

## Selected operational limitations in the operation of passenger and cargo ships under SOLAS Convention (1974)

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**Keywords:** SOLAS Convention, passenger ships, ferry safety, life-saving appliances, on board ships, maritime safety, mechanical propulsions

**JEL Classification:** Q25, Q48, R41, D81

### Abstract

Presented are regulations concerning the operation of passenger ships (with particular emphasis on Polish ferries) designed to increase maritime safety the SOLAS Convention, established in 1974 and codified in 2002, codifies these regulations, and the International Maritime Organization mandates additional regulations, created in response to a rapidly increasing number of maritime disasters. The analyses described herein were based on restrictions established for the “Jan Śniadecki” and “Mikołaj Kopernik” ferries. Safety of ro-ro units, which also typically have a significant number of people on board, was also analyzed. Also included in the study were ship operational- limitation characteristics with respect to structure, unsinkability, and stability of machinery and electrical equipment, fire protection, operational requirements, and rescue measures and devices, along with their purposes. Safety management consists of taking appropriate actions to prevent or minimize the effects of an accident or a disaster and is assessed on the basis of calculations and experience gleaned from analogous cases. Safety management can proceed if a problem has been thoroughly assessed. The potential risk of negative consequences with respect to the safety of the transport process as a whole must be considered, and the safety of the whole must not be risked for that of a particular part of it. A safety management decision can be made when its necessity is not in doubt. A problem is assumed to have only one solution. The effectiveness of the previously used method should be carefully assessed before proceeding to the next method. Security management is not easy and requires much professional knowledge and experience.

### Introduction

Safety constitutes an extremely important element of maritime shipping, and the International Convention for the Safety of Life at Sea (SOLAS, 1974) is the most well-known Convention on safety regulations involving ships in since May 25, 1980, and in Poland since June 15, 1984 (Jankowski, Purowski

& Olszak, 1996), the SOLAS Convention was adopted on November 1, 1974, by the International Conference for the Safety of Life at Sea. It replaced and repealed the previous Convention, which was signed in London on June 17, 1960, and was to become effective either 12 months from the date on which at least 25 countries became signatories to the Convention or on May 25, 1980, whichever date occurred first.

## Identification studies

The consolidated text of the 2002 SOLAS Convention consists of two parts, the first of which contains the 1974 SOLAS Convention and the 1988 protocols, requirements, and certificates. Its second part consists of Resolution A. 883 (21), entitled “Uniform Worldwide Implementation of the Harmonized System of Supervision and Certification (HSSC)”, the list of certificates and documents that every ship should carry on board, and lists of resolutions adopted at four successive conferences of the contracting signatory governments. Issues and ship requirements addressed by the Convention’s provisions are the following:

- Ship construction, unsinkability measures, and stability as well as machinery and electrical installation;
- Fire protection regulations;
- Life-saving appliances and devices;
- Radiocommunication arrangements;
- Conditions to maintain navigational safety;
- Cargo transportation specifications to avoid endangering ship and cargo safety;
- Provisions relating to the transport of potentially dangerous goods;
- Safety provisions for nuclear-powered ships;
- Principles of safe ship operation and management;
- Security measures for high-speed craft;
- Special measures intended to increase maritime safety; and
- Additional safety measures for bulk carriers.

To ensure the effectiveness of the Convention’s provisions its signatory governments have issued appropriate decrees, laws, and regulations, in effect mandating adoption of all measures to ensure maritime safety. All other agreements, treaties, and conventions relating to life at sea and applying to ships when the SOLAS Convention is inapplicable or to matters it does not cover remain in over their respective defined periods. When agreements, treaties, and conventions conflict with SOLAS Convention provisions, the latter take precedence and prevail.

The IMO (International Maritime Organization) and Conferences consider proposed amendments to SOLAS Convention provisions. Any instrument of acceptance, approval, or accession to the Convention shall become effective three (3) months after its deposit date with the IMO’s secretary general. A government may terminate the Convention only after five (5) years have elapsed since its entry into force for that government. Such a denunciation shall take effect one (1) year from the date the document

of denunciation was received. The Convention has been deposited with the secretary general of the IMO, who is obliged to deliver copies to the governments which have signed or acceded to it (IMO, 1974).

## SOLAS Convention Particulars

Regulations contained in the first chapter of the Convention apply only to ships engaged in international voyages. However, provisions of the SOLAS Convention do not apply to the following vessel types:

- Ships lacking mechanical propulsion;
- Ships not engaged in commercial navigation, e.g., yachts;
- Wooden ships of primitive construction;
- Fishing vessels;
- Ships for troop transportation and warships; and
- Vessels operating only in the Great Lakes of North America and on the River St. Lawrence.

A government official may perform ship inspections and reviews which the government may entrust to appointed inspectors. As Regulation 11 states, no changes may be made to a ship after a survey of it has been conducted. If a ship is involved in an accident or damage is detected following a survey, the ship’s master or operator must report the incident or findings, respectively, to the authorities or to the inspector who issued the relevant certificate, who should then initiate an inspection to determine whether a survey is needed. A Passenger Ship Safety Certificate is valid for one year, whereas the comparable certificate for cargo ships is valid for a time period not exceeding five years. In addition, the government of a ship involved in an accident is to undertake an accident investigation subject to SOLAS, and, upon conclusion of the investigation, that government is required to provide IOM with information on its results (IMO, 1974).

With regard to their construction, unsinkability, and stability, machinery and electrical installations on ships should be designed, maintained, and constructed in accordance with the requirements of the classification society. For instance, oil tankers and bulk carriers must have an effective corrosion protection system, and a tanker’s crew should have safe access to the bow even in difficult weather conditions. The floodable length of passenger ships refers to spaces below the line of the bulkhead (IMO, 1974; Plewiński, 1996). The Convention also stipulates location of the fore peak, or collision, bulkhead. In addition, the ship should have a stern peak

bulkhead and others located at the front and rear of the machinery space. Double bottom provisions apply to passenger and cargo ships other than tankers. On oil tankers, access to spaces in the cargo area is required. Regulation 14 deals with the construction and preliminary testing of watertight bulkheads and other structural elements of passenger and cargo ships. Each bulkhead should be constructed so as to withstand the pressure of a water column of the maximum height that could occur during the failure. Steps and recesses in bulkheads should be watertight and possess strength comparable to that of the rest of the bulkhead. The SOLAS Convention also specifies how side scuttles, watertight doors, watertight decks, tunnels, keels, and trunks are to be constructed. Distribution boxes and manually controlled valves in the gas piping system are to be located so as to be accessible. After completion of construction, a ship should be subjected to an inclining test, which should be repeated every five years the ship is in use (IMO, 1974; Jankowski, Purowski & Olszak, 1996).

The SOLAS Convention's section on ship construction, fire protection, and fire detection and extinguishing provides information for ships constructed on or after July 1, 2002. This section's content also applies to ships undergoing repair, dimensions or passenger accommodation spaces have been significantly and service life extended. Regulation 2 deals with fire safety tasks and "functional requirements", which concern division of a ship into primary horizontal and vertical zones and separation of rooms from the rest of the ship by means of structural and thermal partitions (IMO, 1974; Jankowski, Purowski & Olszak, 1996; Szyca, 1996). Also covered, *inter alia*, are limits on use of flammable materials; detection, limiting, and extinguishing of any fire its origin; constant readiness of fire-fighting equipment and devices and minimizing likelihood of igniting flammable cargo vapors. To prevent ignition of flammable materials or liquids (IMO, 1974), the following actions are specified:

- Control leakage of flammable liquids and minimize accumulation of flammable vapors;
- Reduce flammability of combustible materials and ignition sources;
- Maintain cargo-tank atmospheres out of explosive range;
- Use no liquid fuels having a flash point below 60°C; and
- Properly store, distribute, and use liquid fuel.

In addition, liquid fuel tanks must be located outside machinery spaces and must constitute a separate part of the hull structure. The Convention also

stipulates protection of surfaces, *i.e.*, installations, that are subject to high temperatures through use of lubricating oil, other flammable oils, liquid fuel in periodically unattended machinery spaces, gas fuel for commercial purposes, etc., and ballasting. Also discussed are inert gas installations on chemical and gas carriers, including their general requirements gas-measurement instruments, topics related to protection for cargo area and cargo pump rooms, fire potential and smoke, and toxicity.

Part C of Chapter II-2 is dedicated to fire suppression. In the event of a fire, patrols are to detect and locate and then alert the navigation bridge of the fire's occurrence and location. A permanent fire-detection and alarm system is to be installed in periodically unattended engine rooms and machinery spaces where automatic and remote control systems are installed. Smoke detectors must be deployed in living quarters, staircases, corridors, and ventilation ducts and along escape routes. On board passenger ships, cargo spaces must be equipped with detection and alarm systems. Regulation 8's purpose is to reduce the spread of smoke, and so. It specifies, *inter alia* protection of control posts located outside machinery spaces, smoke extraction from machinery spaces, and draft barriers. Regulation 10 governs isolation of fire to its point of origin, mandating use of technical and structural divisions to create compartments and divisions within a ship's structure. Moreover, adequate thermal insulation is to be installed within divisions commensurate with the fire risk these compartments and their adjacent spaces pose (IMO, 1974; Jankowski, Purowski & Olszak, 1996; Szyca, 1996).

Regulation 10 also describes the act of firefighting. For it to be effective, functional requirements must be met; that is, fixed fire extinguishing systems must be used, and fire extinguishing equipment must be easily accessible. Moreover, ships are to be equipped with fire pumps, hydrants, delivery hoses, and pipelines, and the regulation specifies the number and arrangement of and pressure within hydrants for both passenger and cargo ships. Specifically, the maximum water pressure in each hydrant should not exceed the pressure at which their associated delivery hoses were checked. Passenger ships should be equipped with at least three pumps gross tonnage of 4,000 and more, at least two pumps capacity of less than 4,000, at least two with less than 1,000, and one of the latter should be independently propelled (IMO, 1974; Oleszek, 1996; 1997).

Part E of Chapter II-2 deals with performance (*i.e.*, operational) requirements. The objective of

Regulation 14 is to maintaining and monitoring the effectiveness of ship fire safety measures. Fire safety systems and extinguishing installations and equipment must always be ready for immediate use, and periodic tests and inspections must ensure their continued readiness. Fire protection systems, i.e., fire detection and alarm systems, escape route systems and equipment, bulkheads, and openings protections should be maintained to keep them in good condition. Maintenance and testing of these installations are to be performed according to guidelines developed by IOM, and all vessels should have maintenance plans available for inspection at any time. According to Regulation 14, these plans should include the following (IMO, 1974; Oleszek, 1996; 1997):

- Fire-fighting and water installations, fire pumps, and hydrants, including hoses, nozzles, and international connectors;
- Fire detection and fire alarm installations;
- Fixed fire extinguishing systems and other fire extinguishing equipment;
- Automatic sprinkler systems equipped with fire detection and alarm;
- Ventilation systems with fire and smoke dampers, fans, and associated controls;
- Emergency cut-off of the fuel supply;
- Fire doors, including surging;
- General alarm systems;
- Emergency escape breathing devices;
- Fire extinguishers, including spare charges; and
- Propelled fire-fighting equipment.

In addition, passenger ships carrying more than 36 passengers must have a maintenance plan for low-location lighting and notification systems. Regulation 15 mandates posting of general plans that show locations of control stations on each deck; details of the ship’s detection, alarm, and sprinkler system; locations of fire-fighting equipment; and access routes to particular compartments. Part G of Chapter II-2 concerns special requirements for ships equipped with helipads, including helicopter equipment, landing pad construction, escape routes, fire-fighting equipment, drainage, helicopter refueling facilities, and landing pad operating manual and fire service. Regulation 19 concerns transport of dangerous goods, including water supply, ignition sources, detection installations, ventilation, portable fire extinguishers, water sprinklers, or documents of compliance propelled (IMO, 1974; Oleszek, 1996; 1997).

The five regulations contained in the Convention’s Chapter 3 deal with life-saving appliances and devices and apply to ships constructed on or after

July 1, 1998. Exempt from these provisions are ships that sail not more than 20 nautical miles from the nearest land mass and passenger ships used in special shipping for the transport of large numbers of special passengers (e.g., pilgrims). The chapter’s Regulation 4 mandates testing of life-saving appliances to confirm that they meet IMO requirements, and Regulation 6. Its Paragraph 2 discusses radio-equipment for life-saving appliances and applies to all passenger and cargo ships of 300 gross tonnage and over. Table 1 shows the number of radar radios and transponders with which a ship should be equipped, depending on its capacity (IMO, 1974; Plewiński, 1995).

**Table 1. Ship’s required number of radar radios and transponders dependent on ship capacity**

Ship’s gross tonnage	For ships of 300–500 gross tonnage	For ships of 500 gross tonnage and more
VHF radio for two-way communication	At least 2 pieces	At least 3 pieces
Radar transponders	At least 1 shall be posted on each cargo ship	At least 1 on each side of each passenger ship

VHF radios for two-way communication and radar transponders must meet the technical and operational requirements adopted by the IMO. In ships equipped with two radar transponders and lifeboats, one transponder should be placed in the “free fall” boat and the other in the immediate vicinity of the navigation bridge. At least 12 rockets must be kept on board and located in or near the control room. In passenger ships, the general alarm must be audible on all open decks, and on-board notification systems’ audibility above noise level must be assured in all spaces.

Regulation 10 deals with manning and supervision of survival craft passenger ships. Boarding ladders are to be provided along a passenger ship’s sides at each survival craft launching site, whose purpose is to ensure the safe launch of survival craft, including ensuring their clean separation from propeller and hull overhangs. Survival craft launches are best performed along a ship’s straight sides. Survival units should meet the following criteria:

- Positioned as closely as is safe and practical to the water’s Surface;
- Positioned in a safe and sheltered place protected to the greatest extent possible from potential damage due to fire or explosion; and
- Always fully equipped and ready for use;

**Table 2. Characteristics of personal life-saving appliances to be carried on passenger ships**

Rescue measure	Characteristics and location on the ship
Lifebuoys	<ul style="list-style-type: none"> <li>– Positioned so as to provide passengers and crew easy access.</li> <li>– At least one lifebuoy in the vicinity of the stern should be fitted with a 30-m floating lifeline. Half of lifebuoys on board should be fitted with self-igniting light buoys.</li> <li>– At least two (2) lifebuoys must have self-activating smoke buoys.</li> <li>– Each lifebuoy is to be marked with both the name of the ship to which it belongs and that ship's home port in capital Latin script.</li> </ul>
Lifejackets	<ul style="list-style-type: none"> <li>– One for every person on board the ship.</li> <li>– Number of lifejackets for children should equal at least 10% of the number of passengers on board.</li> <li>– Lifejackets for watchkeepers must be stowed in the wheelhouse.</li> <li>– Lifejackets for remainder of crew and for passengers should be stored in easily accessible and well-marked locations.</li> <li>– Lifejackets for free-fall boats should not obstruct access to boat.</li> </ul>
Rescue and protective suits	<ul style="list-style-type: none"> <li>– Number sufficient to be worn by all those assigned to rescue boat crew or marine evacuation system.</li> <li>– Not needed when ship operates solely in warm climate zones</li> </ul>

- Lastly, lifeboats can be kept continually in position ready to be launched for a period not exceeding 5 minutes.

Regulation 15 describes regulations governing set up of marine evacuation systems. Ships' sides should include no openings, and each marine evacuation system must be arranged so that the parcel, platform, box with mechanism, and other positioning devices do not interfere with other life-saving appliances and their launch devices. Facilities for embarking on a lifeboat are also to be provided, and time to embarkation on a fully equipped rescue boat should not exceed 5 minutes in calm water. In addition, rescue-boat embarkation and recovery arrangements should ensure easy and safe use of stretchers for injured persons (IMO, 1974; Plewiński, 1995).

Regulation 19, on the other hand, deals with training and drills in leaving ship and includes safety measures and practical exercises including, inter alia, abandon ship and fire drills. In addition, each crew member must be briefed on the following, related topics:

- Mode of operation and use of pneumatic life rafts;
- Hypothermia issues;
- First aid;
- Use of emergency measures in difficult weather conditions; and
- Method of operation of fire extinguisher devices.

According to Regulation 20, rescue measures should undergo inspection, including verification of completeness and condition, once a month, and each pneumatic life raft and sea evacuation system is subject to technical inspection every 12 months. All emergency measures and devices are to comply with

the requirements set forth by the International Code of Emergency Measures (LSP Code).

Table 2 presents characteristics of personal life-saving appliances and rescue equipment i.e., lifebuoys, lifejackets, rescue suits, and protective suits – to be carried on passenger ships.

Clear instructions for action in the event of an alarm should be prepared for and made available to each person on board, displayed in conspicuous places throughout the ship (i.e., control room, engine room, crew accommodation, and passenger cabins). A ship's crew should include persons trained to assist passengers and to operate survival craft and their launching devices, and each unit is to be commanded by a designated deck officer or chartered lifeguard. Life boats and rafts should be positioned as closely as possible to accommodation and service spaces, and muster stations are to be in close proximity to emergency unit embarkation areas. Passengers who will be on a ship for more than 24 hours must undergo training in use of seat belts and in what to do in the event of an emergency.

Passenger craft that undertake voyages other than short ones in general and short international ones in

**Table 3. Based on SOLAS 1974, the minimum number of lifebuoys to be carried by a passenger ship depending on its length (IMO, 1974)**

The length of the ship [m]	The minimum number of lifebuoys
Less than 60	8
60–120	12
120–180	18
180–240	24
240 and more	30

**Table 4. Ferries “Mikołaj Kopernik” and “Jan Śniadecki” basic information**

Ferry data	“Mikołaj Kopernik”	“Jan Śniadecki”
Gross tonnage	8734	14 417
Ship type	Railway and car ferry	Railway and car ferry
Number of passengers taken	36	57
Speed	14 knots	17 knots
Construction date	08–05–1974	15–04–1988
Number of IMO	7336721	8604711
Flag under which the unit is registered	Saint Vincent and the Grenadines (Central America)	Cyprus
Home port	Kingstown (The port and the capital on the Caribbean Sea)	Limassol
Call sign	J8SK6	P3TX6
Ship class	KM PASSENGER/FERRY I (Jankowski, Purowski & Olszak, 1996) L2	KM PASSENGER/FERRY I (Jankowski, Purowski & Olszak, 1996) L2
PRS number	110052	110068
Maximum draft	4.5 m	5.10 m
Unit load capacity	2079 tons	5544 tons

particular and that do not comply with subdivision requirements are to be equipped with partially or fully enclosed lifeboats capable of accommodating 50 percent of the total number of persons on board. Conversely, passenger ships engaged in short international voyages must be equipped with partially or fully covered lifeboats capable of accommodating 30 percent of their passengers. In both cases, life boats should be evenly distributed on each of a ship’s sides. Moreover, this ship type is to be equipped with sufficient pneumatic or rigid life rafts to accommodate the total number of persons on board (IMO, 1974; Plewiński, 1995; Oleszek, 1996) and with lifebuoys in numbers dependent on the ship’s length, as shown in Table 3.

Table 4 presents information on the ferries “Mikołaj Kopernik” and “Jan Śniadecki”. For the “Mikołaj Kopernik”, the Polish Register of Shipping (PRS) approved restrictions that were then issued on February 22, 2002, in Gdańsk under flag country authorization also approved and issued restrictions for the “Jan Śniadecki” under flag country authorization on July 30, 2002, in Gdańsk.

## Conclusions

For years, the International Maritime Organization (IMO) has improvement in maritime safety regulations. Additionally, since its inception in 1974, the SOLAS Convention has been and continues to

be subject to continual revision with the periodic introduction of new safety regulations. In Poland, the Polish Register of Shipping, whose purpose is to help ensure ships’ technical safety, controls and implement safety regulations on the basis of the Convention and other, safety-oriented provisions. The Register mandates safety standards and then supervises their implementation during ship construction and operation. Due to the rapidly increasing number of accidents involving passenger craft, a list of operational limitations was drawn up in 1995 based on regulation V/30 of the 1974 SOLAS Convention, and since that time, each ship must have an up-to-date List of Operating Restrictions.

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**Cite as:** Stępień, J. & Pilarska, M. (2021) Selected operational limitations in the operation of passenger and cargo ships under SOLAS Convention (1974). *Scientific Journals of the Maritime University of Szczecin, Zeszyty Naukowe Akademii Morskiej w Szczecinie* 65 (137), 21–26.