

Requirements Regarding Safety Maritime Transport of Explosives Materials

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ABSTRACT: Author of this publication identifies safety requirements regarding maritime transport of dangerous goods class 1. Various modes of transport are used to hazardous materials that often include maritime transport of hazardous materials, such as explosives. Dangerous Goods' refers to items that are potentially dangerous during transportation. The above paper is based of techniques in ship operations, as well as the desirability of having more comprehensive recommendations which included dangerous goods. Dangerous goods have special transport requirements to eliminate or minimize the risk of injuring people or damaging property and the environment. The Recommendations are aligned with relevant IMO codes and the IMDG Code in particular. The above article is based on the results of safety research on maritime transport of hazardous materials, as Sworn Expert of the Polish Chamber of Maritime Commerce.

1 INTRODUCTION

The transport of dangerous goods is a special type of transport and is subject to the specified legal regulations, fulfilling and observing a number of specific requirements. The safety of this type of transport depends on the proper organization of its transport and maximum involvement of the participants of the whole process. The organization of dangerous goods transport requires a comprehensive, comprehensive view of the means of transport, packaging and cargo (the vehicle and packaging should be adjusted for transported goods), as well as for persons involved in the preparation of transport, drivers with appropriate qualifications and training, route designation, securing this route in terms of maintaining safety in the event of an emergency. Incorrect handling of dangerous goods during storage or transport can cause a great risk of imbalance in the functioning of living organisms (including deaths of

humans and animals) or be a serious threat to the environment.

Transportation of dangerous goods through any route of transport requires a lot of precautionary and safety measures. Massive quantities of dangerous goods are transported each day through maritime transport modes. In order to enforce a proper method of transporting such hazardous materials there is a proper categorisation for them, which ensure utmost safety and precaution. In terms of marine transport, the dangerous goods classification is based on SOLAS and MARPOL convention of the IMO which ultimately finds its place in the International Maritime Dangerous Goods (IMDG) Code [2].

Shipping hazardous goods is not an easy task. There are many aspects to consider when it comes to packaging and labeling as well as handling of the goods in loading terminals, ports and on vessels. In this article, I have summarised what dangerous goods are, which international guidelines to follow and

what kind of special treatment dangerous goods require to enable safe transportation at sea. Shipments requiring handling of dangerous goods in maritime transport are specific character of carriage, require individual solutions.

The term *maritime* or *shipping* industry is often used to encompass many different maritime-related industries, sectors or activities, including transport, shipbuilding, insurance, classification, fishing, leisure or cruising, brokerage, shipping agencies and many more. Transport by water is described by different terms, such as “shipping”, “marine/maritime transport”, “sea transport”, “merchant marine” or “waterborne transport.” Although used to express different meanings in different contexts, these terms are often used interchangeably. Maritime transport of dangerous goods constitutes a system or subsystem in its own right, in particular transport of bulk dangerous cargoes. Many products are carried in large quantities in a very specialized system for dangerous cargoes only [1].

This publication deals with the maritime transport system of dangerous goods.

Although dangerous goods are largely carried together with other non-dangerous goods in cargo ships and cargo/ passenger ships, given its distinct technical and operational features the maritime transport system of dangerous goods constitutes a specific element or subsystem of the maritime transport system. There are special handling installations on the terminals, factory sites, ports and docks for the dangerous goods. The applicable safety rules, i.e. issued by the International Maritime Organization, the Road Administration or Rail Administration, should be strictly respected [3].

2 THE INTERNATIONAL MARITIME DANGEROUS GOODS

The International Maritime Dangerous Goods or IMDG Code was adopted in 1965 as per the SOLAS (Safety for Life at Sea) Convention of 1960 under the IMO. The IMDG Code was formed to prevent all types of pollutions at sea [9].

The IMDG code also ensures that the goods transported through seaways are packaged in such a way that they can be safely transported. The dangerous goods code is a uniform code. This means that the code is applicable for all cargo-carrying ships around the world [2].

The “state-of-the-art” regulatory system governing maritime transport of dangerous goods is also described. The chapter focuses on technical and operational aspects of maritime transport. It is mainly organised based on the transport model and the IMDG Code (Figure 1).



Figure 1. The International Maritime Dangerous Goods or IMDG Code. Source: <https://www.amazon.com/IMDG-Code-2018-39-18-Volumes/dp/9280116827>

The dangerous goods code has been created as per the recommendations of the United Nations’ panel of experts on transportation of hazardous goods along with the IMO (International Maritime Organisation). This proposal by the UN was presented as a report in the year 1956 after which the IMO IMDG Code was started to be drafted in the year 1961.

In this paper described the main components of the maritime transport system are defined and described the main components of the maritime transport dangerous goods traffic and the physical environment. Since marine transportation has undergone a lot of development and changes, it becomes essential that the code also keeps up with the changes. This is why there have been constant amendments to the IMDG code. The amendments are proposed every two years, and the adoption of the amendments takes place after two years of the proposal by the concerned authorities. The amendments are proposed in this manner:

- The countries that are members of the IMO present the required proposal;
- The UN’s expert panel then views and decides what proposals merit immediate attention in the upcoming amendment [4].

The author the paper is an independent Surveyor, sworn Expert Polish Chamber of Maritime Commerce (PCMC). PCMC is a nationwide, voluntary and self-government organization of business entities running activities under broadly defined maritime economy. The principal purpose of the activities of the Chamber is to create conditions for using the sea as a natural factor of economic development and also supervises the activities of the team of sworn experts that consist of 150 specialists of different branches [6].

2.1 Importance of IMDG Code for seafarers

All the crew members engaged on a ship and involved directly with dangerous cargo carried on the ship must undergo dangerous goods course, which is

based on STCW requirements and prepared as per IMO guidance. DG training is in Part B of STCW Code, i.e. the course is not mandatory. It is Flag Administration requirement. There are several shore-based training centres which offer dangerous goods training to handle the IMDG cargo on a ship. Following are important points, which a seafarer must understand under IMDG code:

- The seafarer should be able to classify dangerous goods and identify the shipping names of the dangerous goods.
- He/she should know how the particular IMDG cargo should be packed.
- He should understand different types of markings, labels or placards used to address various dangerous goods.

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- Must know safe practice to load/unload the cargo unit carrying the IMDG product.

At present, the reach of the IMDG Code extends to about 150 countries around the world with around 98% ships following the requirements of the code. This figure helps us to understand the effectiveness of the code with respect to shipping dangerous goods across the oceans and the marine life-forms that exist therein.

3 CLASIFICATIONS OF DANGEROUS GOODS

Shipping dangerous goods is a very tricky business. This is why to avoid complications or problems while categorizing the aspect and level of danger; there is a set of classification for the dangerous goods [5]. There are nine clauses in which the dangerous goods are classified (Figure 2).



Figure 2. Appropriate labels indicating the hazard (Flammable, toxic, Corrosive etc.) are also pasted over the package. The label must be water resistant such that even in case of immersion, it should be readable for at least 3 months. Source: <https://www.portsecuritycenter.eu/handling-imd-g-cargo/>

The dangerous goods labels and dangerous goods certificate for the cargo are issued as per the nine clauses which are explained as follows:

- Classification 1 is for explosives (Fig. 3). The same classification has six sub-divisions for materials which pose high explosive risk, low explosive risk, to name a few;



Figure 3. Reloading of a container with explosives materials in a seaport. Source: Pol-Mare Ltd.

- Classification 2 is for gases. This clause has three sub-categories that talk about gases that are highly flammable, that are not flammable and gases that neither flammable nor toxic;
- Classification 3 is for liquids and has no sub-divisions;
- Classification 4 is for solids. There are three sub-categories that deal with highly combustible solids, self-reactive solids and solids that when interact with water could emit toxic gases;
- Classification 5 is for substances that have the chances of oxidization;
- Classification 6 is for all kinds of substances that are toxic and that could prove to be infective;
- Classification 7 is specifically for materials that are radioactive;
- Classification 8 is for materials that face the threat of corrosion and erosion;
- Classification 9 is for those substances that cannot be classified under any of the above heads but still are dangerous goods [7].

Dangerous goods The SOLAS 74, regulation 1, (part A, Chapter VII), as amended, and the MARPOL 73/78, regulation 1, (Annex III), as amended, which are incorporated into the IMDG Code (2018, Chapter 1, pp 18-28), define dangerous goods for the purpose of the respective Conventions as follow:

- Dangerous goods classified under regulation 2 which are carried in packaged form or in solid bulk, in all ships to which the present regulations apply and in cargo ships less than 500 tons gross tonnage.
- Harmful substances are those substances which are identified as marine pollutants in the IMDG Code. Packaged form is defined as the forms of containments specified for harmful substances in the IMDG Code.

Regulation 2 (Classification) of SOLAS 74 describes 9 classes of dangerous goods, which are further defined and described in greater detail in the IMDG Code (2002) [10].

3.1 Primary Hazard Class and Subsidiary Class for Dangerous Goods

Some dangerous goods have multiple hazards. The primary class is the class of dangerous goods that takes precedence over any other class. The subsidiary class is the other class that further identifies the hazards of the dangerous goods. More than one subsidiary class is possible. For most of dangerous goods, the primary class and subsidiary class can be found in Dangerous Goods List.

For goods having multiple risks which are not specifically mentioned by name in Dangerous Goods List, you have to follow the following hazard precedence rules to determine their primary hazard class and subsidiary class.

When shipping dangerous goods by sea it is necessary not only to placard and mark each single package but it is necessary to correctly placard also the unit of transport, as for example the container (Fig. 4) [10].



Figure 4. Marking on a container with dangerous goods - Class 1 explosives. Source: Pol-Mare Ltd.

Placards (enlarged labels) (minimum size 250 mm x 250 mm) and, if applicable for maritime transport, "MARINE POLLUTANT" marks (minimum size of a side 250 mm) and other signs should be affixed to the exterior surfaces of a CTU or unit load or overpack to provide a warning that the contents of the unit are dangerous cargoes and present risks, unless the labels, marks or signs affixed to the packages are clearly visible from the exterior of the unit. This type of marking can be omitted on unit loads and overpacks if the hazard labels, markings or warning symbols are clearly visible from the outside.

A Cargo transport unit containing dangerous goods or residues of dangerous goods shall clearly display placards as follows:

- 1 A freight container, semi-trailer or portable tank: one on each side and one on each end of the unit;
- 2 A railway wagon: at least on each side;
- 3 A multiple-compartment tank containing more than one dangerous substance or their residues: along each side at the positions of the relevant compartments; and
- 4 Any other cargo transport unit: at least on both sides and on the back of the unit.

According to the kind of goods and quantities, the labels, marks, placards and panels to use on the container will be different.

4 TRANSPORT OF DANGEROUS GOODS

An explosive material, or simply an explosive, is a reactive substance that contains a great amount of potential energy that can produce an explosion if released suddenly, usually accompanied by the production of light, heat, sound, and pressure.

The key element in the circulation and transport of dangerous goods type of explosives material is their safety, which depends largely on the sender, and in particular on the packaging they make and marking of the material and of the carrier obliged to properly adapt the vehicle for transporting specified materials as dangerous. Improper approach to issues related to ensuring security in the transport of goods may be the cause of events or crisis situations [7].

Threats arise primarily in cases where a dangerous load is handled during transport or to a road accident in which a vehicle transporting such goods is involved. Serious threats to port security also result from penetration into the area of vehicle ports under control or being a potential hazard due to technical condition, poorly fixed load or for employees without appropriate qualifications [8].

The subject of research, the results of which are presented in the paper referred to above, was the process of transporting high-risk goods in seaports and decisions taken at particular stages of these transports in the context of seaport security. The results presented in the paper are the result of several years of research carried out using various methods, techniques and research tools, and based on available source materials referring to theory and practice.

It is very important primarily concerned with the diversity of approaches and positions related to the safety of transloading hazardous materials in seaports and the specificity of individual users.

Today the lack of contemporary scientific studies, which would clearly indicate to what extent decisions taken at particular stages of transport of high-risk goods have an impact on the safety of seaports (Fig. 5).



Figure 5. Loading Class 1 explosives into a container. Source: Pol-Mare Ltd.

Therefore, appropriate measures should be taken in a wide range to obtain the necessary level of security (Fig. 6). Awareness of the existing threats and

their potential effects forces the necessity of interest in these issues of various entities, both in the national and international dimension. The evolution of views in this matter, as well as the growing awareness among decision-makers, show significant progress in the European transport of dangerous goods.



Figure 6. Securing the closure of the container with a bottled seal. Source: Pol-Mare Ltd.

Cargo transport units containing IMDG classified cargo (according to the IMDG Code) shall have appropriate IMDG placards and markings for the sea voyage and the proper shipping name and the UN number shall be displayed when required. (IMDG Code chapter 5.3).

According to the ADR regulations (paragraph 5.3.1.) it is fully acceptable and recommended to have the IMDG placards affixed to the unit in the place of loading before haulage to the port [10].

The gate control in the ports will be tightened to ensure that the units have the required placards. The transport company is to ensure that the unit is marked and labeled according to requirements.

An unplacarded unit poses a safety risk during the sea voyage. The unit cannot be loaded until the appropriate placards and markings are properly attached to the unit.

Old placards and markings must be removed from non-hazardous units before arriving in the port [7].

5 SECURITY OF EXPLOSIVES MATERIALS IN MARITIME TRANSPORT

The European Commission Communication provides for the adoption of storage, transportation and traceability measures for explosives at all stages of the supply chain. The ultimate goal remains the fight against terrorism and, in particular, preventing explosives from falling into the hands of terrorists.

The European Commission has identified a number of security measures for explosives, detonators, bomb-making equipment and firearms with the aim of ensuring the security of citizens by reducing and eliminating the possibility of their misuse. These measures concern the storage, transportation, production and detection of explosives, and are designed to encourage

cooperation between the parties concerned, in particular industry, the Member States and Europool.

Class 1 explosives need to be handled safely by people who have sufficient knowledge and practical skills and meet certain character requirements.

The IMO Dangerous Goods Declaration form multimodal dangerous goods form is used by shippers who offer hazardous materials for shipping by cargo or passenger ships. It offers information on the hazard, the shipper and much more. This form meets the requirements of SOLAS 74 [9], chapter VII, regulation 4; MARPOL 73/78, Annex III, regulation 4 and the IMDG Code, Chapter 5.4.

For this reason, most people (except certain persons carrying out their official duties must hold a controlled substance licence (CSL) to possess certain class 1 explosives. These substances must not be supplied to anyone who does not hold a CSL.

However, a quantity no greater than 15 kg of black powder (gunpowder UN0027), can be supplied to a person holding a firearms licence or firearms dealer's licence. If you have not properly prepared your hazardous cargo and the appropriate documents for shipping dangerous goods by sea, you risk having your shipment delayed or denied entry at port.

When your business depends on the safe delivery of this cargo, you can't afford that kind of risk.

Safety Requirements Port requirements apply to the handling and transport of explosives in port areas, but not limited to:

- 1 Adequate warning notices advising the public not to enter the restricted area while explosive are present.
- 2 Adequate measures are in place to prevent the public from entering the protected place separation distance as required by the Class 1 Net Explosive Quantity (NEQ) from the wharf when explosive are present.
- 3 Explosives shall not be unloaded from a ship unless the means of transport, by which they are to be removed from the port area, are on the terminal and ready to receive them.
- 4 Explosives of Divisions shall be taken directly to or from a ship, and not be held on a berth for more than 2 hours
- 5 Explosives of Divisions shall be taken directly to or from a ship, and not be held on a berth for more than 12 hours
- 6 Explosives shall be unloaded as soon as reasonably practicable.
- 7 Explosives shall not be brought to a berth for loading onto a ship unless the ship is ready to receive them.
- 8 Explosives shall not be brought to a berth for loading onto a ship unless the ship is ready to receive them within 12 hours of being on the terminal.
- 9 The area of the berth where explosives are being handled, and a space of at least 15m beyond the immediate handling area, shall be excluded of non-essential personnel involved in the loading/unloading of explosives while the explosives are being loaded/unloaded from the vessel.

- 10 The handling of explosives, once commenced, shall proceed without delay or interruption. Except during an electrical storm, such operations shall be suspended and not resume until the storm has passed.
- 11 Explosives shall not be handled unless they have been classified in accordance with the IMDG Code.
- 12 Explosives shall be handled in a safe, efficient and secure manner.
- 13 On completion of loading of the explosives onto a vessel, the loaded ship shall depart from the port area as soon as practical.
- 14 On completion of the vehicle being loaded with explosives, the vehicle must leave the port area as soon as possible being within 2 hours of the explosive being unload from the vessel.
- 15 On completion of the vehicle being loaded with explosives, the vehicle must leave the port area as soon as possible (within 12 hours) of the explosive being unload from the vessel [11].

Whilst explosives are being handled, ignition sources shall not be permitted in or near handling areas, smoking shall be strictly prohibited on the ship and on the berth (except in safe areas).

Please follow normal safety procedures and be alert to the following:

- Identify potential hazards and make the work area safe before proceeding.
- Follow instructions from the Foreman and Supervisor.
- No Smoking on Board or near the vessel. Signs to be placed.
- No naked flames near containers.
- Supervisor to have ready, written evacuation and emergency response plan.
- Identify escape routes and safety zones in the event of a leak.
- Copy of Stow Plan to be placed at the top of the gangway and a copy on wharf.
- Do not work alone and be alert to the location of fellow workers [12].

Notices shall be displayed on the ship and on the berth bearing the words DANGER-NO SMOKING-NO NAKED LIGHTS and repairs involving hot work shall be prohibited on the ship and on the berth.

The vessel pre departure and operational checks must be completed prior to receiving explosives and the ship's engines and ancillary equipment shall be kept ready at all times, so that the ship can leave the berth immediately.

6 CONCLUSIONS

Proper maritime transport of hazardous materials is important to avoid compromising personal or environmental safety.

Every day, thousands of shipments containing hazardous materials are safely transported over on the water.

The transport of hazardous materials is very important for the continuance of strong national and international economies.

Shipping hazardous materials can be both risky and rewarding. However, making a successful transport of hazardous material is difficult if you don't have a clear understanding of the rules and regulations surrounding the practice. Alternately, ignorance to legal rulings for hazardous material shipping can lead to some serious financial and license penalties.

However, there are still a handful of companies who ship these materials without complying by legal regulations – some statistics displaying surprising numbers. The general rule of thumb is to be on guard with everything when shipping hazardous materials. Everything from routing options, storage, transportation, to documentation and labeling all matter.

REFERENCES

- [1] Chmieliński M., K. Pałucha, Logistics activities important for the safety of the transport equipment province-tem and explosives carried out by specialist tangential civilian operator Material Management and Logistics 09/2016 ISSN: 1231-2037.
- [2] Chmieliński M., Pałucha K., Identification of activities in the charge of the safety of transport of cargo requiring special conditions in terms of logistics, forwarding port wo sea. Material Management and Logistics 12/2016 ISSN: 1231-2037.
- [3] EC (European Commission) (1995) The trans-European Transport Network. European Commission Document.
- [4] Shipper's Guide to Loading and Securement of Hazardous Materials/Dangerous Goods in Intermodal Equipment-Highway, Rail and Water, October 1999, Institute of Packaging Professionals.
- [5] Strategic importance and hazardous cargo <http://http://pol-mare.pl/en/oferta/strategic-importance-and-hazardous-cargo/> (online access 01/28/2019).
- [6] Act of 20 December 1996. Ports and harbors. (Dz. U. of 2010. No. 33, pos. 179).
- [7] The Act of 18 August 2011. On maritime safety. (Dz. U. No. 228, item. 1368, as amended).
- [8] Recommendations regarding the transport of hazardous materials and operations related to ports. Annex II - transport and handling of loads dangerous k1.1 / IMO. MSC.Circ.675 from 09/12/1994.
- [9] Regulation of the Minister of Transport, Construction and Maritime Economy of June 17, 2013. on determining additional requirements regarding the transport of dangerous goods by ships not subject to the SOLAS convention (Journal of Laws of 2013 Pos. 798).
- [10] Convention CSC (Convention for Safe Containers), International Convention on Safe Containers, drawn up in Geneva on. December 2 1972 (Journal of Laws of 1984 No. 24, item 188, as amended).
- [11] Marking of containers carrying dangerous cargoes <http://www.rishishwarlogistics.com/documents/Marking%20of%20containers%20carrying%20dangerous%20cargoes.pdf> (online access 01/28/2019).
- [12] Dangerous Goods Explosives Guidelines - https://www.portauthoritynsw.com.au/media/1338/explosives_in_port_of_eden_final_v1_0_2_july_2014_doc.pdf