Summary of Stakeholder Feedback:

Proposed changes to the draft quality standards under review by the IEC

February 2020

In April 2019, Lighting Global Quality Assurance[1] requested feedback on proposed changes to the draft of the quality standards under review by the International Electrotechincal Committee (IEC). This memo describes the feedback we received from Lighting Global stakeholders, followed by our responses and a description of changes we made in the draft of the IEC document. As described in our request for public comment, the proposed changes included increased PV and battery safety requirements, as well as additional labeling and performance reporting requirements.[2] Most respondents generally supported the proposed changes, and the feedback received enabled our team to make key improvements and clarifications to the draft.

We received direct feedback from twelve stakeholders who completed the online survey, which included consolidated responses from the Global Off-Grid Lighting Association (GOGLA). The respondents represented the diversity of the sector, including manufacturers, assemblers, distributors, development agencies, and test laboratories (Figure 1). Additionally, we gained understanding from comments and questions during a webinar we jointly hosted with GOGLA that focused primarily on the proposed lithium battery safety requirements. Further, in our decision making process we continued to seek advice from battery and PV experts from Fraunhofer ISE, Intertek, ZSW-BW (Center for Solar Energy and Hydrogen Research, Baden-Wurttemberg), the U.S. National Renewable Energy Laboratory (NREL), Relsol Inc., SMQ, the IEC, and GOGLA's Technology Working Group.

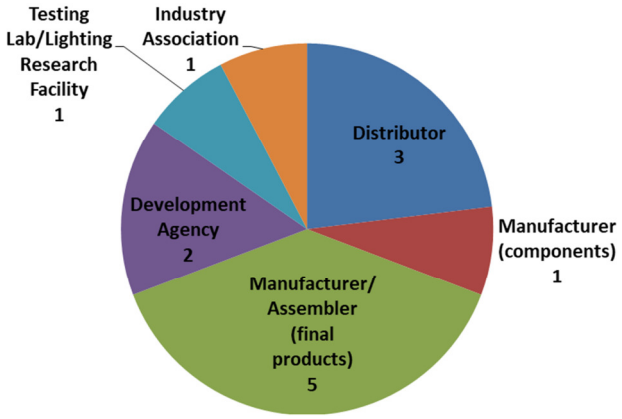

Figure 1. Distribution of stakeholders that provided comments through the online survey.

[1] Note, in early 2020, the Lighting Global Quality Assurance program will transition to a new brand, VeraSol. VeraSol will continue to support high-performing, durable off-grid products that expand access to modern energy services. VeraSol builds upon the strong foundation for quality assurance laid by the World Bank Group and expands its services to encompass off-grid appliances, productive use equipment, and component-based solar home systems. VeraSol is managed by CLASP in collaboration with the Schatz Energy Research Center at Humboldt State University. Foundational support is provided by the World Bank Group's Lighting Global program, UKaid, IKEA Foundation, and others. Please visit VeraSol.org for more information.

[2] For details on this and prior stakeholder outreach, visit: https://www.lightingglobal.org/work-with-us/shape-the-sector-and-the-quality-standards/past-stakeholder-outreach/

In January 2020, IEC Technical Committee 82 voted and approved the revised draft for adoption by the IEC. Previously, we had referred to this as a draft of IEC TS 62257-13-1; however, it has now been relabeled with the number IEC TS 62257-9-8. Documents are typically published within one to six months of a positive vote, so we anticipate the final document being published in the first half of 2020. Based on prior conversations, we expect several country governments will likely adopt the published IEC document as a mandatory standard for both pico-solar products and solar home system (SHS) kits with power up to 350 W. Once the IEC document is published the Lighting Global Quality Assurance program plans to use the IEC document in place of the Lighting Global Quality Standards for all pico-solar products and SHS kits. The document would thus replace both the Pico-PV Quality Standards (Version 8.0) and the Solar Home System Kit Quality Standards (Version 2.5). The *Change Log for Quality Standards* describes differences between the existing Lighting Global Quality Standards and the upcoming IEC document to enable companies to prepare to meet the new requirements. Additional details on this transition will be released in the coming months.

FEEDBACK AND RESPONSES

In the descriptions of feedback provided below, text was altered from the original submissions; alterations were not intended to change the meaning of the comment, but only to condense responses and protect the anonymity of the respondent. Similar comments from multiple stakeholders were combined when indicated.

1. Battery safety

The current Lighting Global quality standards require that all lithium-based batteries carry at least one battery safety certificate; in April, we proposed changes to be included in the IEC document that would strengthen this requirement to ensure that batteries are tested at the pack level (as opposed to only testing a single cell) and assessed for safety during use (rather than only for safety during transport). We received the following feedback on this proposed change and some recommendations for additional requirements that should be considered. The summary of opinions is presented in Figure 2.

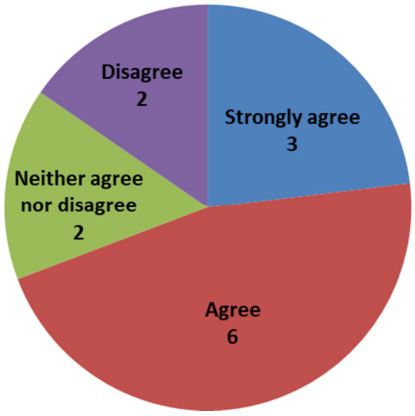

Figure 2. Do you agree with the proposed battery safety requirements?

Strongly Agree or Agree:

- The proposed requirements and selected standards are appropriate. Also, it is important that the testing facilities are third party laboratories.
- The proposed requirements are good, but the requirements should also consider temperature during storage.

- In general, it is a very good idea for Lighting Global to focus more on the quality and safety aspects of a product. But regarding battery safety we have a few doubts if the suggested way is the best to follow:
    - Several quotations for battery pack certifications were in the range of approximately $2000-$2500 + 22 samples each. For companies that use multiple different battery packs, these costs can escalate to the tens of thousands. That said, in cases where the packs are based on the same cells or sub-packs, testing only one pack per type would significantly reduce testing cost. Requiring testing for all packs seems unlikely to increase safety significantly. Our suggestions in terms of battery testing would be that IEC 62133 is required only for the single cell or a very limited number of packs. This will already limit the risk of failure significantly but would keep testing cost in reasonable range and would be a good balance between cost and safety.
    - In our many years of experience we have not seen a battery pack itself that caused a safety problem; all cases of dangerous heat development were caused by the electronics, either because the short circuit/overcurrent protection malfunctioned or because the system was heavily misused. In those cases, a safe battery will still lead to dangerous problems. In our opinion it would be much more helpful for Lighting Global to revise IEC TS 62257-9-5 to include tests that assess the battery on a system level with battery, PCB and housing. (We could share suggestions on how to design those tests).
    - The examples that were quoted during the webinar were all applications with very high C-rates, where heat development during normal usage is a common phenomenon (EV batteries, electrical cigarettes). This raises the risk of a thermal runaway. Many PV applications do not use high C-rates, which reduces the risk of thermal runaway.
    - Lithium-Iron-Phosphate batteries are well known to be a safe technology, though we understand the need to have streamlined standards without too many exceptions.
- The certificates would be good to have, but not be able to guarantee safety because the battery safety issues will be very hard to catch in labs. Generally, small battery packs (e.g., a pack wired with 4 cells in parallel, “1S4P”) are exempted from being tested as a pack if the individual cells are certified by IEC 62133. The IEC document could waive the small battery pack safety testing for IEC TS 62257-9-8 when the cells are IEC 62133 or UL certified.
- Battery safety requirements will strengthen quality. Lithium batteries are high risk components that should be avoided until the risks are well mitigated before use. Additionally, all work places should use ISO / IEC standards and good occupational health and safety practices to ensure high productivity for maximum profitability.
- GOGLA’s members have advised that they generally agree with additional battery safety requirements and Lighting Global’s focus on quality and safety of products. However, some members have expressed their concerns that the additional costs were not justified (particularly for smaller battery packs where the risk of thermal runaway was perceived to be lower), and the changes did not add value (given the lack of instances of failure under the current scenario). It was noted during the recent GOGLA / Lighting

Global webinar that no member was aware of failure of a battery pack leading to thermal runaway. It was suggested the greater risk of fire comes from the electronics, and that the battery safety requirements will not mitigate these issues. Additionally, for some members with a large product range, the additional battery testing required will represent a significant cost, particularly for smaller companies. We encourage Lighting Global to explore the potential for accepting test certificates for sub-packs that can be aggregated into a battery pack. This would enable manufacturers to offer a range of battery pack capacities without incurring significant testing costs.

- Three additional respondents agreed, but did not provide further comments.

Neither Agree nor Disagree:

- Often a variety of battery packs can be built with the same battery cells and a similar battery management system (BMS). The only key difference between the packs is the quantity of cells. Only one IEC 62133 test report for one version of the pack should be required instead of requiring a test report for each configuration. UN 38.3 reports for each pack could still be provided.
- Lighting Global is out of touch with the SHS and pico-solar sectors. The market and NGOs are fluid in their specifications and requirements, while Lighting Global is rigid and does not permit a manufacturer/distributor to respond to opportunities without laborious and bureaucratic activities. For example, if a product has been tested at 200 lm and a particular run time, but a tender is issued for a product requiring 160 lm and a corresponding longer run time, a company cannot quickly respond if Lighting Global verification is required. This rigidity/lack of flexibility is counter-productive; Lighting Global seems out of touch with the way its constraints affect its members. In light of these larger issues, the proposed battery and other requirements are almost immaterial. Lighting Global has seemingly good intentions, but industry-frustrating execution. I think Additionally, Lighting Global's behavior seems to favor a small group of members at the expense of many other members.

Disagree:

- The proposed requirements are too strict and not practical for private companies and the market at large - a lot of time will be consumed in trying to follow the processes. More importantly, requirements should focus on proper disposal or reuse of batteries.
- The proposed requirements will be detrimental for companies that are able to assemble battery packs in local workshops in Africa. The testing cost, shipping cost, and time delays associated with testing each new pack will make local assembly impractical. Instead, requirements should focus on ensuring electronics and wiring are sized appropriately and ensuring the quality of the manufacturing and components. Battery safety should also consider the enclosure as a good enclosure can mitigate some safety risks.

Response from Lighting Global:

We appreciate all the feedback we received regarding battery safety requirements through the official feedback process, during the battery safety webinar, and during the IEC committee meeting. Though we acknowledge the significant burden the additional testing requirements will place on some companies (especially for smaller companies and those assembling locally), all the lithium battery safety experts we consulted concluded that requiring safety testing at the pack level is imperative. Similarly, the experts were reluctant to provide any justification for exceptions to pack-level testing for small battery packs and/or packs constructed with the same cells or sub-packs. All stated that testing should follow the accepted safety standards. Additionally, national representatives in Joint Working Group 1 of IEC Technical Committee 82 (i.e. the off-grid working group within IEC that manages the 62257 series) agreed that the safety requirements in the proposed draft of document were necessary and should be applied to all lithium chemistries.

Based on the feedback and the subsequent discussions with lithium battery experts, we maintained the core changes we proposed, but did refine the requirements for clarity. The relevant text included in the upcoming IEC document is included in Appendix A.

A few of the other comments above addressed issues beyond the battery safety testing requirements; our responses are as follows:

- One respondent suggested the importance of temperature during storage for batteries. We agree that temperature during storage and use can dramatically impact battery performance, and in the case of some lithium batteries, extreme temperatures (either hot or cold) can pose battery safety issues. At this time, we are not proposing to include any additional safety requirements to address this issue. One test that is already included in IEC TS 62257-9-5 is the durability storage test in which the DUT's lithium-ion battery is stored for 30 days at 60 °C ± 5 °C at a state of charge of 50%. This is primarily designed to assess capacity loss during storage, but could identify potential safety issues as well.
- Several respondents mentioned the need to look beyond the battery safety standards and also assess the electronics, wiring, and enclosure. We agree that these elements are critical to the safety of the battery. Currently, as part of IEC TS 62257-9-5, we do conduct tests to ensure batteries have appropriate charge control set points, and require companies to provide documentation showing that lithium batteries have overcharge protection for individual cells. Additionally, we conduct a visual screening of all electronics and wiring. In the future, we may consider both ways to strengthen these assessments and methods to take the design of the battery enclosure into consideration when determining battery safety.
- One respondent noted frustration with the rigidity of the Lighting Global quality assurance framework, particularly with regard to companies with tender-based business models. In response to this concern, we are considering an alternative policy that could

enable companies to "pre-qualify" one version of a product that could then be scaled/adapted in response to specific tenders. This policy is still under development, but if we identify a viable pathway that meets the needs of the tender-based companies while still protecting the consumer, we will reach out to stakeholders with details of the new pathway.

- One respondent noted the need to also consider the disposal and re-use of batteries. We agree that this is a key issue, but are not currently addressing it in the proposed standards (aside from trying to minimize the production of poor quality products). Several partners are currently working on efforts to confront the issue of e-waste including Global LEAP, which is managing a solar e-waste challenge: https://globalleapawards.org/e-waste

2. PV safety

In April, we proposed strengthening the requirements for PV modules to better align with international standards. The proposed changes included requiring all PV modules not tested to IEC 61730 to undergo additional safety testing, including:

- Increased visual screening testing
- Durability of markings (not required for integrated PV modules)
- Sharp edge test (not required for integrated PV modules)
- Screw connection test (for non-plug-and-play products only)
- An impact test (not required for integrated PV modules already subject to drop test)
- A bending and folding test (if the module is intended to be bent or folded during use)
- A modified version of the hot spot test from IEC 61730 for modules greater than 10 W

We received the following feedback on these proposed changes. The summary of opinions is presented in Figure 3.

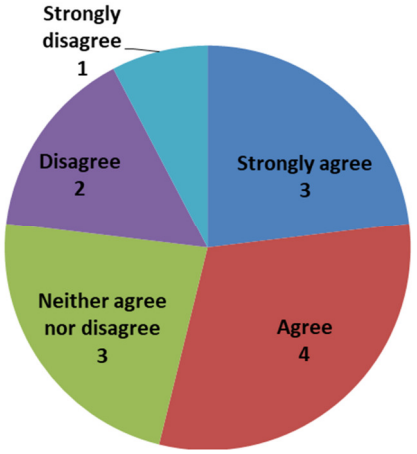

Figure 3. Do you agree with the proposed PV safety requirements?

Strongly Agree or Agree:

- It is also important to ensure PV modules are installed at the recommended angle.
- GOGLA's members have advised that they generally agree with additional PV safety requirements. There was resistance to the requirements being introduced for PV modules lower than 240W given the limited availability and high cost of PV module providers that can supply this.
- Training in proper solar installation is critical for PV systems' manufacturers, distributors, assemblers, contractors and end users.
- We strongly support the increased quality tests on PV modules. Splitting PV testing into several power classes is a very good compromise between cost and quality assurance. The threshold of 240Wp/8 Asc/35V/40 cells seems to be useful from our point of view.

The "cherry picking" of individual tests from IEC 61730 is a very useful approach. The original approach would have caused costs of over $50,000 for two modules. We especially appreciate the addition of the hot spot test. Hot spots can be prevented by adding at least two bypass diodes to a module; however, in our experience most PV manufacturers only use one bypass diode, so are not protected against hot spots. There is a big lack of understanding of the mechanism and prevention of hotspots. A fine tuning of this guideline would be to tie the requirement to the number of cells (or Voc) instead of the power, since the risk of a hotspot is not a function of absolute module power, but is a function of power per area.

- Three additional respondents agreed, but did not provide further comments.

Neither Agree nor Disagree:

- The impact test and bending or folding test should not be required for integrated PV modules which are less than 1W. These typically small (<1 W) PV modules are not suitable for a 51-mm diameter steel ball to drop onto. Further, they are integrated into a lantern, so there is no bending pressure during usage.
- Lighting Global is too expensive; PV safety requirements are going to increase prices!
- One additional respondent did not provide comments.

Disagree or Strongly Disagree:

- The new requirements are complex to understand.
- For DC devices with or without ground connection, 60 V d.c. should be a safe operation voltage, so PV modules do not need to be limited to 40 cells in series. Since a 350 W (72 cell in series, 36 Vmax) solar panel is one of the most popular solar modules in the market and can be easily purchased from all kinds of well-known PV brands, the safety range does not need to be limited to 240 W (60 cells, 30 Vmax). The 72-cell solar panels are still very safe to use. See some references regarding recommended voltage ranges:
    - The IEC member organizations and the UK IET (BS 7671:2008) define an ELV device or circuit as one in which the electrical potential between conductor or electrical conductor and earth (ground) does not exceed 50 V a.c. or 120 V d.c. (ripple free). Modern battery operated hand tools fall in the SELV category. In more arduous conditions 25 volts RMS alternating current / 60 volts (ripple-free) direct current can be specified to further reduce hazard. (https://en.wikipedia.org/wiki/Extra-low_voltage)
- Small PV modules should be exempted from the modified hot-spot test. There would be a very rare chance for manufacturers and/or customers to use solar panels from a pico solar system in series/parallel. Plus, such "hot spot" testing would only cover a small fraction of the samples and would likely not identify the potential corner cases. Aside from that, solar panel testing in the lab would NOT address partial shading in the field or the fact that customers might not clean their modules. Finally, the heat a 10 W solar panel could generate with a shaded cell would be very minimal. Requiring the industry to use IEC certified solar panels for applications between 240 W ~ 350 W solar panels is

reasonable, but for non-standard solar panels of > 80 W, a reverse diode should cover the majority of protection needs.

- The additional certifications will add cost to the product and to Lighting Global testing. Will Lighting Global accept 3rd party certifications and not re-do tests to avoid requiring that manufacturers pay twice for the same test?

Response from Lighting Global:

Thank you to all who provided information, insight, and constructive criticism regarding the proposed requirements for PV modules. Based on the feedback received and on-going discussions with PV experts and the IEC technical committee, we decided to maintain the proposed requirements largely as they were originally proposed, but made a few adjustments in response to comments. The revised text regarding the new safety requirements for PV modules is included in Appendix B.

In response to some of the other specific comments noted above:

- We agree that the proper installation of PV modules, including the angle at which PV modules are installed is also important, though at the level of global quality assurance, there is no clear way to assess installation. For larger SHS kits (products with PV modules larger than 10 W), there are required elements that must be included in the user manual, including encouraging the user to direct the module toward the sun and ensure the module is not shaded.
- We appreciate the support of the decision to minimize testing for modules smaller than 240 W. We also appreciate the recommendation to increase the threshold for the modified hot spot test. Despite working with several experts and companies to better understand a threshold below which modules would not be at risk of developing hot spots, we were not able to identify a threshold higher than 10 W. In the upcoming IEC document, all modules with rated power (at STC) greater than 10 W will be required to pass either:
    - the hot-spot endurance test of IEC 61730-2 or IEC 61215-2, or
    - the partial shading test for photovoltaic modules described in IEC TS 62257-9-8 or a future version of IEC TS 62257-9-5

  We will continue to work to understand if a higher threshold could be set (for example 40 W or 80 W), but for now, the threshold is aligned with the division between pico-PV and SHS kits (or as described in the upcoming IEC document, the difference between size A and size B products). We welcome any research or information that could help us define an appropriate higher threshold for the hot-spot test.
- We agree that the impact test and bending or folding test should not be required for integrated PV modules which are not intended to be routinely bent or folded during use. Additionally, a product with an integrated PV module will already be subject to the drop test, which better assesses the likely failure mode for these products. We have suggested edits to the document to exempt integrated modules from the impact and bending or folding tests.
- We also agree that 72-cell solar modules can be safe to use in off-grid products and should be covered by this document. The scope of the document is written to include modules with maximum power up to 350 W and maximum power point voltage of up to

35 V (the open circuit voltage could be higher). However, because of increased safety concerns, modules with power greater than 240 W, open-circuit voltage greater than 35 V, or short-circuit current greater than 8 A will require testing to verify compliance with IEC 61730. Modules of this size that meet the requirements of IEC 61730 are commonly available, so this requirement is not expected to be onerous.

- The upcoming IEC document includes provisions to enable products which have already met other relevant standards to be exempted from repetition of essentially the same test. For example, PV modules which have already met the requirements of IEC 61730 may be exempted from repeating the durability of markings, sharp edges, screw connections, breakage, and hot-spot endurance tests.

3. New performance reporting requirements

To better ensure that consumers and distributors have access to basic, comparable information about product performance, we proposed including additional performance reporting requirements for SHS kits, components either packaged separately or with a kit, and PV modules. These are in addition to the existing requirements presented in the Performance Reporting Requirements policy, which have already been included in the IEC document.

- All SHS kits must present at least one solar run time profile for all the included light points on high and any other included appliances must be provided on the packaging or in the user manual (An example run time profile for a product that includes lights, a torch and a TV, and no other appliances, could be: “After a day of solar charging, you can use the main lights on high for 4 hours, the torch for 8 hours and the TV for 3 hours.”)
- Component specifications, such as battery capacity, voltage, power, and light output, shall be provided in a consumer-facing location for all components, whether packaged with a kit or sold with a kit but packaged separately.

We received the following feedback on these proposed changes. The summary of opinions is presented in Figure 4.

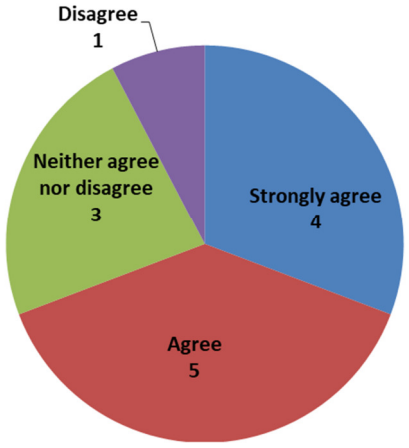

Figure 4. Do you agree with the proposed performance reporting requirements for SHS kits?

Strongly Agree or Agree:

- It is very important to provide performance metrics / specifications on the product packaging. It promotes transparency and is key in decision making when purchasing.
- It is expected that manufacturers could list the usage period in day-time and night according to our own market research. For example, a product might advertise a usage profile that assumes the following use/charging:
  - all lights - 100% use at night while not solar charging;
  - all the other appliances (TV, radio, mobile phones, etc) - 60% use while solar charging, and 40% use at night while not solar charging.
- We must be in truthful with our customers.

- The proposed performance reporting requirements for SHS kits are very good for the solar PV systems manufacturers / distributors / assemblers / site contractors / technical trainers & end-users / customers.
- Nameplate marking to ensure traceability and information to clients is most welcomed.
- Four other respondants agreed, but did not provide further comments

Neither Agree nor Disagree:

- GOGLA has not received a sufficient amount of feedback agreeing or disagreeing with these requirements. However, the additional requirements seem reasonable and add value.
- Two other respondants did not provide further comments.

Disagree or Strongly Disagree:

- One respondant disagreed, but did provide further comments.

Response from Lighting Global:
Feedback regarding these additional performance reporting requirements was generally positive, with most respondents noting that the requirements will help add transparency to the market. We note that these requirements will add complexity in ensuring a company's packaging and user manuals accurately advertise all the required elements, but we will continue to offer to review packaging and other consumer-facing materials prior to testing to help minimize the need for follow-up actions. If test results identify that elements have not been advertised accurately, Lighting Global will continue to use the Conditional Pass policy as an option to correct issues without retesting.

In response to the question regarding whether the advertised usage profile can assume a specific pattern of daytime or nighttime use/charging, we agree that this is reasonable to allow for all non-lighting appliances and have included a recommended change to the document.

4. PV labeling requirements
To improve access to information regarding PV panels, we proposed that all PV modules not integrated into a product must include markings on the module to identify the module and provide basic performance information. We received the following feedback on these proposed changes. The summary of opinions is presented in Figure 5.

Strongly Agree or Agree:

- PV labeling promotes openness and improves product knowledge especially in PV distributor.
- Labeling will enhance easy identification of PV modules.
- The proposed labeling requirements for PV modules are very good for solar PV systems manufacturers / distributors / assemblers / site contractors / technical trainers & end-users / customers.

- Seven other respondents agreed, but did not provide further comments.

Neither Agree nor Disagree:

- GOGLA has not received a sufficient amount of feedback agreeing or disagreeing with these requirements. However, the additional requirements seem reasonable and add value.
- One other respondent did not provide further comments.

Disagree or Strongly Disagree:

- It is not easy to label PV modules or at what cost! For very small solar panels, a trademark may be sufficient.

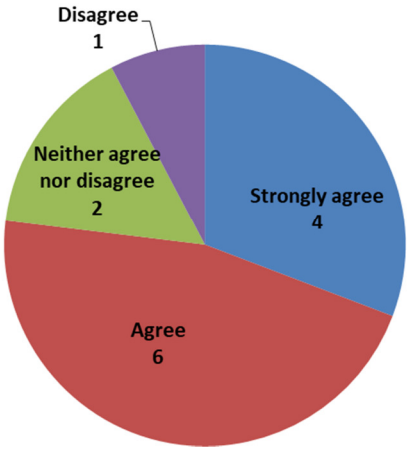

Figure 5. Do you agree with the proposed labeling requirements for PV modules?

Response from Lighting Global:
The majority of respondents were supportive of the proposed PV labeling requirements. The proposed labeling requirements are standard requirements for larger PV modules and seem appropriate to require for all smaller modules which are not integrated into a product. We note that these requirements may be new for some companies and will offer to review PV labels prior to testing to help minimize the need for follow-up actions. Again, if test results identify that elements have not been advertised accurately, Lighting Global will continue to use the Conditional Pass policy as an option to correct issues without retesting.

5. Date of manufacture:
Historically, some products have not included a way to identify the date of manufacture. To increase clarity in the market and enable accurate market monitoring, we proposed requiring all products be labeled with the date of manufacture or alternatively, a serial number assuring traceability of date of manufacture (i.e., the date does not necessarily have to be discernable to consumers, only to those who are able to interpret the code).

We received the following feedback on these proposed changes. The summary of opinions is presented in Figure 6.

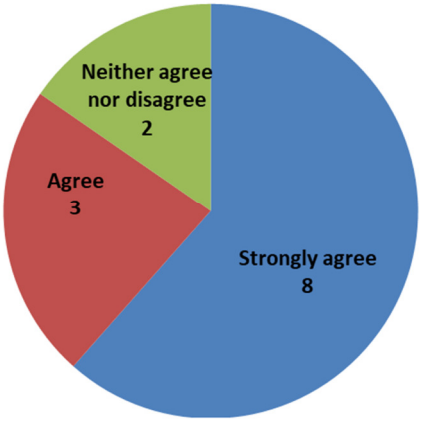

Figure 6. Do you agree with the proposed requirement to include a traceable date of manufacture on the product or packaging?

Strongly Agree or Agree:

- Providing a date or serial number will enhance easy identification. Knowing the product life will reduce risks from expired products.

- This requirment will help companies and distributors easily trace products in case of a defect.
- Manufacturers need to know when products have been manufactured, but I don't think customers need to see the date.
- The PV system must include a traceable date of manufacture on the product or packaging.
- I think this is a burning issue on these types of products as they have a battery. An expiry date and/or manufacturing date can help distributors track the storage time of their products.
- Our serial number contains the production week and year. Is this enough to be considered as a “date”?
- Five other respondents agreed, but did not provide further comments.

Neither Agree nor Disagree:

- GOGLA has not received a sufficient amount of feedback agreeing or disagreeing with these requirements. However, the additional requirements seem reasonable and add value.
- One other respondent did not provide further comments.

Disagree or Strongly Disagree:

- No respondents disagreed with the proposal.

Response from Lighting Global:
This proposal was supported by nearly all respondents and many noted that having a traceable date would allow manufacturers and distributors to better track products in the market. One respondent asked whether a production week and year would be sufficient as a date; this degree of precision would be sufficient. For some companies, depending on the rate of production, providing the production month and year would be sufficient, while others may prefer to provide the day of production. We have recommended that the document require a level of precision of at least the month and year.

6. Ports on appliances:
Currently, we only require that ports on included appliances (such as radios and TVs) undergo the full ports and protection assessment if they are advertised or reasonably expected to be used for power delivery, such as charging mobile phones. In practice, we have found it difficult to determine whether a port should be “reasonably expected” to be used for power delivery. We proposed to make this decision more explicit by requiring testing for all ports unless they are explicitly advertised on the packaging, user manual, or at the port as “not for charging.” (Similar language may be accepted.) We received the following feedback on this proposed change. The summary of opinions is presented in Figure 7.

Strongly Agree or Agree:

- This change will enhance and ensure quality.
- For ports which are clearly fool-proof for end-users, and/or with clear markings, assessment could be handled through the "visual screening" process.
- Need more clarification here...are we to print this info on the product OR on the user manual/packaging?
- Three other respondents agreed, but did not provide further comments.

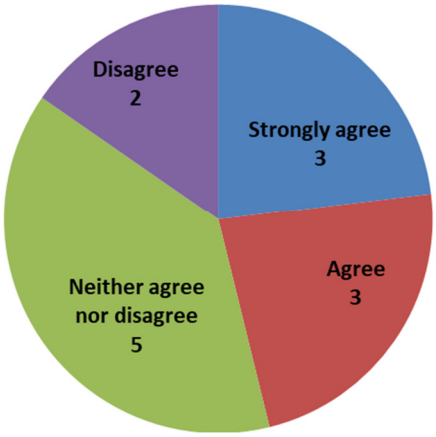

Figure 7. Do you agree with the proposed practice to test ports on auxiliary appliances for safety and charging functionality unless they clearly state that they are "not for charging"?

Neither Agree nor Disagree:

- Labelling a port "not for charging" is not going to prevent people from using the ports for charging! If we test any ports we should test them all, but if we don't test some, then we should not test any!
- GOGLA has not received a sufficient amount of feedback agreeing or disagreeing with these requirements. However, the additional requirements seem reasonable and add value.
- Three other respondents did not provide further comments.

Disagree or Strongly Disagree:

- Some appliances like TVs and radios are generally available in market. It's quite normal to include a USB or other port on them for data import. The TV and radio industry do not include these kinds of requirements. It's quite strange that when the appliances are inside a SHS kit, they would need to include a statement "not for charging."
- If no rating for those ports is provided, they should also not be tested. Labeling them “not for charging” might be a approach to avoid meeting the testing requirement.

Response from Lighting Global:

Though this proposal represents a very small change to current practice, the requirement to label ports on appliances that are not intended for charging was somewhat controversial among respondents. However, to ensure testing is conducted consistently across all products and all test laboratories, we have still included this change in the upcoming IEC document. The text included is as follows, which allows the statement to be included on the port, packaging, or user manual:

> Ports that are intended primarily for a function other than providing power (i.e. data ports or input ports) are not expected to meet these requirements. To be exempted from testing, these ports shall be labelled on the port, packaging, or user manual that the port

is “not for charging” or similar. The laboratory may check the functionality of these ports (e.g. by connecting a compatible device), and any port so tested shall be functional.

Additionally, while it is true that a statement in a user manual will not prevent a person from trying to use a port to charge a device, it will ensure that the capabilities of the product are properly advertised. As with all advertisements, these statements cannot conflict with other advertisements made about the product in an attempt to avoid testing. If any advertisement suggests that a port on an appliance is appropriate for charging, the port will be subjected to testing regardless of whether it is also labeled “not for charging” or similar.

7. Extend the “Wiring and connector safety” requirement to pico-products:

Currently, SHS kits are required to meet the following: “All wires, cables and connectors must be appropriately sized for the expected current and voltage.” This is assessed primarily using a manufacturer declaration, and confirmed during testing by observing the product during normal use. We proposed to extend this requirement to pico-products, as it is an appropriate safety requirement regardless of product size. We received the following feedback on these proposed changes. The summary of opinions is presented in Figure 8.

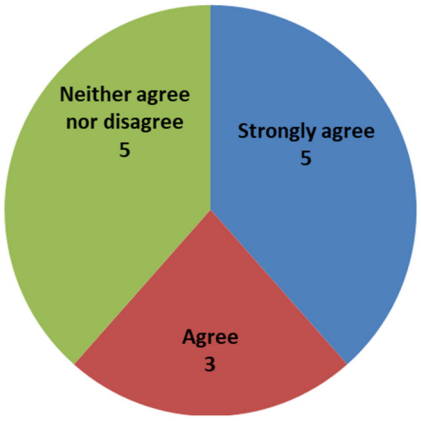

Figure 8. Do you agree with the proposed plan to extend the "Wiring and connector safety" requirement to pico-products?

Strongly Agree or Agree:

- Wiring of an electrical product must be appropriate.
- This declaration will promote safety.
- The proposed plan to extend the "Wiring and connector safety" requirement to pico-products is good for end-users.
- Extend the “wiring and connector safety” requirement to pico-products so that “‘All wires, cables and connectors must be appropriately sized for the expected current and voltage; *and firm connector or wire joints integrity must be met*.’
- Four other respondents agreed, but did not provide further comments.

Neither Agree nor Disagree:

- Manufacturers have to propose adapted wiring and connectors for a safe use.
- Pico-products, especially those with intergraded PV modules do not require much wiring. Can't see much quality improvement for pico-products after adding this requirement. While adding more test will increase the cost and delay the test leadtime.
- This would make sense for SHS products > 5A output, but not really necessary for lamps or other simple products.

- GOGLA has not received a sufficient amount of feedback agreeing or disagreeing with these requirements. However, the additional requirements seem reasonable and add value.
- This requirement will not make much of a difference, there are larger issues with the QA framework.

Disagree or Strongly Disagree:

- No respondents disagreed with the proposal.

Response from Lighting Global:
No respondents disagreed with this proposal, though several did not fully agree or voiced concerns about the change. In practice, this proposal represents a very minor change with no additional testing. The main change is to require manufacturers of pico-products to sign the same declaration regarding wiring safety as is currently required for manufacturers of SHS kits. No additional testing would be required, but a test lab would be enabled to identify issues either during the visual screening process, or by noting if a product, cable, or component overheated at any point during normal use. Because no extra testing is required, but the change will enable test labs to identify very poorly designed products, we have included the required declaration for pico-solar products in the upcoming IEC document.

Additionally, in response to the recommendation above, we have suggested adding the wording, "all connectors and wire joints are robust" to the declaration. Again, this would cover an element that is not directly addressed in the test methods as the strain relief test assesses permanent connections, but does not assess joints such as the solder joint in a barrel plug.

8. General Stakeholder Comments:
We received several additional comments from stakeholders; please see the following individualized responses in line with each comment:

- GOGLA supports the proposed changes to the draft quality standard. Safety of consumers is paramount and rightly merits robust measures in the standard. We recognize that as the market grows – with larger systems and bigger batteries, and new market entrants – the risk of incident becomes greater. Beyond the obvious suffering an incident would cause a consumer, such an event risks negative publicity that would damage the sector's reputation and undermine market growth. It should be noted that the proposed changes to the lithium battery safety requirements were not universally welcomed; two manufacturers believed the additional costs were not justified (particularly for smaller battery packs where the risk of thermal runaway was perceived to be lower), and the changes did not add value (given the lack of instances of failure under the current scenario). Furthermore, for manufacturers with a large product range it would represent a significant cost. These companies have been advised to submit feedback independently. We welcome efforts by Lighting Global to maintain a careful consideration of the cost of compliance and seek to balance the costs of compliance with quality, durability and safety considerations.

- ***Response from Lighting Global:*** We appreciate GOGLA's general support of the proposed changes to the lithium battery safety standards. We acknowledge the concerns raised by some members, though as noted above, all the lithium battery safety experts we consulted concluded that requiring safety testing for all packs at the pack level is imperative. All stated that testing should follow the accepted lithium battery safety standards. That said, in both lithium battery testing and all aspects of the quality assurance program, we will continue to strive to balance the costs of compliance with quality, durability and safety concerns to ensure that products can remain affordable.

- We saw more and more tests added into current standard, but few existing tests removed from standard. Considering our target end users are the poorest ones in the world, adding tests will increase the testing cost, which will increase the retail price and reduce affordability. With this in mind, we suggest to also do more review of the existing tests and regularly remove any unnecessary tests.
  - ***Response from Lighting Global:*** The observation that more tests have been added, while few have been removed is an accurate observation. The addition of the majority of tests are due to the clear need to better ensure the safety of lithium-based batteries, and concerns raised by the IEC regarding PV safety tests that are required for most modules, but were omitted under IEC TS 62257-9-5. Though these tests represent substantial additions, we have worked diligently to minimize the additional burden of testing. In the upcoming IEC document, we have clarified that the dynamic ports test need not be conducted as the outcomes of this test did not justify the added expense of the test. Similarly, we worked with the IEC and other PV experts to ensure that we were only requiring critical PV safety tests relevant to small modules to avoid requiring that all modules meet the requirements of IEC 61215 and IEC 61730. With future revisions of the quality assurance framework (i.e., IEC TS 62257-9-5 and IEC TS 62257-9-8), we will continue to work to eliminate any tests that have been identified as no longer relevant to the industry.

- I sincerely wish the other working groups outside of Joint Working Group 1 (JWG1) [of Technical Committee 82 of the IEC] would be able to look into the market and industry more deeply, in order to avoid applying redundant standards into this lean margin industry.
  - ***Response from Lighting Global:*** We fully agree that it would be ideal for other working groups within the IEC to take into consideration the needs and limitations of the off-grid industry when developing test methods and standards. Similarly, we will continue to work with the IEC, governments, and other programs to encourage the use of the quality assurance framework for off-grid renewable energy products to minimize redundant testing and certifications.

- Is there a plan for Lighting Global to allow manufacturers to choose a lab on their own and send through products directly for testing to the IEC standards governed by Lighting Global? If that is likely to happen sometime soon, would it not make sense to stay with

the IEC requirements that the manufacturers are using for the usual shipment exercise instead of enforcing additional requirements and associated added costs on manufacturers for such testing?

- ***Response from Lighting Global:***
  The addition of the majority of tests are due to the clear need to better ensure the safety of lithium-based batteries, and concerns raised by the IEC regarding PV safety tests that are required for most modules. Though these add complication, at this stage, these issues cannot be ignored.

  With the transfer of the Lighting Global Quality Standards to IEC TS 62257-9-8, we are enabling companies to have products tested directly to the IEC standards. However, in the past, we have observed that test reports produced by some test laboratories that were unfamiliar with the test methods described in IEC TS 62257-9-5 were inaccurate, misleading, or at times, incomprehensible. To ensure the integrity of the Lighting Global program, we will continue to only accept reports from test labs that are in the Lighting Global network. Additionally, for the immediate future, we will continue to work with companies in advance of testing to ensure the test plan for their product adequately covers the nuances of the product. We agree that the new requirements introduced in IEC TS 62257-9-8 will add complication and feel that we can continue to provide a role of assisting both companies and test labs as they navigate the requirements.

  That said, we are always open to including more high quality labs in the Lighting Global network. If there is a lab you think would be interested in conducting testing for our program, please have them review our test lab policy: https://www.lightingglobal.org/resource/test-lab-policy/. If they have (or plan to acquire) the needed equipment and qualifications, they can then contact us to request an application form. Dependent on their responses and available funding, we could then work with them to conduct some training and practice tests to ensure competency and familiarity with the test methods. Labs would also need to enter into a MOU with CLASP to cover key issues such as data management and conflicts of interest.

- Certification increases the price of products, especially if manufacturing is done in Africa. We need to ensure quality of off-grid products, but also have to propose solutions for long term development, which may include local manufacturing. Perhaps consulting local manufacturers will help Lighting Global have more consideration for those who want to develop facilities in countries with off-grid solar markets to provide both energy and work.
  - ***Response from Lighting Global:*** Thank you for this recommendation. We are interested to consult with local manufacturers to better understand their needs and ways to better support their efforts. One activity currently underway is the development of capacity at several new test labs in Africa which will be trained to conduct testing according to IEC TS 62257-9-5. These labs may be able to

alleviate some of the difficulties associated with shipping products overseas for testing. As noted earlier, the addition of the requirements for battery safety testing of lithium batteries may prove especially problematic for companies assembling lithium batteries in countries without adequate testing facilities. We are interested in brainstorming how to ensure locally assembled lithium batteries can be tested to ensure safety and to meet the requirements of IEC TS 62257 9-8.

Appendix A

The following text regarding the new safety requirements for lithium-based batteries is included in the upcoming IEC document. This text may still undergo slight changes prior to the final publication.

Specific requirements for lithium-based batteries

Safety standards

All lithium batteries, including those in appliances, shall meet the requirements of a standard for safety during use. Test reports shall cover both the individual cell and the fully assembled battery pack. Test reports shall be prepared by a laboratory that has demonstrated competence, metrological traceability, and impartiality, for example by accreditation to ISO/IEC 17025.

a) Batteries used in portable applications shall meet either IEC 62133-2, UL 62133, or the combination of UL 1642 and UL 2054. For this purpose, portable applications are defined as easily hand-carried devices (such as torches/flashlights, battery-powered radios, mobile phones and tablets). Any components that would be subject to the drop test shall be considered portable applications.

b) Batteries that are not intended to be used in portable applications (i.e. used in stationary applications), but are used in a component with a mass 18 kg or less shall meet either:

   1) the requirements of a) or

   2) the requirements of both of the following:

   - either the *United Nations Recommendations on the transport of dangerous goods: manual of tests and criteria* or IEC 62281, and
   - either IEC 62619 or UL 1973

c) Batteries used in a component with a mass greater than 18 kg shall meet the requirements of IEC 62619 or UL 1973.

The 18 kg mass threshold includes the battery and any housing or component in which it is integrated, but does not include external system components (e.g. a separate solar module included with the system).

NOTE 1 The 18 kg threshold is derived from the scope of IEC 61960-3:2017.

NOTE 2 The United Nations *Recommendations on the transport of dangerous goods: manual of tests and criteria* is often referenced as UN 38.3.

Overvoltage protection for individual cells

All lithium batteries, including those in appliances, shall have overvoltage protection for individual cells or cell blocks. This protection may be part of the battery pack or the component in which the battery is installed. The overvoltage protection limit for an individual cell shall be as specified by the battery manufacturer. In the absence of manufacturer-specified values, the overcharge protection voltage in Table 7 may be used.

NOTE 1 The product of the individual-cell overvoltage protection limit (specified by the battery manufacturer) and the number of cells or cell blocks in series can be greater than the maximum charging voltage for the battery pack. For example, for a four-cell battery pack, the maximum charging voltage could be 14,2 V (3,55 V per cell) and the overvoltage protection voltage could be 3,8 V. (These values are presented as an example and are not intended as a recommendation.)

The requirement for individual-cell overvoltage protection may be assessed through manufacturer declaration. To the degree possible, the results of the visual screening should be used to verify that the appearance of the battery pack and circuitry is generally consistent with the declaration.

NOTE 2 There is no test procedure to evaluate individual-cell overvoltage protection in IEC TS 62257-9-5:2018.

EXAMPLE 1 The following case would suggest that the battery pack and circuitry are not consistent with the declaration, so it is possible the battery does not meet the requirements of this clause: Consider a product with a lithium-ion battery having four cells in series. If the manufacturer's declaration states that individual cell protection is provided on the main unit PCB, but there are only two wires connecting the PCB and battery, then individual cell protection cannot be on the PCB as described. It could be internal to the battery pack or absent entirely.

EXAMPLE 2 In this case, the battery pack and circuitry are not consistent with the declaration, and the battery cannot meet the requirements of this clause: Consider the same product as example 1, but the manufacturer states that the individual cell protection is internal to the battery pack. However, the test report states that the battery pack does not contain an internal PCB. In this case, there cannot be individual cell protection, and the product is not as described.

Appendix B

The following text regarding the additional safety requirements for PV modules is included in the upcoming IEC document. This text may still undergo slight changes prior to the final publication.

Additional tests for PV modules

General

All PV modules (unless otherwise noted) shall meet the requirements of 0. The sample sizes and renewal requirements for these tests are given in Table 1. For renewal tests as described in 4.3, AVM follow-up tests as described in 4.2.3.1 b), or market check method (MCM) tests (as described in IEC 62257-9-5), these tests are required only if specified in Table 1 or if the PV module has changed.

Table 1 – Sample size and renewal requirements for PV tests

Subclause	Sample size	Required for renewal, AVM follow-up, or market check method (MCM) tests	Provision of IEC 61730 (all parts) sufficient to meet requirements
Wiring inspection	Same as IEC 62257-9-5 visual screening	yes	no
Visual screening	Same as IEC 62257-9-5 visual screening	yes	no
Durability of markings and sharp edges	1	no	yes
Screw connections	1	no	yes
Breakage	1	no	yes
Bending or folding	1	no	no
Hot-spot endurance (size B products only)	1	no	yes

Outside test results to IEC 61730 (all parts) or IEC 61215 (all parts) may be provided to meet some of these requirements. Such testing shall be conducted at a laboratory that has demonstrated competence, metrological traceability, and impartiality, for example by accreditation to ISO/IEC 17025. For such testing, the sampling requirements of IEC TS 62257-9-5 do not apply, and sample sizes shall be as specified in the referenced standard.

NOTE The requirements of 5.5.5.4, 5.5.5.5, 5.5.5.6, and 5.5.5.8 are fulfilled by any PV module that has met the requirements of IEC 61730 (all parts).

Subclauses 5.5.5.4 through 5.5.5.8 reference procedures in Annex B and Annex C. These procedures, as well as the contents of 5.5.5.2 and 5.5.5.3, are intended to be added to a future version of IEC TS 62257-9-5. If the most recent version of IEC TS 62257-9-5 includes one of the referenced procedures, the procedure in IEC TS 62257-9-5 shall take precedence, and the procedure in this document shall not be used.

Wiring inspection

If the most recent version of IEC TS 62257-9-5 includes a wiring inspection procedure for PV cables, that procedure shall be used. Otherwise, the following procedure shall be used.

The conductors connecting the PV module to the main shall be sized to safely carry the maximum short circuit current of the module. The conductor diameter shall be measured using an appropriate instrument (e.g. callipers, micrometer, or wire gauge); for multi-stranded conductors, multiple measurements should be made to determine an average diameter for the bundle, or an individual strand may be measured and then the result multiplied by the number of strands. Examples of maximum ratings are given in Table 2. The determination of whether the wire is sized safely is ultimately at the test laboratory's discretion.

Table 2 – Examples of maximum current ratings

Wire size American wire gauge (AWG)	Wire size mm^2	Example current rating A
18	0,82	11,4
16	1,31	14,7
14	2,08	20,5
12	3,31	24,6
10	5,26	32,8
NOTE The example maximum ratings are referenced from ANSI/NFPA 70:2017, Table 310.15(B)(16), assuming multi-conductor insulated cable at an ambient temperature of 50 °C and a conductor temperature of 90 °C. These values are provided for general guidance. To provide strict safety requirements, the insulation temperature limit, thickness, thermal conductivity, air convection and temperature should all be taken into account. Further, these values only take into account the current-carrying capacity. To minimize voltage drop, good practice warrants the use of larger diameter conductors (for example, the use of 2,5 mm^2 wire to carry 7 A).		

Visual screening

During the visual screening described in IEC TS 62257-9-5, any of the following visual defects identified in the PV module shall be included in the deficiency score calculated during the internal inspection. These deficiencies are not classified as functionality deficiencies and should be treated similarly to soldering, wiring, and fixture deficiencies. If any hazards or immediate safety issues are present, these safety issues should be treated similarly to those identified during the internal inspection and the product's workmanship quality shall be noted as poor.

a) broken, cracked, or torn external surfaces, including superstrates, substrates, frames and junction boxes;

b) bubbles or delaminations forming a continuous path between the electric circuit and the edge of the module;

c) bent or misaligned external surfaces, including superstrates, substrates, frames and junction boxes to the extent that the operation of the module would be impaired:

d) loss of mechanical integrity, to the extent that the installation and/or operation of the module would be impaired;

e) module markings (label) are no longer attached or the information is unreadable.

NOTE 1 In IEC TS 62257-9-5:2018 the deficiency score and workmanship quality is described in F.4.3.c).

NOTE 2 Guidance regarding deficiencies that could pose safety issues for PV modules was derived from IEC PAS 62257-10 and IEC 61730-2.

If the visual screening procedure in a future version of IEC TS 62257-9-5 contradicts the requirements of this subclause, the requirements of IEC TS 62257-9-5 shall take precedence.

Durability of markings and sharp edges

All PV modules that are not integrated into other components shall meet the requirements of the following tests as described either in IEC 61730-2 or in a future version of IEC TS 62257-9-5, or in Clauses C.2 and C.3 of this document.

a) Durability of markings

b) Sharp edge test

Screw connections

Any PV modules with screw connections intended to be used at the time of installation shall meet the requirements of the screw connection test defined in IEC 61730-2, a future version of IEC TS 62257-9-5, or Clause C.4 of this document.

Breakage

All PV modules that are not integrated into portable components (i.e. modules that are not subject to the drop test described in IEC TS 62257-9-5) shall pass the module breakage test of IEC 6173-02 or the impact test described in a future version of IEC TS 62257-9-5 or Clause C.5 of this document.

Bending or folding

All PV modules that are designed or advertised to be flexible or foldable shall pass a bending or folding test described in a future version of IEC TS 62257-9-5 or in Clause C.6 of this document, except that modules that are mounted or integrated into a component in a way that they would not be flexed or folded during installation or use do not need to undergo this testing, regardless of whether the module itself is flexible or foldable.

Hot-spot endurance (size B products only)

All modules with rated power (at STC) greater than 10 W shall pass one of the following hot-spot endurance tests:

a) the hot-spot endurance test of IEC 61730-2 or IEC 61215-2;

b) the partial shading test specified in a future edition of IEC TS 62257-9-5; or

c) if the most recent edition of IEC TS 62257-9-5 does not specify a partial shading test, the partial shading test for photovoltaic modules described in Annex B of this document.

Requirements for systems with large PV modules or arrays

If a product includes a PV module or array with maximum power greater than 240 W, open-circuit voltage greater than 35 V, or short-circuit current greater than 8 A, the module and other components in the system, as appropriate depending on the design of the product, are subject to the following additional requirements:

a) PV modules shall meet the requirements for class II modules in IEC 61730 (all parts).

b) All components intended to be directly connected to the output of the PV module shall meet the requirements of IEC 62109-1 or UL 1741. Typically, this requirement applies to the main control unit.

c) Any component intended to be connected to an electrical output of components to which b) applies shall meet the requirements of IEC 62109-1 or another applicable standard (e.g. UL 1741 or the relevant part of IEC 60331) assessing protection from fire and electric shock, unless the circuit to which the component is connected meets the requirements of IEC 62109-1 or another applicable standard for protection in case of direct contact.

If a product is intended to be used with multiple PV modules in series or parallel, regardless of whether the PV modules are included with the kit, requirements a) through c) shall apply if the total power, open-circuit voltage, or short-circuit current of the combination can exceed 240 W, 35 V, or 8 A respectively.

If outside test results are provided to meet this requirement, the testing shall be conducted at a laboratory that has demonstrated competence, metrological traceability, and impartiality, for example by accreditation to ISO/IEC 17025.