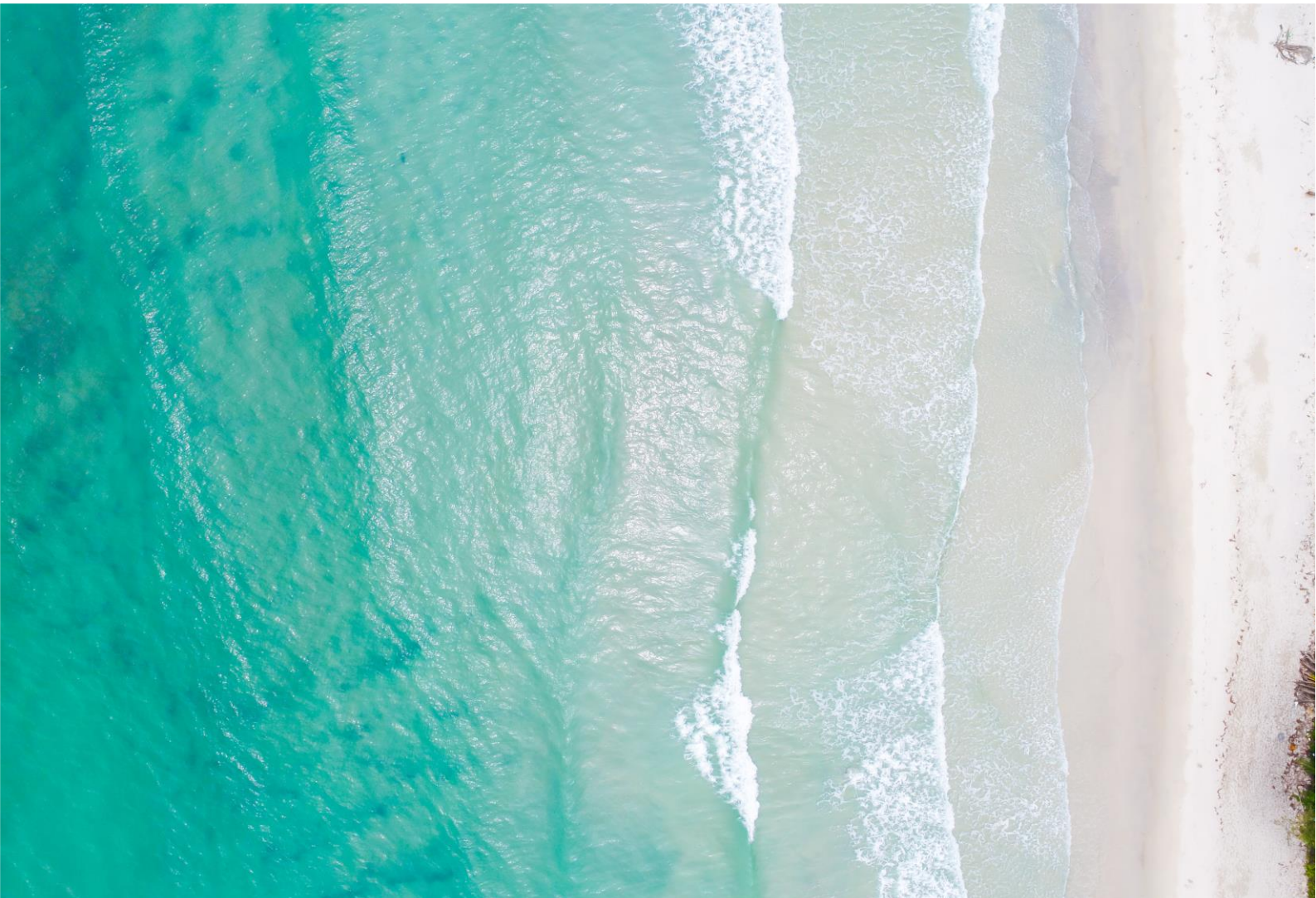


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**AFP-C(EV) Notation  
- For Safe Transportation of Electric Vehicles, 2023**



# AFP-C(EV) Notation

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### Executive Summary

With the increasing transportation of electric vehicles on ships, concerns regarding fire risks related to electric vehicles on ships have been emerging through the industries.

In response, Korean Register has developed Class Notation "**AFP-C(EV)**" to enhance the safety standards for PCTC (Pure Car and Truck Carrier)/PCC (Pure Car Carrier).

The primary goal of this document is to provide a realistic and practical understanding of the AFP-C(EV) Class Notation, without reiterating technical information already available in the market.

# Chapter 1 General

## 1. Background

With the advancement of technology, new types of cargo such as electric vehicles, hybrid vehicles, fuel cell vehicles have been increasingly transported by ships.

In particular, the risk of fire related to the transportation of electric vehicles on ships has increased. However, specific safety requirements are currently in the process of being developed by IMO and the related parties.

Effective fire extinguishing methods for electric vehicle fires remain unclear due to characteristics of electric vehicle battery fires known, such as thermal runaway, flammable/toxic gases emission, risk of electric shock, chemical reaction, re-ignition, difficulties to suppress battery fires, and practical limitations related to the ship's structure and densely loaded cargoes of PCTC (Pure Car and Truck Carrier)/PCC (Pure Car Carrier) vessels are pose major challenges.

To meet the industry demands, KR developed safety standards through collaboration with a PCTC shipping company and shipyard with in-depth discussions considering cost and feasibility.

As a result, KR released Class Notation "**AFP-C(EV)**", and this document was prepared for the purpose of facilitating understanding of the notation.

## 2. Application

**AFP-C(EV)** notation is applicable to ocean-going PCTC/PCC vessels.

The application of this notation is an optional and can be assigned to ships if complied with the requirements of "**KR Rules - 402.3 of Annex 8-9, Part 8**".

The submission of drawings and scope of survey work in relation to this notation is determined to minimize the level of burden levied on the ship-owner and shipyard to a level that does not deviate from the scope of the classification society's general survey work.

# Chapter 2 Requirements for AFP-C(EV) notation

## 1. General

Fire response principles can be divided into two distinct operations: "Fire detection" and "Fire fighting", and for such perspective, the **AFP-C(EV)** notation is prepared for related equipment/provisions of practical response on ships.

This chapter provides an explanation of equipment/provisions required by **AFP-C(EV)** notation, with major requirements of **AFP-C(EV)** summarized in the table below. For details, please refer to **KR Rules - 402.3 of Annex 8-9, Part 8**.

Item	Summary of AFP-C(EV) Notation Requirements
Fire Detection and Fire Alarm System	Installation of combined type smoke and heat detectors for ro-ro spaces and vehicle spaces
Camera (CCTV)	Installation of colour CCTV for monitoring ro-ro spaces and vehicle spaces, with colour video monitoring available at the navigation bridge or fire control station
Portable Thermal Imaging Camera	Two (2) Ex-proof type portable thermal imaging cameras are to be provided on-board
Additional Requirements for Fixed CO2 Fire-Extinguishing System	Installation of non-permanent connection between fire main line and CO2 discharge piping to provide an auxiliary means to cool down the temperature of ro-ro spaces and vehicle spaces
Additional Requirements	Two (2) sets of fire-fighter outfits in addition to SOLAS requirements One (1) water mist lance and One (1) fire blanket at each sealable cargo space (zone)

## 2. Fire Detection and Fire Alarm System

### 1) Combined-Type Smoke and Heat Detector

While SOLAS Convention and FSS Code require either a smoke type detector or heat detector for cargo spaces, it may not be effective considering the ship's structure, airflow, etc.

Considering the characteristics of smoke and heat generated in the event of a battery fire, installation of a combined type of smoke and heat detector can be a more effective way to detect fire events. In this perspective, KR notation requires the installation of combined-type smoke and heat detectors and fire alarms for ro-ro spaces and vehicle spaces.

### 2) Camera (CCTV)

PCTC/PCC vessels have large and consists of multiple deck spaces in cargo spaces, visual identification of fire can be of a challenge. In addition, considering cases where entry into the space is not available, remote monitoring means are required to assist in responding to fire events.

Therefore, by installing CCTV(s) that can identify colour images, monitoring can be made at the navigation bridge or fire control location, making it easy to identify in the event of fire. The installation number and location of CCTV are to be discussed with the Society.

### 3) Portable Thermal Imaging Camera

Thermal runaway and chemical exothermic reactions are well-known characteristics of battery fire even when the flames are believed to have been extinguished. Therefore, it is required to confirm that the temperature does not increase. In this regard, at least two (2) explosion-proof portable thermal imaging cameras are to be placed on board to measure the temperature during patrol and fire suppression operations.

### 3. Fixed Fire-Extinguishing System

#### 1) CO<sub>2</sub> Fire-Extinguishing System

High expansion foam fire-extinguishing system, CO<sub>2</sub> fire-extinguishing system and water-based fire-extinguishing system are considered acceptable types for installation in cargo spaces. High expansion foam fire-extinguishing system and CO<sub>2</sub> fire-extinguishing system are mainly applied as fixed fire-extinguishing system for cargo spaces of PCTC/PCC. For CO<sub>2</sub> fire-extinguishing system, once the total amount of CO<sub>2</sub> fire-extinguishing agents is discharged, there is no additional CO<sub>2</sub> fire-extinguishing agent remaining, and there is also the problem of entering the fire area.

When a CO<sub>2</sub> fire-extinguishing system is applied to a vessel, with a non-permanent connection, such as a spool piece or flexible hose, between the fire main line to the CO<sub>2</sub> discharge pipe, water can be supplied to CO<sub>2</sub> discharge nozzle as an auxiliary means to cool down the temperature of ro-ro spaces and vehicle spaces.

However, it is important to note that the purpose of this arrangement is to provide an auxiliary means to cool down the ro-ro spaces and vehicle spaces by supplying water through CO<sub>2</sub> discharge nozzles in case the total amount of CO<sub>2</sub> fire extinguishing agents is discharged in the event of a fire, or the CO<sub>2</sub> fire-extinguishing system fails to operate.

In addition, supplying seawater through CO<sub>2</sub> discharge nozzle does not provide the same fire extinguishing performance level as a water-based fire extinguishing system, such as a water spray system, for instance. It is an auxiliary means that can be expected to cool down the temperature inside the fire area, and this operation necessitates consideration of safety-related factors such as ship stability, fire extent, ship condition, and risk analysis, etc.

### 4. Fire-fighting Equipment

#### 1) Fire-fighter's Outfit

One of the difficulties of responding to fire events is that vehicles are loaded densely, and fire spreads to nearby vehicles once fire breaks out. In the event of a fire, crew members are directly involved in the fire-fighting operation, attention should be paid to the crew's safety.

Considering PCTC/PCC vessels are large and consist of multiple deck spaces in cargo spaces, and for feasibility reasons, KR requires two (2) sets of fire-fighter's outfits in addition to SOLAS requirements.

#### 2) Water Mist Lance and Fire Blanket

Electric vehicle fires pose a high safety risk due to the placement of batteries in the lower part of the vehicle, issues related to gas emissions, and the potential for fire propagation. In cargo spaces where a sizable number of vehicles are densely packed, the likelihood of a fire leading to a large-scale blaze due to rapid spreading is significant. Therefore, using a fire blanket to shield the vehicle and a water mist lance for water spraying inside the vehicle could be one method. When fire is detected early, employing a fire blanket for vehicle coverage can help prevent the spread of fire to nearby vehicles. Additionally, the use of a water mist lance for water spraying inside the vehicle at this stage can help in effective suppression. However, when using a water mist lance, it should be avoided from directly penetrating the battery or the hood of the vehicle, as it could increase the safety risk.

From this perspective, KR mandates the placement of one (1) fire blanket and one (1) water mist lance in each sealable cargo spaces, considering that PCC/PCTC vessels have typically four (4) cargo spaces(zone) to be sealed.

# Appendix – KR Rule 402.3 of Annex 8-9, Pt.8

## AFP-C(EV) notation

### 402. Ro-ro ship and vehicle carrier (2022)

#### 1. Application

This article is applicable to the ro-ro ship and vehicle carrier which apply to the following notations.

- (1) AFP-C: Ships whose cargo spaces comply with the requirements specified in **402. 2**
- (2) AFP-C(EV): Ships whose cargo spaces comply with the requirements specified in **402. 3**

#### 2. AFP-C

The fixed fire detection and fire alarm systems for all ro-ro spaces and vehicle spaces are to be capable of individually identifying each detector.

#### 3. AFP-C(EV) (2022)

The following requirements are to be satisfied for ro-ro spaces and vehicle spaces intended for the carriage of battery-powered electric vehicles and a plan for fighting its fire is to be available on board.

- (1) Fire detection and fire alarm system
  - (A) Combined-type smoke and heat detectors and fire alarms are to be arranged and installed for all ro-ro spaces and vehicle spaces.
  - (B) Cameras (CCTV) are to be installed to monitor the ro-ro spaces and vehicle spaces intended for the carriage of battery-powered electric vehicles. Color video monitoring is to be available at the navigation bridge or the fire control station.
  - (C) At least two explosion-proof portable thermal imaging cameras are to be provided on board to measure the temperature of the ro-ro and vehicle spaces periodically.

#### (2) Fixed fire extinguishing arrangement

Where the fixed CO<sub>2</sub> fire extinguishing system is fitted for ro-ro spaces and vehicle spaces, a connection such as a spool piece or flexible hose that connects the fire main system and the CO<sub>2</sub> discharge piping is to be provided to supply water to the CO<sub>2</sub> discharge nozzles. The purpose of this arrangement is to provide an auxiliary means to cool down the ro-ro spaces and vehicle spaces by supplying water to the CO<sub>2</sub> discharge nozzles, in case of the total amount of CO<sub>2</sub> extinguishing agent is discharged in the event of fire, or the CO<sub>2</sub> fire extinguishing system fails to operate.

#### (3) Fire fighting equipment

- (A) In addition to the fire-fighter's outfits required by **SOLAS Reg. Ch. II-2**, at least two sets of fire-fighter's outfits are to be provided in an easily accessible location adjacent to the designated area for the carriage of battery-powered electric vehicles.
- (B) At least one water mist lance together with at least one fire blanket shall be provided at each cargo space where capable of being sealed and carrying battery-powered electric vehicles.