



Guideline No. E-25 (202401)

E-25

**MARINE CONTAINERIZED
MOBILE POWER SUPPLY**

Issued Date: January 1, 2024

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Foreword

China Classification Society (hereinafter referred to as 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 release version and release time: Newly released

Main changes: None

CONTENTS

1 Application..... 4

2 Normative references..... 4

3 Terms and definitions 4

4 Drawings and documents 5

5 Technical requirements 6

6 Materials and components 14

7 Type tests..... 15

8 Unit/path inspection 19

MARINE CONTAINERIZED MOBILE POWER SUPPLY

1 Application

The Guidelines are applicable to marine containerized lithium-ion mobile power supplies that are used, partially or entirely, as the power source for ships. Containerized lithium-ion power supplies used for other purposes may also reference relevant requirements of the Guidelines.

2 Normative references

- 2.1 CCS Rules for the Classification of Sea-going Steel Ships
- 2.2 CCS Rules for Construction of Inland Waterways Steel Ships
- 2.3 CCS Rules for Classification of Inland Waterway Ships
- 2.4 CCS Rules for Ships Applying Battery as a Power
- 2.5 CCS Guidelines for Survey of Hybrid Ships
- 2.6 CCS Rules for Survey of Containers
- 2.7 CCS Guidelines for Type Approval Test of Electrical and Electronic Products (including IACS UR E10)
- 2.8 IMO International Convention for Safe Containers, 1972 (CSC Convention)
- 2.9 IMO International Code for Application of Fire Test Procedures (FTP Code)
- 2.10 IMO International Code for Fire Safety Systems (FSS Code)
- 2.11 IEC 60309-1:2021 Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements
- 2.12 ISO 6469-1:2019 Electrically propelled road vehicles – Safety specifications – Part 1: Rechargeable energy storage systems (RESS)

3 Terms and definitions

3.1 For the definitions of terms such as product survey, approval, type test, and single item/batch survey, please refer to Clause 3.1.2 of Chapter 3, Part 1 of the CCS Rules for the Classification of Sea-going Steel Ships.

3.2 Containerized mobile power supply: Refers to a battery power system that utilizes the casing of a container as the installation platform for batteries (hereinafter referred to as "containerized power supply").

3.3 Battery swap: Refers to the process of electrical energy replenishment for battery-powered ships achieved by rapidly replacing the containerized power supply via specialized equipment or with manual assistance.

3.4 Battery swap connector: Refers to a connecting device located on the containerized power

supply, used to connect the containerized power supply to a ship's systems or shore-based systems for the transmission of electrical energy, electrical signals, communication data, and thermal media (which generally includes electrical connectors, and may also include cooling connectors for transmitting coolant, firefighting connectors for transmitting fire suppression agents, and any other connectors that need to be connected between the ship and the containerized power supply).

3.5 Battery system: Refers to the energy storage assembly, including integrated battery modules or battery packs, battery management systems, high-voltage circuits, low-voltage circuits, thermal management equipment, and mechanical assembly.

3.6 Battery management system (BMS): Refers to a system that monitors the state of the battery (temperature, voltage, state of charge, etc.), and can provide communication, safety, battery cell balancing, management control for the battery, and offers communication interfaces with application equipment.

3.7 High-voltage compartment: Refers to a management module that connects the battery clusters of the battery system to the power supply circuit and possesses functions such as battery cluster voltage/current collection, contactor control, and protection.

4 Drawings and documentation

4.1 The following drawings and documentation shall be submitted to CCS for approval during the review of containerized power supply drawings:

4.1.1 General arrangement and structure

- (1) Technical specification of the containerized power supply;
- (2) General arrangement plan;
- (3) Container structure drawings;
- (4) Fire zone plan;
- (5) Battery rack structure drawings;
- (6) Arrangement plan for fire insulation/decking auxiliaries;
- (7) Typical fireproof detail drawings.

4.1.2 Ventilation system (including emergency exhaust system), temperature control system (air conditioning system or water cooling system) and fire extinguishing system

- (1) Schematic diagrams of the ventilation and temperature control systems;
- (2) Piping arrangement plans for the ventilation and temperature control systems;
- (3) Schematic diagram of the fixed fire-extinguishing system piping;
- (4) Calculation documents for the fixed fire-extinguishing system;
- (5) Arrangement plan for firefighting equipment (including flammable gas detection, fire

detection, and extinguishing equipment).

4.1.3 Electrical system

- (1) Electrical system diagram (including battery system, BMS system, and auxiliary equipment such as lighting, detection, and firefighting systems.);
- (2) Electrical schematic diagrams;
- (3) Panel arrangement plan and outline drawings for components of the electrical system;
- (4) Protection device setting parameter table for the electrical system (including BMS control strategy and protection value settings);
- (5) Emergency shutdown system diagram;
- (6) Electrical system arrangement plan;
- (7) Detailed list of monitoring and alarm items for the containerized power supply.

4.2 The following drawings and technical documentation shall be submitted to CCS for information:

- (1) List of major components and materials;
- (2) Emergency operation instructions;
- (3) Maintenance inspection and functional test instructions;
- (4) Overall risk assessment report (including safety description of battery system hazards);
- (5) Nameplate drawing of the containerized power supply;
- (6) Strength calculation for the container structure;
- (7) Strength calculation for the battery rack structures;
- (8) Strength calculation for the connection structures (e.g., bolts, welds, etc.) if applicable;
- (9) Ventilation system calculation;
- (10) Heat load calculation for the temperature control system;
- (11) Functional description of the fire extinguishing system;
- (12) Functional description of the ventilation and temperature control systems.

5 Technical requirements

5.1 Operating conditions

5.1.1 The containerized power supply shall operate normally under the operating conditions specified in Sections 2 and 3, Chapter 1, Part 3 of the Rules for Construction of Inland Waterways

Steel Ships. If used on sea-going ships, it shall operate normally under the operating conditions specified in Section 2, Chapter 1, Part 4 of the Rules for the Classification of Sea-going Steel Ships.

5.2 System composition

5.2.1 A containerized power supply shall generally consist of a container (including A-60 fire-resisting structure), a battery system (including BMS and high-voltage compartment), a battery rack, a ventilation system (including an emergency exhaust system), a temperature control system (air conditioning system or water cooling system), a fire detection system, a combustible gas detection system, a fixed fire-extinguishing system, a lighting system, a video surveillance system, an integrated alarm display and control system, an uninterruptible power supply (UPS), a battery swap connector, a data transmission unit, among others.

5.3 General requirements

5.3.1 Unless otherwise specified in the Guidelines, the requirements for arrangement, installation, and ventilation of batteries within a containerized power supply shall be consistent with the requirements for batteries and their compartments as applicable to marine primary power and/or propulsion power sources in the CCS Rules for Ships Applying Battery as a Power.

5.3.2 The total stored electrical energy of batteries in a single battery compartment within a containerized power supply shall not exceed 2000 kWh.

5.3.3 Installation of new materials containing asbestos is prohibited inside a containerized power supply.

5.3.4 The ingress protection (IP) rating of battery packs within a containerized power supply shall not be less than IP67. Their temperature regulation devices and fire prevention/control measures shall meet the relevant requirements of the Rules for Ships Applying Battery as a Power.

5.3.5 The grounding of electrical equipment arranged inside a containerized power supply and of the containerized power supply itself shall meet the relevant requirements for electrical equipment grounding in the Rules for Classification of Sea-going Steel Ships or the Rules for Construction of Inland Waterways Steel Ships.

5.3.6 Within the battery compartments of a containerized power supply, electrical equipment required to operate under conditions of high combustible gas concentration (20% LEL), such as lighting fixtures, fire detectors, combustible gas detectors, and emergency exhaust fans, shall be certified explosion-proof equipment. Their explosion-proof class and temperature class shall not be lower than IICT4.

5.3.7 Containerized power supplies intended for use on ships with non-metallic structures or non-metallic masts shall be provided with a satisfactory lightning protection system.

5.3.8 A containerized power supply shall be capable of measuring and displaying the temperature of battery cells and the ambient temperature during lifting, transportation, shore-based charging, and storage periods. It shall be capable of issuing local visual and audible alarms in case of abnormal temperatures and simultaneously transmit the alarm signal to a remote shore-based monitoring platform.

5.4 Certification requirements

5.4.1 A containerized power supply shall hold a marine product certificate after the approval of drawings and survey. Specific certification requirements for raw materials and components are detailed in Clause 6.

5.5 Internal arrangement, container structure (including battery racks), and structural fire protection requirements

5.5.1 Containers used for containerized power supplies shall comply with the applicable parts of the CCS Rules for the Survey of Containers regarding containers. The container structure shall consider the impact of local stresses caused by fixed supports within the container under various operating conditions.

5.5.2 The container structure at battery rack fixing points and their connecting members, such as bolts, shall meet the local strength requirements under conditions of ship motion and container tilt.

5.5.3 Battery racks shall be made of steel materials, and their structural strength shall withstand loads under various operating conditions. For containers where enclosure walls consist of fire doors, the structural strength of the battery rack shall also consider deformation during ship tilt and swing to prevent it from acting on the fire doors.

5.5.4 All equipment inside a containerized power supply shall be effectively secured, including but not limited to: battery boxes/cabinets/packs, busbar cabinets, high-voltage compartments, and firefighting devices.

5.5.5 When battery boxes/cabinets/packs, arranged inside a containerized power supply, rely on the common internal space for ventilation and heat dissipation, the clear distance between the battery box/cabinet/pack and the internal bulkhead shall not be less than 150 mm. The clear distance to the internal bulkhead refers to the net distance after deducting internal equipment, stiffeners, decorative panels, etc.

5.5.6 The distance between battery boxes/cabinets/packs inside a containerized power supply and the container walls/roof shall not be less than 150 mm, and the clear distance to the container wall/roof stiffening structure shall not be less than 100 mm, to help reduce collision risks during lifting operations.

5.5.7 For general-purpose containerized power supplies, the boundaries of the space containing the batteries shall be of A-60 class fire-resisting divisions. If the dimensions and structural form of the fire-resisting divisions differ from the A-class standard core elements in the FTP Code, standard fire tests shall be conducted. If the strength and stiffness of the fire-resisting divisions are equivalent to the standard core, including plate thickness, stiffener dimensions, and spacing, standard fire tests may be omitted.

5.5.8 Insulation and thermal insulation materials shall be installed to prevent the effect of water ingress on fire protection/thermal insulation effectiveness.

5.5.9 If cables, fire-fighting pipes, ventilation ducts, etc., penetrate "A" class divisions, measures shall be taken to ensure the integrity of the fire-resisting divisions.

5.5.10 The external surface of a containerized power supply shall have clearly visible safety warning signs such as "No Open Flame" and "Unauthorized Personnel Prohibited".

5.5.11 The battery system inside a containerized power supply shall not be located in the same

space as the switchboard. Equipment used for inversion, transformation, and distribution in the power system shall be arranged separately from the battery system. Control equipment for battery clusters, such as high-voltage compartments/cabinets, may be arranged in the same space as the battery system.

5.5.12 Except for pre-engineered fire-extinguishing systems, components of the fixed fire-extinguishing system for a containerized power supply, such as extinguishing agent containers and release control valves, shall be arranged in a dedicated space outside the battery space. This space shall be provided with emergency lighting.

5.5.13 The overall design of a containerized power supply shall consider facilitating maintenance of battery system-related equipment. When internal maintenance is adopted, sufficient access shall be provided for personnel to inspect, repair, and handle emergencies. For battery compartments accessible to personnel, the arrangement of escape routes shall comply with the relevant regulations of the competent authority for non-category A machinery spaces (sea-going ships) or other machinery spaces (inland ships).

5.5.14 Doors to battery compartments shall remain closed. When opened, an alarm shall be generated and transmitted remotely to a continuously manned location on board, or self-closing doors shall be used, which shall open outwards.

5.5.15 The arrangement of batteries inside a containerized power supply shall consider the harmful effects of impact forces during lifting operations on the batteries.

5.5.16 A containerized power supply shall meet CCS Rules' requirements for salt spray resistance of electrical equipment.

5.5.17 The design of a containerized power supply shall consider the harmful effects of internal condensation.

5.5.18 The container and external openings of a containerized power supply shall meet weathertight requirements.

5.6 Temperature control system requirements

5.6.1 To prevent excessively high internal temperatures from affecting battery life during charging/discharging, short-term transfer, and storage, effective temperature control shall be implemented inside a containerized power supply. Typically, air conditioning ventilation or water cooling systems are used to regulate the ambient temperature inside the container and the battery temperature within the range required for battery operation.

5.6.2 The heat load calculation for the temperature control system of a containerized power supply shall account for both battery heat generation and external environmental heat load.

5.6.3 Failure of the temperature control system of a containerized power supply, such as loss of ventilation capacity or water cooling system failure, shall generate an alarm capable of being transmitted remotely to the bridge.

5.6.4 If air conditioning ventilation is used for temperature control, ventilation systems shall meet the requirements of Clause 5.2.2 of the Rules for Ships Applying Battery as a Power.

5.6.5 Ventilation systems shall be arranged to ensure effective ventilation of all spaces within the

battery compartment. The ventilation system for each battery compartment shall be independent and completely separated from the ventilation systems of other compartments. Ventilation ducts shall be made of steel or other equivalent materials. Ventilation openings shall have measures to prevent the entry of water and flame. Air inlets shall be located away from air outlets.

5.6.6 At least two control devices capable of stopping battery compartment fans shall be provided, one of which must be located at an operating position outside a containerized power supply.

5.6.7 When using cooling water or other cooling media circulating through battery packs and high-voltage compartments, the design and arrangement of the water manifold channels shall facilitate the expulsion of gases within the channels to aid heat transfer. The water circuit shall be capable of being shut off to facilitate battery pack replacement. Simultaneously, cooling fluid leakage monitoring and alarm shall be provided.

5.7 Emergency exhaust system requirements

5.7.1 Lithium batteries installed inside a containerized power supply may release combustible hazardous gases in case of thermal runaway. To promptly discharge combustible hazardous gases generated during battery thermal runaway, an independent emergency exhaust fan shall be provided for battery compartments with safety level 2, or the ventilation system mentioned in Clause 5.6.4 may be used for this purpose.

5.7.2 The emergency exhaust air flow rate shall be determined based on assessment, but shall not be less than 30 air changes per hour.

5.7.3 An emergency exhaust system shall be supplied by two power sources, one of which shall be from a power system outside the area it serves. The power supply duration shall meet the requirements of the relevant rules for emergency power supply duration.

5.7.4 Emergency exhaust fans shall be of the non-sparking type. If the motor is located inside the ventilation duct or battery compartment, it shall be certified explosion-proof equipment. Non-sparking fans shall meet the requirements of Clause 3.3.5, Part 6 of the CCS Rules for the Classification of Sea-going Steel Ships.

5.7.5 An emergency exhaust fan shall be interlocked with the combustible gas detection system installed in the battery compartment. When the combustible gas concentration in the battery compartment is detected to be greater than 20% of its lower explosive limit by volume fraction, the emergency exhaust fan shall automatically start. The emergency exhaust fan shall automatically stop when the fire extinguishing agent is discharged into the battery compartment.

5.7.6 Exhaust gases from an emergency exhaust fan shall be ducted to a safe location on the open deck, away from occupied spaces or spaces containing heat sources, and at least 3 meters away from air inlets of other spaces, the local operating position of the containerized power supply, firefighting locker entrances, and electrical room entrances.

5.7.7 An emergency exhaust outlet shall be fitted with an automatic fire damper with self-closing function, interlocked with the emergency exhaust fan. If this is not feasible, the emergency exhaust outlet of a containerized power supply shall lead outside the ship and have functions to prevent rainwater and seawater ingress. If an electrically operated fire damper is used, it shall be certified explosion-proof unless the relevant electrical components are not inside the battery compartment and are isolated from or located at least 3 meters away from the exhaust outlet.

5.8 Fire extinguishing system

5.8.1 Enclosed spaces containing batteries shall be protected by one of the following fixed fire-extinguishing systems:

- (1) Heptafluoropropane fire-extinguishing system, with a minimum extinguishing design concentration of 9%. This system shall also be equipped with a backup supply of extinguishing agent, cylinders, and related piping accessories equivalent to the required quantity, ready for immediate use. If dedicated fire prevention and control devices are installed within the battery packs, the backup extinguishing agent may be omitted.
- (2) Carbon dioxide fire-extinguishing system, with the quantity of extinguishing agent designed based on at least 40% of the total volume of the protected space. This system shall also be equipped with a backup supply of extinguishing agent, cylinders, and related piping accessories equivalent to the required quantity, ready for immediate use. If dedicated fire prevention and control devices are installed within the battery packs, the backup extinguishing agent may be omitted.

5.8.2 The heptafluoropropane fire-extinguishing system shall meet the requirements of the IMO Guidelines for the Approval of Fixed Equivalent Water-based Fire-Fighting Systems for Machinery Spaces and Cargo Pump-Rooms (Revised) (MSC/Circ.848) and its amendments, or Section 3, Chapter 8, Part 5 of the Technical Regulations for Statutory Survey of Inland Waterway Ships. The carbon dioxide fire-extinguishing system shall meet the requirements of Chapter 5 of the IMO International Code for Fire Safety Systems, or Chapter 2-2, Part 4 of the Technical Regulations for Statutory Surveys of Sea-going Ships Engaged on Domestic Voyages, or Section 3, Chapter 8, Part 5 of the Technical Regulations for Statutory Survey of Inland Waterway Ships.

5.8.3 The fixed fire-extinguishing system of a containerized power supply (including backup extinguishing agent) shall have remote control operation capability in addition to local control.

5.8.4 Water-based firefighting (except high-pressure water mist) is generally not recommended as the primary choice for overall fire extinguishing of the battery system inside a containerized power supply. If a water-based firefighting system is used, appropriate protective measures shall be taken to prevent secondary hazards caused by water-based firefighting.

5.9 Electrical control system (battery system (including BMS), lighting, fire detection, combustible gas detection, video surveillance, alarm interlocking, uninterruptible power supply (UPS), emergency shutdown, etc.)

5.9.1 A battery system (including BMS) shall meet the relevant requirements of the CCS Guidelines for Survey of Marine Lithium-ion Battery Products. The selected battery system shall be compatible with the ship's operating conditions. Protective measures shall be provided between directly paralleled battery subsystems (minimum independent power supply units) inside a containerized power supply to prevent internal circulating currents.

5.9.2 Sufficient lighting shall be provided inside the container to meet normal operation and maintenance requirements. Lighting fixtures inside battery compartments shall be certified explosion-proof products.

5.9.3 Power cables inside a containerized power supply shall be separated from communication cables as far as practicable. Cables of intrinsically safe circuits shall be separated from cables of

non-intrinsically safe circuits (e.g., not bundled together, not placed in the same enclosure or conduit, and not fixed with the same cable clamp). The outer sheath of intrinsically safe circuit cables shall be blue or marked with blue stripes, which shall be clearly visible. Cables for equipment required to operate in a fire condition, such as fixed fire detection and fire alarm systems, combustible gas detection systems, firefighting systems, emergency shutdown systems, including their power supply cables, shall be of fire-resistant type if they pass through spaces with significant fire risk.

5.9.4 Battery compartments and electrical rooms (if provided) inside a containerized power supply shall be fitted with a fixed fire detection and fire alarm system meeting the IMO International Code for Fire Safety Systems (FSS Code) or the requirements of the competent authority. The design of the detection system and installation of detectors shall be such that they will quickly detect the onset of fire in any part of the compartment and under normal conditions of ventilation and ambient temperature range required for the equipment's operation. Heat detectors alone shall not be installed in battery compartments. A combination of heat and smoke detectors is recommended. Detectors installed in battery compartments shall be certified explosion-proof products. Electrical rooms (if provided) shall be fitted with smoke detectors.

5.9.5 The fixed fire detection and fire alarm system for battery compartments shall be capable of remotely identifying each detector individually. If the system does not have the function to identify individual detectors, each detector shall be arranged on an independent circuit. The fixed fire detection and fire alarm system shall be supplied by two power sources, one of which shall be from a power source outside the area it serves. The power supply duration shall meet the requirements of the relevant rules for emergency power supply duration.

5.9.6 An independent combustible gas concentration detection device shall be installed inside a battery compartment. This device shall be capable of activating an audible and visual alarm locally, on the bridge, or other continuously manned location on board, when the combustible gas concentration in the battery compartment exceeds 20% of its lower explosive limit (LEL) (by volume fraction). It shall also automatically start the emergency exhaust fan and automatically disconnect the battery system. Combustible gas detectors shall be certified explosion-proof products. The combustible gas concentration detection device shall be supplied by two power sources, one of which shall be from a power source outside the battery it monitors.

5.9.7 If personnel are permitted to work inside or enter the container to operate and maintain equipment in the battery compartment, an automatic audible and visual pre-discharge alarm device for the fixed gas fire-extinguishing system (CO₂ / Heptafluoropropane) shall be installed in the battery compartment. The alarm duration shall consider the time required for evacuation from the space. The alarm shall operate for at least 20 seconds before the discharge of the extinguishing agent. The pre-discharge alarm device shall be supplied by two power sources, one of which shall be from a power source outside the battery it monitors.

5.9.8 The fire-extinguishing system may be set for automatic release. When personnel enter the container's battery compartment, the system shall automatically switch to manual release, for example, via a door interlock or other devices upon entry. The automatic release of the fire-extinguishing system shall fully consider the activation of fire detection system detectors, combustible gas concentration detectors, battery system alarms (especially individual cell over-temperature), and compartment ambient temperature alarms. Power supply to all equipment in the battery compartment shall be automatically disconnected before the fire-extinguishing system is released.

5.9.9 If the design does not consider onboard maintenance for the containerized power supply, explosion-proof cameras shall be installed inside the battery compartment of the containerized power supply to facilitate internal debugging and inspection. The display shall be available locally, on the bridge, and on a remote shore-based monitoring platform.

5.9.10 The containerized power supply shall be equipped with an emergency shutdown device to disconnect the entire system operation in fault mode, including but not limited to: battery system, ventilation system (including emergency exhaust system), air conditioning system, internal lighting, and video surveillance system. The emergency shutdown device shall be located locally and on the bridge or other continuously manned location on board, with its activation accompanied by simultaneous visual and audible signals. The emergency shutdown device shall be independent of the control system and protected against accidental operation.

5.9.11 The fixed fire detection and fire alarm system, combustible gas detection system, emergency exhaust system, battery management system (BMS), and alarm system of the containerized power supply shall be supplied by two independent power sources. One of them shall be from a power system other than the main power source of the containerized power supply, and its power supply duration shall meet the requirements of the relevant rules for emergency power supply duration. Among these, the power supply for the battery management system (BMS) shall meet the potentially longest waiting time for the containerized power supply, whichever is greater. This can be achieved through a suitably sized uninterruptible power supply (UPS) to ensure continuous power supply to the aforementioned systems during transfer, lifting, and other operations of the containerized power supply.

5.9.12 The arrangement of batteries for the uninterruptible power supply (UPS) shall meet the requirements for battery arrangement in Chapter 2, Part 4 of the Rules for Classification of Sea-Going Steel Ships or Chapter 5, Part 3 of the Rules for Construction of Inland Waterways Steel Ships.

5.9.13 Overload and short-circuit protection shall be provided on all insulated poles of the main circuit of the battery system.

5.9.14 The main circuit connecting the battery system to the switchboard shall be connected to the distribution system busbar via an isolating switch or circuit breaker for isolation purposes during maintenance.

5.10 Battery swap connector requirements

5.10.1 The battery swap connector for a containerized power supply generally includes electrical connectors (power and communication) and water connectors. The design and selection of connectors shall consider insertion/withdrawal losses.

5.10.2 The surface of the battery swap connectors shall be free of burrs, foreign matter, flash, and similar sharp edges.

5.10.3 Battery swap connectors shall be easy to operate and shall be equipped with locking devices to ensure a secure connection between the electrical and water systems inside the container and the ship's systems, preventing loosening. They shall also have a structure or design to prevent incorrect coupling.

5.10.4 Electrical connectors shall ensure correct electrical connection and power-off sequence to

avoid unintended conduction of high-voltage or low-voltage circuits during battery swap operations. The design of electrical connectors shall prevent hot-plugging.

5.10.5 The short-time withstand current rating of electrical connectors shall meet the requirements of the ship's power system short-circuit current calculation.

5.10.6 Power and communication connectors shall be capable of monitoring the connection status of each connector.

5.10.7 Communication connectors shall enable communication of data information from the battery system and BMS and alarm information from the containerized power supply with the ship. Simultaneously, data information from the battery system and BMS shall be transmittable to a shore-based management system for status monitoring of the battery system during charging, transfer, lifting, and other processes.

5.10.8 The overall ingress protection rating of electrical connectors after connection shall meet the protection rating requirements of the corresponding location. If located on an exposed deck, they shall meet a minimum enclosure protection rating of IP56. Battery swap connectors shall be easy to replace and maintain.

5.10.9 In case of accidental leakage of medium from water connectors (if provided), it shall not cause insulation failure of the electrical connectors or other safety hazards.

6 Materials and components

The container shall obtain a certificate under the International Convention for Safe Containers, 1972 (CSC) and hold a safety approval plate. Attention shall also be paid to the status of the container's external openings during certification. Openings that may affect structural strength should be avoided as much as possible after the container is certified. Otherwise, a re-assessment of strength shall be conducted.

Generally, the certification requirements for various components within a containerized power supply are as follows. Certification requirements for other raw materials and components shall comply with the product certification requirements specified in the Rules for Classification of Inland Waterway Ships or the Rules for the Classification of Sea-going Steel Ships:

S/N	Product Name	Certificate Category		Approval Mode				Plan Approval	Remarks
		C/E	W	DA	TA-B	TA-A	WA	PA	
1	A-Class fire protection division	—	X	—	X	—	—	X	A-60 fire-resistant deck/bulkhead
2	Deck covering	—	X	—	—	—	X	—	
3	Fire doors	X	—	—	X	O	—	X	
4	Fire dampers	X	—	—	X	O	—	X	
5	Battery system	X	—	—	—	—	—	X	For details, please refer to Table 1.3.1.3 of the Rules for Ships Applying Battery as a Power
5.1	Battery pack	X	—	—	X	—	—	X	
5.2	Battery management system (BMS)	X	—	—	X	—	—	X	Only the main control module is required to hold a C/E certificate, and the slave control module can hold a W certificate.
5.3	HV compartment	X	—	—	—	—	—	X	

E-25 (202401) MARINE CONTAINERIZED MOBILE POWER SUPPLY

	(cabinet)								
5.4	Combiner box (cabinet)	X	—	—	—	—	—	X	
5.5	Wires and cables	X	—	—	—	—	X	X	For internal connecting cables of equipment, such as those in battery packs and high-voltage boxes, the certificate category can be W.
5.5	Fire prevention and control device	X	—	—	X	—	—	X	
6	Compartment fan	X	—	X	O	O	—	X	Including exhaust fans
7	Fire alarm controller	X	—	—	X	O	—	X	
8	Fire alarm detector	X	—	—	X	O	—	X	
9	Manual fire alarm button	X	—	—	X	O	—	X	
10	Combustible gas detector	X	—	—	X	O	—	X	
11	Heptafluoropropane fire-extinguishing system	X	—	—	X	O	—	X	
12	Carbon dioxide fire-extinguishing system	X	—	—	X	O	—	X	
13	Lighting fixtures	—	X	—	X	—	—	X	
14	Uninterruptible power supply (UPS)	—	X	—	X	O	—	X	The capacity of the uninterruptible power supply (UPS) is 50kVA and above, and the certificate category should be C.
15	Programmable controller	—	X	—	X	—	—	X	Including touch screen
16	Circuit breaker	—	X	—	X	—	—	X	Acceptable with the special consent of CCS.
17	Contactors	—	X	—	X	—	—	X	Acceptable with the special consent of CCS.
18	Fuse	—	X	—	X	—	—	X	Acceptable with the special consent of CCS.
19	Cables	X	—	—	—	—	X	X	Connecting cables between equipment
20	Power conversion device (power module)	X	—	—	X	O	—	X	Power 50kW and above
21	Piping and accessories	—	X	—	—	—	X	—	
22	Penetration fittings (or penetration devices) for A-Class and B-Class divisions	—	X	—	X	—	—	X	Includes: 1) (a) Cable penetration devices; (b) Pipe penetration fittings (Note: Penetration sleeves made of steel or equivalent material with a thickness $\geq 3\text{mm}$, length $\geq 900\text{mm}$, and without openings may be exempt from certification).

Symbols:

(1) C — Product Certificate; E — Equivalent Documentary Evidence; W — Manufacturer's Certificate.

(2) DA — Design Approval; TA — Type Approval; WA — Workshop Approval; PA — Plan Approval.

(3) X — Applicable; O — Optional; — — Not Applicable.

(4) Where a "C/E" is not required, the manufacturer shall submit a copy of the relevant approval certificate along with the original manufacturer's certificate (W) upon product delivery.

Note: The battery system may be certified separately or together with the containerized power supply.

7 Type tests

7.1 The first unit of a containerized power supply of the same model and specification shall undergo type tests according to the requirements of Clauses 7.2 to 7.5.

7.2 If the battery rack is secured through the container walls, the design load capacity of the securing points shall not be less than the envelope value from the strength calculations for various operating conditions. The strength of the securing points shall be verified during the container survey through a container cargo securing test.

7.3 The battery rack, with a typical structure and carrying simulated battery pack loads, shall undergo strength tests. These shall at least include the vibration, and tilt and swing tests required by GD22-2015 Guidelines for Type Approval Test of Electrical and Electronic Products. If the containerized power supply is subject to frequent road transport conditions during use, the battery rack shall also undergo mechanical vibration and mechanical shock tests according to the requirements of ISO 6469-1:2019 Electrically propelled road vehicles – Safety specifications – Part 1: Rechargeable energy storage system (RESS). Mechanical shock tests may be substituted by simulation calculations.

7.4 Electrical connectors (including power and communication connectors) shall undergo the following tests per the requirements for outdoor equipment in GD22-2015 Guidelines for Type Approval Tests of Electrical and Electronic Products: tilt and swing test, vibration test, high temperature test, low temperature test, alternating damp heat test, salt spray test Kb, insulation resistance measurement, withstand voltage test, enclosure protection rating test, flame retardancy test (where applicable). Power connectors shall also undergo, with reference to the requirements in IEC 60309-1 Plugs, socket-outlets and couplers for industrial purposes, at minimum: normal operation test, interlock function test, temperature rise test, test for flexible cables and their connections, mechanical strength test, tests for screws, current-carrying parts and connections, measurement of creepage distances, clearances and distances through sealing compound, resistance to heat and tracking test, resistance to corrosion and rusting test, conditional short-circuit current withstand test.

7.5 Tests for the containerized power supply shall be conducted step-by-step according to the construction and assembly sequence, and shall at least include the following test items:

7.5.1 Container and structural component inspection. After the container and structural components are manufactured, they shall be inspected. The container certificate shall be verified, and the container's condition shall be confirmed to match the certificate. The consistency of structural components with the drawings shall be checked. Component dimensions, welding procedures, and weld quality shall be inspected.

7.5.2 A-60 fire insulation inspection. After the installation of A-60 fire insulation materials, an A-60 fire insulation inspection shall be conducted. Certificates for A-60 insulation materials, fire sealing strips, fire doors, etc., shall be verified. The consistency of insulation material thickness and installation method with drawings and certificates shall be checked. The installation technique and completeness of the insulation materials shall be inspected.

7.5.3 Piping hydraulic pressure test. After fabrication in the workshop, internal fluid piping within the container shall undergo a hydraulic pressure test. The hydraulic test shall be conducted after the completion of manufacturing and before the application of insulation or coatings. The test pressure shall not be less than 1.5 times the design pressure, and shall be held for 10 minutes. The piping shall show no leakage, deformation, or damage. The hydraulic test may also be conducted together with the tightness test after piping assembly within the container.

7.5.4 Piping tightness test. After installation of all piping, a tightness test shall be conducted to check for leaks. During the test, pressure shall be increased gradually and slowly to the test

pressure, which shall not be less than the design pressure, and shall be held for 5 minutes. No leakage shall occur anywhere in the piping.

7.5.5 Ventilation system (including emergency exhaust system) functional test. After installation of the ventilation system, the following tests shall be conducted:

- (1) Ventilation accessory operational inspection: Operational tests shall be conducted on all fire dampers and ventilation valves with pneumatic/electric actuators within the system. Each fire damper and ventilation valve shall be operated to open and close three times each.
- (2) Fan operational test: The fan shall be run for not less than 30 minutes. Fan operation and vibration shall be checked. After the test, the hot insulation resistance of the fan motor shall be measured, and shall not be less than 1 M Ω .
- (3) Air velocity measurement: Air velocity shall be measured at 3 positions on the left and right sides of the duct using an anemometer, and data shall be recorded. The calculated actual ventilation rate shall not be less than the design ventilation rate. The emergency exhaust system shall meet the requirement of 30 air changes per hour.

7.5.6 Battery system (including BMS) test. After installation of the battery system, functional tests shall be conducted, at least including the following:

- (1) Appearance and structure inspection
- (2) BMS functional test
- (3) Over-temperature protection test
- (4) Overcurrent protection test
- (5) External short-circuit protection simulation
- (6) Overcharge protection test
- (7) Over-discharge protection test
- (8) Insulation resistance measurement
- (9) Emergency shutdown function test (for systems exceeding 50 kWh)
- (10) Capacity test (conducted once on at least one cluster at the battery system's rated charge/discharge current)

If the battery system (including BMS) has been certified separately, the test items for the battery system and BMS may be simplified.

7.5.7 Temperature control system functional test. After installation of the temperature control system, the following functional tests shall be conducted:

- (1) Temperature control system coolant accessory operational test (where applicable): Sensors on the coolant piping circuit shall be calibrated. Operational tests on motorized valves shall be conducted. Each motorized valve shall be operated to open and close three times each.

- (2) If the temperature control system uses an air conditioning ventilation system, the operational test is as follows: Charge/discharge tests on the battery system shall be conducted at the rated current specified in the containerized power supply technical manual. The air conditioning activation temperature shall be set, and it shall be observed if the system starts normally upon reaching the setpoint. After the air conditioning system is started, it shall be used to reduce the internal container temperature until the target temperature is reached. After the target temperature is reached, the system shall continue running for a period, and internal temperature changes shall be observed. Test duration shall be not less than 4 hours, and at least one complete charge/discharge cycle shall be performed. Initial ambient temperature inside the container, initial battery temperature inside battery packs, initial high-voltage compartment temperature, and initial external ambient temperature shall be recorded. The cooling time to reach the target temperature shall be recorded. The ambient temperature inside and outside the container, battery temperature inside battery packs, high-voltage compartment temperature, and various air conditioning system parameters shall be measured and recorded every 15 minutes. The cooling effectiveness of the air conditioning ventilation system for the battery system during the charge/discharge cycle shall be confirmed.
- (3) If the temperature control system uses a water cooling system, the operational test is as follows: Charge/discharge tests on the battery system shall be conducted at the rated current specified in the technical manual. The water cooling system's flow rate, pressure, and inlet temperature shall be measured to verify conformance with design. Test duration shall be not less than 4 hours, and at least one complete charge/discharge cycle shall be performed. Initial ambient temperature inside the container, initial battery temperature inside battery packs, initial high-voltage compartment temperature, and initial external ambient temperature shall be recorded. The ambient temperature inside and outside the container, battery temperature inside battery packs, high-voltage compartment temperature, and various water cooling system parameters shall be measured and recorded every 15 minutes. The cooling effectiveness of the water cooling system for the battery system during the charge/discharge cycle shall be confirmed.

7.5.8 Fire extinguishing system operational test. After installation of the fire extinguishing system, an external examination shall be conducted. The completeness of system components, arrangement, structure, and extinguishing agent capacity shall be checked against approved drawings and calculations. The manufacturing and installation quality of components and their securing shall be inspected. An operational test of the emergency mechanical release device (without agent discharge) shall be conducted, and manual/automatic activation and system interlock tests, including automatic cut-off functions, shall be performed. The remote release function shall also be verified.

7.5.9 Alarm system test. The alarm system test shall at least include:

- (1) Fire detection and fire alarm system test;
- (2) Combustible gas detection system alarm test;
- (3) Fixed fire-extinguishing system release alarm test;
- (4) Internal ambient temperature monitoring alarm test;
- (5) Other relevant safety interlock alarm tests.

7.5.10 Emergency shutdown system test. The emergency stop button shall be pressed during a charge/discharge process, and the response of relevant components shall be checked. The remote emergency shutdown function shall also be verified.

7.5.11 Connector system test. The connector system test shall include charge/discharge connector and water system connector tests. The connector system shall meet the requirements of Clause 5.10.

7.5.12 UPS system test. Whether the UPS capacity and connected loads match the drawings shall be checked. The UPS power supply shall be disconnected, and the operation of the connected loads shall be checked.

7.5.13 Lighting system test. The completeness and correctness of the lighting system installation shall be checked, and an operational test shall be conducted.

7.5.14 Video surveillance system test. The completeness and correctness of the video surveillance system installation shall be checked, and an operational test shall be conducted.

7.5.15 Main circuit protection functional test. The functionality of protective devices in the main circuit shall be checked.

7.5.16 Insulation resistance measurement. The insulation resistance of various systems shall be measured. The values shall not be lower than the relevant requirements in the Guidelines for Type Approval Test of Electrical and Electronic Products.

7.5.17 Container weathertight test. With container doors and other openings closed, water shall be sprayed on the external surfaces of the container, including door end, frame end, and external openings, to check if the container achieves weathertightness. The nozzle for the weathertight test shall have an internal diameter not less than 12.5mm, with an outlet water pressure not less than 0.1 MPa. The distance from the nozzle to the test surface of the container shall be 1500 mm, and the nozzle movement speed shall be 100 mm/s. The container shall show no signs of leakage during or after the test.

7.5.18 Final inspection. The appearance, structure, equipment installation, painting condition, markings, and labels of the containerized power supply shall be inspected. This item shall be conducted after completion of all tests and inspections, when the product is in the final state.

8 Unit/path inspection

8.1 Raw materials and components of the containerized power supply shall be certified according to the requirements in Clause 6.

8.2 The first unit of each specification/type shall undergo type tests as required in Clause 7 of the Guidelines. Based on the manufacturer's self-inspection tests, subsequent units shall be surveyed according to the single item/batch survey test items.

8.3 Prior to single item/batch survey, the manufacturer shall submit factory survey reports for the container/structural components and for the piping hydraulic pressure test to the surveyor for review.

8.4 Single item/batch survey shall, in principle, be conducted on each unit. The survey and test items shall at least include

- (1) A-60 fire insulation inspection;
- (2) Piping tightness test;
- (3) Ventilation system (including emergency exhaust system) functional test
- (4) Battery system (including BMS) test;
- (5) Temperature control system functional test;
- (6) Fire extinguishing system operational test;
- (7) Alarm system test;
- (8) Emergency shutdown system test;
- (9) Connector system test;
- (10) Uninterruptible power supply (UPS) system test;
- (11) Lighting system test;
- (12) Video surveillance system test;
- (13) Main circuit protection functional test;
- (14) Insulation resistance measurement;
- (15) Container weathertight test;
- (16) Final inspection.