TÜRK LOYDU

Additional Rules for the Certification, Installation and Testing of Lithium Batteries

January 2023

This latest edition incorporates all rule changes. The latest revisions are shown with a vertical line. The section title is framed if the section is revised completely. Changes after the publication of the rule are written in red colour.

Unless otherwise specified, these Rules apply to ships for which the date of contract for construction as defined in TL- PR 29 is on or after 1st of January 2023. New rules or amendments entering into force after the date of contract for construction are to be applied if required by those rules. See Rule Change Notices on TL website for details.

"General Terms and Conditions" of the respective latest edition will be applicable (see Rules for Classification and Surveys).

If there is a difference between the rules in English and in Turkish, the rule in English is to be considered as valid. This publication is available in print and electronic pdf version.

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Additional Rules for the Certification, Installation and Testing of Lithium Batteries

SECTION 1

GENERAL

A. Application

1. These rules are applicable to lithium battery installations with a capacity greater than 20 kWh for all electric ships or ships with hybrid power systems and when batteries are used for propulsion and/or redundant source of power for main.

2. If batteries are utilized as a backup power source with a capacity less than 20kW other than as the main supply or main propulsion power source, Section 2 Battery System requirements shall apply.

3. These Rules are to be used in conjunction with the requirements of **TL** Rules, Chapter 4, 4-1, and 5.

4. Since the battery technology is a field that is continuously evolving with respect to lithium battery chemistry, additional requirements to those specified in these Rules may be required by **TL** on a case by case basis.

5. The additional class notation **Li-BATTERY** may be assigned to ships when Lithium batteries are used for propulsion and/or main source of power supply or main source of power in standby. The battery system capacity is to be stated in the annex of the classification certificate.

6. The rules define design, installation and certification requirements for li-ion battery systems. The lithium battery types covered by these additional rules include lithium-ion, lithium-alloy, lithium metal, and lithium polymer types. For requirements applicable to conventional battery types (such as leadacid, alkaline, etc.), please refer to the requirements in Chapter B Part 5 of the TL Rules.

B. Definitions

1. The following definitions and abbreviations are additional to those given in the applicable Rules:

- Battery Management System (BMS): an electronic system associated with a battery pack which controls, monitors and manages the state of the battery by protecting the battery from operating outside its safe operating-limits.
- Power Management System (PMS): a complete switchboard and generator control system providing monitoring and control of the energy capacities.
- Energy Management System(EMS): a system providing monitoring and control of the energy.
- Integrated alarm and monitoring Control System (IAMCS): The system is a platform for all subsystems onboard, with monitor, control and alarm functionalities for operational continuity and safety for crew and vessel.
- Battery system converter: equipment controlling the charging and discharging of the battery.
- Cell: basic electrochemical unit of a battery containing an assembly of electrodes, electrolyte, and terminals.
- Battery: assembly of cells ready for use as storage of electrical energy characterized by its voltage, size terminal arrangement, capacity and rate capability.
- Battery compartment: enclosed space in which lithium batteries located.
- Battery system: the whole battery installation including battery modules, electrical interconnections, BMS and other safety features.
- State of Charge (SOC): available capacity expressed as percentage of the rated capacity
- State of Health (SOH): reflects general condition of a battery, including its ability to deliver the specified performance compared with a new battery.
- Venting: release of excessive internal pressure from a cell/battery in a manner

intended by design to preclude rupture or explosion.

- Explosion: failure that occurs when a cell container or battery case opens violently and major components are forcibly expelled.

- Lower explosive limit (LEL); The lower explosive limit (LEL) is the lowest concentration of gas, fumes, or vapors required to produce fire in the presence of an ignition source like flame or heat.

- Current Interrupting Device (CID): is a part that breaks the current and discharges gas when the internal pressure of the battery rises.

- High voltage Interlock (HVIL): is a safety feature that uses a low-voltage loop to monitor the integrity of a high-voltage circuit.

C. Documents to be Submitted

1. The documentation listed in Table 1.1 and Table 1.2 is to be submitted in triplicate or TL Electronic Approval System (TL - EPAS) for approval:

2. **TL** reserves the right to request the submission of additional documentation in case of non-conventional design or if it is deemed necessary for the evaluation of the system, equipment or components.

Table 1.1 Documents to be submitted for Li-BATTERY additional class notation

No	Designation of documents	Approval type	Explanation
1.1	Test Plan and Test procedures	I	Test programs related to factory test, onboard tests, sea trials. Test plan for the battery installation on board. Test procedures for battery installation and the FAT, HAT or IT and SAT phase.
1.2	Functional description	I	Functional description of the controls and mechanisms to enhance battery safety, such as battery management system (BMS),power management system (PMS) and Energy management system (EMS), shutdown mechanism, etc. An overall description of the propulsion and power installation for all relevant operating modes, including charging.
1.3	Technical specification	I	Nominal voltage and operational limits for battery system (e.g., voltage, current, and temperature), safety devices, cell/batteries configuration, battery chemistry, method of activation, discharge and recharge rates for the batteries, Shore charging connection requirements etc.
1.4	Load analysis	A	Load analysis (energy and power) including size of battery system, battery converter capacity and discharge/recharge capacity. The load analysis shall reflect capacity calculation for intended application. Remaining available propulsion and essential service loads power after a single failure shall be calculated.

No	Designation of documents	Approval type	Explanation
1.5	Failure Mode Effect Analyisi (FMEA)	I	Failure analysis according to IEC 60812 regarding the availability of the ship capacity of the propulsion (if available, depending on the special operation of the vessel) and power of essential consumers after a single fault.
1.6	Block diagram	A	Block diagram and electrical wiring diagram of the battery system and system interfaces to the battery system, including control,monitoring and alarm system, energy management system (EMS), alarm system, emergency shutdown and other systems.
1.7	Emergency Shutdown (ESD) arrangement	A	Emergency shutdown of the battery system including location of emergency disconnection button.
1.8	Arrangement plans	I	- Arrangement showing battery system and other equipment within the battery spaces including ventilation and if applicable, gas detection system. - General arrangement drawing indicating the battery space arrangement onboard. - Battery installation/mounting arrangement including battery weights, weight of the battery cabinets and connection details between battery cabinets and deck and/or bulkhead structure.
1.9	Battery system risk assesment document	I	A report which covers all potential hazards represented by the chemistry of batteries, the evaluation of the risk factors and measures to control and reduce the identified risks. A Risk Assessment, to be initiated in the design phase, covering: - All potential hazards represented by the type (chemistry) of battery, - Evaluation of the risk factors, - Measures to control and reduce the identified risk, including potential gas development (e.g. toxic, corrosive), fire and explosion risk and - Action to be implemented,is to be carried out to establish if battery system need to be installed in a room assigned to lithium batteries only Risk assessment shall cover all potential hazards represented by the type chemistry of battery including:

No	Designation of documents	Approval type	Explanation
			- Potential gas development (toxic, flammable, corrosive) - Safety philosophy - Fire risk - Batteries behaviour during submersion (ingress protection) - Explosion risk, including a description of the gas that can be released from the cell(s) during venting and thermal runaway(gas volume, release rate and gas composition) - A suitable fire extiungishing method - Detection, monitoring and alarm systems (gas detection,fire detection) - Ventilation rates fort he battery space - Thermal runaway (internal cell failure) - External fire /Hazard - Internal and external short circuit and earth faults - Electrical protection of the battery system - Flooding of battery modules due to cooling liquid leakage - External heating/fire - Safe charge/Discharge characteristics
1.10	Electrical one-line diagram	A	Diagram including power supply connections, alarm and monitoring interconnections , etc.
1.11	Fixed fire extinguishing system (FFES)	A	Fixed fire-extinguishing arrangement plan for the battery spaces.
1.12	Fire control plan	A	Plan for firefighting appliances and escape.
1.13	Fire detection and alarm system arrangement	A	Fire detection and alarm system arrangement plan for the battery spaces.
1.14	Structural fire protection drawing	A	
1.15	Operations and Maintenance manual	I	

Table 1.2 Documents to be submitted for certification

No	Designation of documents	Approval type	Explanation
1.1	General Arrangement	I	- Arrangement of the materials and general construction, view of the detail. - Installation of the terminal contacts with structure and dimension. - Types and size of internal wiring. - Relevant parts list detailing all material used - Venting and pressure relief arrangement - Detailed mechanical and forced ventilation - Cell and battery designation as specified with IEC 62620 5.3 - Gas Analysis test procedure details all material used.
1.2	FAT Test procedure	I	Test procedure for the workshop test which includes relevant standart and technical requirements
1.3	Functional description	I	Functional description of the controls and mechanisms to enhance battery safety, such as battery management system (BMS), methods of cooling and/or thermal dissipation
1.4	Technical specification	I	Including ratings and environmental data. Short circuit current capacity shall be stated for both maximum(fully charged new battery) and minimum(discharged battery at estimated end of lifetime) capacity. Documentation of the SOH and SOC calculation.
1.5	Electrical diagrams	A	- Block diagram of the battery management system (BMS) - Wiring diagram of power supply arrangement of the battery management system (BMS) - Circuit diagram of the battery management system (BMS)
1.6	I/O List	A	Alarm, indication and other functions such as shutdown, load reduction etc. of the battery system.
1.7	Software description	I	Document including software description of the BMS.

SECTION 2

BATTERY SYSTEM

A. Battery System

1. Construction

1.1 Battery cells are to be designed to be within temperature, voltage and current limits specified by the cell Manufacturer. The battery system designer is to ensure proper design and assembly.

1.2 Batteries are to be located where they are not exposed to excessive heat, extreme cold, spray, steam, shocks or vibration or other conditions which would impair performance.

1.3 Battery and/or module terminals are to be provided at an accessible position clearly marked and protected against mechanical damage and accidental contact for earthing, short-circuit or touching, as applicable.

1.4 The exposed battery casing, covering cells and modules, is to be constructed of durable, flame-retardant, moisture-resistant materials suitable for the marine environment likely to be exposed.

1.5 The design of a module should prevent the propagation of a thermal event from the first cell to another cell. In addition; the battery system shall be designed such that a fire in one cell may spread within that module but will not propagate to another module.

1.6 Battery cells of different physical characteristics, chemistries and electrical parameters are not to be used in the same electrical circuit.

1.7 The minimum degree of protection of the battery module enclosures is to be not lower than IP 44.

1.8 The casing of a cell, module, battery pack, and battery systems are to be provided with a pressure relief mechanism/arrangement to prevent rupture or explosion. If encapsulation is used to support cells within an outer case, the type of encapsulating material and the method of encapsulation shall neither cause the battery system to overheat during normal operation nor inhibit pressure relief.

1.9 Terminals are to have a clear polarity marking on the external surface of the battery. The size and shape of the terminal contacts are to ensure that they can carry the maximum current. External terminal contact surfaces are to be formed from conductive materials with good mechanical strength and corrosion resistance. Terminal contacts are to be arranged to minimize the risk of short circuits.

1.10 The cells shall be so constructed as to prevent the spilling of electrolytes due to an inclination of 40° from the normal position. The filling plugs shall be so constructed as to prevent spilling electrolytes due to the ship's movements e.g. Rolling and pitching.

1.11 For sealed batteries, a safety pressure valve or other means of explosion protection shall be included in the battery design.

1.12 CID is to be provided for the cell**.** The criterion for independent overcharge protection is considered satisfied for systems with cells equipped with CID or similar devices.

1.13 The cells shall be grouped in crates or trays of rigid construction and suitable material equipped with handles. The mass of crates or trays should preferably not exceed 100 kg.

2. Battery System Safety

2.1 Required explanations in accordance with Sec.1, Table 1.1, item 1.9 shall be provided by the manufacturer in the safety procedures (risk assessment) for the battery system.

2.2 Control, monitoring, and safety system are to have self-check facilities. In the event of failure to the system or power supply, an alarm is to be activated.

2.3 The safety system is to be designed so as to limit the consequence of failures. It is to be constructed on the fail-safe principle.

2.4 The sensors are to be designed to withstand the local environment. The enclosure of the sensor and the cable entry is to be appropriate to the space in which they are located. Any malfunctioning in the sensors is to be detectable.

2.5 Sensors for safety functions are to be independent of sensors used for other purposes (e.g. for alarm systems).

2.6 The battery system shall incorporate a battery management system (BMS).

2.7 The BMS shall communicate the voltage and current limits to the battery converter.

2.8 The battery system shall be equipped with an independent emergency shutdown (as required in Sec.3, A, 3.3) for disconnection of the battery system.

2.9 The safety system is to be activated automatically in the event of identified conditions which could lead to damage of lithium battery system. Activation of any protective safety actions is to activate an alarm in a normally attended location.

2.10 A thermal protection device, capable of disconnecting the battery in case of high temperature, is to be provided to the battery.

2.11 The battery system's main power contactors or circuit breakers shall disconnect both poles.

2.12 High voltage interlock (HVIL) shall be used for the main power connectors to allow connection/disconnection only when the battery contacts are open.

2.13 The voltage of any one of the single cells is not to exceed the upper limit of the charging voltage as specified by the cell Manufacturer.

2.14 The clearance and creepage distances given in Ch.5, Sec.5 F shall be met based on the end-of-charge voltage for the battery system.

2.15 Battery systems shall be designed such that the risk of cooling liquid leakage in the battery system is minimized and does not lead to hazardous creeping currents, electrolysis, short circuit, electric arcing, earth faults or other hazards. Leakage detection shall be operable.

3. Battery Alarms to Ship Monitoring

3.1 The alarm system is to be continuously powered and an alarm is to be given in the event of failure of the normal power supply.

3.2 Any abnormal condition in the battery system is to initiate an alarm in the vessel's main alarm system with individual or group indication.

3.3 For vessels without a centralized main alarm system, battery alarms are to be presented at the bridge.

3.4 Abnormal conditions which can develop into safety hazards are to be alarmed before reaching the hazardous level. Sensors and other components for such alarms are to be separated from emergency shutdown or other protective safety functions.

3.5 The following are to result in an individual or group visual and audible alarm to be displayed in a continuously attended location:

- Tripping of the battery protective device,
- High Cell or module temperature,
- Over and under voltage,
- Cell voltage unbalance,
- Battery module/pack ground fault,
- Failure of communcation,
- Failure/shutdown of the battery system or failure of any individual modules,
- availability of cooling system of batter (e.g. of the ventilation system or of the liquid cooling system).

Note:

Other possible abnormal conditions are to be considered based on the Risk Assessment (e.g. gas detection, smoke detection, heat detection, overcurrent, ventilation failure, under voltage, voltage unbalance between battery cells, charging failure, etc.).

3.6 An alarm is to be given on the bridge when State of Charge (SOC) reaches minimum required capacity as required for the intended operation of the vessel.

4. Battery Management System (BMS)

4.1 The battery system is to have a Battery Management System (BMS).

4.2 Battery Management System (BMS) is to be capable of the following conditions;

- Monitoring cells and ensuring balanced operation against overcharge or over-discharged due to voltage unbalance between the cells,
- Provide limits for charging and discharging to the battery converter,
- Protection against over-current, over-voltage and under-voltage by disconnection of the battery system,
- Protection against over-temperature by disconnection of the battery system,

4.3 Battery Management System (BMS) is to be continuously powered so that a single failure of the power supply system does not cause any degradation of the BMS functionality, and an alarm is to be given in the event of failure of the normal power supply.

4.4 The BMS shall be considered as a the following parameters shall be measured at least by BMS;

- Cell Voltage
- Cell or module temperature
- String Current

The following parameters shall be indicated at local control panels or in the control station

- System Voltage
- Cell voltage (max, min, average)
- Cell or module temperature (max, min, average)
- Battery String Current

4.5 State of Charge (SOC) and State of Health (SOH) of the batteries are to be monitored at a normally attended location for the remaining capacity of batteries and state of health when lithium batteries are used as storage of power dedicated to the propulsion system or as part of the main source of electrical power. SOC and SOH parameters shall be available for the energy management system.

5. Battery System Converter

5.1 Converter capacity shall have enough capacity for the intended operation.

5.2 The battery charging equipment shall operate within the limits given by the BMS.

5.3 The battery charger is to be stopped when the upper limit of the charging voltage is exceeded for any one of the single cells.

5.4 Charging and discharging (supply to ship mains) failure shall give an alarm at a manned control station.

5.5 The converters shall maintain the battery system against overvoltage and under-voltage.

The voltage protection shall be independent of the battery system, i.e. utilize independent voltage sensors and be independent of the battery management system. The protection levels shall be within the allowable operating values of the battery system.

Note: *Alternatively when the vessel has several battery converters and/or a battery converter located on shore then the independent voltage protection could be implemented in the DC switchboard where the battery system is connected.*

SECTION 3

BATTERY SYSTEM INSTALLATION

A. Battery System Installation

1. General

1.1 This section applies to situations where batteries supply the main power source and propulsion power.

2. System Design Requirements

2.1 Battery systems used as the main source of electrical power or used as a source of hybrid power system must meet flag State and SOLAS requirements, as applicable.

2.2 High-speed **TL** rules shall be taken into consideration.

2.3 In addition to the capacity submitted in accordance with Sec.1, Table 1.1, Load analysis based on the intended operations of the boat will be submitted for approval.

2.4 In addition to the requirements of the electrical protection devices of the system, Chapter 5 Electrical Installation Section 4 is applicable.

2.5 The cable requirements for the Battery System are to be evaluated with **TL** Rules, Chapter 5, Sec.12.
In addition, where required as result of the Risk Assessment, cables to be operable under fire conditions are to be of a fire-resistant type complying with IEC Publication 60331 series.

2.6 In addition to the requirements of the Power Management System (PMS) is to be provided Ch. 4-1.

2.7 In addition to the requirements of the Ventilation [9] is to be in compliance with Ch.28 Ventilation Rules.

3. System Design

3.1 The main sources of power shall consist of at least two independent battery systems located in two separate spaces.

3.2 Electrical insulation resistance to the earth of each battery system shall be monitored, and the low level below 50 ohms per 1 volt shall be given with an alarm. (Safety)

3.3 The battery system is to be fitted with an independent emergency shutdown mechanism adjacent. Circuits shall be hardwired and independent of control, monitoring, and alarm system circuits.

3.4 The emergency stop buttons shall be arranged at the following locations. In addition to the requirements as specified, Ch.5, Sec.9, B.3 are applicable.

- adjacent to (outside of) the battery space
  Navigation bridge

3.5 A battery system shall be able to supply the short circuit current necessary to obtain selective tripping of downstream circuit breakers and fuses. (if used as the main power for the propulsion)

3.6 It shall be possible to operate the battery system locally. This local operation shall be independent of remote control systems (IAMS, PMS).

Note: *The requirement for local operation applies only to vessels where the battery system is necessary in order to maintain propulsion. This does not apply to hybrid solutions where the main class propulsion requirement is fulfilled by diesel or gas-fuelled propulsion engine(s) or generator(s).*

The local operation workstation can be located at the battery system, the switchboard room or the battery converter. Local operation is understood as being able to connect the battery system to the switchboard.

3.7 In the event of a battery system overheating, a visible and audible request for manual load reduction shall be provided on the bridge. Alternatively, a reduction in load can be implemented automatically.

3.8 Batteries and propulsion motors should be placed closer to one another to minimize power loss.

4. Battery Capacity

4.1 The capacity of the batteries is to be sufficient for the intended operation of the vessel, when the batteries are used in place of the required main sources of power as specified in Ch.5, Sec.3, B, 1 Electrical Installation Rules.

4.2 The design ensures that any single fault in the battery system, eg. Loss of the main switchboard or main power source, shall not render any main functions unavailable for more than the maximum restoration time. The energy remaining after any single fault condition If the battery system uses as the main supply or main propulsion power source shall be sufficient for its intended operation as item 4.1.

4.3 Provide a failure analysis that takes into consideration a single failure of the battery system and the ship's capacity to reach a safe destination or operate life-saving appliances and safety systems.

** Operation limitation shall be indicated in the vessel certification.*

5. Electrical Protection

5.1 All outgoing circuits of the battery system are to be protected against overload and short circuits.

If the battery system is composed of paralleled strings, each string of batteries is to be provided with individual protection.

5.2 The battery system is to have means by which it can be electrically isolated for maintenance purposes. This isolation mechanism is to be independent of the emergency shutdown arrangement. Switching devices are to be provided to prevent accidental battery turn-on.

6. Energy Management System (EMS)

6.1 An energy management system (EMS) shall be provided.

6.2 The energy management system (EMS) is to be provided complying with the requirements of Electrical Installation Ch.5, Sec.9, consisting of several levels of controls and alarm functions, such as:

- Monitoring and alarm functions of all power sources, inverters and disconnectors;
- Voltage and power control for DC distribution system;
- Available power and charge/discharge status of the stored energy source;
- Interface with Power Management System (PMS) for combinations of AC and DC distribution systems;
- Inverter control for the overall system.

6.3 The energy management system (EMS) is to be independent of:

- The power management system (PMS), and
- The battery management system (BMS) for lithium batteries.

6.4 The energy management system is redundant, and redundancy is to be ensured to the relevant power supplies. It is to be continuously supplied by uninterruptible power supply systems (UPS), and a failure is to initiate an alarm in a manned location.

6.5 The following parameters shall be provided with remote monitoring at the navigation bridge:

- The energy available from batteries (SOC)
- Power available from batteries,
- Time or range for which the battery can provide energy and power according to actual operational conditions,
- Battery state of health (SOH).

6.6 The following warning alarms shall be provided at the navigation bridge:

- Reaching the minimum capacity as required for planned operation or voyage.

7. Location

7.1 Batteries are to be located in dedicated spaces reserved for batteries within the machinery space or adjacent to it if they are used as storage of power dedicated to the propulsion system or as part of the main electrical power source.

7.2 If the battery system is to be used as part of the emergency source of electrical power, it is not to be installed in the same space as the emergency switchboard. If the battery bank is used in conjunction with an emergency power source (e.g., emergency diesel generator), it should not be located in same space as the emergency power source. Both spaces are to be readily accessible and as near as practical.

7.3 Batteries are not to be located in a battery box at open deck exposed to sun and frost.

7.4 Batteries shall be so installed to ensure accessibility for changing cells, inspection, testing, topping-up and cleaning.

7.5 Storage batteries shall not be installed in the accommodation area or in cargo holds.

8. Battery-Space

8.1 Battery spaces are not to be located forward of the collision bulkhead. The battery space's boundaries shall be part of the vessel structure or enclosures with equivalent structure integrity.

8.2 In order to prevent the loss of essential services in the event of an accident such as thermal runaway, battery spaces shall not contain any equipment (including cables and pipelines) supporting essential services as described in Ch.5, Sec.1 of the Electrical Installation.

8.3 Battery space shall be accessible for replacement of parts of the system.

8.4 Battery spaces shall provide protection against external hazards (e.g. fire, mechanical impact).

8.5 The battery space is not to contain heat sources or high-fire-risk objects.

Note:
High fire risk objects are objects to those listed in SOLAS Reg. II-2/3.31. Heat sources are sources with temperature higher than 220 °C as used in SOLAS Reg. II-2/4.2.2.6.1.

8.6 Battery spaces are to be arranged in such a way that danger to persons and damage to vessel is avoided due to failure of the batteries (e.g. caused by gassing, explosion, and fire).

8.7 According to the risk assessment that includes evaluation based on battery chemistry as specified in Sec.1, Table 1.1, 1.9 fixed fire detection and fire extinguishing system shall be provided in the battery space. The extinguishing system is selected according to the manufacturer's instructions. Examples of fire extinguishing systems may be a powder or a, gas-based or water-based fixed fire extinguishing system provided.

8.8 Electrical equipment in battery space shall be certified of safe type with explosion protection of IIC T1 at least.

8.9 As independent of the battery system, battery space ambient temperature shall be monitored, and high temperature shall be given alarm at a continuously manned location.

8.10 Access to the battery space shall be through a self-closing or normally closed door with an alarm.

9. Ventilation

9.1 Battery room is to be air-conditioned and also mechanically ventilated (the temperature control shall follow recommendations given by the battery maker – max. and min.) and discharges from the exhaust fans are to be provided to a place on the open deck where the such discharge will not cause a fire or explosion hazard.

9.2. The ventilation ducting system shall be reasonable gas-tight and able to withstand the off-gas temperature.

9.3 In the event of gas-off from the batteries, the battery space ventilation shall be activated.

9.4 The ventilation system for the battery space is to be independent of any other ventilation systems serving other ship spaces.

9.5 Where installed fans in the battery space are to be of a non-sparking type and shall provide six (6) air changes per hour.

9.6 In case of fire in the battery space, ventilation shall be stopped automatically.

9.7 Ventilation shall be able to be started and stopped locally without entering the battery space. Failure of the automatic or remote control system must not preclude the use of local manual control.

9.8. The power of the ventilation shall be supplied from two separate power sources at least.

9.9. Indication of running and fault of the ventilation shall be provided at a continuously manned location.

9.10 Ventilation inlet and outlet openings shall be arranged to ensure fresh air flows over the surface of the storage battery. The air inlet openings shall be arranged below, and the air outlet openings shall be arranged above. In addition to these requirements, Sec.3, E, Battery Space Hazardous Area Definition shall be considered.

10. Gas Detector

10.1. The battery space shall be equipped with gas detection systems that are compatible with the battery chemistry in use.

10.2. Whenever the concentration of gas in the battery space reaches 30% LEL, the gas detection system is to be given an alert at the bridge and instantly disconnect the battery system. The ventilation at the battery space is to be started before the gas level reaches 30%.

10.3. Giving an alarm at 60% LEL and automatic disconnection of all non-certified electrical equipment at the battery space shall be provided.

10.4 Any failure of the gas detection system shall not cause of closed the battery systems.

B. Fire Protection

1. For battery spaces housing batteries in accordance with this Section, the Battery Space is considered as Machinery Space Category A as defined in SOLAS Regulation II-2 and is subject to the structural fire protection requirements listed therein.

2. A battery space that contains a battery system with stored energy shall be defined as:

- Areas of major fire hazard ('fire category A') on vessels built according to Ch.7 High-Speed Craft.
- Fire category 6 (machinery space of category A) on a cargo vessel passenger ship carrying not more than 36 passengers built according to SOLAS Ch. II-2
- Fire category 12 (machinery space of category A) on a passenger vessel carrying more than 36 passengers built according to SOLAS Ch. II-2.

3. Any battery spaces constructed with SOLAS Ch.II-2 in addition to item 2 shall have A60 fire integrity towards;

- Machinery spaces of category A as defined in SOLAS Reg. II-2/3
- Enclosed cargo areas for carriage of dangerous goods.
- spaces with high or moderate fire risk

4. The fire category and structural fire protection shall provide equivalent protection to the above for vessels built to different standards than SOLAS Ch.II-2 and Ch.7, High-Speed Craft TL regulations.

C. Fire Detection

1. A fixed fire detection system shall be provided in all battery spaces. Combined multi-smoke and heat detectors or both smoke and heat detectors shall be installed. The arrangement shall comply with the international code for fire safety systems (FSS code).

2. The components of the fire detection system installed inside the battery space shall be of a certified safe type for use in explosive atmosphere.

D. Fire Extinguishing System

1. Battery spaces shall be protected by a fixed fire extinguishing system. Any of the following systems by also taking into account the manufacturer's recommendation will be accepted:

- Water-based system according to IMO MSC/Circ. 1165, as amended by MSC.1/Circ.1269 and MSC.1/ Circ.1386
- A gaseous agent according to FSS Code Ch.5, IMO MSC/Circ.848, as amended by IMO MSC/Circ. 1267 and FSS Code Ch.5,
- A CO_2 system as specified in FSS Code Ch.5 and, FSS Code Ch.5.

** The automated discharge of water-based extinguishing systems shall be permitted by the flag administration on a case-by-case basis.*

E. Battery Space Hazardous Area Definitions

1. The functioning of a battery may result in the production of flammable gases, depending on the c onstruction and chemistry of the battery. According to IEC 60079-10-1, battery space must be classified as hazardous. In addition, the following additional conditions shall be satisfied for batteries of this type:

2. The Operations and Maintenance Manual should list hazardous gases released.

3. The equipment selection is to comply with the applicable requirements in Chapter 5.

4. The hazardous area plan and related electrical equipment list for the battery space is to be part of the overall hazardous area plan for the vessel.

5. The space for the batteries shall have an independent deck drain. It is required that the independent deck drain be drained either to a secure area or to a closed drain tank. The drain tank is to be provided with:

- A vent pipe to a safe location on the open deck
- Adequate capacity
- A high-level alarm
- The material of the drainage piping systems, tanks, and other components which may come into contact with corrosive materials in the presence of liquid electrolyte solution is to be of a suitable grade of alloyed steel coated with appropriate anti-corrosion coating, non-combustible plastic, or other compatible material established to be suitable for the application. Non-alloyed steels, copper, copper-containing alloys, and zinc-coated steels are not to be used for the drain tank or piping systems.

6. Areas on the open deck within 3 meters of the battery space intake(s) and exhaust ventilation outlet(s) are to be classified as Zone 2 hazardous areas.

SECTION 4

CERTIFICATION, TESTING and INSPECTION

Page

A. Certification

1. The provisions in this section are requirements for obtaining of classification of **Li-BATTERY** notation.

2. Battery system used as storage of power dedicated to the propulsion system, as part of the main source of electrical power, as alternative power supply or as transitional power supply to emergency services is to be type approved.

3. The battery system is to be provided with test certificates issued by the Manufacturer or by an independent testing organisation the tests are to be carried out at the presence of and to the satisfaction of the attending **TL** surveyor. Relevant Test Reports are to be submitted for acceptance.

4. Batteries are to be subjected to functional and safety tests according to IEC Publication 62620 and 62619 or in accordance with other equivalent national or international standards recognized by **TL.**

5. Battery chargers are to be tested according to Ch.5, Sec.20, D in addition the correct operation of the communication system between the charger and the BMS is to be verified.

6. Performance tests are to be carried out on the battery system according to a test program which is to be submitted for approval (see Section 1, C.1) and which is to include functional tests (alarm system, safety system, control system, etc.) and further tests, if any, resulting from the Risk Assessment.

7. On the issued Type Approval certificate, the following information shall be provided at a minimum;

- Module capacity,
- Maximum ambient operating temperature limit
- Module operating voltage Range
- Module and cell shutdown voltage limit
- Limit for continuous charge and discharge
- Peak bolted short circuit current
- Rating regarding equipment ingress protection
- Gas volume generated (calculate per module)
- Classification of gas temperature and zone group (Gas Analyisis)

8. For type approved products, tests to verify the conformity of the product with the approved prototype are to be carried out before installation on board; the tests are to be carried out according to a test program which is to include functional tests (alarm system, safety system, control system, etc.) and further tests, if any, resulting from the Risk Assessment.

9. The battery system includes BMS is subjected to type approval certification plus **TL** test certification per vessel or **TL** product certification per vessel. Please see “Rules for Testing and Certification of Materials and Equipment to be used in ships classed by Türk Loydu” on **TL** website.

Type tests from Table 4.1 are to be carried out during type approval process on the prototype. Routine tests are to be carried out on the type of certifed systems before installation onboard.

10. For product certification all tests from Table 4.1 are to be performed on the certification process for each battery system.

11. The energy management system (EMS) shall be certified by **TL**. The energy management system may be used within different systems such as "Power Management System (PMS) " or "Automation- refers to Ch.4-1 TL rules". In this situation, EMS shall be certified as a part of these systems.

The power management system (PMS) shall be certified by **TL** in accordance with IEC 60092-504.

Batteries converters, including the control system used for the essential of the main, emergency or transitional source of power are to be certified to meet the requirements specified in Ch.5, Sec.20, D, of the Electrical Installation, as applicable.

Table 4.1 Type and Routine Tests

No	Test	Type Test	Routine Test	Reference
1	External short-circuit test	X		IEC 62619 7.2.1
2	Impact test	X		IEC 62619 7.2.2
3	Drop test	X		IEC 62619 7.2.3
4	Thermal abuse test	X		IEC 62619 7.2.4
5	Overcharge test	X		IEC 62619 7.2.5
6	Forced discharge test	X		IEC 62619 7.2.6
7	Internal short-circuit test/Propagation test	X		IEC 62619 7.3.2/7.3.3
8	Overcharge control of voltage	X		IEC 62619 8.2.2
9	Overcharge control of current	X		IEC 62619 8.2.3
10	Overheating control	X		IEC 62619 8.2.4
11	Battery system/BMS safety function tests		X	Sec. 3, B-D-E
12	Battery system cell and module voltage measurement		X	Sec.3, B.7
13	Battery system / cabinets temperature measurement during rated operational conditions.		X	Sec.3, B.7
14	Battery system cooling method control		X	Sec.3, B.4

B. Plans to be Kept on Board

At a minimum, the following documents are to be kept on board for easy reference by the crew during maintenance or repair:

An operation manual is to be kept on board which includes at least:

- Charging procedure,
- Normal and local operating procedures of the battery system,
- Emergency operation procedures,
- Estimated battery deterioration (ageing) rate curves, considering modes of operation.

A plan for systematic maintenance and function testing shall be kept on board showing in detail how components and systems shall be tested and what shall be observed during the tests. It also includes validation procedures for SOH.

C. Testing After Installation on Board

1. After installation, and after any important repair or alteration which may affect the safety of the arrangement, at least the following items are to be checked to the satisfaction of the Surveyor in charge:

- Visual inspection,
- Operational tests,
- Tests of proper working of all the alarms and related functions,
- Charging and discharging capacities,
- Emergency shutdown operation,
- Checking of operation of sensors, including simulation of changes in parameters and simulation of sensor failure,
- Simulation of communication failure,
- Insulation resistance test,

- Correct operation of ventilation, cooling, gas detection system, fire detection system and fire extinguishing system, etc., where provided.

2. All periodical surveys associated with the **Li-BATTERY** notation are to be carried out at the same time and interval as the periodical survey of the vessel.At the discretion of **TL**, the checks may be carried out directly by the Manufacturer of the installation or by the person responsible for maintenance authorised by the above-mentioned Manufacturer and certified by the appointed **TL** Surveyor.