Manufacturer:	
Test item:	
Identification:	*Serial No.:*
Receipt No.:	*Date of receipt:*
Testing laboratory and its address:	
Test specification:	**IS 16270:2023**
Test Result:	*The test item passed / failed the test specification(s).*
Other Aspects:	*Nil*
This test report relates to the test sample submitted.	

Tested by:	**Approved by / Authorized Signatory:**	**Issued by:**
Date:	**Date:**	**Date:**

TEST REPORT IS 16270:2023 Secondary Cells and Batteries for Solar Photovoltaic Application- "General Requirements and Methods of Test"	
Report No. .....:	
Date of issue.....:	
Total number of pages	31
Testing Laboratory .....:	
Address .....:	
Manufacturer's name .....:	
Address .....:	
Test specification:	
Standard .....:	**IS 16270:2023**
Test procedure .....:	Compliance Report
Non-standard test method……..:	N/A
Test Report Form No.....:	**BIS_BSPV_16270_V1.0**
Test Report Form(s) Originator	**BIS**
Master TRF.....:	17.05.2023
Test item description .....:	
Trade Mark .....:	
Model/Type reference .....:	
Ratings .....:	
Other Documents submitted.....:	Please refer to table – List of attachments at page no. *xx*

Tested by:	**Approved by / Authorized Signatory:**	**Issued by:**
Date:	**Date:**	**Date:**

TEST SUMMARY:		
Description	**Measurement/ testing**	**Page No.**
General condition	Condition of use (Cl. No. 4)	
General requirements	Mechanical endurance (Cl. No. 5.1)	
General requirements	Charge efficiency (Cl. No. 5.2)	
General requirements	Deep discharge protection (Cl. No. 5.3)	
Marking requirements	Marking (Cl. No. 5.4)	
General requirements	Safety (Cl. No. 5.5)	
General requirements	Documentation (Cl. No. 5.6)	
Electrical performance	Functional characteristics (Cl. No. 6.0)	
General conditions	General test conditions (Cl. No. 7.0)	
Electrical performance	Capacity test (Cl. No. 8.1)	
Electrical performance	Endurance test (Cl. No. 8.2)	
Electrical performance	Charge retention test (Cl. No. 8.3)	
Electrical performance	Cycle endurance in Photovoltaic application(Extreme conditions) (Cl. No. 8.4)	
Electrical performance	Sulphation Test (Applicable to lead acid batteries only) (Cl. No. 8.5)	
Electrical performance	Water loss Test (Valid for flooded lead acid batteries only) (Cl. No. 8.6)	
Electrical performance	Type tests (Cl. No. 9.1)	
Electrical performance	Acceptance test (Cl. No. 9.2)	

Certificate: It is certified that the above tests were performed and found to be passing/Failing in the requirement tested.

.....

(Approving Authority)

Copy of marking plate(s):

TABLE 1	Sample and sequence of tests for Cells and or Batteries Lead Acid or Nickel or Lithium									
SI NO.	TYPE TEST	CLOUSE	1	2	3	4	5	6	7	8
1										
2										
3										
4										
5										
6										
7										
8										

Table – List of Attachments

Attachment No.	Attachment Description	No. of pages in Attachment
Attachment – 1	Pictorial view of the equipment	---

General remarks:

The test results presented in this report relate only to the object tested.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.

Test item particulars .....:

Classification of installation and use .....:

Connection to the mains.....:

Possible test case verdicts:

- test case does not apply to the test object ..... : N/A
- test object does meet the requirement ..... : P (Pass)
- test object does not meet the requirement ..... : F (Fail)

Testing ..... :

Date of receipt of test item ..... :

Date(s) of performance of tests..... :

Laboratory conditions ..... :

Ambient Temperature..... :

Ambient Humidity ..... :

General product information:

1) Application details / Description of the product:

2) Differences between the models:

Model No. tested with-in the family series:

3) Options:

The equipment was tested without any optional accessory installed. Hence, this report does not cover parameters that are influenced by the installation of optional accessory that might affect safety in the meaning of this standard.

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
4.0	Conditions Of Use		
	This clause specifies the particulars operating conditions experienced by secondary batteries in photovoltaic applicants during their use.		
4.1	Photovoltaic Energy System		
	The photovoltaic energy system with secondary batteries referred to in this standard can supply a constant, variable, or intermittent energy to the connected equipment (lighting systems, communication systems, etc.		
4.2	Secondary Cells and Batteries		
	Secondary cells and batteries mainly used in photovoltaic energy systems are of the following types: a) vented (flooded); b) valve-regulated, including those with partial gas recombination; and c) Gastight sealed.		
	The cells and batteries are normally delivered in filled and charged or unfilled and uncharged. a) discharged and drained (vented nickel cadmium batteries only); b) charged and filled; c) dry charged and unfilled (vented lead-acid batteries only); and d) Discharged and filled (nickel-cadmium batteries only).		
	For optimum service life, the battery manufacturer's instructions for initial charge of the battery shall be followed.		
	Other secondary cells and batteries such as based on sodium or vanadium electrochemical systems can be Potentially used for such an application.		
	Due to the fact that they are in a phase of adaptation for a possible use in PV systems, it is recommended that their respective supplier be contacted for the Necessary planning, test and operation details.		
4.2.1	Material and Constructions		
	All the materials used in the manufacture of stationary batteries for photovoltaic system shall be the best of their respective kind, free from flows and defects and shall conform to the relevant Indian standard, if any.		
4.3	General operating condition		
	Batteries in a typical PV system operating under average site weather conditions may be subjected to following conditions:		
4.3.1	Autonomy Time		
	The battery is design to supply energy under specified condition for a period of time, typically from 3 days to 15 days, with or without solar radiation.		
4.3.2	Typical charge and Discharge currents		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
	The typical charge and discharge currents are the following a) Maximum boost charge current: C/10A b) Average float/trickle charge : C/50A c) Average discharge current determined by the load: C/120A		
	Depending on the system design, the charge and the Discharge current may vary in a wider range.		
	In some systems the load current must be supplied at the same time as the battery charging current.		
4.3.3	Daily cycle		
	The battery is normally exposed to a daily cycle as follows		
	a) Charge during daylight hours		
	b) Discharging during night-time hours		
	A typical daily usage results in a discharge between 2 percent and 20 percent of the battery capacity		
4.3.4	Seasonal cycle		
	The battery may be exposed to a seasonal cycle of state of charge. This arises from varying average charging conditions as follows:		
	a) Period with low solar irradiation, for instance during rainy season/monsoon season causing low energy production. the state of charge can go down to 20 percent of the rated capacity or less and b) Period with high solar irradiation, for example in during other seasons, this will bring the battery up to the fully charged condition, with the possibility that the battery could be overcharged		
4.3.5	Period of High state of charge		
	During summer batteries will be operated at high state of charge (SOC), typically between 80 to 100 percent of rated capacity		
	A voltage regulator system normally limits the maximum battery voltage during the recharge period.		
	When the generation voltage exceeds beyond the limits, the controller should trip-off and reconnect back as soon as the generation voltage comes to normal range to avoid any delay in charge cycle.		
	Charge controller should be sized accordingly to keep the battery and load always safe and getting charged.		
	The system designer normally chooses the maximum charge voltage of the battery as a compromise allowing to recover to a maximum state of charge (SOC) as early as possible in the seasons other than the monsoon but without substantially Overcharging the battery.		
	The overcharge increases the gas production resulting in water consumption in vented cells.		
	In valve regulated lead acid cells the overcharge will cause a lesser water consumption and gas emission but more heat generation.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
	Typically the maximum charge voltage is 2.4V/cell for lead-acid batteries and 1.55V per cell for vented nickel-cadmium *refer temperature specified by manufacturers*		
	Some regulators allow the battery voltage to exceed these Values for a short period as an equalizing or boost charge.		
	For the other batteries, the battery manufacturers shall give the most adapted charge voltage values. Charge voltage compensation shall be used according to the battery manufacturer instructions if the battery operating temperature deviates significantly from the reference temperature.		
	The expected life time of a battery in a PV system even kept regularly at a high state of charge may be considered less than the published life of the battery used under continuous float charge.		
4.3.6	Period for sustained low state of charge		
	During period of low solar radiation, the energy produced by photovoltaic array may not be sufficient to fully recharge the battery.		
4.3.7	Electrolyte Stratification		
	Electrolyte Stratification may occur in lead-acid batteries		
	In vented lead-acid batteries electrolyte Stratification can be avoided by electrolyte agitation/recirculation or periodic overcharge whilst in service.		
	In Valve regulated lead-acid (VRLA) batteries, electrolyte stratification can be avoided by design or by operating them according to the manufacture instructions.		
4.3.7.1	Specific gravity		
	Specific gravity of electrolyte for flooded lead acid battery shall be 1.240±0.005. This is specific requirement for cells/batteries for SPV application and shall override all other requirements specified in any other standard.		
4.3.8	Storage		
	Manufacturers' recommendations for storage shall be observed. In the absence of such information, the storage period may be estimated according to the climatic conditions as shown in Table 1 as below;		
	The exact limits of storage conditions are to be verified with the manufacturer.		
	Lead-acid or nickel-cadmium batteries with electrolyte shall be stored starting from a state at full charge..		
	A loss of capacity may result from exposure of a battery to high temperature and humidity during storage.		
	The temperature of a battery stored in a shipping container in direct sunlight, can rise to + 60 °C or more in daytime. Choice of a shaded location or cooling should avoid this risk.		
4.3.9	Operating Temperature		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
	The temperature range during operation experienced by the battery at the site is an important factor for the battery selection and the expected lifetime		
	Manufacturers' recommendations for operating temperatures and humidity shall be observed. In the Absence of such information, operating temperatures and humidity may be those shown in Table 2.		
4.3.10	Charge control		
	Excessive overcharge does not increase the energy stored in the battery. Instead, overcharge affects the water consumption in vented batteries and consequently the service interval		
	. In addition, valve-regulated lead-acid batteries may dry out resulting in a loss of capacity and / or overheating.		
	Overcharge can be controlled by the use of proper charge controllers. Most non-aqueous systems, such as lithium-ion batteries and similar, will not accept any overcharge without damage or safety problems. Such batteries are normally supplied with a BMS (battery management system) that prevents, independently from its charge controller that such Overcharge happens.		
	The parameters of the regulator shall take into account the effects of the PV generator design, the load, the temperature and the limiting values for the battery as recommended by the manufacturer		
	Vented lead-acid or nickel-cadmium batteries including those with partial gas recombination shall have sufficient electrolyte to cover at least the period between planned service visits. Overcharge in valve regulated lead-acid batteries shall be carefully Controlled to be able to reach the expected service life.		
	The water consumption is measured during the cycle test and can be used together with the system's design information to estimate the electrolyte service intervals.		
4.3.11	Physical Protection.		
	Physical protection shall be provided against consequences of adverse site conditions, for example, against the effects of: - uneven distribution and extremes of temperature; - exposure to direct sun light (UV radiation); - air-borne dust or sand; - explosive atmospheres; - flooding, water vapor condensation and water spray; - earthquakes; - shock and vibration (particularly during transport		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
5	General Requirements		
5.1	Mechanical Endurance		
	Batteries for photovoltaic application shall be designed to withstand mechanical stresses during normal transportation and handling taking in account that PVES installations may be accessed via unpaved roads and installed by less qualified Personnel. Additional packing or protection shall be used for off-road conditions.		
	Particular care shall be taken while handling unpacked batteries. Manufacturer's instructions shall be observed.		
	In case of specific requirements regarding mechanical stresses, such as earthquakes, shock and vibration, these shall be individually specified or referred to the relevant standard.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
5.2	Charge efficiency		
	The charge efficiency is the ratio between the quantity of electricity delivered during the discharge of a cell or battery and the quantity of electricity necessary to restore the initial state of charge under specified conditions.		
	Where no data are available from the battery manufacturer, the following efficiencies as given in Table 3 may be assumed.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
5.3	Deep Discharge Protection		
	Lead-acid batteries shall be protected against deep discharge to avoid loss of capacity due to irreversible sulphation. This could be achieved by using a system, which monitors the battery voltage and automatically disconnect the battery before it reaches its maximum depth of discharge.		
	Vented and partial gas recombination's nickel-cadmium batteries do not normally requires this type of protections.		
	For the other types of batteries, the manufacturer's recommendations shall be followed.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
5.4	Marking		
5.4.1	Cells or monobloc batteries shall follow the instructions of the applicable standards defined in clause 7.2.		
5.4.2	For clear identification of secondary cells and batteries as per their chemistry (electrochemical storage technology), marking of symbols shall be in accordance with IEC 62902.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
5.5	Safety		
	Applicable local regulations and the manufactures instructions for procedure to be observed during installation, commissioning, operation, taking out of service and disposal shall be followed.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
5.6	Documentation:		
	Manufacturers documentation for the transport and storage, commissioning, putting into service, operation and maintenance shall be followed. Generally, the initial charging of the battery at site shall be done as per manufacturers general guideline with proper charges provided.		
	However, for initial charging at site where only SPV array are available as power source, specific instructions to be obtained from the manufacturers for initial charging on a case to case basis.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
6.0	Functional characteristics		
	The following parameters need to be tested for qualification of cell/battery according to this standard		
	a) Rated capacity		
	b) Endurance		
	c) Charge retention		
	d) Cycling endurance in photovoltaic application (extreme conditions)		
	e) Recovery from Suphation test		
	f) Water loss on float charge		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
7.0	General Test conditions		
7.1	Accuracy of measuring instruments		
	The accuracy of the measuring instruments shall be in compliance with the relevant requirements of the Applicable standards listed in **7.2.**		
	The parameters and accuracy values shall be in accordance with relevant clauses of the applicable Standards listed in **7.2.**		
7.2	Standard to be Referred for testing		
	The test batteries shall be prepared according to the procedures defined in the following standards or, in their absence, according to the manufacturer's instructions:		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
8.0	Test Method		
8.1	Capacity test		
	Test batteries shall be selected, prepared, installed and tested according to the applicable standards listed in 7.2		
	The verification of the rated capacity shall be performed by using a current of I10 (A) for leadacid batteries, It /5 (A) for nickel-cadmium, Ni-MH and lithium batteries and I10 (A) for other batteries according relevant clauses in the Indian standards listed in 7.2.		
	The verification of long duration capacity shall be performed by using a current of I120 (A) up to an end voltage of 1.85 V/cell (for lead acid batteries) or 1.00 V/cell (for Ni-Cd and Ni-MH batteries). In case of long duration capacity test, the discharge duration shall not be less than 120 h. For other batteries the test shall be performed considering the recommendation of manufacturer for C120 rated capacity and the corresponding end voltage.		
8.1.1	Requirement		
	For batteries and cells, the capacity (excluding long duration capacity) shall not exceed 120 percent of the rated capacity		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
8.2	Endurance Test		
	Test samples shall be tested according to the applicable standards described in clause 7.2.		
8.2.1	As per the standards mentioned in **7.2.**		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
8.3	Charges Retentions Test		
	The test samples shall be tested according to the clauses, if any, of the applicable standards listed in **7.2.**		
8.3.1	As per the standards mentioned in **7.2.**		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
8.4	Cycle Endurance in Photovoltaic Applications (Extreme conditions)		
8.4.1	General		
	In photovoltaic applications the battery will be exposed to large number of shallow cycles but at different states of charge. The test below is designed to simulate such service under extreme conditions by submitting the batteries at + 40 °C, to several aggregates of discharge/charge cycles each comprising 50 cycles at low state of charge (phase A) and 100 cycles at high state of charge (phase B)		
	The cells or batteries shall therefore comply with the requirements of the test below, which is a simulation of the photovoltaic energy system operation:		
	a) the test battery shall be selected, prepared and installed according to the applicable standards listed in 7.2; b) the test shall be carried out with a battery composed of such a number of cells that its open circuit voltage is ≥ 12 V; c) the test battery shall meet or exceed the rated capacity value when tested for capacity according to 8.1; d) the test shall be started with the battery fully charged; e) the test battery shall be brought to a temperature of + 40 °C ± 3 °C and stabilized at this temperature for 16 h; and f) the test battery shall be maintained at + 40 °C ± 3 °C throughout the test phase A) and phase B).		
8.4.2	Phase A: Shallow Cycling at low state of charge (*see Table 4*)		
8.4.2.1	*Lead-Acid batteries and other batteries*: a) Discharge the battery for 9 h with a current I_{10} (A); b) Recharge for 3 h with a current 1.03 I_{10} (A); and c) Discharge for 3 h with a current I_{10} (A).		
8.4.2.2	Nickel-Cadmium, NI-MH and lithium Batteries a) Discharge the battery for 9 h with a current 0.1 It (A); b) Recharge for 3 h with a current 0.103 It (A); and c) Discharge for 3 h with a current 0.1 It (A). The steps b) and c) shall be repeated 49 times		
	At the termination of the 49th execution of step c) the test batteries, still at + 40 °C ± 3 °C, shall be fully charged according to the manufacturers recommendations and then cycling as specified for phase B shall be continued.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
8.4.3	Phase B: Shallow cycling at High State of Charge (*see Table* 5) .		
8.4.3.1	Lead-acid batteries and other batteries a) Discharge the battery for 2 h with a current 1.25 I10; and b) Recharge for 6 h with a current I10 A until for lead-acid batteries a voltage of 2.40 V/cell is reached, unless otherwise specified by the manufacturer, and then continue charging at 2.40 V/cell until a total charging time of 6 h is reached. For other batteries, the charge voltage shall be limited to a safe level as specified by the manufacturer.		
8.4.3.2	Nickel-Cadmium, Ni-MH and Lithium Batteries a) Discharge the battery for 2 h with a current 0.125 It A; and b) Recharge for 6 h with a current 0.1 It A until, for vented Ni-Cd batteries, a voltage of 1.55 V/cell is reached unless otherwise Specified by the manufacturer, then continue charging at 1.55 V/cell until a total charging time of 6 h is reached.		
	For Ni-MH and lithium batteries the charge voltage shall be limited to a safe level as specified by the Manufacturer. The steps i) and ii) shall be repeated 99 times.		
	At the termination of the 99th execution of step ii) the test battery shall be submitted to a capacity test according to **8.4.4.**		
8.4.4	*Residual Capacity Determination*		
	a) At the conclusion of phase B, the battery shall be cooled down, under continued charge, to the temperature defined for a capacity test in the applicable standards as listed in 7.2, and then stabilized at this temperature for 16 h;		
	b) The residual capacity test for lead acid and other batteries shall be carried out with the I10 current to 1.80 V × n cells for lead acid batteries and at the 0.2 It current to 1.00 V × n cells for nickel-cadmium, and Ni-MH batteries. For lithium batteries and other batteries, the end voltages are defined by the battery manufacturer;		
	c) At the completion of the residual capacity test, and if no condition for test termination is encountered (see below), the batteries shall be recharged according to the manufacturer's specifications and a new set of phase A) cycles initiated; and		
	d) When the residual capacity is found in b) below 80 percent, then the fully recharged batteries shall be submitted also to a determination of the C120 capacity according to 8.1.		
8.4.5	*Test termination*:		
	The cycling endurance test in photovoltaic applications shall be considered terminated when one of the conditions below is fulfilled:		
	a) When during the discharge c) of phase A, a battery with *n* cells showed a voltage of *n* ×1.5 V/cell for lead acid batteries, *n* × 0.8 V/cell for nickel-cadmium or Ni-MH batteries or*n* × XYZ V/cell that is the manufacturer's recommended minimum safe cell voltage for lithium and other batteries;		
	b) When during the residual capacity determination according to **8.4.4**, the determined capacity was found lower than 80 percent of the rated capacity; and		

	c) The cycling endurance in photovoltaic applications shall be expressed in terms of completed aggregate phase A + B cycles before a limit, as specified in a) or b) above, was encountered together with the value of C_{120} capacity, expressed in per cent of the rated one, as determined at the conclusion of the test.		
8.4.6	Water Consumption of Flooded Battery Types and Cells with Partial Gas recombination. During the cycle endurance test, vented type batteries may be topped up with water to the level indicated and with a quality specified by the manufacturer. The amount of water added shall be measured and reported.		
8.4.7	Requirements		
	The minimum number of completed A + B phase cycle sequences (150 cycles each) shall be not lessthan 3.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
8.5	Sulphation test: (Applicable for lead Acid batteries only)		
	The test is to be carried out on a fully charged cell/battery. The test shall be carried out as described in 8.5.1.		
8.5.1	*Test Method*		
	a) Discharge at a rate of 0.0135xC_{10} for a period of 24 h. b) Leave the battery for 120 h c) Recharge of 0.056 x C10 for 4h followed by 0.0135 xC10 for 12h d) Discharge at 120h rate (that is 0.0125 XC_{10} to an end voltage of 1.9V/Cell)		
8.5.1.1	Requirement		
	The batteries shall give at least 108 h.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
8.6	Water loss test (valid for flooded lead acid batteries only)		
	The water loss test shall be done as per the latest version of the relevant specification with all its amendments mentioned in clause 7.2 of this specification.		
8.6.1	*Requirement*		
	As per the standards mentioned in **7.2**.		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
9	Recommended use of tests		
9.1	Type Tests		
	The following shall constitute the type tests:		
	a) Verification of marking and dimensions (**5.4** and **7.2**)		
	b) Rated capacity test (**8.1**);		
	c) Endurance test		
	d) Cycling endurance test in photovoltaic application (extreme condition)		
	d) Sulphation test (applicable for lead acid batteries only)		
	e) Water loss test (valid for flooded lead acid cells/batteries only)		
	The minimum number of samples shall be specified in the relevant standards listed in 7.2		

Cl. No.	Test / Requirement name	Test result/ observation	Verdict
9.2	Acceptance Test		
9.2.1	Factory test		
	The acceptance test shall be agreed between the customer and the supplier. Compliance to marking, labeling rated capacity may be verified.		
9.2.2	Commissioning test		
	commissioning test is recommended to prove the integrity of the installed battery system by means of a capacity test at 10 hour rate for lead-acid batteries or 5 hour rate for Ni-Cd/Ni-MH and Li-ion batteries		

	List of critical Components				
Object/ part No.	**Manufacturer/ trademark**	**Type/ Model**	**Technical Data**	**Standard**	**Marks of Conformity[1]**
Supplementary information:					

ATTACHMENT 1

PICTORIAL VIEW OF THE EQUIPMENT

---------END OF THE TEST REPORT---------