



Solar Lantern Solution Guidance

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This solution and guidance material has been developed with the contribution of Innovation Norway for the IOM E-waste Project. The IOM E-waste Project focuses on creating a circular economy for e-waste in displacement settings. Solvoz developed various solutions to support sustainable procurement practices, focusing on the procurement aspect of the e-waste value chain to green humanitarian responses. As part of the Project, Solvoz has developed sustainability and circularity criteria for several product types and services, in consultations with numerous humanitarian and private actors. This is one of the outcomes of this partnership.

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1 SOLAR LANTERNS

Solar lanterns revolutionised the living conditions and the quality of life of millions of people who live off-grid. Humanitarian and aid organisations have distributed a large quantity of solar lanterns in displacement settlements and for the victims of natural disasters. At the same time, the e-waste (electrical waste) issue arising from the broken solar lanterns has drawn an intensive attention in recent years.

1.1 FUNCTIONAL USE GUIDANCE FOR SOLAR LANTERNS

The following guidance document is targeted at buyers of solar lanterns. The guidance is intended to inform a buyer of the basic features of solar lanterns and expected requirements for simple functional use cases in displacement settings.

The selection of a solar lantern should be based on the main functional use of the lantern. In a displaced camp setting lanterns may have multiple uses and the priority uses (i.e. for homework or safe access amenities at night) should be considered when selecting a lantern. A solar lantern is a safer lighting source than liquid-fuel lanterns and many lanterns on the market are multifunctional that can act as a focused light source (torch or reading light) or a static light for lighting a room.

1.1.1 Lantern configuration

Solar lanterns either have an integrated solar panel in the body of the lantern or have a detachable solar panel with a cable up to a few meters. In general, a detachable solar panel can be larger, and be situated optimally allowing a greater charging potential for batteries and hence power available for lighting. Many panels also allow charging via a secondary source such as a USB port.

1.1.1.1 Solar panels

Solar lanterns typically have solar panels of around 2 Watt peak or less. Monocrystalline panels are more efficient and work better in hot weather but are more expensive than polycrystalline panels.

1.1.2 Brightness

Brightness is measured in lumens and at a specific point, equally important is the area across which the lantern shines. Less than 100 lumens for example can be used for homework if the child sits very close or the light is focused on a small area (less than 40 Lumens with a focused light). Where more than one child needs to do homework at the same time more than 200 Lumens may be needed to light the wider area of a working table. Similarly for lighting a small room of 10m² 500 Lumens would provide enough light for most tasks.

1.1.2.1 Brightness Control

Being able to adjust the brightness allows the user to match the energy used with the lighting need, saving battery life and a longer duration of use each day. This is recommended feature to have.

1.1.2.2 Focused light

Lanterns that provide a focused light source can increase the functional use of the lantern even with limited brightness for reading lamp as a torch.

1.1.3 Power Source and battery type

The power source for lanterns are rechargeable batteries. In general three battery types are common Li-ion, Ni-Cd and Ni-MH. Batteries themselves vary in charging density, lifetime, price and toxicity. Li-ion cells are most often used in solar lanterns and other mobile home appliances and IT equipment, due to their capacity versus mass ratio, have no memory effect and last a long time. Cycles

The number of times the battery can be charged and discharged will determine the usable life. Depending on the battery chemistry the number of recharging cycles can vary (20 for Alkaline up to 2000 for some Li-ion batteries). More than 1200 cycles will give around 3 years of operation.

1.1.3.1 Time to charge

The time to charge will be a factor of the charging sources, solar panels, size, and battery capacity. The time to charge under optimum conditions should be no more than a few hours. Under normal operating conditions 5 hours or less will allow daily use. However many factors will affect the charging time, clouds, temperature, angle of the panel to the sunlight and can extend the charging time. IEC standard /VeraSol refer to 7h as one solar day for charging. Additional charging sources such as a USB port can provide a quicker time to charge.

1.1.3.2 Run-time

Runtime is based on the stored charge and intensity setting on the bulb. 3+ hours of use at maximum brightness should be the minimum charge available for normal daily use.

1.1.4 Durability

The durability of the lantern will depend on the design and materials used. Lanterns should have an **ingress protection rating** for input and output ports of IP67 to protect electrical components and IP64 for the mechanical parts that will protect the components from dust and water spray in any direction. Similarly, the lanterns should be **impact resistant** and will be undamaged if dropped from one meter or more. The casing material must assure electrical and heat insulation and it must be durable. ABS (acrylonitrile butadiene styrene) and PC (polycarbonate) for example are suitable. PP is also commonly used and is recyclable.

1.1.5 Lifespan

A lantern should have an effective warranty of 2 years where no repairs are required. Lanterns can last many more years with maintenance and replacement of basic parts with heavy use if the lantern is of good quality.

1.1.6 USB Port

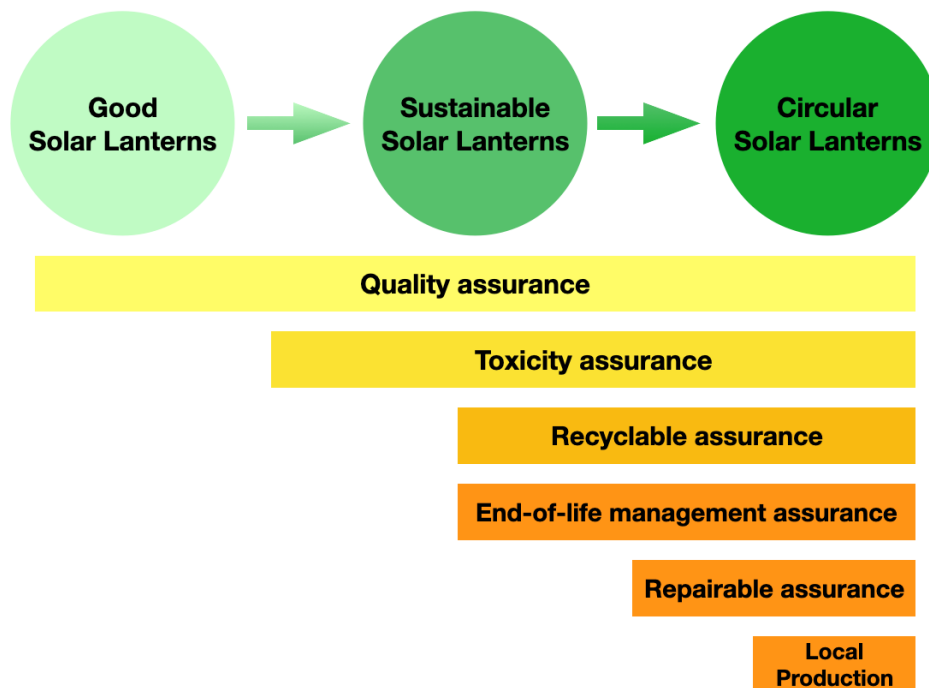
USB ports can both be used for charging other devices such as mobile phones as well as used to charge the lantern's battery via USB C port for example. A USB port adds to the utility of its general use.

1.1.7 Standards/Compliance

The standard IEC- 62257-9-5 is a standard specific for solar products. This standard is used by certification bodies such as Verasol to certify solar lanterns. The second relevant standard is compliance to EU's RoHS directive or similar standards which details minimum levels of toxic material that can be utilised in products.

1.2 SUSTAINABILITY GUIDANCE

This guidance explains how to choose sustainable and circular solar lanterns. Sustainability criteria are not static, and they require continuous assessment and modification. The following diagram shows how a solar lantern can become green and greener.



1.2.1 What is a sustainable solar lantern?

Sustainability is defined as « meeting the needs of the present without compromising the ability of future generations to meet their own needs », so a sustainable solar lantern should not leave negative heritage to the future generations (no toxic waste and good waste management), it has enhanced material loops (made of recyclable materials and recycled materials), and the end-of-life solar lanterns must be responsibly managed. Hence, the main criteria for a sustainable solar lantern are Toxicity, Recyclability, and End-of-life management.

1.2.2 What is a circular solar lantern?

A circular solar lantern has multiple life-stages (new product, repaired product, reused product, and as a spare part) with an extended product life-time. Its end-of-life stage provides a valuable resource for the production of new products made of recycled material, closing the resource loop. So a circular solar lantern must be designed for repair, reuse and recycling. Hence, the main criteria for a circular solar lantern are Toxicity, Recyclability, End-of-life management, Repairability, and Local production or assembly.

1.2.3 Toxicity

Solar lanterns can contain a range of toxic substances that cause short-term and/or long-term harm to the human health and the environment. Toxicity must be considered as the most important sustainable criteria by humanitarian and aid organisations.

The solar lanterns that are to be procured by humanitarian and aid organisations must contain minimum level of toxic substances, and the buyers can choose from the following four criteria. Detailed information on toxicity criteria and standards is provided in Annex 1 to 3.

1.2.3.1 Restriction of Hazardous Substances (most important)

Currently the EU's RoHS (Restriction of Hazardous Substances in Electrical and Electronic Equipment) is the most comprehensive and widely implement standard globally. Manufacturers compliant will display a CE-marking on their solar lantern. RoHS directive prohibits the use of 10 most toxic substances in electric and electronic equipment. China RoHS II (6 toxic substances) must be complimented for the compliance to EU's RoHS directive. See Annex 1 and 2 for more information.

1.2.3.2 List of declarable substances as specified by IEC 62474 (optional)

It is recommended especially if product disassembly is envisaged. In order to facilitate the downstream service activities (repair, recycling and waste management) that require disassembly of a solar lantern, the knowledge of hazardous chemical use is important. See Annex 3 for more information including the list of substances to be declared. Suppliers must provide the list upon request.

1.2.3.3 Minimum allowable halogens in electric wires (optional)

It is recommended if open-field burning is of a common practice in the place of solar lantern distribution. Halogenated compounds generate toxic smoke (dioxins) when burned, so the solar lantern must contain none or minimum level of halogens in plastic insulating materials. Avoid PVC (polyvinyl chloride) wires and prefer the PE (polyethylene) or Nylon wires. Suppliers must guarantee the avoidance of halogens.

1.2.3.4 Minimum allowable halogens in plastic (optional)

Same argument as the previous criterion for other plastic parts such as product casing. Avoid PVC casing, and prefer other plastics such as ABS (acrylonitrile butadiene styrene) and PC (polycarbonate) for example. Suppliers must guarantee the avoidance of halogens and the absence of dangerous flame retardant coating (included in 1.2.1.1 and 1.2.1.2 criteria).

1.2.4 Repairability

Repairable products have an extended product life-time, so it is more sustainable and circular as it increases the product life stages (repaired, reused, and repurposed product). Product repairability strongly correlates to the product design, so a buyer of solar lanterns should opt for exigent repairability criteria especially when a large volume of single-branded solar lanterns is distributed in a localized place (such as displacement settlement).

1.2.4.1 Availability of user manual with trouble-shooting guidance (minimum requirement)

Supplier must provide a hard copy or an electronic copy of user manual written in a language commonly used in the place of intervention (use of pictograms is strongly encouraged). Trouble-shooting guidance must be precise in description and the use of images is encouraged.

1.2.4.2 Frequently replaced parts list (Minimum requirement)

Frequently replaced parts must be listed in the user manual and/or in the supplier's website.

1.2.4.3 Availability of spare parts (minimum requirement)

Spare parts for parts listed in “Frequently replaced parts list” must be provided to the local supplier for a sufficient quantity to assure the repair operation for minimum one year.

1.2.4.4 Availability of repair manual (Minimum requirement)

Supplier must make repair manual available on their website or on public domain sites. The basic content of repair manual is summarized in Appendix 5.

1.2.4.5 Designed for disassembly (recommended)

Solar lanterns must be intentionally designed for disassembly and reassembly to facilitate the repair and recycling activities. Supplier must self-evaluate the ease of disassembly by minimising the number of steps required for disassembly sequence.

1.2.4.5.1 Use of interoperable parts (recommended)

The use of interoperable parts is recommended as it facilitates the repair service by pooling the spare parts among different products and product types.

1.2.4.5.2 Use of standard plugs, connectors, and charging solutions (recommended)

The use of standard plugs, connectors, and charging solutions is recommended as it facilitates the repair service by pooling the spare parts among different products and product types.

1.2.4.5.3 No special tools required for disassembly and repair (recommended)

Disassembly and repair processes shall not require special tools as it will not allow local repair shops to perform basic repair operations.

1.2.5 Recyclability

Making prudent use of available resources is crucial for the sustainable development. The manufactures of solar lanterns must design their products with recycled and/or recyclable materials although the level of recycling in developing countries remains a limiting factor. Most recycled materials in developing countries are metals and plastics but if they are soiled with paints, chemicals and oils, these substances prohibit the recycling processes. Buyers can choose from the following two recyclability criteria, and the definitions are given in Appendix 1.

1.2.5.1 Use of recycled materials

The use of recycled materials (metals, plastics for casing, and glass for mini solar panel) must be encouraged. There are a number of certification systems, so manufacturers can provide the certification or self-declare and report the use of recycled materials.

1.2.5.2 Labelling of plastic components

Plastic components can be labelled according to the ASTM International RIC (Resin Identification Coding) System to facilitate the recycling processes. Most plastics used in solar lanterns are in the group 7, so it would be helpful to grave the polymer abbreviation below the RIC mark.

1.2.6 End-of-Life Management

E-waste is an emerging problem worldwide. In most developing countries, e-waste legislation is still at the development stage but the capacity to properly treat e-waste is

developing steadily. Buyer of solar lantern must refer to local legislative framework for e-waste in the country of interest:

<https://www.gsma.com/mobilefordevelopment/e-waste-legislative-framework-map/>

Suppliers or humanitarian organisations are encouraged to contract local businesses when a large number of solar lanterns are procured for a localized distribution. A list of e-waste management facilities of some African countries is compiled by CLASP and provided by EEP Africa: <https://eepafrica.org/resources/e-waste-toolkit/recycling-facilities/>

1.2.6.1 Product take-back scheme

End-of-life solar lanterns must be collected for recycling and waste treatment purposes. The supplier must plan and establish collection points or a collection network for efficient product take-back. Alternatively, product take-back scheme can be procured to a local service provider such as repair shops and waste collectors. The advantages of procuring the take-back scheme to repair shops include the reintroduction of broken products into a functional product pool, and the creation of locally sourced spare parts. Both advantages contribute significantly to the development of a circular economy at a local scale. It is widely known that an efficient take-back scheme requires economic incentive to persuade users to give away their broken products especially in low-income countries. Paied take-back schema must create an economic value by resale of repaired products.

1.2.6.2 Service contract with local waste management company

End-of-life solar lanterns must be transported to and treated correctly in an authorised recycling and waste treatment facility. Since such activities can only be feasible locally, a service contract with a local waste management company must be signed either by the supplier of procured solar lanterns or by the procuring organisation.

1.2.7 Local production

Local production facilitates a quick repair service, shorter transportation distance, and local empowerment, so it is strongly recommended from social, economic and environmental perspectives. However, the capacity to manufacture in most developing countries is limited. Where no local producers exist suppliers that assemble and the refurbish locally repaired and repurposed products can be sought out. In addition regional (continental) production can also limit the environmental impact.

Local production or assemblage

Local production or assemblage of solar lanterns reduces transportation and enables local availability of spare parts and of repair and maintenance services empowering local communities.

1.3 PROCUREMENT GUIDANCE

To procure in a sustainable way, the buyer needs to consider environmental, ethical, social, and economic considerations when selecting their suppliers.

Those considerations should be judged in the following:

- Product quality specifications & sustainable criteria
- Application of sustainable principles by suppliers (CSR responsibilities)
- Supplier services: warranty (repairability service), take back service, transport

- Economic evaluation (price and associated costs; transport, taxes and customs duty)

For each part, the guidance provides clear advises and recommended documents to request. This will help to develop the award process with recommended supplier selection criteria and weighting system. An example of the weighting and evaluation criteria is available in Annex 7.

1.3.1 Product quality and sustainability standards (product quality and sustainable specification)

The supplier needs to demonstrate that the lanterns match the minimum requirements according to the buyer's requirements related to quality and sustainability. Many of the requirements can will be related to certification and labelling that the lantern holds.

All sustainable criteria links to product it-self has been presented in the above section 1.2. and needs to be defined in the supplier selection criteria. All minimum required criteria should have a higher weighting level in the award process. Those are:

- CE marking – RoHS directive to proof the reduction of toxicity
- Service of take back (end of life management)
- Repairability with repair instructions and availability of spare parts

Ensure that labels and certifications displayed on products are genuine by checking public databases and asking for verification documentation from suppliers and manufacturers.

Batch numbers can be checked with manufacturers to ensure products are genuine. It is advised to request samples from suppliers and identify technical support (internally or externally) to check the quality of the lanterns.

It should be noted that local or small manufacturers may not have the resources to gain certification for their products even though their products may be of good quality. Buyers can support local suppliers through rigorous sample testing as well as supporting independent audits of products (where the technical capacity is available).

1.3.2 Service provided by the supplier

1.3.2.1 Warranty

A minimum **2-year warranty** is advised that provides for repair or replacement of the lantern if it breaks down in the period under “normal use”.

It is important to agree with the supplier on what “normal use” is and what actions by the user may **void** the warranty (i.e. DIY repair by users of the lantern). This would include all part that are cover by a standard warranty (no extra fee).

It is also recommended to agree on repairs and replacement pricing outside the warranty as part of the agreement. This would include all cost related to **extra warranty** in terms of services but also in terms of duration (i.e. warrant cost after 2 years)

The supplier should ensure that they can provide an effective warranty and with a **short lead time** for repair or replacement of lanterns. This will ensure that users of the lanterns are not adversely impacted by their absence. Suppliers should have the capacity in-house or through service providers to repair lanterns with genuine and quality spare parts or ensure short lead times for replacement.

The supplier should have a clear and simple **claims** process to trigger the warranty.

1.3.2.2 Take back scheme

To manage the end of life, the supplier should provide a clear “take back” process. This process should include the physical flow (reverse logistic) but also clarification in terms of financial award.

1.3.2.3 Transport

Transport of goods to the required location is an important service particularly if the buying organisation has limited logistics means. Batteries when encapsulated within the lantern itself will not fall under dangerous goods restrictions. Where spare parts and batteries are carried with the same transport then provisions maybe such as IATA 2022 for the transport of Lithium batteries.

1.3.3 Supplier qualification and sustainability

Even if the product is intrinsically a sustainable product the way in which it was manufactured, transported or supplied may not be sustainable. In this part we advise the way to assess sustainability related to suppliers and manufacturers, their ethical and social responsibilities and their compliance to commercial activities.

1.3.3.1 Registration

The supplier should have an active business registration in its country of operation. The business registration in most countries can be checked against publicly available databases. Similarly, a tax registration for value added taxes (VAT) or goods and services taxes (GST) should be registered to the supplier. This will ensure the buyer organization can deduct taxes if and where possible as a charitable organization.

1.3.3.2 Financial audits and outstanding obligations

The buyer should request the audited financial statement of the supplier and information on its major suppliers and customers. A financially secure supplier with many customers is likely to be a lower risk partner to engage with. Suppliers with significant outstanding obligations, debt or significant commitments for large contracts compared to the size of the company also pose a risk.

1.3.3.3 Litigation

Companies that are involved in **litigation** proceedings may pose a risk in being able to fulfil their obligations as well as offer an insight into the organizations reputation.

1.3.3.4 Code of conduct and certification

There are a number of codes of conduct and standards related to human rights, labor rights, the environment, and anti-corruption; that they roughly fall into roughly three categories:

1. Voluntary registration to codes of conduct and practice
2. Buyer assessment or audits
3. Independent bodies certification and audits

Suppliers and manufacturers can demonstrate their intent to be a sustainable organization by voluntarily signing up to a recognized charter, standard or code of conduct. This document clarifies the expectation of supplier/buyer in terms of human rights, labor, environment, and anti-corruption measures. This includes amongst other principles, no

forced or child labor, security and safety of workers, proper wages and benefits, rules on bribery or highlight conflict of interest.

Independent certification normally recognizes independent auditors or conduct audits themselves. The most well-known certifications are “Ecovadis”, “B-Corp” or ISO 26000. These certifications are obtained for a fixed period and undertaken by an independent auditor and describe the level of sustainability of the organization.

A list of company that are engaged in sustainable management can be registered under request in the UN Global compact database. <https://www.unglobalcompact.org/what-is-gc/participants>

Many suppliers in low- and middle-income countries do not apply for certification due to cost or accessibility to certification processes. Buyers can support local organizations by not disqualifying them immediately due to a lack of certification and instead support the assessment of the supplier during procurement process by the inclusion of criteria in the supplier evaluation that directly assess sustainability and ethical practices of the supplier or manufacturer.

A toolkit can help you to take the right action in terms of sustainable procurement and undertake the decent work, respectful procurement practices, human and labor rights and building trust with your suppliers.

<https://www.unglobalcompact.org/take-action/sustainableprocurement>

1.3.3.5 Supplier reputation

An important objective for all buyers is to create savings through their purchasing decisions. Equally important in the decision is to ensure that the supplier that you engage with is a good actor. To give some examples of a good actor; a good supplier complies with good labor practices and human rights, does not harm the environment, its ownership is transparent (company directors and investors) and the company is **not** subject to contravening any embargoes and/or sanctions.

There are a number of databases that are searchable related to corporate and social responsibility, sanctions lists and transparency of companies. A suggested list of databases and relevant guidance can be found in Annex 7. It is always as minimum useful to search online (google the company) in the relevant languages to check if the background of the organization.

1.3.4 Economic criteria

Sustainable product can be considered as premium in term of cost. However, the buyer team needs to consider the total cost when selecting the product. This should include the cost throughout the total life cycle of the product (LCC) but also considering the environmental cost.

Prioritising local suppliers should be considered when selecting the vendor, reducing the environmental logistics footprint while supporting local economies.

In practice, the cost to consider should be:

- Purchasing cost in comparison with total life cycle duration
- Transport cost with a clear priority for local procurement

- Insurance cost and extra warranty cost with a clear understanding on warranty offer
- Preventive maintenance cost

1.4 PRODUCT EXAMPLES

<https://solvoz.com/solution/169098>

<https://solvoz.com/solution/15113>

<https://solvoz.com/solution/169115>

<https://solvoz.com/solution/16974>

1.4.1 Partners to develop a solution with

Bright, Verasol and C-Ten

1.4.2 Reference and sources

- ❖ IEC EN 45554:2020
- ❖ NSF 457:2019
- ❖ Instructions manual for the calculation of the reparability index of electrical and electronic equipment by French Ministry of Ecological Transition
- ❖ TCO certification criteria documents
- ❖ VeraSol Doc
- ❖ IEC 62257-9-5

<https://www.maine.gov/dep/waste/ewaste/tvcomputerguidelines.html>

STEP: Developing legislative principles for e-waste policy in developing and emerging countries (2018)

APPENDIX 1 SUSTAINABILITY CRITERIA

TOXICITY

The danger of toxic substances in electric and electronic products is widely recognised. The proposed sustainability criteria integrate the most acknowledged standards as criteria. However, the trend to avoid any level of chemical hazard will continue, and it is highly recommended to replace the traditional plasticisers, flame retardants and process chemicals by safer alternatives. GreenScreen® provides detailed up-to-date information on safer chemicals. The list of most commonly used chemical groups in electric and electronic products are provided by TCO certification as TCO Certified Accepted Substance List:

<https://tcocertified.com/industry/accepted-substance-list/>

Criteria and definitions

Electrical and electronic equipment and its spare-parts

| Criteria | Definitions | Source |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Complies with EU's RoHS Directive* | Conformance to RoHS Directive: heavy metals (Pb < 1000 ppm, Hg < 1000 ppm, Cd < 100 ppm, Cr(VI) < 1000 ppm), brominated flame retardants (PBB < 1000 ppm, PBDE < 1000 ppm), PVC softener for wire insulation (DEHP < 1000 ppm, BBP < 1000 ppm, DBP < 1000 ppm, DIBP > 1000 ppm). | NSF/ANSI 457 - 2019 |
| List of declarable substances as specified by IEC 62474** | Manufacturer shall list the presence of IEC 62474 declarable substance groups and declarable substances in the product at or above the reporting threshold amounts stated in the IEC 62474 Standard. | NSF/ANSI 457 - 2019 |
| Contains minimum allowable halogens in electric wires | Avoidance of electric cables containing halogenated compounds. Level of chlorine or bromine greater than 5000 ppm, or fluorine greater than 1000 ppm, based on the test method IEC 62321-3-1 and IEC 62321-3-2. | NSF/ANSI 457 - 2019 |
| Contains minimum allowable halogens in plastics | Avoidance of halogenated compounds in plastic parts exceeding 25g. Level of chlorine or bromine greater than 5000 ppm, or fluorine greater than 1000 ppm, based on the test method IEC 62321-3-1 and IEC 62321-3-2. Exemptions for printed circuit boards. | NSF/ANSI 457 - 2019 |

* Annex 1 provides the basic information on EU's RoHS Directive.

** Annex 2 provides IEC 62474 listed substance information.

Batteries

| Criteria | Definitions | Source |
|---------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Contains minimum level of heavy metals | No more than 0.0005% (5 ppm) of mercury by weight and no more than 0.002% (20 ppm) of cadmium by weight. | EU Battery Directive*** |
| Components with heavy metals clearly marked | Batteries with more than 40 ppm lead, 20 ppm cadmium or 5 ppm mercury must also be marked with the chemical symbol for the metal. Exemptions for fire alarms. | EU Battery Directive*** |

*** Annex 3 provides the basic information on EU's Battery Directive.

RECYCLABILITY

End-of-life product components can provide a valuable resource to produce a new product by means of recycling. Most commonly recycled materials on the African continent are metals and plastics. Metals have infinite recycling capacity whereas plastics have finite recycling capacity due to the degradation of polymerisation. In addition, metal recycling can take place at a very small and a local scale as small and affordable electric smelters are omnipresent on the African continent. However, recent movement on the continent allows simple plastics such as PET, PE, and PP (sometimes PS) to be recycled as post-consumer resins. The plastic recycling companies and the types of recycled polymers in African are

listed (non-exhaustive list) in the website of ENF Recycling:

<https://www.enfrecycling.com/directory/plastic-plant/Africa>

Criteria and definitions

| Criteria | Definition | Source |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Recycled materials used | Manufacturer shall declare the minimum percentage by weight of recycled content in the product and for each of the components as applicable. NSF 457-2019-1 (Article 6-1-1) | NSF/ANSI 457 - 2019 |
| Product components' materials labelled if recyclable | Plastics shall be classified and indicated according to the ASTM International Resin Identification Coding System. | NSF/ANSI 457 - 2019 |

END-OF-LIFE MANAGEMENT

E-waste is an emerging problem worldwide. The humanitarian interventions shall not leave such waste as a negative heritage to the places of interventions as such waste contains hazardous substances that can endanger the human health and the environment. In most developing countries, the capacity to properly treat e-waste exists locally even if limited.

In order to assure the proper treatment of e-waste, international cross-sectorial partnership is necessary. Such a partnership involves manufacturers, suppliers, humanitarian organisations and agencies, as well as the local waste treatment actors, and the integration of the end-of-life management requirement for the humanitarian procurement of electric and electronic products is recommended.

Criteria and definitions

| Criteria | Definition | Source |
|------------------------------------------------------|------------------------------------------------------------------------------------------------|---------------------|
| End-of-Life product take-back scheme available | Manufacturers shall provide a nationwide product take-back service for recycling and disposal. | NSF/ANSI 457 - 2019 |
| Service contract with local waste management company | Manufacturers shall contract a local company for the disposal of end-of-life products. | |

REPARABILITY

Reparable products contribute significantly to reduce environmental impacts and to develop local economy. The main objective is to provide multiple life stage to a product before reaching its end-of-life by designing the product that facilitates repairing and repurposing. The introduction of reparability in the product design is rather a new concept. Most vigorous effort was taken by France where Reparability Index (measurable indicator) as a consumer indicator was officially introduced to five categories of electronic equipment (smartphones, laptops, televisions, washing machines and lawnmowers) since 2021.

The reparability category of Sustainability Criteria has two sets of criteria; mandatory and recommended, to accommodate manufacturers to adapt in steps. In open-access space, organisations such as [ifixit.com](https://www.ifixit.com) provide repair manuals of various electronic equipment. The use of such open-space knowledge database is strongly encouraged particularly for the products procured by humanitarian and aid organisations as it will allow the sharing of repair know-how for those who are remotely located.

Mandatory criteria and definitions

| Criteria | Definitions | Source |
|----------|-------------|--------|
|----------|-------------|--------|

| | | |
|------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| User manual with trouble shooting guidance available | Manual should be in language(s) accessible to the target population, language level relevant to target group and contain graphic content for ease of use and understanding. | IEC 45554:2020 |
| Availability of spare parts | IEC 62550:2017. Or whereas spare parts are defined as part which can replace a faulty, failed or worn-out replaceable part, the supplier must provide information on the list of spare parts with specifications and how to obtain them. All parts listed in « Frequently replaced parts » must be available as spare parts. If a special tool is required to replace a spare part, such a tool must be provided with the spare part. | IEC 45554:2020 |
| Frequently replaced parts listed | Parts list should provide sufficient information on parts specification to support sourcing. | IEC 45554:2020 |
| Repair manual**** available | Manual should be in language(s) accessible to the target population. The repair manual contains safety procedures, energy specifications, component list, repair tool list, diagnostic procedures, and repair procedures. | IEC 45554:2020 |

**** Annex 4 provides the list of minimum contents to be included in a repair manual.

Recommended criteria and definitions

| Criteria | Definitions | Source |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| Designed for disassembly | Whereas disassembly is defined as a process whereby an item is taken apart in such a way that it could subsequently be reassembled and made operational (source: IEC 62542 definition), the item must be designed intentionally for repair, material recovery, value retention, and meaningful next use. Disassembly steps and manipulations must be counted and clearly documented. | IEC 45554:2020 |
| Interoperable parts used | Interchangeable parts are parts (or components) that are, for practical purposes, identical. They are made to specifications that ensure that they will fit into any assembly of the same type. | TCO certification |
| Standard plugs, connectors, and charging solutions used | IEC plugs and connectors (IEC 62196, 60309, 60320, 60906-X, 62180-1-X), IEC charging solutions (IEC63002 based on the USB technologies) | TCO certification |
| No special tools required for disassembly and repair | Disassembly and repair sequences require only the common tools (listed in IEC 45554 Table A.3), or special tools are provided with the provision of spare parts. | IEC 45554:2020 |
| Upgradeability | Where applicable, updates of firmware and software must be available. | TCO certification |

LOCAL PRODUCTION

Locally produced or assembled products allow quick and local repair services, so it would be the ideal in the perspective of the development of a circular economy.

Criteria and definitions

| Criteria | Definition | Source |
|------------------------------|---------------------------------------------------------------------------------------|--------|
| Local production or assembly | A product is manufactured or assembled locally with a certificate of origin as proof. | |

ANNEX 2 EU RoHS DIRECTIVE IN A NUTSHELL

EU's RoHS directive regulates the hazardous substances used in the manufacture of electrical and electronic equipment (EEE). It specifies maximum levels of 10 restricted substances that are toxic to the environment (risk of landfill pollution), and are dangerous when exposed during manufacturing, waste treatment, and recycling. These 10 restricted substances and their maximum levels are the following:

- Cadmium (Cd): < 100 ppm
- Lead (Pb): < 1000 ppm
- Mercury (Hg): < 1000 ppm
- Hexavalent Chromium: (Cr VI) < 1000 ppm
- Polybrominated Biphenyls (PBB): < 1000 ppm
- Polybrominated Diphenyl Ethers (PBDE): < 1000 ppm
- Bis(2-Ethylhexyl) phthalate (DEHP): < 1000 ppm
- Benzyl butyl phthalate (BBP): < 1000 ppm
- Dibutyl phthalate (DBP): < 1000 ppm
- Diisobutyl phthalate (DIBP): < 1000 ppm

The scope of the original RoHS was expanded to cover all electrical/electronic equipment, cables, and spare parts with compliance required by July 22, 2019.

The list of exemptions is contained in Annex III and specific exemptions for medical devices and monitoring and control instruments are listed in Annex IV of ROHS II:

http://ec.europa.eu/environment/waste/rohs_eee/legis_en.htm.

Permanent exclusions from RoHS include the following: military equipment, space equipment, equipment designed to be part of another piece of equipment falling outside the scope of RoHS, large scale industry tools, large scale fixed installations, means of transport for persons or goods, non-road mobile machinery, active implantable medical devices, photovoltaic panels, equipment for research and development only available business to business.

There are on-going discussions (called RoHS Pack 15) taking place for the possible amendment and inclusion of seven new substances. The seven additional substances being assessed include:

- Beryllium
- Cobalt (dichloride and sulphate)
- Nickel (sulphate and sulfamate)
- Diantimony trioxide
- Indium phosphide
- Medium-Chain Chlorinated Paraffins (MCCPs)
- Tetra-bromobisphenol A (TBBP-A)

ANNEX 3: IEC 62474 DECLARABLE SUBSTANCE LIST IN A NUTSHELL

<https://incompliancemag.com/article/the-power-of-iec-62474-for-product-compliance-and-eco-design/>

The IEC 62474 Declarable Substance List (DSL) is an internationally recognised and consolidated list of substances that are subject to regulations. The DSL listed substances are considered as potentially present in electrical and electronic products and systems. Manufacturers and suppliers use the DSL in their design and supply chain management to specify and control substances of interest.

Substances on the DSL are declarable, but not always hazardous or restricted. Entries may be included on the DSL because the substances and materials are valuable for recovery. This includes critical raw materials (CRMs) which are starting to appear in regulations that require reporting to assist in recycling.

The DSL and exemption lists are available online from the IEC 62474 database at <http://std.iec.ch/iec62474>.

ANNEX 4 EU BATTERY DIRECTIVE IN A NUTSHELL

All batteries and accumulators, and waste batteries and accumulators, regardless of type or application, are covered under the EU Battery Directive (2006/66/EC and Amendment 2013/56/EU: https://ec.europa.eu/environment/topics/waste-and-recycling/batteries-and-accumulators_en). The Directive specifies the following:

Chemical symbols shall only be mentioned if batteries contain one or more of the heavy metals above the following limits: 0,0005 % mercury (Hg), 0,002 % cadmium (Cd) or 0,004 % lead (Pb). The chemical symbols must be accompanied by the crossed-out wheeled bin logo.

The capacity label requirement is only applicable for rechargeable, portable and automotive batteries (more information on [Regulation \(EU\) 1103/2010](#)).

The mercury restriction for batteries is less than 0,0005%. An exception is made for button cells: a mercury content less than 2% was allowed until 1 October 2015 (more information on [Directive 2013/56/EU](#)).

The mercury restriction for automotive batteries is stated in the End-of-Life Vehicles (ELV) (more information [Directive 2000/53/EC](#)).

The cadmium restriction for portable batteries is less than 0,002%. The restriction did not apply to battery packs for cordless power tools until 31 December 2016.

Medical devices/equipment and alarm/emergency systems are excluded for cadmium restrictions.

The EU is preparing new battery regulations which are expected to come into force in 2022 - 2023. The new regulations will envisage a circular economy of batteries and set sustainability requirements by requiring more information to be publicly available, enhanced traceability of batteries, increased recycling and reuse of batteries, and increased use of recycled raw materials. More information can be found:

[https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI\(2021\)689337](https://www.europarl.europa.eu/thinktank/en/document/EPRS_BRI(2021)689337)

ANNEX 5: REPAIR MANUAL CONTENT RECOMMENDATIONS

Repair manual must be available publicly either on the manufacturer's or the supplier's website, or on the open-source website dedicated for the development of repair culture such as ifixit.com so that repair professionals as well as local suppliers and users have access to such information.

The repair manual does not have specific format or technical requirements, but it is expected to contain the following topics.

SAFETY PROCEDURES

Nothing is more important than safety. The repair manual must provide safety measures to avoid accidental electrocution and other injuries. In addition to the personal safety, the procedures to assure equipment safety must be provided.

ENERGY SPECIFICATIONS

Power, voltage, and current used by the product must be clearly specified.

COMPONENT LIST

In order for a repair person to understand the product, it is essential to provide the list of components and component drawings. In addition, their placement can be shown in diagrams for a better understanding. For products containing multiple active components, it is advised to provide a block diagram as well as wiring and connection diagrams. The list must contain the specifications of the component (if generic component can be used to replace the original broken component) or the product number (if the component is specific to the product) so that a repair person can source a spare part.

LIST OF REQUIRED REPAIR TOOLS

Required repair tools must be clearly named with their specifications if necessary. If a special tool is required, it is the responsibility of the manufacturer to provide such tool(s) to each local supplier.

DIAGNOSTIC AND TESTING PROCEDURES

It is recommended to provide an overall approach to troubleshooting techniques so a repair person can understand the global and logical process of the product. Effective way to present the overall approach is by providing a flow chart with "yes or no" options that leads to identify the cause of fault. It is also helpful to provide testing procedures (if any) to confirm the cause of fault. In addition, if the use of basic test equipment (digital multimeters, capacitance checker, etc) can assure the safety and the diagnostic, it must be listed in the diagnostic section.

REPAIR SEQUENCES AND PROCEDURES

Each repair sequence must contain a specific disassembly sequence to remove the component to be repaired or exchanged and a step-by-step explanation of repair procedures. If applicable, instructions for installation of relevant software and firmware must

be provided. It is also useful to indicate where possible the level of difficulty of each repair sequence so the user will determine if it is self-repairable or not.

ANNEX 6: PROCUREMENT EVALUATION CRITERIA.

Proposed evaluation criteria and weighting for the procurement award process is an example. Your procurement team and tender committee should discuss what are the key requirements for the tender and weighting before formal engagement with suppliers.

SOLAR LANTERNS

| Parameter | Criteria | Weighting Level |
|----------------------|--------------------------------------------------------------------------------------------|-----------------|
| Technical score | Performance test | Medium |
| | CE Label or/and compliance with RoH's directive to proof the reduction of toxicity | High |
| | Comply to technical specification (power source, battery cycle, runtime, EC- 62257-9-5...) | High |
| Economical score | Purchasing cost | Medium |
| | Transport cost | Medium |
| | Extra warranty cost | Medium |
| Sustainable criteria | Repair manual | High |
| | Product life span/Life Cycle Analysis | Medium |
| | Toxicity (product composition) | Medium |
| | Recyclability (product composition and/or plastic components) | Medium |
| | End of Life management (partnership with local recycling company) | High |
| | Repairability (repair manual - spare part availability - designed to ease repair) | High |
| | Local production | Medium |
| Service score | Warranty services performance | High |
| | Take Back service / buyback offer | High |
| | Logistics services (lead-times - delivery) | Medium |
| | Invoicing and contracts | Medium |
| Company reliability | Sustainable engagement (certification, code of conduct or equivalent) | High |
| | References | Medium |
| | Financially stable | Medium |

ANNEX 7: PROCUREMENT REFERENCES

DUE DILIGENCE CHECKS

For screening the main sources are

- <https://sanctionssearch.ofac.treas.gov/>
- <https://webgate.ec.europa.eu/europeaid/fsd/fsf>
- B2B Supplier/
- Buyer Blacklist (SBBL)

Litigation check depends per country whether it is public data and easily accessible.

Paid databases

- <https://www.reprisk.com>
- <https://www.sustainalytics.com/> basic score is searchable, but again only stock listed companies)
- <https://www.msci.com/our-solutions/esg-investing/esg-ratings>, (there are many more).

STANDARDS, AUDITS AND CHARTERS

- ISO 2600 & 26001
- Global compact
- Ecovadis
- B-Corp

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