

REPUBLIC OF RWANDA



MINISTRY OF INFRASTRUCTURE

**Ministerial Guidelines on Minimum
Standard Requirements for Solar Home
Systems**

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PREFACE

Rwanda has electrified its population at one of the fastest rates in the world over the past decade. As of March 2025, 82.2% Rwandan households have access to electricity (57.4% grid and 24.8% off-grid), rising from 6% in 2009 (REG, 2025). A rapid increase in electricity access has been found to result in a decrease in energy expenditure and an improvement in the households' living conditions. Given this impressive pace of electrification and continuous intervention from the Government, Rwanda is on track to achieve universal electrification before 2030.

The Rural Electrification Strategy that was approved on 27th April 2016 by the cabinet, emphasizes providing households with access to modern energy services using various solutions ranging from stand-alone off-grid home systems to grid connection and mini-grids. To ensure effective implementation of this strategy, whilst guaranteeing the protection of end-users and the private sector, stand-alone off-grid solar home systems need to meet minimum standard requirements to participate in the Government programs.

Therefore, the purpose of this document is to guide and provide information on the standards required for installation of off-grid renewable energy systems, namely stand-alone power systems utilizing photovoltaic technology. This Ministerial guideline does not attempt to provide reference to all relevant clauses and all considerations as this is the purpose of the standards in their totality. This guideline does not in any way replace the standards or relevant training in the design and installation of these systems.

All those designing, installing, and working with the relevant systems should have access to the associated standards and familiarize themselves with the requirements in detail.

CHAPTER ONE: GENERAL PROVISIONS

Article 1: Objectives

The objectives of these Ministerial guidelines on minimum standard requirements for solar home systems are to clearly describe the minimum requirements to be fulfilled by a stand-alone solar home system to ensure Quality and Reliability of services to the beneficiaries. This document has been published primarily for practitioners in the small-scale renewable energy industry who are involved in the business of installing stand-alone home systems in Rwanda.

Article 2: Scope

These Guidelines provide the Minimum Standard Requirements for stand-alone photovoltaic power systems for the implementation of the National Electrification program. They define the minimum service level energy requirements for an off-grid solar home system to be considered under rural electrification in Rwanda as established in the Rural Electrification Strategy. Additionally, they cover the corresponding minimum requirements for the off-grid solar home system accessories such as Lamps, Cables, Batteries, Solar Photovoltaic Panels, Charge Controllers, Installation requirements, and other Accessories required for off-grid solar home system installation to ensure the safety of end-users and the quality of the system as well as the quality of service.

Article 3: Definitions

Unless the context otherwise requires, the terms used in these guidelines shall have the following meaning:

- **Solar Home System (SHS):** stand-alone photovoltaic systems that offer a cost-effective mode of supplying comfortable power for lighting and appliances to off-grid households in Rwanda. In urban and rural areas not connected to the grid, SHS can be used to meet a household's energy demand, fulfilling its basic electricity needs. For the purposes of this document, solar home systems are defined as off-grid solar photovoltaic systems that include multiple light

points (i.e., three or more). The peak power rating of the PV module or other power-generating device is less than or equal to 350 W.

- **Access to Electricity:** In accordance with the National Rural Electrification Strategy, access to electricity in Rwanda is considered only if a household has sufficient electricity to provide lighting (at least 3 lamps for each house), phone and appliance charging services. The Minimum Service level is fully defined in Article 5.
- **Rural Electrification Programme:** a set of public policies and programs by the Government of Rwanda to increase electricity access in rural areas in accordance with the Minimum Service level and System Performance requirements set forth in this document.
- **Electrical Installation:** a photovoltaic system in or on any premises that is used for the generation and transmission of electrical energy from a point of control to a point of consumption anywhere on the premises, including any equipment that forms part of such an installation irrespective of whether it is part of the electrical circuit.

CHAPTER TWO: PRODUCT SPECIFICATIONS

Article 4: Quality requirements

Quality standards, warranty requirements, and performance targets are used to interpret the measurements and observations made about a product. Together, they form a product specification.

The Institution in charge of Standards enforcement shall ensure that solar home system products comply with the applicable requirements from the following documents in accordance with the guidance provided in the table below:

1. RS IEC 62257-9-5: Recommendations for renewable energy and hybrid systems for rural electrification — Part 9-5: Integrated systems — Laboratory evaluation of stand-alone renewable energy products for rural electrification
2. RS IEC/TS 62257-9-8: Renewable energy and hybrid systems for rural electrification – Part 9-8: Integrated systems – Requirements for stand-alone renewable energy products with power ratings less than or equal to 350 W

3. RS IEC 62133-2: Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 2: Lithium systems
4. RS IEC 61056: Secondary cells and batteries containing alkaline or other non-acid electrolytes – Sealed nickel-cadmium prismatic rechargeable single cells
5. RS IEC/TS 62257-12-1: Recommendations for renewable energy and hybrid systems for rural electrification – Part 12-1: Selection of lamps and lighting appliances for off-grid electricity systems
6. RS IEC 62124: Photovoltaic (PV) stand-alone systems – Design verification
7. RS IEC 61730 PVC module safety and IEC 61853 Energy performance evaluation
8. RS IEC 62093: Balance-of-system components for photovoltaic systems – Design qualification natural environments
9. RS IEC 62509: Battery charge controllers for photovoltaic systems – Performance and functioning
10. RS IEC 61951: Secondary cells and batteries containing alkaline or other non-acid electrolytes – Portable sealed rechargeable single cells
11. RS IEC 60896: Stationary lead-acid batteries – General requirements and methods of test
12. RS IEC 61960: Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable
13. IEC 61730-1 & 2 (a global photovoltaic (PV) module safety qualification standard)

Should have tempered glass for impact resistance and be **IP65-rated or higher** for weatherproofing for protection.

The efficiency of the PV modules should be at least 17%, and the fill factor should be greater than 70%.

- The module's terminal box should include a provision for replacing or repairing the cable.
- Each PV module must include an RF identification tag (RFID).
- All technical data should be at standard test condition: AM = 1.5, E = 1,000 W/m², cell temperature: 25 °C
- The PV module's electrical performance curve should be attached in detail for different temperatures and irradiation, Temperature Dependence of Isc, Voc, and Pmax, Irradiation Dependence of Isc, Voc, and Pmax.
- The PV modules must be warranted to retain at least 90 % of their rated wattage measured at

STC for 10 years and 80% of the rated wattage at 20 years.

14. IEC 61853-3 Photovoltaic (PV) module performance testing and energy rating – Part 3: Energy rating of PV modules
15. IEC 61427-1:2013 IEC 61427-1:2013 is part of a series which gives general information relating to the requirements for the secondary batteries used in photovoltaic energy systems (PVES) and to the typical methods of test used for the verification of battery performances. This part deals with cells and batteries used in photovoltaic off-grid applications. This standard is applicable to all types of secondary batteries.
16. IEC 60529 Degrees of protection provided by enclosures (IP Code): This Standard describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment.

Upon importation, products shall be accompanied by proof of conformity to the standards mentioned above from an accredited body recognized under IEC Conformity Assessment or another recognized standards certification body. Solar home system products less than 350 W that were evaluated as part of a family of products as defined in IEC/TS 62257-9-8 may meet the relevant requirements provided that the company that manufactures the products in the family provides documentation confirming that it is certified to ISO/IEC 9001. Only Crystalline type solar PV panels shall be accepted for importation.

For Battery;

- The solar battery should be environmentally friendly (Mercury-free), Gel type, sealed, maintenance-free, and deep cycle.
- The manufacturing date of batteries should not be more than 6 months from the supply date and should be labelled on the battery.
- All Batteries offered, must be of the same type, same model, same AH rating, and same manufacturer.
- At DOD (depth of discharge) of 60% and at C10 rate; It shouldn't be less than 3,500 cycles of operation. The maximum allowable DOD operation shall be 60% for lead-acid battery and 80% for Lithium-ion battery.
- Self-discharge shall not exceed 3% per month.

- Efficiency should be more than 70% for lead acid battery and more than 90% for Lithium-ion battery.

Standards Applied to Different System Component Types:

No.	Corresponding Equipment	Standard (Test method and Minimum requirement)
1	Quality requirements for equipment less than or equal to 350 W	RS IEC/TS 62257-9-5 or RS IEC/TS 62257-9-8
2	Component-Based Solar Home system	RS IEC 61215 (PV Module) RS IEC/TS 62257-12-1 (Lamps) RS IEC 61960, RS IEC 62133-2 (Lithium Batteries) RS IEC 60896, RS IEC 61056 (Lead Acid Batteries) RS IEC 62509 (Charge Controllers) RS IEC 62109-1 and RS IEC 62109-2 (PV Inverters reliability test) RS IEC 62124 (Stand Alone System Design Verification)

The Test Certificates used to document compliance shall include, but are not limited to, the following information:

1. For Lighting

- IEC 60598 (General lighting safety)
- IEC 62257-9-8 (Lighting Global Quality Standard)

2. Solar PV modules

- Cell type/Solar material
- Maximum Power (Pmpp)
- Open Circuit Voltage (Voc)
- Short Circuit Current (Isc)
- Voltage at Maximum PowerPoint (Vmp)
- Current at Maximum PowerPoint (Imp)
- Serial number
- Date and Place of manufacture
- Solar module model number

3. Battery

- Battery chemistry
- Battery Capacity (Ah)
- Battery Nominal Voltage (V)
- Discharge protection
- Deep discharge protection voltage (V)
- Battery durability test result

4. For Charge controller

- A charge controller should be able to protect battery overcharge, undercharge, and excessive deep discharge, and against the reverse polarity of the module or battery and reverse polarity of DC load.
- A Charge controller should have Maximum PowerPoint Tracking (MPPT) with minimum efficiency of 90%.
- Charge controller should be supplied with programmable charge and discharge voltage set

- Data display and signal indicator shall be built into the controller to show energy flow from the array to the battery and the battery charge and discharge level.
- Regulatory approvals- UL 1741 of safety.

Article 5: Minimum service level requirements

The average household gaining access to electricity in Rwanda shall have a system capable of supplying enough electricity to power at least:

- Three (3) lamps, each with at least 120 lumens per watt, operating for an average of four (4) consecutive hours per night.
 - A mobile phone charge supply for at least two (2) hours per night;
 - A radio charge supply for at least 5 hours per night; and
 - Supply the above loads for at least 1.5 days without input from the solar module/when there is no sunshine (Days of Autonomy).
 - The system shall have dismountable parts and be designed to allow for spare parts replacement.
- The system should have a panel capacity of at least 20 Wp.

Article 6: Product labelling

Product labelling for system parts is mandatory. The following information shall be included in each component type:

- **Lights:** voltage, power, luminous flux, country of origin;
- **Other appliances included with the system:** operating voltage, power;
- **Solar modules:** open circuit voltage, short circuit current, maximum power at standard test conditions of 1000 W/m² and 25°C, cell type/solar material, serial number, and/or module model number, country of origin, date (month and year);
- **Batteries:** nominal voltage, storage capacity (in mAh, Ah, or Wh), battery chemistry (e.g., lead-acid, lithium iron phosphate, lithium-ion, etc.), country of origin.

Article 7: Warranty requirements

This sets a minimum level of user protection from early failure. The mandatory after-sales service to replace or repair a broken system for each component of the standalone solar home system shall cover both the system performance and the availability of spare parts and system components.

A minimum of three (3) years warranty and an after-sales contract that commits to the availability of spare parts and technical service for a minimum of 5 years after the installation of the system shall be provided to the end users. This warranty shall apply to every component of the system, including but not limited to the PV module, battery, charge controller, and lighting appliances.

CHAPTER THREE: INSTALLATION REQUIREMENTS

Article 8: Installation Requirements

All installations shall comply with RS IEC/TS 62257-9-5 and RS IEC 62124, Regulations 002/EL/ENERGY/RURA/2012 on electrical installations, and any other applicable regulation or standard in place.

1. In addition to the above requirement, the installers shall:
2. The solar PV module should be mounted at an optimal tilt for maximum sun exposure
(equivalent to the latitude of the location, considering the dust and leave effect)
3. Battery should be placed in a cool, dry, and ventilated space
4. Ensure that all connections are securely fixed and protected from the environment.
5. Ensure the continuous operation and functionality of the installed solar home systems by including a remote digital monitoring tool in each eligible system. This tool must provide real-time information on the operational and location of the system, with the capability to access this data remotely
6. Provide adequate training to the users on the operation and maintenance of the system.

7. Provide PVC electrical conduit pipes to protect cables from damage
8. Guarantee high-quality electrical wiring between the components of the SHS system, in compliance with applicable standards
9. Install batteries in a way that allows proper ventilation while keeping them out of children's reach.
10. Mount the charge controller at eye level, approximately 1.50 m from the ground, so the user can easily read the indicator lights (e.g., "battery discharged"). It should be positioned as close as possible to the battery and panel to minimize energy losses and must be protected from direct sunlight and adverse weather conditions.
11. Implement surge protection measures to prevent damage due to voltage spikes and lightning strikes.
12. Provide clear and accessible maintenance instructions to end-users, including troubleshooting guides and contact information for technical support.

CHAPTER FOUR: COMPLIANCE AND ENFORCEMENT

Article 9: Requirements to be fulfilled by off-grid business suppliers

Suppliers or players in the off-grid business sector aiming to benefit from national programs are required to have a cooperation agreement with REG.

Article 10: Compliance and enforcement

Compliance with these guidelines will be monitored and enforced by the Institution in charge of Standards enforcement in Rwanda. Non-compliance with these guidelines will result in penalties including, but not limited to, disqualification from the Rural Electrification Programme and legal action as deemed necessary by the relevant authorities.

Article 11: Non-compliant Solar Home Systems

In case of Seized non-compliant Solar Home Systems without accreditation certificates compliant with the regulations and standards set forth, the importer shall be responsible for their safe disposal or re-exportation at her/his own cost.

CHAPTER FIVE: TRANSITIONAL PROVISIONS

Article 12: Transitional provisions

The products that are already certified to meet the current provisions will continue to be allowed on the market exclusively under the Energy Access and Quality Improvement Project (EAQIP) while others must comply with the new guidelines.

The Institution in charge of Standards enforcement and Consumer Protection will closely monitor compliance with these guidelines. Products that do not meet these guidelines will no longer be allowed under Government programs.

CHAPTER SIX: FINAL PROVISIONS

Article 13: Purchase and Sales Agreements

The agreement between the purchaser and supplier shall cover the following:

- Responsibilities of purchaser/user with a timeline
- Responsibilities of the supplier
- Dispute resolutions/complaints handling
- Details of after-sales services including timeline.

Article 14: Language

To ensure proper use, basic operation and maintenance instructions should be provided to the end user in Kinyarwanda.

Article 15: Data records

The institution in charge of solar products quality inspections shall keep records of the imported Solar Home Systems indicating the quantities of the systems on the market, and agreements on safe

disposal, and submit on request, copies of the records to the regulator in charge of e-waste management.

Article 16: Disposal

The regulator in charge of e-waste management and the importer shall work together to ensure adequate disposal of Solar Home System parts after they have served their purpose according to the regulations in place for e-waste management.

Article 17: Repealing provision

All prior provisions contrary to these guidelines are hereby repealed.

Article 18: Commencement

These guidelines come into force on the date of their publication. The guidelines shall be reviewed regularly when the need arises.

Done at Kigali, on 02/04/2025


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