Changes to Lighting Global testing: Transition to IEC 62257-9-5:2018 (ed. 4)

July 2018

Amended **April 2019** with tables describing the differences between the test methods. See Appendix A.

In June 2018 the International Electrotechnical Commission (IEC) published a new edition of the test methods used for testing solar products, IEC 62257-9-5:2018 (also written as IEC 62257-9-5 ed. 4). It will take our program and the associated test labs some time to phase in use of this new document; this memo describes the associated changes and expected timelines. Additionally, our team has developed tables that provide detailed descriptions of the differences between the new test methods (IEC 62257-9-5:2018) and the older version (IEC 62257-9-5:2016). See Appendix A.

For SHS kits (products larger than 10 W):
We started to conduct testing according to IEC 62257-9-5:2018 in June 2018. The new tests are very similar to the Lighting Global Test Protocols for SHS Kits, Version 2, but include a few small changes to improve the accuracy of the run time estimates and the flexibility of the test methods to handle special cases.

As of July 2018, there are two labs in our network that have capacity to test SHS kits: SMQ in Shenzhen, China and the Schatz Center in California, USA. The Schatz Center will be able to issue accredited test reports for IEC 62257-9-5:2018 tests of SHS kits immediately. SMQ will be able to conduct accredited tests immediately, but there may be a delay of a month or two between when the test finishes and when they can issue the accredited, signed and sealed report. They will be able to issue an unaccredited report in the interim. Any of these reports will be accepted by Lighting Global. Additionally, other labs may be ready to start testing SHS kits within the next year; we will alert you when new options become available. Note, as of April 2019, Intertek Hong Kong, SMQ, and the Schatz Center can all produce test reports accredited to IEC 62257-9-5:2018. See the list of test laboratories in the Lighting Global Lab Network for future additions: https://www.lightingglobal.org/quality-assurance-program/test-laboratory-network/

For pico-PV products (products 10 W and smaller):
We are providing a 6-month transition period and will allow testing according to either the previous edition of the test methods (ed. 3, IEC 62257-9-5:2016) or the new methods (ed. 4, IEC 62257-9-5:2018) at each test laboratory's discretion according to their accreditation schedule. We are offering this transition period to ensure that labs are able to produce accredited test reports because governments or other programs that have adopted standards

for pico-PV products often require accredited reports. Products that are tested according to IEC 62257-9-5:2018 must undergo additional tests to assess ports, power consumption, circuit protection, and overall system performance that are not required if tested to IEC 62257-9-5:2016, but will only need to undergo the full-battery run time and solar run time tests for one setting because the new methods will allow the lab to estimate performance for all other settings. Any product that begins testing during this transition period will be held to the current Lighting Global Pico-PV Quality Standards, regardless of which method was used for the testing. This transition period will end December 1, 2018.

All tests of pico-PV products that begin on or after December 1, 2018 must be conducted according to IEC 62257-9-5:2018 at a test lab that is accredited to conduct the new methods. If you are interested in testing at a specific laboratory after December 1, please contact the lab or our team to ensure that your chosen lab can perform accredited tests to IEC 62257-9-5:2018. All pico-PV products that start testing after December 1, 2018 will be held to revised Quality Standards that include requirements for ports and circuit protection. We have discussed these changes through stakeholder outreach over the past two years. These requirements have been in place for SHS kits and will now be applied to pico-PV products as well, starting with tests that begin on or after December 1, 2018.

In August 2018, we will share a draft of the revised Pico-PV Quality Standards to enable companies to ensure their products will comply with the new standards. In summary, the key additions include:

- **Ports**: Port voltage and current specifications, if provided, must be accurate. Included appliances must function when connected to output ports. Power output of ports must be sufficient to power appliances that are advertised but not included. (Specific requirements for USB and 12 V ports are described in the Quality Standards for SHS Kits - these same requirements will be extended to pico-PV products). [This standard will 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 will 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.
- **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 will 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 will only apply to products with lithium-based batteries, including lithium iron phosphate batteries.] Note that this change will require that

product manufacturers provide additional documentation to verify that their multi-cell lithium batteries have individual cell protection.

Note, the Quality Standards for SHS kits are not changing at this time, and there will still be several key differences between the Quality Standards for SHS kits and the upcoming Quality Standards for pico-PV products. These requirements are only applicable to SHS kits as they are generally larger products with longer expected life spans:

- SHS kits must 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 must meet more extensive user manual requirements.
- SHS kits must provide a warranty of 2 years for the system, PV module, battery, cables, and light points and 1 year for any included appliances, USB charging adapters or similar accessories. (Pico-PV product must provide a 1-year warranty for the entire product).
- To meet the performance reporting requirements, SHS kits must report PV power on the product packaging (pico-PV products must report the light output and solar run time on the highest setting).

For more detail on these requirements, please see the current Quality Standards for SHS Kits.

If you have additional questions on any of the changes discussed above, please reach out to our team at testing@lightingglobal.org. Also, if you are interested in purchasing the new version of the test methods, first check to see if you qualify for a discount on this and other key IEC documents.

Appendix A: Description of differences between IEC/TS 62257-9-5:2018 and prior test methods

An updated version of IEC TS 62257-9-5 was officially published in 2018. As of December 1, 2018, all products are required to test to the newest edition of these test methods, which is either referred to as Edition 4 of the Lighting Global Test Methods or IEC TS 62257-9-5:2018.

Updates to IEC TS 62257-9-5 are based on feedback from test laboratories in the Lighting Global network and from stakeholders such as off-grid lighting manufacturers, government agencies, and product users. Some updates are modest and focus on increasing clarity of test procedures, updating for programmatic thresholds and requirements, improving procedures to minimize errors, increasing flexibility for test laboratories where appropriate, and adding trouble-shooting guides and notes of caution to aid in testing. The major updates are associated with the market's integration of products that include appliances such as radios, fans, etc.; the test methods were expanded to fully characterize these more complicated systems.

The updated IEC TS 62257-9-5 test methods will apply to all products tested through Lighting Global Quality Assurance Program, both pico and solar home systems. There are no longer differences between the pico and solar home system testing methods; IEC TS 65527-9-5: 2018 has replaced the "Lighting Global Solar Home System Kit Quality Assurance Protocols."

Included in this memo are two tables outlining test method updates:

1. Table 1 outlines relevant changes between Edition 3 (IEC TS 62257-9-5:2016) and Edition 4 (IEC TS 62257-9-5:2018).
2. Table 2 outlines tests that previously only applied to solar home system testing under the "Lighting Global Solar Home System Kit Quality Assurance Protocols" but now apply to all submitted products.

Please let us know if you have any questions.

-Lighting Global Quality Assurance Team

Table 1: Edition 4 (IEC TS 62257-9-5:2018) Test Method Updates

Method	Update
Programmatic	**Additional tests** – All products with ports will undergo new tests regardless of product size. These include the miswiring protection test, output overload protection test, PV overvoltage protection test, assessment of DC ports test, appliance tests, and energy service calculations. These tests are explained in detail in Table 2.
	Sample size – QTM tests for larger products (products with peak PV power or other input power greater than 10 W) will only require 4 samples per test. Smaller products will continue to require 6 samples per test, with the continued exception for IP tests (sample size of 1).
	Pay-as-you-go (PAYG) method – This new method was added to provide a set of targeted tests to verify key parameters that may be affected by adding PAYG to a product. This targeted testing includes a visual inspection, durability testing, and standby loss testing. Additionally, manufacturers will be required to submit a declaration indicating that the performance of the PAYG enabled version is equivalent to that of the previously tests non-PAYG product.
Power supply setup (Annex H)	**Typical battery discharge voltage** – This voltage has replaced the average battery voltage. Like the average battery voltage, it is still determined during the full-battery run time test (Annex M); however, it now corresponds to the average power over the full-battery run time rather than the average light output during the run time. The typical battery discharge voltage is used to power the power control unit during the light output, light distribution, assessment of DC ports, and appliance tests.
	Appliance operating voltage – This voltage may be used to power a light point during photometric tests independent of the product's power control unit. The appliance operating voltage is determined in Clause FF.5 by measuring the port voltage while an appliance is in use, and the power control unit is driven at the typical battery discharge voltage. This voltage is also used in the Appliance operating voltage range test described in Clause FF.8 and the Appliance full-battery run time test described in Clause FF.9.
	Standard operating voltage for $LiFePO_4$ batteries – This voltage was changed from 3.20 V/cell to 3.25 V/cell. Historical data shows that most $LiFePO_4$ products perform closer to 3.25 V/cell during FBRT. The standard operating voltage is used during the lumen maintenance test, output overload test, and PV overvoltage protection test.

Light output test (Annex I)	**Each unique light point is individually measured** – For example, if a product has two unique light points that are powered by a single power control unit, each light point must be measured separately. The lab has two options to power the light points: 1) the lab may determine each light point's appliance operating voltage and use that voltage to power each individual light point directly, not from the power control unit, or, 2) the lab may power the two light points simultaneously using the power control unit at its typical battery discharge voltage. Each light point's light output must be measured separately while both are powered on (e.g., only one can be in the sphere at a time). As a second example, if a product has three identical light points that are powered by a single power control unit, the lab has two options to power the light point(s): 1) the lab may determine the light point's appliance operating voltage and use that voltage to power a single light point directly, or, 2) the lab may power the three light points using the power control unit at its typical battery discharge voltage, but shall only measure the light output of one light point. In both options for this second example, the light output of the other two identical light points do not need to be measured for this product.
	Air temperature requirement – The temperature was changed from 24°C ± 3°C to 22°C ± 5°C in the effort to harmonize all ambient temperature requirements.
	Brightest setting only – The lab only tests the brightest setting for each light point unless the manufacturer or specification requests additional settings. Two settings will be tested for products with only one type of light point for reporting on the Lighting Global Standardized Specification Sheets (unless the light has only one setting).
Lumen maintenance (Annex J)	**Warm-up period** – This was changed from 20 min to 60 min ±5 min.
	LM-80 500 h requirement – During the 500 h portion of the LM-80 alternative, only two measurements are required. One at 1 h into the test and the second at 500 h. Previously, more measurements were required.
	Measure each unique light point – If a product has multiple light points, the lab must monitor the relative light output (RLO) of each unique light point separately. Previously, if the product had multiple identical light points, the lab was required to monitor all of the light points, including identical light points. Now only one of each unique light point must be monitored, but each must be monitored separately. The lab has two options for powering the light points: 1. the lab may determine each light point's appliance operating voltage and use that voltage to power each individual light point directly, not from the power control unit, or, 2. the light point(s) may be powered using the power control unit at the standard operating voltage, but only one of each unique light point needs to be turned on.

	Interpolation – The lumen maintenance percentage is calculated by linearly interpolating between two measurements that bracket the target time. This is used for the 500 h, 1000 h, and 2000 h measurements. However, if the measurement is made within 8 h of the target time then interpolation is optional.
	Power outage – If there is a loss of power, the lab may subtract the time the device was turned off from the accumulated lumen maintenance time. When returning power to the product after an interruption, a 20 min warm-up period is required before restarting the cumulative time
Battery test (Annex K)	**Flooded lead-acid battery** – Testing procedures were added to include this chemistry for larger solar home systems.
	Air temperature requirement – The temperature was changed from 24°C ± 3°C to 22°C ± 5°C in the effort to harmonize all ambient temperature requirements.
	Nickel-cadmium batteries – The Lighting Global Quality Assurance Program no longer accepts battery chemistries that include cadmium.
Full-battery run time (Annex M)	**One setting/configuration only** – The full-battery run time is now estimated using the energy service calculations (Annex GG). However, the full-battery run time test is still performed with all of the lighting appliances without internal batteries set to their brightest setting in order to measure the typical battery discharge voltage, average power, energy removed from the battery until the L_{70}, and energy removed from battery until the low voltage disconnect. These are all inputs into the energy service calculations (Annex GG).
	Typical battery discharge voltage – This voltage replaces the average operating voltage and corresponds to the average power over the full-battery run time rather than the average light output during the run time. The typical battery discharge voltage is used to power the power control unit during the light output, light distribution, assessment of DC ports, and appliance tests.
	Waiting period – The waiting period between the product being fully charged and starting the full-battery run time test was updated from 1 - 10 h to 1 - 24 h.
	Multiple arrays with separate deep discharge protection circuits – If a product has multiple separate batteries, a separate full-battery test will be performed on each battery.
Grid charge test (Annex O)	**Energy (E_{grid}) outcome** – Instead of this method estimating the product's grid run time, it now estimates the amount of energy the product accumulates after 8 hours of grid charging. E_{grid} then used in the energy service calculations (Annex GG) to determine the product's grid run time.
	Brightest setting only – The lab only tests the brightest setting unless the manufacturer or specification requests additional settings.
Electromechanical charge test (Annex P)	**Atypical products** – The methods were expanded to include testing products with a single action (e.g. lifting a weight) and electromechanical products without a battery.

	Energy or power outcome – Instead of the test method estimating the product's electromechanical run time, the test method now estimates the amount of energy the product accumulates after a period of charging or instantaneous power during charging; the outcome can subsequently be used with the energy service calculations (Annex GG) to determine the product's electromechanical run time
	Brightest setting only – The lab only tests the brightest setting unless the manufacturer requests additional settings.
Photovoltaic module I-V characteristics test (Annex Q)	**IEC 61215-2 extension** – The test methods provide guidance for generating a set of I-V curve data for a PV module model that is covered by IEC 61215-2, but the specific PV module model wasn't specifically tested (i.e. a different PV module model of the same product family was tested). However, the Lighting Global Quality Assurance team is still working to ensure that the results of this method will be an adequate replacement for the I-V curve test in Annex Q, so is not yet accepting IEC 61215 results as an alternative to this test.
	I_{SC} interpolation – If the I-V curve data set does not include a zero voltage, then I_{SC} should be interpolated, if applicable, or estimated as the measured point with a voltage closest to zero.
	V_{OC} interpolation – If the I-V curve data set does not include a zero current, then V_{OC} should be interpolated, if applicable, or estimated as the measured point with a current closest to zero.
Solar charge test (Annex R)	**Outcome updates** – This test method no longer estimates the product's solar run time; instead the method provides outcomes that are input into the energy service calculations (Annex GG) to estimate the product's solar run time. In addition, a new outcome is generated (average charging voltage) which is used in the assessment of DC ports (Annex EE).
	Auxiliary appliances with internal batteries – These appliances no longer need to be attached to the main unit and charged during the solar charge test but are optional.
	Brightest setting only – The lab only tests the brightest setting unless the manufacturer requests additional settings.
Charge controller behaviour test (Annex S)	**Low-power mode** – Some products may have a special mode they go into after being turned off for a period of time (e.g. its standby loss draw is 10 mA up to 5 h after which the standby loss draw drops to 1 mA). The test methods now include an outcome time before switching to low-power mode and require that the standby loss current be recorded for all modes.
	Passive deep discharge protection and products with ports – If a product includes ports, passive deep discharge protection is NOT allowed unless each port independently has appropriate active deep discharge protection.
	Systems without lighting – The method has been expanded to include a passive deep discharge assessment for products that do not provide lighting (a kit that comes with ports for appliances such as televisions, fans, or radios, but no lighting appliances are included with the kit).
Light distribution test (Annex T)	**Air temperature requirement** – The temperature was changed from 24°C ± 3°C to 22°C ± 5°C in the effort to harmonize all ambient temperature requirements.

Physical and water ingress protection test (Annex U)	**Separate solar module designed to be partially installed indoors** – The outdoor part must meet IP3X, and the indoor part must meet IP2X.
	Advertised IP rating – If a product claims an IP rating that is more stringent than required by the product's form factor (e.g. if a portable integrated product's packaging claims IP57, and the form factor requires testing to IP23), then the manufacturer must provide an appropriate certificate for the IP rating, or the manufacturer must pay the test lab to perform the additional test. Some manufacturers describe their water ingress protection rather than use an IP rating. Below is a list of subjective claims to IP equivalents Lighting Global determined with some reference from IEC 605629: • "Water proof" = IPX7 • "Splash proof" or similar = IPX4 • "Rain proof" or "protection from heavy rain" or similar = IPX3 • "Water resistance", "splash resistance", "rated for outdoor use", or similar = IPX1 • "Dust proof", "protected from dust", or similar = IP5X The IP equivalents are stated in the LG Quality Standards. We intend for the IP assessments required by the test lab to be properly specified in the product's test plan.
Mechanical durability test (Annex W)	**Drop test for non-lighting portable appliances** – The drop test for non-lighting portable appliances (e.g. radio, portable fan, razer) will be performed on two faces as opposed to six faces, with an exception for ISM, following: • Pico-QTM: the two faces shall be rotated between the six samples, so that after the sixth sample, all six faces have been tested twice. • SHS-QTM: the two faces shall be rotated between the four samples, so that after the third sample, all six faces have been tested once; the fourth sample shall be dropped on faces that received the most damage from testing the first three samples or on the faces deemed most mechanically weak. • DISM (AR/MCM/AVM): only four of the six faces can be tested between the two samples so only the four faces deemed most mechanically weak are tested. • ISM: the appliance is dropped on all six faces.
Battery durability test (Annex BB)	**Flooded lead-acid battery** – Testing procedures were added to include this chemistry for larger solar home systems.
	Air temperature requirement – The temperature was changed from 24°C ± 3°C to 22°C ± 5°C in the effort to harmonize all ambient temperature requirements.

Table 2: Additional Edition 4 (IEC TS 62257-9-5:2018) Tests

Programmatic	**Additional tests** – Previously, the following test methods have only been conducted on solar home systems but will now be conducted for all products tested through the Lighting Global Quality Assurance Program.
Protection tests (Annex DD)	The protection tests include 3 parts: 1.) **Miswiring protection test** – examines every possible misconnection between plugs and ports to check safety and continued functionality in case of miswiring during installation or use. 2.) **Output overload protection test** – verifies that the product has protection from excessive loads or short circuits. 3.) **PV overvoltage protection test** – determines if the PV voltage could damage the product's electronics if the battery is physically or electronically disconnected from system.
Assessment of DC ports (Annex EE)	The assessment of DC ports include 2 parts: 1.) **Steady-state port characteristics** – evaluates the output voltage range and current-voltage relationship over a variety of operating conditions, obtains data for determining the efficiency from the DUT's battery to the port, and assesses the ability of included appliances to function at the voltage supplied by the port over a variety of operating conditions. 2.) **Dynamic measurement** – this test was previously conducted with solar home systems; however, Lighting Global no longer requires it.
Appliance tests (Annex FF)	The appliance tests include 4 parts: 1.) **Appliance power consumption** – methods are specific to type of appliance. 2.) **Appliance charging efficiency** – measured as the energy that enters the appliance's battery divided by the energy delivered at the port of the main product under test. 3.) **Operating voltage range** – assesses whether the appliance properly operates at the range of operating voltages it is expected to experience. 4.) **Appliance full-battery run time** – methods are specific to the type of appliance.
Energy Service Calculations (Annex GG)	The energy service calculations (ESC) is a method that uses a number of outputs from other tests (e.g. battery efficiency, power consumption, solar operation efficiency, energy removed from the battery, and more) to determine the following outcomes: 1.) Run times (solar run time and full-battery run time) for appliances used individually on every possible setting. 2.) Run times for appliances combined under an example usage profile specified by the test method. 3.) Run times for appliances combined under advertised usage, as applicable. 4.) Daily energy available to appliances after a standard solar day.