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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law:

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Testing procedure of long discharge rate lead-acid batteries for photovoltaic systems

1 Scope This Japanese Industrial Standard covers vented type and sealed type lead-acid batteries whose rated capacity is based on 10 or more hour rate, among lead-acid batteries for use in photovoltaic systems.

2 Normative references The following standards contain provisions which through reference in this Standard, constitute provisions of this Standard. The most recent editions of these normative documents apply.

JIS B 7307 *Barographs*

JIS B 7411 *Etched-stem liquid-in-glass thermometers, total immersion type*

JIS B 7505 *Bourdon tube pressure gauges*

JIS C 0010 *Environmental testing Part 1: General and guidance*

JIS C 1102 *Electrical indicating instruments*

JIS C 8702 *Small-sized sealed lead-acid batteries (Valve regulated types)*

JIS C 8704 *Stationary lead-acid batteries*

JIS C 8707 *Stationary sealed lead-acid batteries (Valve regulated type)*

JIS C 8905 *General rules for stand-alone photovoltaic power generating system*

JIS C 8960 *Glossary of terms for photovoltaic power generation*

JIS R 3505 *Volumetric glassware*

3 Definitions For the purpose of this Standard, in addition to the definitions stated in **JIS C 8702**, **JIS C 8704**, **JIS C 8707**, Informative reference 2 of **JIS C 8905** and **JIS C 8960**, the following principal definitions apply:

- a) **charging and discharging efficiency test** The efficiency test which is carried out in such a manner that the specimen in the state of full charge is discharged to the cut-off voltage of discharge, charged from this state by an ampere-hour equal to the discharged ampere-hour, then discharged again to the cut-off voltage of discharge.
- b) **PSOC (partial state of charge) efficiency test** The efficiency test which is carried out over a range of charging state specified, by taking the operation under the partial state of charge (or discharge) which occurs under the service conditions in a photovoltaic system into consideration.
- c) **PSOC (partial state of charge) cycle number test** The test which is carried out to confirm the operation for photovoltaic system by means of the charge and discharge pattern estimated from the solar radiation conditions in Japan, by taking the operation under the partial state of charge (or discharge) which occurs under the service conditions in a photovoltaic system into consideration.
- d) **PSOC (partial state of charge) ampere-hour efficiency** The ratio of the discharged ampere-hour to the charged ampere-hour obtained in b) PSOC efficiency test.

- e) **PSOC (partial state of charge) watt-hour efficiency** The ratio of the discharged watt-hour to the charged watt-hour obtained in b) PSOC efficiency test.
- f) **partial discharge end voltage** The voltage at which the discharge shall be completed in b) PSOC efficiency test.
- g) **partial charge end voltage** The voltage at which the charge shall be completed in b) PSOC efficiency test.

4 Classification of tests Tests shall be classified as stated below.

4.1 Rated capacity test The test to confirm the rated capacity stated on the nameplate or the like in such a manner that the specimen is discharged at the rated discharge hour rate current to the specified cut-off voltage of discharge.

4.2 10-hour rate capacity test Such a test that the capacity of a lead-acid battery whose rated capacity is different from 10-hour rate capacity is measured at 10-hour rate current.

4.3 Charge retention rate test Such a test that the specimen is allowed to stand after complete charge for a certain period, then discharged, and the charge retention rate is obtained from the difference between the capacity before standing and the capacity after standing.

4.4 Charge and discharge efficiency test Such a test that the specimen is discharged from the state of full charge to the cut-off voltage of discharge, charged by an ampere-hour equal to the discharged ampere-hour in the above procedure, then discharged again to the cut-off voltage of discharge, and the charging and discharging efficiency is obtained from the charged ampere-hour and the discharged ampere-hour.

4.5 PSOC (partial state of charge) efficiency test The test for measurement of the charging and discharging efficiency over the specified range of charged state.

4.6 PSOC (partial state of charge) cycle number test The test to confirm that the specimen operates without any trouble as the lead-acid battery for photovoltaic system by means of the charge and discharge pattern estimated from the solar radiation conditions in Japan.

4.7 Overcharge life test The accelerated life test by overcharge to evaluate the life of positive electrode grid.

4.8 Overdischarge test The test for performance of recovery from overdischarged state.

4.9 Gas recombining efficiency test The test to evaluate the ability to return oxygen gas and hydrogen gas produced during charging of a shealed type lead-acid battery to water by means of recombination or absorption of oxygen gas into the cathode (negative pole).

4.10 Safety valve operation test The test to verify the operation of safety valve attached to a shealed type lead-acid battery which is the target.

4.11 Explosion-proof test The test to verify explosion-proof performance of exhaust part.

4.12 splash-proof test The test to verify the amount of dilute sulfuric acid splashed out of the battery at charging.

5 Atmospheric conditions for testing Unless otherwise specified the tests shall be carried out under the standard atmospheric conditions for testing specified in **JIS C 0010**.

In some tests the test may be carried out with the explosion and splash proof device and the catalyst plug removed.

6 Test conditions The test conditions shall be as follows:

6.1 Lead-acid battery under test The lead-acid battery under test (specimen) shall be the one within 6 months from its initial charge. Provided that, the storage shall be made under the conditions specified by the manufactures. The test shall be carried out on the storage battery standing correctly.

6.2 Test apparatus Unless otherwise specified the apparatus stated below shall be used as the test apparatus.

- a) **Voltmeters and ammeters** The voltmeters and ammeters shall be those of grade 0.5 specified in **JIS C 1102**, or the instruments at least equivalent thereto in accuracy.
- b) **Thermometers** The thermometers shall be those with a tolerance of $\pm 1^{\circ}\text{C}$ specified in **JIS B 7411**, or those at least equivalent thereto in accuracy.
- c) **Pressure gauges** The pressure gauges shall be those specified in **JIS C 7307** or **JIS B 7505**, or those at least equivalent thereto in accuracy.
- d) **Burettes or measuring cylinders** The burettes or measuring cylinders shall be those specified in **JIS R 3505**, or those at least equivalent thereto in accuracy.

6.3 Full charge Carry out full charging under the charging conditions specified by the manufacturer.

7 Test methods

7.1 Rated capacity test Carry out the test at the rated hour rate current stated on the nameplate or the like, measure the time to the specified cut-off voltage of discharge, and take the product of the said time and discharge current as the capacity.

- a) **Test temperature** The ambient temperature shall be $(25 \pm 2)^{\circ}\text{C}$. If the test temperature of battery is capable of being controlled by the electrolyte temperature, it shall be $(25 \pm 2)^{\circ}\text{C}$.
- b) **Timing for commencement of discharge** Such a point of time that the specimen is fully charged, allowed to stand in the atmosphere at $(25 \pm 2)^{\circ}\text{C}$ for 1 h to 24 h, the surface temperature of specimen is $(25 \pm 2)^{\circ}\text{C}$ and it is confirmed that the said temperature is almost constant by the measurements at 30 min intervals.