

# Solar Home System Kit Minimum Quality Standards

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Lighting Global is in the process of expanding our test methods to cover larger solar home system kits. As an initial step, we have drafted a set of Minimum Quality Standards specific to these larger systems. Just as for the products already supported by the Lighting Global program, these Minimum Quality Standards for Solar Home System Kits will set a baseline level of quality, durability, and truth in advertising to protect consumers. Eligibility criteria for kits to be covered by these Standards are listed below, and the proposed Standards are presented in Table 1 on the next page.

If you would like to provide feedback on these draft Minimum Quality Standards, please visit the Lighting Global Stakeholder page ([www.lightingglobal.org/activities/qa/stakeholder-engagement/](http://www.lightingglobal.org/activities/qa/stakeholder-engagement/)) and submit comments through the online form.

## Product Eligibility Criteria

### 1. All components required to provide basic energy services are packaged as a kit:

- Solar module(s)
- Power control unit(s) including battery charge control
- Battery/batteries
- Cables, switches, and connectors sufficient to connect the solar module(s), power control unit(s) and battery/batteries
- Loads (optional)
  - Lighting
  - Load adapter cables (e.g., for mobile phones)
  - Other appliances (TV, fan, radio, etc.)

Note that the kit may consist of interchangeable components from a product family. The product family may be eligible for testing according to the [Lighting Global Framework for Testing Product Component Families](#).

2. **The battery and PV system voltage must be considered extra-low voltage (below 50 V DC).** Higher voltage outputs up to 120 V DC are permissible as long as the system voltage is below 50 V.
3. **Only DC systems, outputs and loads are covered under these Standards.** No inverters or AC outputs/outlets, or AC appliances are eligible for support under these Standards.
4. **If multiple solar modules are included, the combined peak power rating is between 10 and 100 watts, while the peak power rating may exceed 100 watts if only a single module is included in the kit.**
5. **Kits must be plug-and-play.** Plug-and-play implies that no design expertise is required to choose appropriate system components and no technicians or electricians are necessary to safely install and operate the system. All electrical connections can be made without the use of any tools. Installation and operation instructions are presented in a form that is appropriate for the average consumer.

**Table 1. Solar Home System Kit Minimum Quality Standards**

Category <sup>a</sup>	Metric	Quality Standard	
<i>Truth In Advertising</i>	Manufacturer	Accurately specified	
	Product Name & Model #	Accurately specified	
	Performance Claims: Light Output, Run Time, Appliance Power Consumption	If reported, accurately specified <sup>b</sup>	
	Lamp Type, PV Power, Battery Capacity, Charger Rating, Other Aspects	If reported, accurately specified <sup>b</sup>	
	Functionality	All advertised features must 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.	
<i>Lumen Maintenance</i>	Lumen Maintenance at 2,000 Hours	≥ 90% of specified light output at 2,000 hours OR ≥ 95% of specified light output at 1,000 hours (depreciated at highest setting)	
<i>Health and Safety</i>	Circuit and Overload Protection	The system must pass an overcurrent protection test and an overload protection test. If fuses are used for circuit protection, sizes must be labeled on the device and listed in the user manual, and at least one spare fuse must be included with the product.	
	Charge Controller Safety	Charge controllers with an output greater than 50 V must meet applicable safety standards	
	AC-DC Charger Safety	Any <i>included</i> AC-DC charger carries approval from a recognized consumer electronics safety regulator <sup>c</sup>	
	Hazardous Substances Ban	No battery may contain cadmium or mercury at levels greater than trace amounts	
<i>Battery</i>	Battery Protection	Protected by an appropriate charge controller that prolongs battery life and protects the safety of the user <sup>d</sup>	
	Battery Durability	All samples must pass the battery durability storage test <sup>e</sup>	
<i>Quality and Durability</i>	PV Overvoltage Protection	If the battery is disconnected, the system must not be damaged and PV open-circuit voltage must not be present on load terminals	
	Reverse Polarity 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.	
	Physical Ingress Protection (for components containing electronics or electrical connections)	<i>Fixed Outdoor Components</i>	IP5x
		<i>All PV Modules</i>	IP4x
		<i>All Other Components</i>	IP2x
	Water Protection <sup>f</sup> (for components containing electronics or electrical connections)	<i>Fixed Outdoor Components</i>	Permanent outdoor exposure: IPx5 OR IPx3 AND <i>circuit protection</i>
		<i>All PV Modules</i>	Outdoor rooftop installation: Modified IPx4 OR <i>circuit protection</i>
		<i>Portable Components</i>	Occasional rain: IPx1 OR <i>technical equivalent</i> OR <i>with warning label</i>
		<i>Fixed Indoor Components</i>	No requirement

Category <sup>a</sup>	Metric	Quality Standard	
<i>Quality and Durability continued</i>	Drop Test	<i>Portable components</i>	All samples are functional after drop test (1 m onto concrete); none result in dangerous failures <sup>g</sup>
		<i>Fixed Indoor and Outdoor Components</i>	No requirement
	Soldering and Electronics Quality	System and any included appliances must pass a soldering, electronics and assembly inspection	
	Switch, Gooseneck, Moving Part, and Connector Durability	<i>Mechanisms expected to be used regularly</i>	System is functional after 1000 cycles
		<i>Mechanisms expected to be used primarily during installation</i>	System is functional after 100 cycles
	Strain Relief	All cables must pass a strain relief test	
<i>Consumer Information</i>	Cable Specifications	The cable between the solar module and the battery (or the product housing that contains the battery) must be at least 5 m long. Any outdoor cables must be outdoor-rated and UV resistant.	
	User Manual	User manual must present instructions for installation, use and troubleshooting of the system. Installation instructions must include appropriate placement and installation of the solar module. Basic electrical safety and system maintenance must also be covered. All instructions should be presented using language and graphics that can be understood by the average consumer.	
	Minimum Warranty Terms	Accurately specified and consumer-facing; minimum coverage of at least three years for the system and PV module and at least two years for the battery. Details are noted below.	

Note: Additional Standards are under consideration to be included in the final framework targeted for release in June 2015. Details of the assessment methods and implementation of these Standards will be researched and discussed over the next year. Topics under review are listed below. Note that this is not an exhaustive list, nor is it guaranteed that all topics will be included in the final framework.

- On-the-box performance reporting requirements such as daily energy service in units of watt-hour per solar day (Wh/day)
- Temperature compensation in charge control
- Charge control safety standards and assessment of additional functions, such as equalization
- Requiring Li-ion batteries to be certified to have passed specific safety tests
- Additional quality and durability standards for larger solar modules. Methods may be drawn from IEC 61215, but lower cost methods may be devised.
- Additional safety standards for any appliances included with the kits
- Assessment of user interfaces to ensure that any indicators providing information about the state of charge are functional and accurate
- Thorough assessment of appliance outlets, USB and charging ports
- Acceptance of LM80 data for meeting the lumen maintenance Standard
- Assessment of pay-as-you-go (PAYG) systems

## 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 three years for the system and PV module and two years for the battery from the time of purchase by the end-user.
- 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.
- Full terms of the 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 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 the best quality products in the market.

## Other Notes

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

<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).

<sup>c</sup> Approved marks: UL, TUV, VDE, CE, CSA, GS or similar

<sup>d</sup> Table 2 contains recommended battery deep discharge protection voltages during testing and Table 3 contains recommended 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 minimum voltage specification for nickel-based batteries only applies in cases where more than one cell is wired in series.

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

Battery type	Recommended deep discharge protection voltage (V/cell)	Minimum allowable discharge protection voltage (V/cell)	Maximum allowable discharge protection voltage (V/cell)
Flooded lead-acid	$\geq 1.87$	1.82	--
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. Recommended battery overcharge protection voltage and temperature specifications**

Battery type	Recommended overcharge protection voltage (V/cell)	Minimum allowable overcharge protection voltage (V/cell)	Maximum allowable overcharge protection voltage (V/cell)	Maximum charging temperature (°C)
Flooded lead-acid	$\leq 2.40$	2.35	2.50	TBD
Sealed lead-acid	$= 2.40$	2.25	2.45	45
Lithium-ion	$\leq 4.20$	--	4.25	45
Lithium iron phosphate	$\leq 3.65$	--	3.70	45
Nickel-metal hydride	$\leq 1.40$	--	1.45	60

<sup>e</sup> The battery durability storage test requirement may be waived for flooded lead acid batteries which are shipped dry. In cases where batteries are shipped dry, manufacturers must provide the test labs with an adequate amount of the appropriate solution or accurately specify the density and composition of the solution to be used.

<sup>f</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.”

<sup>g</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).