Guideline No.: E-06(202511)

E-06

STORAGE BATTERIES

Issued date: November, 01 ,2025

Foreword:

CCS Product Inspection and Testing Guideline (hereinafter referred to as this Guideline) contains the technical requirements, inspection and testing criteria related to classification and statutory survey of marine products to be applied for CCS approval/inspection.

This Guideline frees the users to adopt other test methods and requirements which are equivalent to or are stricter than this Guideline.

This Guideline is published and updated by CCS, and is released at http://www.ccs.org.cn. Your comments or suggestions are welcomed and may be sent to our email addressed service@ccs.org.cn.

Historical versions : E-06(201510) Oct., 20, 2015

E-06(201610) Oct., 28, 2016

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Main changes:

1. Revise the requirements for the content of battery nameplates in the guidelines.

2. Update of the " Guidelines for Type Approval Test of Electric and Electronic Products" version

3. Modification of other formats and typos.

Content

STORAGE BATTERY

1 Scope

This Guideline applies to fixed installed Lead-acid storage batteries for communication, illumination and Starting.

2 Normative References

(1) China Classification Society Rules for Classification of Sea-going Steel Ships and its Amendments

(2) GD019 – 2024 Guidelines for Type Approval Test of Electric and Electronic Products.(current valid version)

(3) IEC 60092-305 Electrical installations in ships Part 305: Equipment – Accumulator (storage) batteries

3 Terms and Definitions

3.1 For definitions of terms such as products inspection, approval, type test, sample and unit/batch inspection, refer to 3.1.2 of Chapter 3, PART ONE of CCS Rules for Classification of Sea-going Steel Ships.

3.2 Batch means specifically the products of the same specification, made by the same manufacturer with the same production line and manufacturing processes.

3.3 Vented (Flooded) battery: a vented battery is a secondary battery having a cover provided with one or more openings through which gaseous products may escape. Batteries for communication and illumination shall be equipped with a device to indicate the minimum and maximum electrolyte levels.

3.4 Valve‑regulated (with gas recombination) battery: a valve‑regulated battery is a secondary battery that is closed under normal conditions and has an arrangement that allows the escape of gas if the internal pressure exceeds a predetermined value.

3.5 C_{20}: Nominal capacity of 20h rate. This value is usually expressed in ampere-hours(Ah).

3.6 C_{10}: Nominal capacity of 10h rate. This value is usually expressed in ampere-hours(Ah).

3.7 C_1: Nominal capacity of 1h rate. This value is usually expressed in ampere-hours(Ah).

3.8 C_e: the real capacity of battery under reference temperature(25℃). This value is usually expressed in ampere-hours(Ah).

3.9 I_t: Discharge current in capacity test. This value is usually expressed in ampere (A).

3.10 I_s: Starting Current. This value is usually expressed in ampere (A).

3.11 I_{ca}: Charging current after 10min charging. This value is usually expressed in ampere (A)

3.12 I_0: Discharge current in charge acceptance test. This value is usually expressed in ampere (A)

3.13 I_{20}: Discharge current of 20h rate. The value is twentieth of C_{20}. This value is usually expressed in ampere (A)

3.14 U_{flo}: Float voltage, constant charge voltage specified by the manufacturer for a floating battery

4 Plans and Documents

4.1 The following plans and documents are to be submitted to CCS for approval:

(1) General plans;

(2) Drawings of main parts, including enclosures and pole plates;

(3) Technical specifications of the products;

(4) Type test program

4.2 The following plans and documents are to be submitted to CCS for information:

(1) List of raw materials;

(2) Essential manufacturing processes (such as paste mixing and smearing);

(3) Operation instructions for the products.

5 Technical Requirements

5.1 Appearance and Construction

There shall not crackle, smear or obvious deformation of storage battery. The dimension and specification shall conform to requirements of product drawings. All pole plates are to be of rigid construction, and are to be designed to minimize the shedding of active material to a minimum.

5.2 Polarity

The polarity identification of the battery terminals is correct and consistent with the product drawings approved by our Society .

5.3 Air tightness

Storage batteries shall keep air tightness. For communication and illumination storage battery, vented battery shall be able to withstand positive or negative pressure equivalent to 4kPa, and Valve‐regulated (with gas recombination) battery shall be able to withstand positive or negative pressure equivalent to 50kPa. Starting storage battery shall be able to withstand positive or negative pressure equivalent to 20kPa.

5.4 Insulation Resistance

The insulation resistance of batteries filled with electrolyte to the ground should not be less than 10MΩ.

5.5 Capacity

For communication and illumination storage battery, C_{10} and C_1 is indicated by the manufacturer. The 10h rate actual capacity at 25℃ shall reach $0.95C_{10}$ in first cycle; The 1h rate actual capacity at 25℃ shall reach C_1 . For starting storage battery, C_{20} is indicated by the manufacturer. The actual capacity at 25℃ shall reach 95 percent of nominal capacity in third cycle or prior.

5.6 Charge retention

The Vented communication and illumination storage battery shall be stored for 90 days. After this storage period, the charge retention shall not be less than 80 percent. The valve-regulated communication and illumination storage battery shall be stored for 180 days. After this storage period, the charge retention shall not be less than 73 percent. For starting storage batteries, the vented type should be stored for 21 days, and the vented type with low water loss or valve regulated type should be stored for 49 days. After discharging at a temperature of -18 ℃ for 30 seconds, the average voltage of the battery should not be less than 7.20V.

5.7 Over-charge proof (Valve-regulated battery for communication and illumination)

The batteries are to be free from fluid leakage and any obvious distortion.

5.8 Maximum discharge current proof (battery for communication and illumination)

After maximum current discharge, terminals, poles and confluence bars shall not be melted or fused. Battery tanks and caps shall not be melted or deformed.

5.9 Seal reaction efficiency (Valve-regulated battery for communication and illumination)

The seal reaction efficiency of batteries shall not be lower than 90 percent.

5.10 Valve operation (Valve-regulated battery for communication and illumination)

Valve of batteries will function properly as one-way vent between 1kPa and 49kPa.

5.11 Overcharging life (Vented battery for communication and illumination)

Overcharging life of vented batteries shall not be shorter than 360 days.

5.12 Low temperature crank performance (battery for starting)

The battery shall be discharged with a starting current I_s. After 10s, the terminal voltage shall not be lower than 7.5V. After 30s, the terminal voltage shall not be lower than 7.2V. The time interval of terminal voltage reaching 6V shall not be less than 40s. Low temperature crank performance shall meet the requirement in specific periods. The starting current shall be indicated by manufacturer, but shall not be less than the value in Table 5.12

Starting current of batteries for starting Table 5.12

No.	Nominal capacity of 20h rate C_{20} Ah	Starting current I_s A
1	30	150
2	35	175
3	36	180
4	40	200
5	50	250
6	60	300
7	70	350
8	75	375
9	80	400
10	90	420
11	100	440
12	105	450

Continued Table 5.12

No.	Nominal capacity of 20h rate C_{20} Ah	Starting current I_s A
13	120	480
14	135	520
15	150	560
16	165	600
17	180	630
18	195	650
19	200	680
20	210	680
21	220	680

5.13 charge acceptance (battery for starting)

The ratio of charging current of batteries I_{ca} and I_0 shall not be less than 2.

5.14 Endurance in cycle

5.14.1 Starting storage battery shall conduct the test according to 7.19.1. The number of cycles shall not be less than 120. After 30s discharging, the terminal voltage shall not be lower than 7.2V.

5.14.2 Starting storage battery shall conduct the test according to 7.19.2.The unit of cycles shall not be less than 5. After 30s discharging, the terminal voltage shall not be lower than 7.2V.

5.14.3 Valve-regulated battery for communication and illumination shall conduct the test according to 7.19.3. The number of cycle shall not be less than 300.

5.15 Safety (battery for communication and illumination)

The body of storage batteries is not to explode if sparks occur near exhaust position when overcharged.

5.16 Acid mist proof

No acid mist escapes from the battery when overcharged.

5.17 Inclination resistance

The battery inclines to the fore, aft, left, right sides at an angle of 40° for 15 min respectively, with discharge current being stable and voltage normal, without leakage or splash of electrolyte.

5.18 rolling resistance

The battery rolls along the fore-aft horizontal axis and left-right horizontal axis at an angle of 22.5° with a period of 10 seconds from one position to another for 15 min respectively, with discharge current being stable and voltage normal, without leakage or splash of electrolyte.

5.19 Vibration resistance

The battery is to have no mechanical injury or no leak or splash of electrolyte after required vibration test. Battery for communication and illumination is to have stable discharge current, normal voltage.

5.20 Water consumption (battery for starting)

Mass loss of vented battery shall be 4g/Ah maximum. Mass loss of Vented battery with very low water loss shall be divided by 2 and 1g/Ah.

5.21 Flame retardant

The plastic components of shell of battery shall be flame retardant and self-extinguishing under the influence of a pre-defined flame.

5.22 Nameplate

Each crate or tray is to be provided with a durable nameplate securely attached, indicating the manufacturer’s name, type designation, and the ampere-hour rating at a specific rate of discharge (preferably that corresponding to the duty for the specific application 5 h, 10 h or 20 h rating) .

6 Materials and Components

Materials and components shall comply with relevant requirements of CCS Rules.

7 Type Test

7.1 In the absence of other provisions, the test shall be conducted within the following standard atmospheric conditions:

(1) Temperature range: 25℃±5℃

(2) Relative humidity: 60%±30%

(3) Air pressure: 96kPa±10kPa

7.2 Measuring Instrument

(1) Electrical instrumentation

① Instrument ranges are to match voltage or current to be tested and readings of pointer instruments are to be within the last one third of the range.

② Accuracy of voltmeters is not to be less than grade 0.5 and internal resistance is not to be less than 1kΩ/V.

③ Accuracy of ammeters is not to be less than grade 0.5.

(2) Thermometers

Thermometers are to have an appropriate range, with grade division being not more than 1℃ and nominal accuracy not less than 0.5℃.

(3) Density meters

Density meters are to have an appropriate range, with grade division being not more than 0.005 g/cm3 and nominal accuracy not less than 0.005 g/cm3.

(4) Time meters

Time meters are to be graduated in hours, minutes and seconds with an accuracy of not less than ±1%.

(5) Weighing apparatus

Accuracy of weighing apparatus is not to be less than ±0.05%.

(6) Megohm meters

Accuracy of megohm meters is not to be less than grade 1.5, and voltage rating is not to be less than 250 V.

(7) Measuring devices

Accuracy of measuring devices is not to be less than 1 mm.

(8) Pressure meters

Accuracy of pressure meters is not to be less than grade 0.25.

7.3 Pretreatment of storage batteries for tests

7.3.1 Storage batteries for tests are to be products manufactured within last three months and to be kept upright in testing.

7.3.2 All storage batteries are to be fully charged before test. Dry-charged or conserved-charged storage batteries are to be activated.

7.3.3 Storage batteries are to be fully charged with constant current or constant voltage procedures.
Vented batteries can be charged with constant current or constant voltage procedures.
Valve-regulated batteries can be charged with constant voltage procedure only.

(1) Storage battery for communication and illumination:

① Constant current charging procedure : the battery is to be charged with 0.1 C_{10} Current at room temperature until all the terminal voltage of batteries reaching 2.4V. Then the charging current is changed to $0.05C_{10}$.The batteries are considered fully charged when the terminal voltage and density of electrolyte have no significant change with 2 consecutive hours in the end of charging.

② Constant voltage charging procedure: the battery is to be charged at (2.4±0.01) V the maximum current should not be over $0.2C_{10}$(at the beginning of charging, when the charging current is over $0.2C_{10}$, the appropriate reduction of charging voltage is permitted. The batteries are considered fully charged when the charging current have no significant change (temperature variation shall be considered) within 2 consecutive hours for 5 hours.

(2) Storage battery for starting

① During charging period, the temperature of electrolyte shall be kept between 15℃ and 35℃。The temperature of center cell shall be taken as the standard.

② Constant current charging procedure of vented battery: the battery is to be charged with $2I_{20}$ until the voltage reaching 14.4V, and then charging for 5 hours (charging time is 3 hours after low temperature crank performance test).

③ Constant voltage charging procedure of vented battery: the battery is to be charged at 16V for 24 hours(charging time is 16 hours after low temperature crank performance test). The maximum current is $5I_{20}$.

④ Constant voltage charging procedure of Valve-regulated battery: the battery is to be charged at （14.40±0.10）V for 20 hours with maximum current $5I_{20}$. Then the battery is to be charged with 0.5 I_{20} for 5 hours.

7.4 Type test items for storage battery for communication and illumination is shown in table 7.4:

Type test items for storage battery for communication and illumination Table 7.4

No.	Items	Requirement	Procedure	Sample No.					
				I	II	III	IV	V	VI
1	Appearance and dimension	5.1	7.6	√	√	√	√	√	√
2	Polarity	5.2	7.7	√	√	√	√	√	√
3	Air Tightness	5.3	7.8	√	√	√	√	√	√
4	Insulation Resistance	5.4	7.9	√	√	√	√	√	√
5	Capacity	5.5	7.10.1	√	√	√	√	√	√
6	Charge Retention	5.6	7.11.1			√			
7	Over-Charge Proof	5.7	7.12		√				
8	Maximum discharge current proof	5.8	7.13			√			
9	Seal reaction efficiency	5.9	7.14				√		
10	Valve Operation	5.10	7.15				√		
11	Overcharging life	5.11	7.16					√	
12	Charging and discharging endurance in cycle	5.14.3	7.19.3					√	
13	Safety	5.15	7.20	√					
14	Acid mist proof	5.16	7.21.1		√				
15	Inclination Resistance	5.17	7.22						√
16	Rolling Resistance	5.18	7.23						√
17	Vibration Resistant	5.19	7.24.1						√
18	Flame Retardant	5.21	7.26						

Note①：10h rate capacity is to be tested in cycle1, cycle 3 and cycle 5. 1h rate capacity is to be tested in cycle 2 and cycle 4.

Note②："√"means the sample shall conduct this test item。

Note③： Because of too long test period, the overcharge life test can be accepted by review test report of manufacturer

Note④：Sample raw material of flame retardant test shall be selected with the same batch of the samples.

7.5 Type test items for storage battery for starting is shown in table 7.5:

Type test items for storage battery for Starting **Table 7.5**

No.	Items	Requirement	Procedure	Sample No.					
				I	II	III	IV	V	VI
1	Appearance and dimension	5.1	7.6	√	√	√	√	√	√
2	Polarity	5.2	7.7	√	√	√	√	√	√
3	Air Tightness	5.3	7.8	√	√	√	√	√	√
4	Insulation Resistance	5.4	7.9	√	√	√	√	√	√
5	Capacity	5.5	7.10.2	√	√	√	√	√	√
6	Charge Retention	5.6	7.11.2	√					
7	Low Temperature Crank Performance	5.12	7.17	√	√	√	√	√	√
8	Charge Acceptance	5.13	7.18	√					
9	Cycle Life Endurance	5.14.1 5.14.2	7.19.1 7.19.2		√				
10	Acid mist proof	5.16	7.21.2				√		
11	Inclination Resistance	5.17	7.22.2			√			
12	Rolling Resistance	5.18	7.23			√			
13	Vibration Resistant	5.19	7.24.2			√			
14	Water Consumption	5.20	7.25						
15	Flame Retardant	5.21	7.26						

Note①：20h capacity and low temperature crank performance shall be alternated for three times.

Note②："√"means the sample shall conduct this test item。

Note3：Sample raw material of flame retardant test shall be selected with the same batch of the samples.

7.6 Appearance and dimension inspection

Storage batteries are to be visually examined. Dimensions of storage batteries are to be measured by required measuring devices. The result is to comply with requirements of clause 5.1.

7.7 Polarity inspection

Polarity of storage battery is to be visually examined or with reverse polarity instrument. The result is to comply with requirements of clause 5.2.

7.8 Air-tightness test

Storage batteries not filled with electrolyte are to be filled with or bled of air to reach a difference of 4 kPa (vented battery for communication and illumination), 50kPa (Valve-regulated battery for communication and illumination) or 20kPa (battery for starting) between their internal and external pressures, observing the readings of pressure meters. The readings of pressure meters are to be stable for at least 3s~5s. The result is to comply with requirements of clause 5.3.

7.9 Insulation resistance measurement

The surface of the storage battery filled with electrolyte is to be cleaned at the ambient temperature of 20℃ to 30℃ and relative humidity of 25% to 75%. When dried, the battery is to be placed on a metal plate and one end of the megohmmeter connected to any terminal of the battery and the other end of the megohmmeter to the metal plate for measurement. The insulation resistance of the battery to earth is to comply with requirements of clause 5.4.

7.10 Capacity

7.10.1 Storage battery for communication and illumination

(1) When the temperature of electrolyte of general storage batteries reduces to 25℃±5℃ within 1 h to 24 h after full charge, the discharge can be implemented. The temperature of battery surface, discharge current and terminal voltage shall be recorded simultaneously.

(2) During discharge period, terminal voltage and temperature of battery surface shall be measured and recorded. The interval for 10h rate capacity test is 1h. The interval for 1h rate capacity test is 10min. At the end of discharge, the terminal voltage and temperature of battery surface shall be measured and recorded consecutively in order to determine the accurate time of cutoff voltage.

(3) Cutoff voltage of storage battery capacity test shall conform with table 7.10.1

Discharge current and cutoff voltage of capacity test **Table 7.10.1**

Discharge Regime	Construction	Discharge current I_t （A）	Cutoff Voltage（V）
10h rate capacity test	Vented and Valve-regulated	$0.1C_{10}$	1.80
1h rate capacity test	Vented	$0.45C_{10}$	1.75
	Valve regulated	$0.55C_{10}$	1.60

(4) If the temperature is not the reference temperature of 25℃ when discharge begins, the real capacity shall be calculated according to formula (1).

$$C_e = I_t \times t_2 / [1+K(\mathrm{T}-25)] \quad \text{.....(1)}$$

where: T – Average temperature during discharge, ℃

K – temperature coefficient, K = 0.006/℃ for testing at 10 h capacity; K = 0.01/℃ for testing at 1h capacity;

t_2 – Discharge period, h.

(5) At least one out of five storage battery capacity tests at 10 h rate and 1 h rate is to comply with the requirement of 5.5.

7.10.2 Storage battery for starting

(1) During the entire test period, the storage batteries are placed in a water bath with the temperature of 25℃±2℃, with the upper edge of the batteries being not more than 25 mm above the water surface and the distance between the batteries and between batteries and the tank wall being not less than 25 mm.

(2) When the temperature of electrolyte is at 25℃±5℃, the battery shall be discharged with the current I_{20} . The change in current value during the discharge time should not exceed ± 2%. During the discharge process, the battery voltage should be recorded every 2 hours and the battery temperature should be recorded every 4 hours. When the voltage reaches 10.80V, record the battery voltage every 5 minutes. When the voltage reaches 10.50V ± 0.05V at the battery end, stop discharging and record the discharge duration t2 (h) and the temperature T (°C) of the intermediate single battery at the time of discharge termination.

(3) the real capacity of 20h rate is calculated according to:

$$C_e = I_{20} \times t_2[1 - \mathrm{k}(\mathrm{T}-25)] \quad \text{.....(2)}$$

Where: T – temperature of electrolyte at the end of discharge, ℃

t_2 – Discharge period, h.

K – temperature coefficient, K =0.01, $℃^{-1}$

(4) At least one out of three storage battery capacity tests at 20 h rate is to comply with the requirement of 5.5.

7.11 Charge retention test

7.11.1 Vented storage battery for communication and illumination

(1) The storage battery shall be fully charged. When the temperature of electrolyte is at 25℃ ±2℃ the battery shall be implemented 10h rate capacity test. The capacity is C_{e1}, the capacity before storage.

(2) the battery shall be fully recharged and stored for 90 days at the temperature 25℃±2℃. The surface of the battery shall be kept clean during this period.

(3) After storage for 90 days, the battery shall be implemented 10h rate capacity test immediately without recharge. The capacity is C_{e1}, the capacity after storage.

(4) the result is to comply with the requirements of 5.6.

7.11.2 Valve-regulated storage battery for communication and illumination

After conducting a 10 hour rate capacity test according to 7.10.1, the fully charged port of the battery reaches its nominal capacity. The battery is opened and allowed to stand for 180 days in an environment of 25 ℃± 5 ℃. During the battery's standing process, the terminal voltage and surface temperature of the battery are recorded once a day. After standing for 180 days, the battery is not recharged, and the 10 hour rate capacity test is conducted according to 7.10.1 to obtain the battery's standing capacity Ce2. Calculate the charge retention capacity, and the results should meet the requirements of Article 5.6.

7.11.3 Storage battery for starting

(1) A fully charged battery, with its vent plugs firmly in place and a clean dry surface, shall be stored at 40℃±2℃ on open circuit for 21 days.

(2) After this storage period, the battery shall be submitted, without recharge, to a cranking performance test. The voltage after 30s shall be measured and recorded.

(3) Vented battery with very low water loss or valve-regulated battery shall be stored with open circuit for 49 day according to (1), and tested according to (2).

(4) the result shall comply with the requirements of 5.6.

7.12 Over-charge proof test (valve-regulated storage battery for communication and illumination)

the battery is to be fully charged and continued charging with current $0.03C_{10}$ is to be continuous for 160 h at the temperature of 25℃±5℃, subsequently kept still for 1 h and then the storage batteries are to be examined visually. The result shall comply with the requirements of 5.7.

7.13 Maximum discharge current proof test (Storage battery for communication and illumination)

The vented battery shall be discharged for 1min with the $1.5C_{10}$ at the temperature 25℃±2℃ after fully charged. The result shall comply with the requirements of 5.8. After fully charging the valve regulated battery that has reached the nominal capacity through 7.10.1 capacity tests, discharge it at a current of $3C_{10}$ for 3 minutes in an environment of 20 ℃~25 ℃, and then visually inspect the pole and appearance. The results should meet the requirements of 5.8.

7.14 Seal reaction efficiency (valve-regulated storage battery for communication and illumination)

(1) The battery shall be charged with current $0.01C_{10}$ consecutively for 96 h at 25℃±5℃ after fully charged.

(2) Keep charging with current $0.005C_{10}$ for 1 h and then collect gas for 1 h. charging is to continue during the gas collection. The gas collection is shown in Figure 7.14.

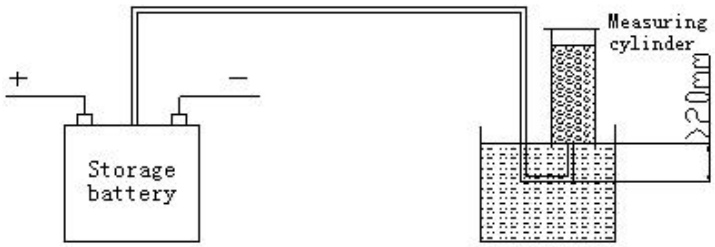

Figure 7.14 Gas collection

(3) Seal reaction efficiency is to be calculated according to formula (3) and formula (4). Test

result shall comply with the requirement of 5.9.

$$V = \frac{P}{P_0} \times \frac{298}{(t+273)} \times \frac{v}{Q} \quad \text{.....(3)}$$

where: V – gas displacement of the storage battery, in m*l*/Ah, at the ambient temperature of 25℃, atmospheric pressure of one standard atmosphere and charged capacity of 1Ah,;

P – atmospheric pressure for gas collection, in kPa;

P_0 – standard atmosphere of 101.3 kPa;

t – ambient temperature surrounding the measuring cylinder, in ℃;

v – collected gas from the storage battery, in m*l*;

Q – battery–charging capacity for other collection, in Ah.

$$\eta = (1 - \frac{v}{684}) \times 100 \quad \text{.....(4)}$$

where: η – seal reaction efficiency, in %;

684 – theoretical gas displacement of the storage battery, in m*l*/Ah, at the ambient temperature of 25℃, atmospheric pressure of one standard atmosphere and charged capacity of 1Ah.

7.15 Valve operation test (valve-regulated storage battery for communication and illumination)

valve operation test is for valve components only. Air pressure is to be increased gradually on the exhaust valve and the pressure shall be measured when the valve opens. The pressure is to be reduced in a natural condition and measured when the valve closes. Test result shall comply with the requirement of 5.10.

7.16 Overcharging life (Vented storage battery for communication and illumination)

(1) The battery shall be charged with current $0.02C_{10}$ at 25℃±5℃ after fully charged. The current fluctuation value shall not exceed ± 1% of the specified value. And the test for 1 h capacity is to be carried out every 30 days as specified in 7.10.1. When the capacity is verified to be less than 80% of the 1 h nominal capacity, the service life of the battery terminates.

(2) The total days of charging the storage battery are to be calculated, and the result shall comply with the requirement of 5.11.

7.17 Low temperature crank performance test (Storage battery for starting)

(1) After a rest period of 24 hours after fully charged, the battery shall be placed in a cooling environmental chamber with (forced) air circulation at a temperature of -18℃±1℃ for 20 hours or until the electrolyte temperature of the middle cells has reached -18℃±1℃.

(2) The battery shall then be discharged, either within or outside the cooling chamber, within 2 min after the end of the cooling period with a current I_s for 30 seconds. After 10 s discharge and 30 s discharge, the terminal voltage shall be recorded and the current shall be cut off.

(3) After a rest period of 20s±1s, the battery shall then be discharged at $0.6I_s$. the discharge shall be terminated when the battery voltage reaches 6V. The period shall be recorded.

(4) The test result shall comply with the requirement of 5.12 at least one of three discharge periods.

7.18 Charge acceptance test (Storage battery for starting)

(1) A fully charged battery shall be placed in a water bath at a temperature of 25℃±5℃ and discharged at a current I_0.

(2) I_0 shall be calculated according to formula (5)

$$I_0 = C_e/10 \quad \text{.....(5)}$$

The value C_e shall be taken as the maximum value C_e of the three previous discharges in accordance with 7.10.2

(3) immediately after the discharge, the battery shall be cooled at a temperature of 0℃±1℃ for 20 h to 25 h.

(4) at this temperature, the battery shall be charged at a constant voltage of 14.40V±0.10V. After 10 min, the charging current I_{ca} shall be recorded.

7.19 Cycle Life Endurance test

Either of the following two requirements can be selected for testing:

7.19.1 Starting storage battery Cycle Life Endurance test procedure 1

A fully charged battery shall be placed in a water bath in accordance with 7.10.2(1)

(1) The battery shall be discharge at $5I_{20}$ for 1 h;

(2) Then the battery shall be charged for 175 min with the voltage U (see table 7.19.1). the maximum current shall not exceed $10I_{20}$.

(3) then the battery shall be charged at a constant current for 5 min. the charging current is $2.5I_{20}$ for vented battery and $0.5I_{20}$ for valve-regulated battery.

(4) repeat step (1) to (3). if the voltage during the discharge drops below 10.5V, the test shall be terminated.

(5) when the cycle life test unit met the requirement or after end of cycle life test, the battery shall be placed in a low temperature chamber at -18℃±1℃ for 20 hours or until the electrolyte temperature of the middle cells has reached -18℃±1℃. The battery shall be discharged at a current $0.6I_s$ for 30s. the terminal voltage shall be recorded. The result shall comply with the requirements of 5.14.1.

Charge voltage of battery **Table7.19.1**

Battery Type	Voltage V
Vented battery	14.80±0.10
Vented battery with very low water loss	15.20±0.10
Valve-regulated battery	14.40±0.10 or 14.80±0.10
Note: the charge voltage of battery could be in accordance with the manufacturer's suggestion.	

7.19.2 Starting storage battery Cycle Life Endurance test procedure 2:

A fully charged battery shall be placed in a water bath in accordance with 7.10.2(1)

(1) the battery shall be discharged at $5I_{20}$ for 2 h.

(2) After discharged, the battery shall be charged for 285 min with the voltage U (see table 7.19.1). The maximum current shall not exceed $5I_{20}$. Then the battery shall be charged at constant current for 15 min, $2.5I_{20}$ for vented battery and $0.5I_{20}$ for valve-regulated battery.

(3) the battery shall be charged for 6h at a temperature of 25℃±5℃ in accordance with complete charge procedure.

(4) the battery is on open circuit for 5 h

(5) the battery then shall be discharged to 10.00V±0.05V, and the capacity shall be recorded.

(6) the battery shall be charged in accordance with complete charge procedure.

(7) step 1 to 6 shall repeat for 18 times as a cycle unit. The number of cycle units shall be recorded.

(8) when the number of cycle units meets the requirement and the capacity is no less than $0.5C_{20}$, the battery shall be placed in a low temperature chamber at a temperature of -18℃±1℃ for 20 hours or until one of the cells has reached -18℃±1℃. The battery shall be discharged at a current $0.6I_s$ for 30s. the terminal voltage shall be recorded. The result shall comply with the requirements of 5.14.2.

7.19.3 Valve-regulated storage battery for communication and illumination

After reaching the nominal capacity through the capacity test in 7.10.1, the battery is fully charged and continuously discharged and charged in an environment of 25 ℃± 2 ℃ according to the following method:

(1) Discharge at a constant current of $0.2C_{10}$ for 2 hours;

(2) Charge at a constant current of U_{flo} (V) [current limiting $0.2C_{10}$] for 22 hours.

After 50 such cycles, the battery shall undergo a 10 hour rate capacity test according to 7.10.1 without recharging. Calculate the discharge capacity C_a. When the discharge capacity C_a is not less than 0.80C10, the battery shall undergo the next 50 discharge and charging cycles according to clauses (1) and (2) of this article after being fully charged. When the discharge capacity C_a is lower than $0.80C_{10}$, conduct another 10 hour rate discharge test verification. If the verification result C_a is still lower than $0.80C_{10}$, the float charging cycle durability test will be terminated, and this 50 cycles will not be counted in the total number of float charging cycles.

7.20 Safety test (Storage battery for communication and illumination)

The fully charged storage battery is to be charged with current $0.05C_{10}$ for 1 h and then sparks are to be produced near exhaust position twice by blowing out the 1A fuse with 24V DC power supply, and test results are to comply with the requirement of “the body of storage batteries is not to explode if sparks occur near exhaust position”.

7.21 Acid mist proof test

7.21.1 Storage battery for communication and illumination

The fully charged storage battery shall be charged with current $0.01C_{10}$. A piece of PH test paper wetted with water used for the storage battery is to be hung 5 mm above vent plugs or safety valves for 2 h, Qualified with test paper not showing acidity. The result shall comply with the requirements of 5.16.

7.21.2 Storage battery for starting

The fully charged storage battery shall be charged with current I_{20} until gas strongly escapes from the electrolyte. A piece of PH test paper wetted with water used for the storage battery shall be hung 5 mm above gas escaping part of acid fog proof device for 1 h, Qualified with test paper not showing acidity. The result shall comply with the requirements of 5.16.

7.22 Inclination test

The fully charged storage battery is to be placed in open circuit for 4 h. The storage battery is to be fixed on the test bed and discharged with current $0.1C_{10}$(Storage battery for communication and illumination) or I_{20} (Storage battery for starting) continuously. The discharge current deviation is to be within ±1% of required value. the battery inclines to the fore, aft, left, right sides at an angle of 40° for 15 min respectively, the result is to comply with requirements of clause 5.17.

7.23 Rolling test

The fully charged storage battery is to be placed in open circuit for 4 h. The storage battery is to be fixed on the test bed and discharged with current $0.1C_{10}$(Storage battery for communication and illumination) or I_{20} (Storage battery for starting) continuously. The discharge current deviation is to be within ±1% of required value. the battery rolls along the fore-aft horizontal axis and left-right horizontal axis at an angle of 22.5° with a period of 10 seconds from one position to another for 15 min respectively. The result is to comply with requirements of clause 5.18.

7.24 Vibration test

7.24.1 Storage battery for communication and illumination

The fully charged storage battery is to be placed in open circuit for 4 h. The storage battery is to be fixed on the test bed and discharged with current $0.1C_{10}$continuously. The discharge current deviation is to be within ±1% of required value. Then the vibration test shall be implemented

according to normal vibration condition of clause 2.7 of GD019 – 2024. The result is to comply with requirements of clause 5.19.

7.24.2 Storage battery for starting

The fully charged storage battery is to be placed in open circuit for 24 h at 25℃±5℃. Then the vibration test shall be implemented according to normal vibration condition of clause 2.7 of GD019 – 2024. The result is to comply with requirements of clause 5.19.

7.25 Water consumption test (Storage battery for starting)

7.25.1 Vented battery

The battery, after being charged according to 7.3.3, shall be cleaned, dried and weighed. Then the battery shall be placed in a water bath maintained at a temperature of 40℃±2℃ according to 7.8.2(1). The battery shall be charged at a constant voltage of 14.40V±0.05V for a period of 500h. Immediately after this overcharge period, the battery shall be weighed under the same conditions as initially, with the same scales. The result is to comply with the requirements of 5.20.

7.25.2 Vented battery with very low water loss

The battery, after being charged according to 7.3.3, shall be cleaned, dried and weighed. Then the battery shall be placed in a water bath maintained at a temperature of 40℃±2℃ according to 7.8.2(1). The battery shall be charged at a constant voltage of 14.40V±0.05V for a period of 500h. After this overcharge period, the battery shall be weighed under the same conditions as initially, with the same scales(W_1). Then the battery shall be placed in a water bath maintained at a temperature of 40℃±2℃ according to 7.8.2(1). The battery shall be charged at a constant voltage of 14.40V±0.05V for a period of 1000h. Immediately after this overcharge period, the battery shall be weighed under the same conditions as initially, with the same scales（W_2）. The result is to comply with the requirements of 5.20.

7.26 Flame retardant test

If the battery case is a non-metallic case, it should be tested in accordance with the requirements of Article 2.16 of GD019 – 2024. The result is to comply with the requirements of 5.21.

7.27 Selection of Typical Samples

Specifications of type test samples are at least to include the products with maximum capacity; six products are to be selected from each specification.

7.28 Qualification Criteria

7.28.1 The items assessed according to the phenomena of inspection shall be assessed according to the phenomena of inspection.

7.28.2 If one of the batteries tested does not conform to this guideline, double inspection is required for the items assessed according to the inspection phenomena. If there is still one that does not meet the requirements, the product will be judged to be unqualified.

8 Unit/Batch Inspection

8.1 Upon Type Approval B, the unit/batch inspection is to be carried out after completion of installation and routine tests at the manufacturer.

8.2 The routine inspection reports are to be submitted together with an application for inspection to CCS.

8.3 Based on 100% routine tests by the manufacturer, the Surveyor is to sample at least 1% of each batch, but not less than 2 batteries; where the batch is unknown, 10% for each specification, but not less than 1 battery, is to be inspected.

8.4 Unit/batch inspection items are to include:

(1) Appearance and dimension inspection

(2) Insulation resistance;

(3) Polarity;

(4) Air-tightness test.