

## Pico-PV Quality Standards

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Lighting Global maintains two sets of Quality Standards, one for pico-products and one for Solar Home System kits. The Quality Standards are benchmarks that set a baseline level of quality, durability, and truth-in-advertising to protect consumers of off-grid lighting products. The Quality Standards for pico-products (off-grid products with peak power ratings less than 15 W) are summarized below and listed in more detail on the following pages. Note: depending on the manufacturer's preference, products with peak power ratings between 10 – 15 W may be tested as either a pico-product or solar home system kit and held to the respective quality standards.

Conformance with the Quality Standards is evaluated based on results from laboratory testing according to the Quality Test Method (QTM) or the Accelerated Verification Method (see [AVM Policy](#)) in the latest edition of the International Electrotechnical Commission (IEC) Technical Specification 62257-9-5. The tests are conducted at a third-party, approved test center using randomly-procured samples. Products with similar or interchangeable components may not require full re-testing (see [Similar Products Policy](#), [Family of Products Policy](#), [Pay-as-you-go Policy](#) and [Co-branding Policy](#)). Information contained in Lighting Global Standardized Specification Sheets (SSS) or Spec Books is acceptable for determining conformity with the Quality Standards. Products that have met the Quality Standards are also issued a Verification Letter and posted on the Lighting Global website: [www.lightingglobal.org/products](http://www.lightingglobal.org/products).

On-going qualification is subject to successful market checks according to the Market Check Method (see [MCM Policy](#)). Renewal testing, equivalent to a primary market check test, is required after two years (see [Associate Renewal Policy](#)).

### Summary of Quality Standards



**Truth-in-Advertising:** Accurate consumer-facing labeling

**Lumen Maintenance:** L85 time is greater than 2,000 hours.

**Battery:** Must be durable and adequately protected.

**Health and Safety:** Batteries may not contain mercury or cadmium, products are safe.

**Durability and Quality:** Appropriate protection to prevent early failure.

**Warranty:** Consumer-facing with at least one year of coverage.

**Performance Information:** Run time and brightness reported along with a note about the impact of auxiliary appliance use, such as mobile phone charging.

**Table 1. Lighting Global Quality Standards for Pico-Products**

Category <sup>a</sup>	Metric	Quality Standard	
<i>Truth In Advertising<sup>b</sup></i>	Manufacturer, Product Name and Model No.	Accurately specified.	
	Light Output and Solar Run Time	Accurately reported on packaging for the highest setting. <sup>c</sup> For other settings, if reported, accurately specified. If there are both pay-as-you-go (PAYG) and non-PAYG versions of a product, each must be truthfully advertised with respect to energy services provided.	
	Charger Rating	If reported, charger power rating accurately specified (e.g. PV power or mechanical charge time).	
	Lamp Type	If reported, accurately specified.	
	Auxiliary Appliance Use	Impact of mobile phone charging or other auxiliary appliances on product performance qualitatively described on packaging. <sup>c</sup>	
	Fee-for-service or Pay-as-you-go (PAYG) metering	The PAYG system should be capable of accurately metering service to customers so they reliably get the service that is paid for.	
	Other Aspects	If reported, accurately specified.	
<i>Lumen Maintenance</i>	Lumen Maintenance at 2,000 hours	Average relative light output of 6 samples $\geq$ 85% of initial light output at 2,000 hours with only one sample allowed to fall below 75% OR All 6 samples maintain $\geq$ 95% of initial light output at 1,000 hours. <sup>d</sup> If an included lighting appliance provides $\geq$ 15 lumens, it is subject to the lumen maintenance standard.	
<i>Health and Safety</i>	AC-DC Charger Safety	Any <i>included</i> AC-DC charger carries approval from a recognized consumer electronics safety certification organization <sup>e</sup>	
	Hazardous Substances Ban	No battery may contain cadmium or mercury at levels greater than trace amounts ( $\leq$ 0.0005% Hg and $\leq$ 0.002% Cd by weight in accordance with the EU Battery Directive)	
<i>Battery</i>	Battery Protection	Protected by an appropriate charge controller that prolongs battery life and protects the safety of the user. Five out of 6 samples must meet the requirements outlined below. Batteries of included appliances must also meet this standard. For PAYG systems, appropriate battery protection must remain active regardless of whether the system is in an enabled or disabled state. To avoid damage to a battery during long-term periods of non-payment disabled system status, the solar module must be able to charge the battery even if the product is in a disabled state.	
	Battery Durability	The average capacity loss of 6 samples must not exceed 25%, and only one sample may have a capacity loss greater than 35% following the battery durability storage test as defined in IEC 62257-9-5 Annex BB. If an included lighting appliance provides $\geq$ 15 lumens, it is subject to the battery durability standard. All other appliances are not required to meet this standard.	
<i>Quality and Durability<sup>g,h</sup></i>	Physical Ingress Protection (for components containing electronics or electrical connections)	<i>Fixed Outdoor</i>	IP5x
		<i>Others</i>	IP2x
		<i>All PV Modules</i>	IP3x OR IP2x with circuit protection

<i>Quality and Durability Continued</i> <sup>g,h</sup>	Water Protection <sup>i</sup> (for components containing electronics or electrical connections)	<i>Fixed Indoor</i> <sup>b,j</sup>	No requirement
		<i>Portable Separate</i> <sup>b</sup>	Occasional rain: <i>IP×1 OR technical equivalent OR warning label</i>
		<i>Portable Integrated</i>	Frequent rain: <i>IP×3 OR technical equivalent + IP×1 OR warning label + IP×1 OR warning label + technical equivalent</i>
		<i>Fixed Outdoor</i>	Permanent outdoor exposure: <i>IP×5 OR IP×3 with circuit protection</i>
		<i>All PV Modules</i>	Outdoor rooftop installation: <i>Modified IP×4 OR circuit protection</i>
	Drop Test	<i>Fixed Indoor</i> <sup>j</sup>	No requirement
		<i>Portable Components</i>	Portable lighting components: 5 out of 6 samples are functional after drop test (1 m onto concrete); none result in dangerous failures <sup>k</sup>  Non-lighting portable appliances (such as battery-powered radios, fans, razors and lights with light output below 15 lumens): 5 out of 6 samples are functional following a modified drop test requiring only 2 drops per sample rather than the standard 6 drops; none result in dangerous failures. The sides on which the product is dropped will be alternated between samples to ensure that all six sides are dropped at least once.
	Soldering and Electronics Quality	The system and any included appliances must be rated “Good” or “Fair” for workmanship quality as defined in Annex F of IEC/TS 62257-9-5. At most, one sample may fail to function when initially evaluated.	
	Switch, Gooseneck, Connector, and Moving Parts Durability	Mechanisms expected to be used regularly	All samples are functional after 1000 cycles
		Mechanisms expected to be used primarily during installation	All samples are functional after 100 cycles
Strain Relief Durability	All cables on all samples and any included appliances must pass a strain relief test.		
<i>Warranty</i>	Minimum Warranty Terms	Accurately specified and consumer-facing; minimum coverage of at least one year on manufacturing defects under normal use, including the battery. Details are noted below. <sup>c</sup>	

### Warranty Requirements Details

To meet the Standard, Lighting Global requires that the following guidelines be followed when presenting and offering a warranty:

- The minimum warranty period is at least one year from the time of purchase by the end-user.
- The warranty must cover the entire product, including the battery.
- The warranty must cover, at a minimum, manufacturing defects that impede operation under normal use and protection from early component failure.
- The consumer-facing warranty must explain how the consumer can access the warranty (return to point of purchase/distributor/service center, call or SMS a number, etc.), how the warranty will be executed (repair, replacement, etc.), and should advise the customer to inquire about the warranty terms prior to purchase.
- The consumer-facing warranty must be available to the consumer in writing in a way that enables the end user to verify and understand the terms of the warranty prior to purchase. The written information should be in a regionally appropriate language. Consumer-facing warranties could be included on the product box or on a user agreement or warranty card that is easily accessed prior to purchase.

Note that this is a *Minimum* Standard, and it is up to the discretion of manufacturers and distribution partners to exceed the basic protection offered in these terms to differentiate their products in the market.

## Other Notes

<sup>a</sup> If a product fails on any aspect at any point during testing, even if not during the specific test used to evaluate that aspect, the product will still fail on the basis of that aspect. For example, if a switch stops functioning on a product while its luminous flux is being measured, this failure would be included in the count of failures for the switch test.

In certain cases, where products are designed for special applications (e.g., productive uses), certain requirements may be waived, altered, or strengthened at the discretion of Lighting Global. Any deviations from the requirements listed in this document will be noted on the Standardized Specification Sheet and Verification Letter for the product.

<sup>b</sup> Numeric aspects, such as light output and run time, must deviate no more than 15% from advertised ratings (though it is always acceptable if actual performance is better than advertised). If a range is provided, the best rating must be within the 15% tolerance. If a run time is advertised, it is assumed to be for solar run time and for the highest setting, e.g., brightest, unless otherwise stated. All advertised features shall be functional. Any description of the product that appears on the packaging, inside the package and in any other medium (internet, etc.) should be truthful and accurate. No statements should mislead buyers or end users about the features or utility of the product.

Light distribution must only be measured for two samples to determine the full-width-half-max (FWHM) angle.

Included appliances are subject to truth-in-advertising requirements for performance claims. Relevant tests include: light output, battery capacity, power consumption, and the full-battery and solar run time. At the discretion of Lighting Global, existing performance test results for non-lighting appliances (such as TV power consumption from Global LEAP testing) may be referenced in place of additional testing. Only lights brighter than 15 lumens are required to be assessed for light output and light distribution.

Advertising regarding physical and water ingress protection is evaluated at the discretion of Lighting Global. If a product advertises an IP rating of IP54 or higher, the manufacturer must provide documentation of meeting that IP rating based on test results from an accredited laboratory. The following common advertising terms are expected to meet the following IP levels:

- IPX7: Water proof, or similar
- IPX4: Splash proof, or similar
- IPX3: Rainproof, protected from heavy rain, or similar
- IPX1: Water resistant, splash resistant, rated for outdoor use, or similar
- IP5X: Dust proof, protected from dust, or similar

Note, advertisements cannot supersede the basic IP requirements by component form factor described in the Quality Standards.

<sup>c</sup> All manufacturers are required to present performance metrics on product packaging and other relevant consumer-facing materials to enable consumers and distributors to compare products and make educated choices. Detailed guidelines are described in the [Performance Reporting Requirements Policy](#). Four elements are required:

- Brightness / light output in lumens
- Daily solar run time in hours per day
- Basic warranty terms as described above (note that warranty terms may be included on a user agreement or warranty card that is easily accessed prior to purchase, rather than on-the-box).
- For products that offer mobile phone charging or other auxiliary services, a note that qualitatively describes the impact of mobile phone charging and other auxiliary services on product performance.

The light output and solar run time must be reported for the highest setting, which is defined as all of the included light points on, including torches or portable lamps, on their brightest settings.

<sup>d</sup> The lumen maintenance standard can be assessed using a 1000-hour or 2000-hour test, or an expedited method that requires LM80 data for the LEDs. Each of these procedures are outlined in Annex J of IEC/TS 62257-9-5. The expedited method includes a 500-hour lumen maintenance test and single point temperature measurements of the LED array. The temperature measurements are compared to IESNA LM80-08 data from the LED manufacturer to determine the lumen maintenance at 2000 hours. For the LM80 method, the average lumen

maintenance at 500 hours and the average estimated lumen maintenance at 2000 hours must be  $\geq 85\%$  of initial light output, with no more than one sample below 75%. The LM80 test is intended as a way to expedite products entering the market and shall not be used for Associate Renewal or Market Check Method tests.

For products undergoing 500-hour tests with a sample size of two ( $n=2$ ) to qualify for or maintain program support (Associate Renewal, Market Check Method or Accelerated Verification Method tests), both samples must maintain  $\geq 95\%$  of initial light output at 500 hours. If a product fails the 500-hour test, re-testing with 6 samples for the full 2000 hours will be required.

<sup>e</sup> Approved marks: UL, CE, TÜV, CCC, or similar, with accompanying valid documentation of testing by an accredited test laboratory. Detailed guidelines are described in the [AC Charger Safety Approval Policy](#).

<sup>f</sup> Table 2 contains default battery deep discharge protection voltages and Table 3 contains default battery overcharge protection voltages and maximum cell temperatures specific to the five common types (i.e., chemistries) of batteries. These default values are used when determining appropriate charge controller behavior, unless alternate appropriate design values are provided by the battery manufacturer for the deep discharge protection voltage cutoff, overcharge protection voltage cutoff or maximum cell temperature. Note that the voltage specifications for nickel-metal hydride batteries only apply in cases where more than one cell is wired in series.

**Table 2. Default battery deep discharge protection voltage specifications**

Battery type	Deep discharge protection voltage (V/cell)		
	Recommended	Minimum	Maximum
Valve-regulated / Sealed lead-acid	$\geq 1.87$	1.82	--
Lithium-ion	$\geq 3.00$	2.95	--
Lithium iron phosphate	$\geq 2.50$	2.45	--
Nickel-metal hydride	$= 1.00$	0.95	1.10

**Table 3. Default battery overcharge protection voltage and temperature specifications**

Battery type	Overcharge protection voltage (V/cell)			Maximum charging temperature (°C)
	Recommended	Minimum	Maximum	
Valve-regulated / Sealed lead-acid	$= 2.40$	2.35	2.45	45
Lithium-ion	$\leq 4.20$	--	4.25	45
Lithium iron phosphate	$\leq 3.65$	--	3.70	45
Nickel-metal hydride	$\leq 1.45$	--	1.50	60

<sup>g</sup> All applicable quality and durability standards are extended to PAYG components, such as remote-entry keypads, integrated circuits, and any other hardware systems that are included with the product.

<sup>h</sup> All applicable quality and durability standards are extended to appliances included with the product. At the discretion of Lighting Global, some quality and durability requirements may be waived for non-lighting appliances that can be proven to meet other relevant standards. For instance, the following tests may be waived if the manufacturer provides evidence (test report, certification, and/or other relevant documentation) showing that the appliance meets an internationally recognized standard for appliance safety, such as IEC 60065 (for TVs and radios) and IEC 60335 (for fans).

- Physical ingress protection,
- Strain relief,
- Switch, gooseneck, moving part, and connector durability,
- Drop test,
- Battery protection (charge controller)

<sup>i</sup> There are two alternative water protection compliance pathways allowed by Lighting Global (i.e., these are alternatives to meeting the IP class requirements). In one alternative (“technical equivalent”), the whole system of protection (ingress protection + electronic circuit protection + manufacturing QC) is evaluated to determine if the protection level is equivalent to that of a product with the required level of ingress protection. In another alternative (“warning label”) there are clear messages to the consumer about the degree of protection from water. The warning level messages must meet Lighting Global program guidelines. The pathways and associated guidelines are described in greater detail in a document titled “[Integrated Water Protection Assessment](#).” Additional guidance on testing IP requirements for PV modules is in a document titled “[Lighting Global Test Methods for Ingress Protection for PV Modules](#).”

<sup>j</sup> The cable between the solar module and the battery (or the product housing that contains the battery) must be at least 3 m long to qualify as a “separate” or “fixed indoor” product.

<sup>k</sup> Dangerous failures are defined as those which may expose the user to physical harm, such as harmful chemicals, heat (e.g., from an electrical short or fire), or sharp materials (e.g. broken glass).

<sup>l</sup> Most switches and connectors are considered to be intended for regular use. Mechanisms expected to be used primarily during installation are limited to only a few cases, such as:

- A safety disconnect switch or circuit breaker that is turned on after installation and only turned off for maintenance.
- Connectors dedicated to light points that are unlikely to be relocated after installation.
- Connections between a light point and an extension cable.

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