionally, the methods for pico-solar products are unable to adequately evaluate an advertising claim that presents run times for various appliances used in combination, even if multiple run time tests are conducted.
- Further, because some country governments have selected 15 W as the upper bound for products that must be tested according to IEC/TS 62257-9-5, many products that would more appropriately be tested as SHS Kits are being tested as pico-solar products, exacerbating the issue above.
- Similarly, many pico-solar products come with ports for charging mobile phones and other devices. There is currently no method in IEC/TS 62257-9-5 that assesses whether these ports can charge a mobile phone or how mobile phone charging impacts the run time of the product.
- Additionally, some of the newly developed safety tests and standards are broadly applicable to all products, regardless of size, but are currently not required for pico-solar products.

¹ The most recent versions of the Pico-PV Quality Standards and SHS Kit Quality Standards are available here: <https://www.lightingglobal.org/resources/quality-standards/>

² The Lighting Global Solar Home System Kit Quality Assurance Protocols are available for review on the stakeholder engagement page: <https://www.lightingglobal.org/ga/stakeholder-engagement/>. The energy service calculations are found in Annex R, which begins on page 217.

The following pages contain an outline of a proposed framework that would provide a continuum of support for all products up to 100 W. We believe the proposed framework will address the issues described above, create a single set of test methods that can more easily be maintained, and ensure a more efficient and appropriate testing process.

We request that you review the proposal below and share any comments you have no later than Friday, June 17. Comments may be officially submitted to the Lighting Global Quality Assurance team through the online form at www.lightingglobal.org/qa/stakeholder-engagement/.

PROPOSED FRAMEWORK

Institutionalization of Test Methods:

The new methods developed for SHS Kits would be fully included in the next revision of IEC/TS 62257-9-5. This addition will enable the new methods to be used for any product under 100 W, as applicable based on the configuration and wattage of the product. This revision could be submitted as early as October 2016 allowing the revised methods to be published in mid-2017.

Reasoning: Previously, we had proposed that the methods for SHS Kits be included in a revision of IEC/TS 62257-9-6; however, by instead including the methods in IEC/TS 62257-9-5, the process of maintaining the documents will be streamlined, duplicative content will be eliminated, and the risk of the two methods deviating will be minimized.

Changes/Additions to the Required Set of Test Methods:

1. Require any product with **ports**³ to undergo the following tests, rather than requiring multiple full battery run time and solar charge tests:
 - Lighting full-battery run time test
 - Solar charge test
 - Assessment of DC ports
 - Appliance power consumption (if appliances are included)
 - Appliance charging efficiency test (if appliances with batteries are included)
 - Energy services calculations

Reasoning: By using the energy service calculations described in the Lighting Global Solar Home System Kit Quality Assurance Protocols, test labs would be able to conduct a single full battery run time test and single solar charge test and subsequently calculate the remaining run time estimates for all other settings. The energy service calculations would also enable the assessment of a variety of advertising claims, including those in which appliances are used in combination. The assessment of DC ports is both an input for the energy service calculations and serves to assess the capability of ports to provide the expected voltage and current capability. The appliance tests serve as inputs to the energy service calculations and provide valuable information regarding the appliances.

These additional tests are not technically complicated and new labs could easily be trained in the methods. Additional equipment needed to conduct the assessment of DC ports is minimal, on the

³ Ports include DC power outlets, sockets, jacks, or receptacles, including USB charging ports. PV sockets are not considered “ports” in this context.

order of a few thousand USD. For products with included appliances, this change would save time during testing and therefore reduce testing costs. For products with multiple different types of ports, but no included appliances, the addition of the DC ports test could increase the cost of testing by approximately 5%. For products with no appliances but a single port, the effort and cost of testing would likely not change, but the method would enable the mobile phone charging capabilities of the port to be assessed.

2. Use the energy service calculations for pico-solar **products without ports** rather than conducting multiple solar run time tests.

Reasoning: The energy service calculations could be applied to pico-solar products without ports to reduce testing time and costs by only requiring a single solar run time test be conducted, rather than one for each setting or lighting configuration.

3. Require **all** products with multiple interchangeable connectors to undergo a user miswiring test, and products with **ports** to undergo PV overvoltage and output overload tests, regardless of size. Additionally, included **appliances** would undergo an assessment of operating voltage range compatibility, which is performed during the assessment of DC ports or separately in the appliance operating voltage range test at the discretion of the test laboratory.

Reasoning: These four tests currently described in the Lighting Global Solar Home System Kit Quality Assurance Protocols are basic safety tests that ensure a product is adequately protected from faults that could harm the product, the appliance, or the user. These tests do not add significantly to the time or cost of testing and are appropriate additions to improve the rigor of the existing test methods for pico-solar products.

4. When conducting the light distribution test, discontinue the measurement of “usable surface area with illumination greater than 50 lux” as a required test and only require that test labs assess the full-width half-max (FWHM) of the light distribution. The methods for assessing the usable surface area would remain in the test methods, allowing manufacturers to request that their products be assessed for this metric if desired and enabling test labs to conduct the test if necessary to verify advertising statements.

Reasoning: The FWHM provides a reasonable estimate of whether the light distribution is “narrow,” “wide,” or “omnidirectional,” which are key descriptors of a given light source. The “usable surface area” provides information about how brightly a light can illuminate a surface, but is a difficult measure to interpret and is rarely used in advertisements. Further, there are no performance reporting, performance targets or quality standards based on this metric currently for the Lighting Global program. The test is, however, time consuming; the elimination of this test may reduce test costs or enable other tests to be conducted without increasing the overall cost of testing.

Clarification of the Required Sample Size Based on Wattage:

For products with peak power less than or equal to 15 W, a sample size of 6 would continue to be used. For products with peak PV power greater than 15 W, a sample size of 4 would continue to be used.

Reasoning: Analysis of historical testing data consistently indicates that reducing the sample size (n) often results in a test outcome for smaller sample sizes (n<6) that disagrees with the test outcome for a full sample size (n=6). Six is already a very small sample size on which to judge an entire product line. Further, as countries have begun to adopt standards for pico-solar products, many have specified that products up to and including 15 W must be tested according to IEC/TS 62257-9-5 with a sample size of 6.

However, a reduced sample size for larger, more complex products helps to mitigate the additional in-kind and shipping costs associated with these products. Additionally, the reduced sample size helps to minimize testing costs for these more complex products that often come with multiple light points and appliances. Setting a clear dividing line of 15 W between the product classes will reduce confusion and avoid potential difficulties with governments and other organizations referencing IEC/TS 62257-9-5.

Changes to the Quality Standards:

1. Products less than or equal to 15 W would need to meet the existing Quality Standards for pico-solar products plus some new relevant standards currently listed for SHS Kits, if applicable to the particular product. The new Standards for pico-solar products would include:
 - **Ports:** Port voltage and current specifications, if provided, must be accurate. Included appliances must function when connected to SHS ports. Power output of ports must be sufficient to power appliances that are advertised but not included. (Specific guidelines for USB and 12 V ports are described in the Quality Standards for SHS Kits). [This standard would only apply to products with ports (DC power outlets, sockets, jacks, or receptacles, including USB charging ports).]
 - **PV Overvoltage Protection:** If the battery is disconnected or isolated, the system must not be damaged and PV open-circuit voltage must not be present on load terminals. [This standard would only apply to products with ports.]
 - **Miswiring Protection:** The user interface should be designed to minimize the likelihood of making improper connections. If improper or reversed connections can easily be made, they should cause no damage to the system or harm to the user. [This standard would only apply to products with interchangeable connectors.]
 - **Circuit and Overload Protection:** The system must pass an overcurrent and an overload protection test. Products must include a current limiting mechanism to prevent irreversible damage to the system. The mechanism must be easily resettable or replaceable by the user, or must automatically reset. If replaceable fuses are used for circuit protection, sizes must be labeled on the device and listed in the user manual, and, if fuses are replaceable by the user, at least one spare fuse must be included with the product. Included appliances are not required to meet this standard. [This standard would only apply to products with ports.]
 - **Battery Protection for Lithium Batteries:** Lithium batteries must carry UN 38.3 certification and have overcharge protection for individual cells or sets of parallel-connected cells. [This standard would only apply to products with lithium-based batteries, including lithium iron phosphate batteries.]

Reasoning: The additional standards listed above are aligned with the additional test methods described above. These standards are relevant to all sizes of solar products and are related to protecting products, appliances, and the user from harm and ensuring that ports perform as expected. Though these new standards would be included for pico-solar products, some differences would still exist between the standards required for products with peak power less than or equal to 15 W and those with peak power greater than 15 W. The larger products would need to meet the existing Quality Standards for SHS Kits.⁴

2. The lumen maintenance threshold would be increased for pico-solar products to an average relative light output of all samples $\geq 90\%$ of initial light output at 2,000 hours, with only one sample allowed to fall below 85%.

Reasoning: This increase in the lumen maintenance threshold (from 85% to 90%) would align the requirements for pico-solar products and SHS kits, and it mirrors improvements in the quality of LEDs. Results from testing over the past two years indicate that all but four products tested would meet the 90% threshold. Figure 1 presents the interquartile range of lumen maintenance performance for products tested by Lighting Global between 2010 and 2015. As shown in Figure 1, though median performance has not changed drastically, performance at the low end of the range greatly improved. During 2014-2015, only outliers (four products in total) fell below the proposed 90% threshold for lumen maintenance. There is no additional testing cost associated with making this change to the requirements.

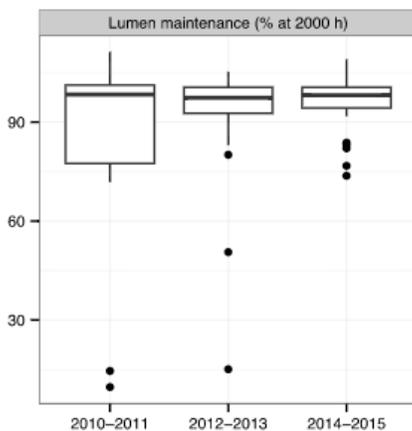


Figure 1. Trend in lumen maintenance performance of products tested by Lighting Global 2010-2015

⁴ The remaining key differences between these Quality Standards for SHS kits and those for pico-solar products are the following. These are already established requirements for SHS Kits and do not represent a proposed change in policy:

- Pico-solar products must report the light output and solar run time on the highest setting on their packaging, while SHS kits must report PV power,
- Pico-solar products would not need to provide a declaration regarding wire and cable sizing or provide documentation regarding the rating of any outdoor cables,
- SHS kits must include a statement on their packaging regarding component/battery replacement,
- SHS kits include more extensive user manual requirements,
- The warranty durations for SHS kits are longer (3 years for the system and light points, 2 years for the battery, and 1 year for any included appliances)

These additional requirements seem appropriate for larger products with longer expected life spans. Again, setting a clear dividing line of 15 W between the product classes is intended to reduce confusion and avoid potential difficulties with governments and other organizations referencing IEC/TS 62257-9-5.

3. The durability tests would be amended so that the switch, gooseneck, connector, moving parts, and strain relief durability tests would no longer allow for any failures, and an additional connector strain relief test would be incorporated for the PV module plug on pico-products which are classified as “portable separate.”

Reasoning: Field reports have indicated that products which have met the Lighting Global Quality Standards are occasionally failing in the field due to switch or connector failures that were not identified in the lab. The Lighting Global team is working to identify ways to improve the durability tests to enable them to more accurately predict failures in the field, but in the interim, making the tests stricter by not allowing any failures will assist with preventing products of uncertain quality from meeting the Quality Standards. There is no additional testing cost associated with making this change to the requirements.

Additionally, field reports have suggested that a common point of failure for small modules is in the strain relief of the barrel plug which connects the PV module to the product. The Lighting Global team intends to incorporate a test for portable pico-products to assess the durability of this connector. This change would likely result in a small additional testing cost for products with relevant connectors.