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CHINA CLASSIFICATION SOCIETY

# **Technical Guidelines for the Safety of Ro-ro Carriage of New Energy Vehicles**

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# CHAPTER 1 GENERAL

## 1.1 Purpose

1.1.1 The purpose of the *Technical Guidelines for the Safety of Ro-ro Carriage of New Energy Vehicles* (hereinafter referred to as “the Guidelines”) is to provide additional safety measures for ro-ro new energy vehicles (NEVs) ships.

## 1.2 Application

1.2.1 The Guidelines apply to the vehicle carriers/ro-ro ships carrying commercial cars and ro-ro passenger ships applying for a NEV Carriage class notation as described in 1.4.1 of this chapter. For other ships ro-ro carrying NEVs, the Guidelines may be referred to.

1.2.2 The part or all of the contents of the Guidelines, if included by the Administration of the Flag State as its statutory requirements, are to be regarded as mandatory requirements, except 1.4 of this chapter.

## 1.3 General requirements

1.3.1 In addition to CCS (China Classification Society) *Rules for Classification of Sea-Going Steel Ships, Rules for Construction of Sea-Going Ships Engaged on Domestic Voyages, or Rules for the Construction of Inland Waterways Steel Ships*, and the relevant provisions of the Administration, ro-ro NEVs ships are to comply with the requirements of the Guidelines.

1.3.2 In addition to the *International Code for Fire Safety Systems* (FSS CODE) or the relevant requirements of the Administration, fire safety systems and equipment are to comply with the Guidelines.

1.3.3 For the specific requirements in Chapter 2 to Chapter 4 of the Guidelines, equivalent design and arrangements may be accepted, subject to satisfactory evaluation and agreement by CCS.

## 1.4 Class notations

1.4.1 CCS classed vehicle carriers/ro-ro ships carrying commercial cars and ro-ro passenger ships which ro-ro carry NEVs may be assigned with the following class notation if the appropriate requirements for the corresponding vehicle type in the Guidelines are complied with:

NEV Carriage (X)

Where, X means the type of NEVs, which may be B, H, N, or a combination of them. B stands for lithium battery-powered electric vehicles, H for hydrogen-powered vehicles, and N for natural gas-powered vehicles. When more than one vehicle type is assigned to a ship, they are to be sequenced in the order of B, H, and N, for example, NEV Carriage (B, H) or NEV Carriage (B, H, N).

1.4.2 The class notation in 1.4.1 of this chapter is categorized as the Cargo Characteristics.

## 1.5 Definitions

1.5.1 For the purpose of the Guidelines, the definitions are as follows:

(1) Ro-ro spaces are spaces not normally subdivided in any way and normally extending to either a substantial length or the entire length of the ship in which motor vehicles with fuel in their tanks for their own propulsion, lithium battery-powered electric vehicles and/or goods (packaged or in bulk, in or on rail or road cars, vehicles (including road or rail tankers), trailers, containers, pallets, demountable tanks or in or on similar stowage units or other receptacles) can be loaded and unloaded normally in a horizontal direction.

(2) Vehicle spaces are cargo spaces intended for carriage of motor vehicles with fuel in their tanks for their own propulsion and/or lithium battery-powered electric vehicles.

(3) New energy vehicles are lithium battery-powered electric vehicles, hydrogen-powered vehicles, and natural gas-powered vehicles.

(4) Lithium battery-powered electric vehicles are motor vehicles with lithium-ion battery pack(s) for their own propulsion, including pure lithium battery-powered electric vehicles and plug-in hybrid lithium battery-powered electric vehicles.

(5) Hydrogen-powered vehicles are motor vehicles with compressed hydrogen in their tanks for their own propulsion, including hydrogen fuel cell vehicles and hydrogen internal combustion engine vehicles.

(6) Natural gas-powered vehicles are motor vehicles with natural gas in their tanks for their own propulsion.

1.5.2 Other terms in the Guidelines are the same as those defined in CCS rules and the regulations of the Administration.

## **1.6 Plans and documents**

1.6.1 In addition to the plans and documents required by the relevant CCS rules, ships are to comply with the requirements of 1.6.2 to 1.6.4 in this chapter.

1.6.2 The following plans and documents relating to the vehicle spaces, ro-ro spaces, or special category spaces of ships are to be submitted to CCS for approval (or for information):

(1) Vehicle loading arrangements (showing the allowable loading areas or spaces for new energy vehicles, and their marking);

(2) Video surveillance system arrangements;

(3) Smoke exhaust piping diagrams with the calculation of total volume and air change rate of the spaces;

(4) Electrical equipment arrangements and lists of equipment, indicating the type of explosion protection, explosion protection category, temperature group, and level of protection (if applicable);

(5) Infrared temperature monitoring system diagram (if applicable);

(6) Image fire detection system diagram (if applicable);

(7) Fixed gas fire-extinguishing system arrangements and extinguishing medium calculation (if applicable);

(8) Risk assessment documents (for information, if applicable), at least including:

① hazard identification (list of all potential hazards);

② risk assessment (risk factor assessment);

③ risk control options (measures for design control and risk-reducing);

④measures to be taken.

1.6.3The plans and documents required in the Guidelines need not be reviewed/approved again if they are already included in other plans and documents submitted for review.

1.6.4Documents on board:

- (1) The emergency response information is to cover the requirements for NEVs;
- (2) The fire patrol and drill information is to cover the requirements for NEVs.

## **CHAPTER 2 GENERAL REQUIREMENTS FOR CARRIAGE OF NEW ENERGY VEHICLES**

### **2.1 General provisions**

2.1.1 This chapter applies to vehicle spaces, ro-ro spaces and special category spaces on board a ship intended for carriage of all types of NEVs.

### **2.2 Loading areas**

2.2.1 The allowable loading areas or spaces are to be designated according to the type of NEVs.

2.2.2 The allowable loading areas or spaces are to be distinctly identified with marks that are different for different types of NEVs. Such marks are to be permanent or painted.

2.2.3 Vehicle loading arrangements are to be available on board to show the allowable loading areas or places for each type of NEVs.

### **2.3 Ventilation Systems**

2.3.1 The mechanical ventilation system in closed vehicle spaces, closed ro-ro spaces and special category spaces is to meet the following requirements:

- (1) The system is to be designed considering the diffusion of combustible gas that may leak or release from power batteries or fuels of vehicles to prevent air stratification and formation of airbags;
- (2) The outlet from any exhaust duct is to be located in a safe position and as far away as possible from the doors, windows, and other openings of superstructures or deckhouses, and other equipment that may constitute a source of ignition;
- (3) Ventilation fans are to run continuously whenever NEVs are in the spaces;
- (4) Exhaust fans are to be of non-sparking type;
- (5) Suitable wire mesh guards are to be fitted at the air inlets and outlets to prevent the entry of foreign bodies.

### **2.4 Measures to prevent combustible gas into other compartments**

2.4.1 The ventilation, smoke exhaust, and drainage pipes of vehicle spaces, ro-ro spaces and special category spaces are to be arranged to prevent combustible gas into other vehicle spaces, ro-ro spaces, special category spaces and any other compartment through these pipes directly.

### **2.5 Fire detection and alarm**

2.5.1 A combination of smoke, temperature or flame detectors is to be provided for the vehicle spaces, ro-ro spaces and special category spaces, and at least smoke detectors are to be included.

2.5.2 In ro-ro passenger ships, the fixed fire detection and fire alarm system in the ro-ro spaces and special category spaces is to be capable of remotely and individually

identifying each detector and manual alarm button. The alarm system section numbering is to consistent with that of other systems, such as video surveillance systems, temperature monitoring systems, image fire detection systems, or fixed water-based fire extinguishing systems, if available.

## **2.6 Video surveillance systems**

2.6.1 Vehicle spaces, ro-ro spaces and special category spaces are to be equipped with a video surveillance system. The number and arrangements of cameras are to enable the crew to observe the important position of the allowable loading areas or spaces of NEVs through the video display screen, such as the entrances and exits, vehicle ramps, and ends of the spaces. The system is to be capable of clearly monitoring images at night and providing instant video playback.

## **2.7 Fire-fighter's outfits**

2.7.1 Ships are to be provided with at least two additional fire-fighter's outfits. They are to be kept ready for use in an easily accessible location outside of the vehicle spaces, ro-ro spaces and special category spaces, and be away from each other.

## **2.8 Smoke exhaust systems**

2.8.1 A mechanical smoke exhaust system is to be provided for closed vehicle spaces, closed ro-ro spaces and special category spaces. The system is to meet the following requirements:

- (1) The smoke exhaust fan is to at least provide 6 air changes per hour to discharge the smoke in such spaces;
- (2) The system is to be controlled manually, and the manual control device is to be located in a safe position outside the protected spaces and easily accessible;
- (3) The inlet of a smoke exhaust duct is to be located in the upper and lower parts of the compartment, and the outlet is to be located in a safe position and as far away as possible from the doors, windows, and other openings of superstructures or deckhouses, and other equipment that may constitute a source of ignition;
- (4) When the inlet temperature of the smoke exhaust duct reaches 280°C, all the smoke exhaust fans serving the place are to be able to automatically shut down;
- (5) Smoke exhaust fans are to be of non-sparking type;
- (6) The smoke exhaust ducts are to be made of steel or other equivalent materials, and their arrangement and penetration details are to meet the relevant requirements for the ventilation system.

2.8.2 The smoke exhaust system can be combined with the ventilation system described in 2.3.1 of this chapter, in which case the ventilation system is to meet the requirements of 2.8.1 of this chapter.

# CHAPTER 3 SPECIAL REQUIREMENTS FOR CARRIAGE OF LITHIUM BATTERY-POWERED ELECTRIC VEHICLES

## 3.1 General provisions

3.1.1 In addition to complying with the requirements of Chapter 1 and Chapter 2 of the Guidelines, vehicle spaces, ro-ro spaces and special category spaces intended for carriage of lithium battery-powered electric vehicles are to comply with the requirements of this chapter.

## 3.2 Loading areas

3.2.1 The allowable loading areas or spaces for lithium battery-powered electric vehicles are not to be adjacent to the tanks for storing fuel, lubricating oil, or other flammable oils. If this is impractical, the common boundary area is to be minimized and comply with the requirements of 3.5.1 of this chapter.

3.2.2 According to the potential high-temperature climate in the service area, effective measures (e.g. watering pipes for cooling) are to be taken, if necessary, to prevent adverse impacts on the power battery of lithium battery-powered electric vehicles on the weather deck.

## 3.3 Detection and alarm

3.3.1 At least two portable gas detectors are to be provided for the detection of combustible gas (at least hydrogen and carbon monoxide) that may be released from power batteries. Such detectors are to be of a certified safe type<sup>1</sup> for use in the explosive atmosphere of the combustible gas and air mixture.

3.3.2 At least two portable thermal imagers are to be provided which are to be designed, manufactured, and tested according to recognized standards<sup>2</sup> and approved by CCS.

3.3.3 In ro-ro passenger ships, in addition to fixed fire detection and fire alarm systems, ro-ro spaces and special category spaces are to be provided with an image fire detection system. The weather decks maybe only fitted with an image fire detection system. The system is to meet the following requirements:

(1) Detectors are to be activated at the flame generated during combustion through video image analysis. Detectors are to be designed, manufactured, and tested according to recognized standards<sup>3</sup> and approved by CCS. Detectors are to be arranged to ensure that the field of view image can cover all the allowable loading areas for lithium battery-powered electric vehicles, and to avoid being installed at the positions that are easy to be blocked, polluted by water vapor, oil, etc., and the positions that may cause impact or physical damage;

(2) The system is to be capable of remotely and individually identifying each detector;

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<sup>1</sup>Refer to the Recommendations of the International Electrotechnical Commission, in particular, publication IEC 60079.

<sup>2</sup>E.g. GB/T 19870-2018 Industrial Detection Infrared Thermal Imaging Devices.

<sup>3</sup>E.g. GB 15631-2008, Special Fire Detectors.

(3) The alarm system section numbering is to be consistent with that of other systems, such as fixed fire detection and fire alarm systems, video surveillance systems, and fixed water-based fire extinguishing systems, if available;

(4) The system may be combined into one device with the video surveillance system described in 2.6.1 of Chapter 2 of the Guidelines.

3.3.4 Ro-ro passenger ships, ro-ro spaces and special category spaces may be provided with an infrared temperature monitoring system as an alternative to the image fire detection system required in 3.3.3 of this chapter. The system is to meet the following requirements:

(1) The system is to be able to cover all the allowable loading areas for lithium battery vehicles;

(2) A temperature alarm value is to be set appropriately for the system and is not to exceed 80°C. The alarm is to be sent out in the navigation bridge, or in spaces where the crew are often on duty;

(3) The system may be combined into one device with the video surveillance system described in 2.6.1 of Chapter 2 of the Guidelines.

### **3.4 Electrical equipment and cables in ventilation/exhaust ducts**

3.4.1 Electrical equipment, if installed in any exhaust ventilation duct or smoke exhaust duct, is to be of a certified safe type<sup>1</sup> for use in the explosive atmosphere of combustible gas that may be released from power batteries and air mixture.

3.4.2 Electrical equipment, if installed in any supply air duct, is to be of a certified safe type<sup>2</sup> for use in the explosive atmosphere of combustible gas that may be released from power batteries and air mixture, except when the followings are met:

(1) At least one gas detector is provided at any air supply outlet;

(2) The detector is interlocked with all electrical equipment in the air supply duct. When detecting the concentration of combustible gas and air mixture in the duct reaching 20% of the lower explosive limit, an alarm is to be activated in the navigation bridge and all electrical equipment in the air supply duct is to automatically shut down.

3.4.3 Cables, if available, in ventilation and smoke exhaust ducts are to be armored or laid in metal pipes.

### **3.5 Structural protection**

3.5.1 The fire integrity of the boundary bulkheads and decks of vehicle spaces, ro-ro spaces or special category spaces are to be insulated to "A-60" class standard. However, where an open deck space, toilet, liquid tank with little fire risk, or a void space, is on one side of the division, the standard may be reduced to "A-0". In vehicle carriers and ro-ro ships carrying commercial cars, where fuel oil tanks are below a vehicle space or a ro-ro space, the integrity of the deck between such adjacent spaces may be reduced to "A-0" standard.

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<sup>1</sup>Refer to the Recommendations of the International Electrotechnical Commission, in particular, publication IEC 60079.

<sup>2</sup>Refer to the Recommendations of the International Electrotechnical Commission, in particular, publication IEC 60079.

3.5.2 The fire integrity of ro-ro decks separating vehicle spaces, ro-ro spaces and special category spaces is to be of "A-60" class standard. In ro-ro ships carrying commercial cars, the fire integrity of the decks between open ro-ro spaces may be of "A-0" standard.

3.5.3 In addition, ro-ro passenger ships are to meet the following requirements:

- (1) For weather decks intended for carriage of lithium battery-powered electric vehicles, the fire integrity of bulkheads between such spaces and adjacent enclosed spaces are to be A-60;
- (2) Weather decks located above ro-ro spaces or special category spaces, if used as the lifeboat embarkation area, are to be insulated to "A-60" standard.

### **3.6 Watersupply systems**

3.6.1 At least four jets of water with required pressure and flow are to be provided for weather decks, open vehicle spaces and open ro-ro spaces. The total capacity of fire pumps is to be capable of delivering water to four nozzles of the required size at the required pressure, and reaching any part of such spaces when empty.

### **3.7 Fixed fire-extinguishing systems**

3.7.1 In ro-ro ships carrying commercial cars, the fixed water-based fire extinguishing systems installed in ro-ro spaces are to be approved in accordance with the guidelines<sup>1</sup> developed by the International Maritime Organization (IMO). The system provider is to provide a document describing the allowable vehicle size under the system layout, which can ensure that the arrangement and type of nozzles will not affect the atomization effect of the maximum height limit vehicle. The document is to be kept on board and incorporated into the company's safety management system.

3.7.2 In ro-ro passenger ships, if ro-ro spaces are provided with only one fixed gas fire extinguishing system, the system is also to meet the following additional requirements:

- (1) Such spaces are to be capable of being sealed from a location outside and all openings are to be closed before the extinguishing agent is released;
- (2) Measures are to be taken to deal with the re-ignition of the power battery of lithium battery-powered electric vehicles. For this purpose, the system is also to be equipped with the extinguishing agent with the same amount as that required as a standby, gas cylinders, and relevant pipeline accessories, and designed to be capable of releasing all gas extinguishing agents in two times, with 50% of the total amount of extinguishing agent released each time;
- (3) After the system is operated, the space is to be sealed for enough time, and the doors are not to be opened until the space is cooled sufficiently;
- (4) The pipeline connector that can be connected with the shore-based equipment is to be set so that the shore-based equipment can supplement and release the extinguishing agent to the protected space through the gas fire extinguishing pipeline.

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<sup>1</sup>Refer to IMO Revised Guidelines for the Design and Approval of Fixed Water-Based Fire-Fighting Systems for Ro-Ro Spaces and Special Category Spaces (MSC.1/Circ.1430) and their amendments. As to paragraph 3.18 of MSC.1/Circ.1430, except for ships engaged on international voyages, only system operation and maintenance manuals/plans in Chinese are required onboard. There is no need to translate it into English, French or Spanish.

3.7.3 The Administration may permit the use of any other fixed fire-extinguishing system that has been shown by a full-scale test in conditions simulating a lithium-ion battery pack fire in a vehicle space, a ro-ro space or a special category space, to be not less effective in controlling fires likely to occur in such a space.

### **3.8 Fire-fighting appliances**

3.8.1 At least two portable foam fire extinguishers are to be added in vehicle spaces, ro-ro spaces and special category spaces, and stored near the allowable loading areas for lithium battery-powered electric vehicles so that the crew can use them easily in case of fire.

### **3.9 Drainage systems**

3.9.1 The drainage system of vehicle spaces, ro-ro spaces and special category spaces is to ensure that the accumulated water in such spaces can be removed in time, taking into account the removal of accumulated water generated by the additional water jet and water cooling system, if available.

### **3.10 Battery state of charge(SOC)**

3.10.1 For vehicle carriers/ro-ro ships carrying commercial cars intended for carriage of lithium battery-powered electric vehicles, the document delivered by the vehicle transport consigner to the shipper is to state in writing that the state of charge (SOC) of the vehicle power battery does not exceed 50%.

### **3.11 Vehicle charging**

3.11.1 Charging facilities for lithium battery-powered electric vehicles are not to be provided on board. For vehicle carriers/ro-ro ships carrying commercial cars, if there is a need for charging during vehicle unloading, a risk assessment is to be conducted, which is to be approved by CCS. The risk assessments are to include but not limited to:

- (1) Electrical protection grade design of charging facilities (including IP protection class, salt fog resistance and high temperature resistance, etc.);
- (2) Explosion protection design of charging facilities (including the installation of charging cables in charging stations);
- (3) Anti-vibration design of charging facilities;
- (4) Electromagnetic compatibility design of charging facilities;
- (5) Interference of voltage and frequency deviation on charging facilities;
- (6) Adaptability and security between network parameters and charging facilities;
- (7) Risk of charging cable (including electrical risk, connection falling off risk, wear and damage, etc.);
- (8) Procedures of charging cable storage, connection, and disconnection;
- (9) Manual and remote emergency shutdown design of charging facilities;
- (10) Design of charging device integrated into the ship's power management system;
- (11) Comprehensive protection design of charging device (including short circuit protection, overcharge protection, overheating protection, battery management system alarm shutdown, etc.);

- (12) Design of charging facilities abnormal information access to ship monitoring and alarm system;
- (13) Marking and identification of charging position;
- (14) Design of ventilation in charging position;
- (15) Design of fire safety in charging position.

# **CHAPTER 4 SPECIAL REQUIREMENTS FOR CARRIAGE OF HYDROGEN-POWERED VEHICLES AND NATURAL GAS-POWERED VEHICLES**

## **4.1 General provisions**

4.1.1 In addition to complying with the requirements of Chapter 1 and Chapter 2 of the Guidelines, vehicle spaces, ro-ro spaces and special category spaces intended for carriage of hydrogen-powered vehicles or natural gas-powered vehicles are to comply with the requirements of this chapter.

## **4.2 Gas detection**

4.2.1 At least two portable gas detectors are to be provided and such detectors are to be suitable for the detection of hydrogen (for hydrogen-powered vehicles) or methane (for natural gas-powered vehicles).

4.2.2 Such detectors are to be of a certified safe type<sup>1</sup> for use in the explosive hydrogen (for hydrogen-powered vehicles) or methane (for natural gas-powered vehicles) and air mixture.

## **4.3 Electrical equipment and cables**

4.3.1 All electrical equipment in closed vehicle spaces and ro-ro spaces is to be of a certified safe type<sup>2</sup> for use in an explosive atmosphere of hydrogen (for hydrogen-powered vehicles) or methane (for natural gas-powered vehicles) and air mixture. Cables in such spaces, including passing and terminal cables, are to be armored or laid in metal pipes.

4.3.2 Electrical equipment, if installed in any ventilation duct and smoke exhaust duct, is to be of a certified safe type<sup>3</sup> for use in an explosive atmosphere of hydrogen (for hydrogen-powered vehicles) or methane (for natural gas-powered vehicles) and air mixture. Cables, if available, in ventilation and smoke exhaust ducts are to be armored or laid in metal pipes.

## **4.4 Fire-fighting appliances**

4.4.1 At least half of the portable fire extinguishers equipped in vehicle spaces and ro-ro spaces are to be dry powder extinguishers and stored near the allowable loading areas for hydrogen-powered vehicles or natural gas-powered vehicles so that the crew can use them easily in case of fire.

## **4.5 Risk assessment**

4.5.1 For ro-ro passenger ships intended for carriage of hydrogen-powered vehicles or

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<sup>1</sup> Refer to the Recommendations of the International Electrotechnical Commission, in particular, publication IEC 60079.

<sup>2</sup> Refer to the Recommendations of the International Electrotechnical Commission, in particular, publication IEC 60079.

<sup>3</sup> Refer to the Recommendations of the International Electrotechnical Commission, in particular, publication IEC 60079.

natural gas-powered vehicles, a risk assessment is to be carried out, which is to be approved by CCS. The risk assessment is to include, but not limited to:

(1) The space containing the above vehicles is ventilated in such a way as to ensure the timely elimination of possible gas leakage under all circumstances without the risk of fire or explosion;

(2) The ship is designed in such a way as to ensure that the consequences of fire and explosion caused by vehicle fuel leakage/diffusion in high-risk scenarios will not affect the safe evacuation of passengers.