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LLOYD'S
Agency

# Dangerous Goods Cargo

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**17. August 2017**

*Asia - Europe – Middle East – North & South America*

# Andrew Moore & Associates

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***Fire, Marine, Engineering & Science Consultancy Services, for Sea & Land Incidents Worldwide***

***Asia – Europe – Middle East – North & South America***

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# Multi-disciplinary Team & Services

- Master Mariners
- Scientists
- Engineers
- Naval Architects
- Consultants
- Surveyors
- Fire Investigators

## Operational Support
***Proactive / Reactive***

## Casualties
***Proactive / Reactive***

## Claims & Disputes
***Proactive / Reactive***

## Consulting
**Proactive / Reactive**

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# Experience

### *Chemicals & Fuels*

- Chemicals & petrochemicals
- Fertilisers & pesticides
- Pharmaceuticals
- Jet fuels (A, A-1), Bunker fuels
- Lubricating oil analysis

### *Oil & Gas*

- Crude oil & its products
- LPG
- Oil pollution

### *Hazardous Materials*

- Dry & liquid bulk chemicals loading
- Styrene monomer
- Cyanide, THT, $H_2SO_4$
- Leaking tank containers

### *Mineral Ores & Metals*

- Iron, nickel, bauxite & other ores
- Coal, sulphur
- Base & precious metals
- Steel, aluminum
- Electrodes & Project cargoes
- Metal failure analysis

### *Food Products*

- Dairy, edible oils & TVP
- Fish, meat-poultry
- GM products

### *Grains & Cereals*

- Maize (Corn), wheat, rice, soybean, meal, DDGS, seed cakes,
- Infestation, Fumigation

### *Perishables*

- Fruit & vegetables
- Cocoa

### *Environment & Pollution*

- Hull antifouling & corrosion
- Cargo, residue & ballast water management
- Structural, materials & engineering failures
- $NO_x$, $SO_x$ & particle emission controls
- Mixed & hazardous cargo compatibilities & safe stowage advice
- Battery explosions

### *Fire Expertise*

- Fire investigations

### *Others*

- Energy generation & storage systems (batteries, solar cells)
- Coating disputes
- Semiconductor based materials

# Dangerous Goods Cargo (DG)


The key risk factors for casualties / incidents on ships are:

- Cargo misdeclaration (from fraud or miscommunication).
- Non-declaration of dangerous cargo by shippers.
- Poor quality and selection of packaging or improper container packing.
- Provision and accuracy of documentation and labelling.
- Professionalism of the container packing process.
- Human factors – regional, cultural & company attitudes to good practice and compliance.
- Unchecked irregularities in the product production process.
- Mis-handling or dropping containers.

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# Polling Question No.1

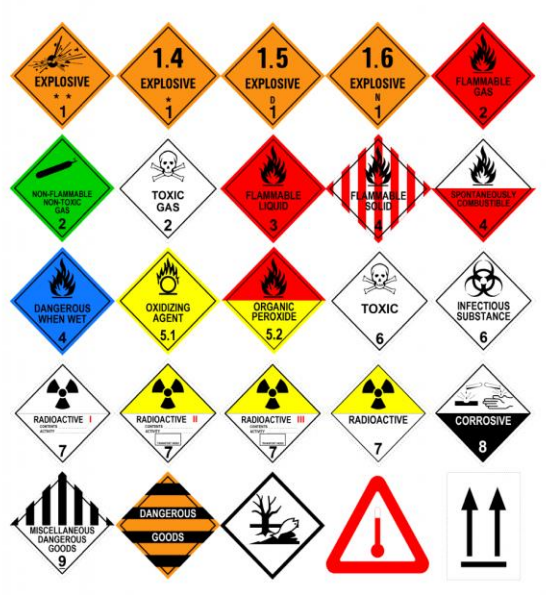
What is the total global container trade of Dangerous Goods?

a) 3-5 %

b) 20-22 %

c) 10-12 %

d) 6-8 %

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# Polling Question No.1

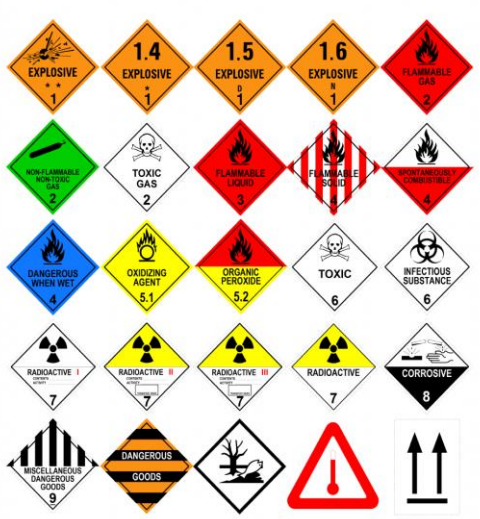
What is the total global container trade of Dangerous Goods?

a) 3-5 %

b) 20-22 %

**c) 10-12 % ⟶ Up to 6 million shipments per year**

d) 6-8 %

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# Dangerous Goods - Definitions

**"Dangerous goods mean the substances, materials and articles covered by the IMDG Code."**

Ref. SOLAS, Ch. VII, Part A, Reg. 1

**"The carriage of dangerous goods in packaged form shall be in compliance with the relevant provisions of the IMDG Code."**

Ref. SOLAS, Ch.VII, Part A, Reg. 3

- ***A shipper*** *is under a duty not to load dangerous goods without the carrier's knowledge and consent.*
- *A ship's master must be provided with a correct, universally recognised description of the goods and the potential hazards they may present.*

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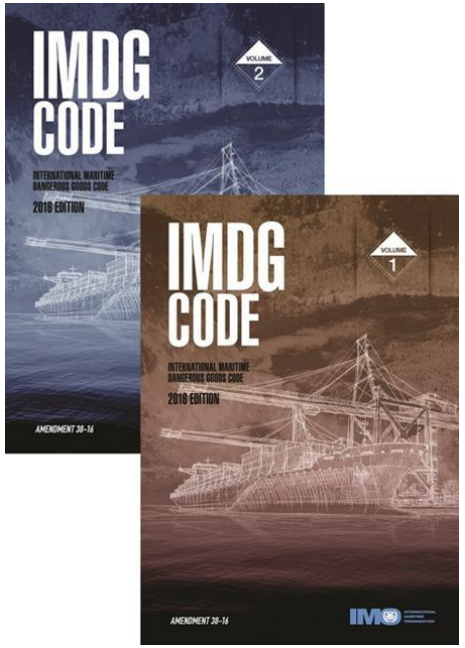
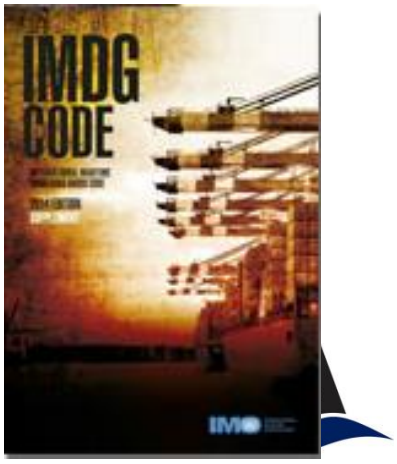
# IMDG Code - Objective




- Implemented in 1965 by International Maritime Organisation (IMO), became mandatory for compliance on 1st January 2004 by all countries.
- IMDG Code is directed to all ships carrying DG which are covered under SOLAS Convention.
- IMDG Code enhances the safe transportation of dangerous goods and protects the marine environment.
- The Code is followed by "cargo interests" and port and ship must be suitably knowledgeable and equipped and personnel adequately trained.

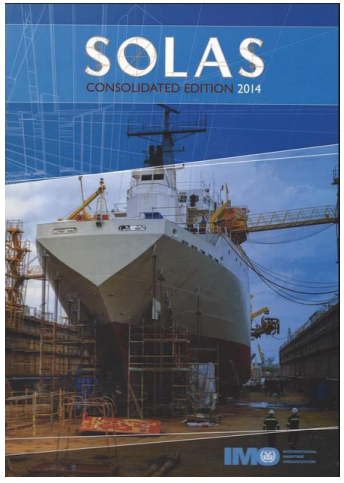



*IMDG Code has been adopted by 172 countries*

# International Maritime Organisation (IMO) and United Nations (UN)

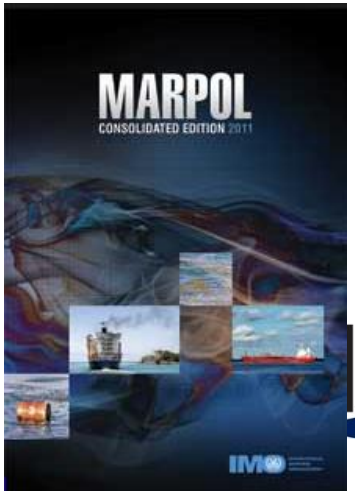
**SOLAS Convention** (The Safety of Life at Sea)

***Chapter VII*** *form the SOLAS influenced the creation and contents of the IMDG Code.*




**MARPOL Convention** (Prevention of Pollution from Ships) - *MARPOL 73/78*.

***Annex III*** *of MARPOL contains mandatory provisions and is the basis of the rules regarding* ***marine pollutants*** *in the IMDG Code.*



# Identifying DG – Key points

Guidance list through the identification and classification procedure:

a) Is the product a pure substance or a mixture containing only one dangerous substance?

b) Is the substance listed by name or synonym in the list of dangerous goods?

c) Is the product a mixture of dangerous goods, and is this mixture specifically listed?

d) Is it listed under a 'generic chemical family' name (e.g. BUTANOLS or OXALATES)?

e) Is it listed under a 'generic non-chemical' name (e.g. BATTERY FLUID, ACID, ADHESIVES, PAINT, etc.)?

f) Is it listed under a generic N.O.S (Not Otherwise Specified) name (e.g. ALCOHOLS, N.O.S. or FLAMMABLE LIQUIDS, N.O.S., or PESTICIDES LIQUID, TOXIC, FLAMMABLE, N.O.S. etc.)?

g) Is there more than one risk associated with the substance?

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# DGs Consignment Procedures
## (Shipper's / Cargo Interest Responsibility)

1. Classification of the goods.
2. Check if the goods can be transported and if special conditions apply.
3. Segregation requirements.
4. Selection of the correct packaging (Class and Packing Groups).
5. Mark and label the goods in accordance with the appropriate code (UN number, PSN, Class label, Subsidiary Risk Label, Packing Group).
6. Provide a DGs declaration, additional information section should be checked.
7. Pack CTU according to segregation requirements and document container packing certificate.
8. Label CTU with Class placards and UN number.

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# Standard Transport Document - Key Points

- **UN Number,**
- **PSN, Class or Division**
- **PG (if assigned),**
- **Number and description of packages,**
- **Total quantity,**
- **Name & address of consignor/consigr**

IMO DANGEROUS GOODS DECLARATION

1 Shipper/Consignor/Sender | 2 Transport Document Number
3 Page of pages | 4 Shipper's Reference
5 Consignee | 6 Freight Forwarder's Reference
7 Carrier (to be declared by the Carrier)

SHIPPER'S DECLARATION

10 Vessel/Flight & Date | 11 Port/Place Handling | 9 Additional Handling Information
12 Port/Place of Discharge | 13 Destination

14 Shipping Marks | Number & Kind of Packages, Description of Goods | GW (kg) | CUBE (m³)

15 CTU ID No. | 16 Seal No. | 17 CTU Size & Type | 18 Tare Mass (kg) | 19 Total Gross Mass (kg)

CONTAINER/VEHICLE PACKING CERTIFICATE

21 Receiving Organization Receipt

20 Name of Company | Hauler's Name | 22 Name of Company Preparing Note
Name/Status of Declarant | Vehicle Registration No. | Name/Status of Declarant
Place and Date | Driver Name and Date | Place and Date
Signature of Declarant | Driver's Signature | Signature of Declarant

Standard transport documentation is the same for all transport modes (by road, sea or air),

# Polling Question No.2

How many Classes of hazardous materials are there?

a) 7

b) 15

c) 9

d) 12


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# Polling Question No.2

How many Classes of hazardous materials are there?

a) 7

b) 15

**c) 9**

d) 12


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# Classification of DG

## 9 Hazard Classes and Divisions


Class 1 - Explosives

Class 2 - Gases

Class 3 - Flammable Liquids

Class 4 - Flammable Solids

Class 5 - Oxidising Substances and Organic Peroxides

Class 6 - Toxic and Infectious Substances

Class 7 - Radioactive material

Class 8 – Corrosive Substances

Class 9 – Miscellaneous Dangerous Substances and Articles

**Dangerous goods are classified based on their properties.**

**Marine Pollutants**

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# Marine Pollutants Group (MP)

Many substances assigned to classes 1 to 6.2, 8 and 9 are deemed as being marine pollutants.

e.g. UN 1263 PAINT (triethylbenzene) Class 3 PG III (27°C c.c.) MARINE POLLUTANT

If the substance does not fall under Classes 1 to 8, or in Class 9, then it is transported as :

- **Environmentally hazardous substance, Solid, N.O.S, UN No. 3077**
- **Environmentally hazardous substance, Liquid, N.O.S, UN No. 3082**

A "marine pollutant mark" needs to be applied to the goods packaging and to the outside of the shipping container.

# Substances with multiple hazards

DG that pose more than one hazard risk (primary and secondary hazard(s))

**Mixture of A + B**

**Primary hazard class is 6.1 – Toxic substance**

**Subsidiary hazard class is 8 – Corrosives**

**PSN: Toxic liquids, corrosive, organic, n.o.s.**

## Hazard Precedence Table

[Hazard class and packing group]

| | 4.2 | 4.3 | 5.1 I[1] | 5.1 II[1] | 5.1 III[1] | 6.1, I dermal | 6.1, I oral | 6.1, II | 6.1, III | 8, I liquid | 8, I solid | 8, II liquid | 8, II solid | 8, III liquid | 8, III solid |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3I | | | | | | 3 | 3 | 3 | 3 | 3 | (3) | 3 | (3) | 3 | (3) |
| 3II | | | | | | 3 | 3 | 3 | 3 | 8 | (3) | 3 | (3) | 3 | (3) |
| 3III | | | | | | 6.1 | 6.1 | 6.1 | 3[4] | 8 | (3) | 8 | (3) | 8 | (3) |
| 4.1 II[2] | 4.2 | 4.3 | 5.1 | 4.1 | 4.1 | 6.1 | 6.1 | 4.1 | 4.1 | (3) | 8 | (3) | 4.1 | (3) | 4.1 |
| 4.1 III[2] | 4.2 | 4.3 | 5.1 | 4.1 | 4.1 | 6.1 | 6.1 | 6.1 | 4.1 | (3) | 8 | (3) | 8 | (3) | 4.1 |
| 4.2 II | | 4.3 | 5.1 | 4.2 | 4.2 | 6.1 | 6.1 | 4.2 | 4.2 | 8 | 8 | 4.2 | 4.2 | 4.2 | 4.2 |
| 4.2 III | | 4.3 | 5.1 | 5.1 | 4.2 | 6.1 | 6.1 | 6.1 | 4.2 | 8 | 8 | 8 | 8 | 4.2 | 4.2 |
| 4.3 I | | 5.1 | 4.3 | 4.3 | 4.3 | 6.1 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 | 4.3 |
| 4.3 II | | 5.1 | 4.3 | 4.3 | 4.3 | 6.1 | 4.3 | 4.3 | 4.3 | 8 | 8 | 4.3 | 4.3 | 4.3 | 4.3 |
| 4.3 III | | | 5.1 | 5.1 | 4.3 | 6.1 | 6.1 | 6.1 | 4.3 | 8 | 8 | 8 | 8 | 4.3 | 4.3 |
| 5.1 I[1] | | | | | | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 | 5.1 |
| 5.1 II[1] | | | | | | 6.1 | 5.1 | 5.1 | 5.1 | 8 | 8 | 5.1 | 5.1 | 5.1 | 5.1 |
| 5.1 III[1] | | | | | | 6.1 | 6.1 | 6.1 | 5.1 | 8 | 8 | 8 | 8 | 5.1 | 5.1 |
| 6.1 I, dermal | | | | | | | | | | 8 | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 |
| 6.1 I, oral | | | | | | | | | | 8 | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 |
| 6.1 II, inhalation | | | | | | | | | | 8 | 6.1 | 6.1 | 6.1 | 6.1 | 6.1 |
| 6.1 II, dermal | | | | | | | | | | 8 | 6.1 | 8 | 6.1 | 6.1 | 6.1 |
| 6.1 II, oral | | | | | | | | | | 8 | 8 | 8 | 6.1 | 6.1 | 6.1 |
| 6.1 III | | | | | | | | | | 8 | 8 | 8 | 8 | 8 | 8 |

# PSN (Proper Shipping Name), UN Number and Generic Names

1. Single entries for well-defined substances or articles:
e.g. UN 1090 ACETONE

2. Generic entries for well-defined groups of substances or articles:
e.g. UN 1133 ADHESIVES
UN 3101 ORGANIC PEROXIDE TYPE B, LIQUID

3. Specific N.O.S. entries covering a group of substance or articles meeting the criteria of one or more classes:
e.g. UN 1477 NITRATES, INORGANIC, N.O.S.

4. General N.O.S. entries covering a group of substances or articles meeting the criteria of one or more classes:
e.g. UN 1325 FLAMMABLE SOLID, ORGANIC, N.O.S.

*The Proper Shipping Name of a mixture of a dangerous substances with one or more non-dangerous substance(s) should have the word* ***'SOLUTION'*** *or* ***'MIXTURE'*** *added.* (e.g. ACETONE 75 % SOLUTION)

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# Packing Groups - Key Points

"Packed form means the form of containment specified in the IMDG Code."

Packing Group does not apply for: ***Class 1 – Explosives, Class 2 – Gases, Class/Division 6.2 – Infectious Substances, Class 7 – Radioactive Materials***

**Group I –** substances presenting **great danger**

**Group II –** substances presenting **medium danger**

**Group III –** substances presenting **low danger**

Questions to ask before loading of DG package/container:

1.Does it comply with the relevant code's specific requirements?

2. Is the substance compatible with the packaging?

3. Has the packaging been tested to the correct test specification?

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# Marks, Labels and Placards

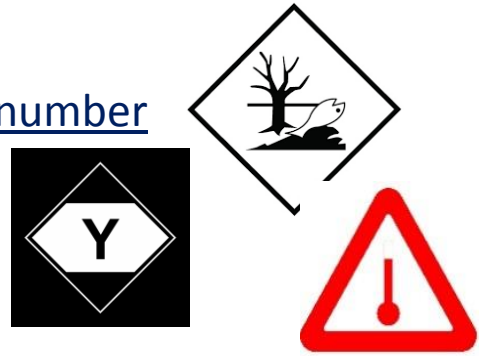

## Labeling

Labelling specifically refers to Class label(s) and Subsidiary Risk labels.

## Marks

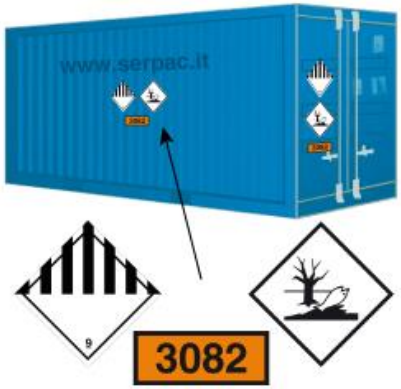
Marking refers to the Proper Shipping Name and corresponding UN number

e.g. UN 2902 PESTICIDE, LIQUID, TOXIC, N.O.S. (contains 80% drazoxolon)




## Placards

Placarding refers to the labeling/marking of the cargo transport unit.

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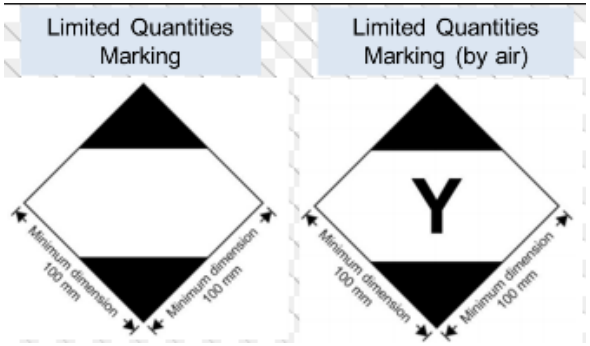
# Dangerous Goods in Limited Quantities

In limiting the quantity, due consideration shall be given:

- to size,
- construction and equipment of the ship,
- the packaging, and
- the inherent nature of the substances.




The maximum quantity permitted per inner package is prescribed and depends on the **Class**, **Packing Group** and whether it is **solid or liquid**.

Substances that require a special transportation mode are:

- Flammable, toxic, corrosive or oxidising gases (except aerosols UN 1950 are permitted).
- Some Classes or Divisions of DGs (e.g. Class 1, Division 6.2 and Class 7).

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# Materials Forbidden to be Transported

"Any substance or article which, as presented for transport, is liable to explode, dangerously react, produce a flame or dangerous evolution of heat or dangerous emission of toxic, corrosive or flammable gases or vapours under normal conditions of transport".

In Chapter 3.3 in the IMDG Code, special provisions **349, 350, 351, 352, 353** and **900** list certain substances, which are forbidden for transport.

*e.g.*
***Special provision 349*** *– Mixtures of a hypochlorite with an ammonium salt are not to be accepted for transport. UN 1791 hypochlorite is a substance of Class 8.*

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# Segregation Groups

**The process of segregation is the responsibility of ship loaders and handlers loading CTU.**

1. Acids
2. Ammonium compounds
3. Bromates
4. Chlorates
5. Chlorites
6. Cyanides
7. Heavy metals and their salts (including their organometallic compounds)
8. Hypochlorites
9. Lead and its compounds
10. Liquid halogenated hydrocarbons
11. Mercury and mercury compounds
12. Nitrites and their mixtures
13. Perchlorates
14. Permanganates
15. Powdered metals
16. Peroxides
17. Azides
18. Alkalis

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# Segregation Rules and Segregation Table

Segregati

1 - "away

2 - "sepa

3 - "sepa

4 - "sepa om"

X – the D ion

provision

* - see th

| Class | | 1.1 1.2 1.5 | 1.3 1.6 | 1.4 | 2.1 | 2.2 | 2.3 | 3 | 4.1 | 4.2 | 4.3 | 5.1 | 5.2 | 6.1 | 6.2 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Explosive | 1.1 1.2 1.5 | * | * | * | 4 | 2 | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 4 | 2 | 4 | X |
| Explosive | 1.3 1.6 | * | * | * | 4 | 2 | 2 | 4 | 3 | 3 | 4 | 4 | 4 | 2 | 4 | 2 | 2 | X |
| Explosive | 1.4 | * | * | * | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | X | 4 | 2 | 2 | X |
| Flammable gas | 2.1 | 4 | 4 | 2 | X | X | X | 2 | 1 | 2 | X | 2 | 2 | X | 4 | 2 | 1 | X |
| Non-flammable gas | 2.2 | 2 | 2 | 1 | X | X | X | 1 | X | 1 | X | X | 1 | X | 2 | 1 | X | X |
| Toxic gas | 2.3 | 2 | 2 | 1 | X | X | X | 2 | X | 2 | X | X | 2 | X | 2 | 1 | X | X |
| Flammable liquid | 3 | 4 | 4 | 2 | 2 | 1 | 2 | X | X | 2 | 1 | 2 | 2 | X | 3 | 2 | X | X |
| Flammable solid** | 4.1 | 4 | 3 | 2 | 1 | X | X | X | X | 1 | X | 1 | 2 | X | 3 | 2 | 1 | X |
| Spontaneous combustible | 4.2 | 4 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | X | 1 | 2 | 2 | 1 | 3 | 2 | 1 | X |
| Dangerous when wet | 4.3 | 4 | 4 | 2 | X | X | X | 1 | X | 1 | X | 2 | 2 | X | 2 | 2 | 1 | X |
| Oxidizing agents | 5.1 | 4 | 4 | 2 | 2 | X | X | 2 | 1 | 2 | 2 | X | 2 | 1 | 3 | 1 | 2 | X |
| Organic peroxide | 5.2 | 4 | 4 | 2 | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | X | 1 | 3 | 2 | 2 | X |
| Toxic substance | 6.1 | 2 | 2 | X | X | X | X | X | X | 1 | X | 1 | 1 | X | 1 | X | X | X |
| Infectious substance | 6.2 | 4 | 4 | 4 | 4 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 1 | X | 3 | 3 | X |
| Radioactive | 7 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 2 | 1 | 2 | X | 3 | X | 2 | X |
| Corrosive | 8 | 4 | 2 | 2 | 1 | X | X | X | 1 | 1 | 1 | 2 | 2 | X | 3 | 2 | X | X |
| Miscellaneous | 9 | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |

| Key | | |
|---|---|---|
| 1 2 3 4 | Must not be loaded in the same transport unit | |
| X | Can be loaded in the same transport unit - However, individual UN numbers may not be compatible. Compare UN numbers in column 16 of IMDG code or call Strait Shipping to do this for you | |

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# Loading and Stowage Plan of DGs

- Stowage – on deck, under deck (based on **5 stowage categories**)
- Segregation – vertical, horizontal.
- Provisions in event of an accident / fire precautions.
- External condition of cargo transport unit (CTU). Labels.
- Empty containers – any previous residues of DG cargo?
- Ventilation, condensation, heat protection, temp control.
- Tracking and monitoring equipment.
- Documentation.
- **Emergency Response Procedures – are necessary to be on every vessel carrying DG.**

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# Case Study 1 – 'Toxic' Fumes

Stevedores were incapacitated by toxic fumes **– carrier left handling TEUs of chemical**

Why the drum leak occurred:

- Improper packing/securing of steel drums inside the CTU


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# Case Study 2 - Carcinogenic Smoke

Chemical reaction in CTU made carcinogens, next port was in USA – **vessel fully discharged**


The cause of an incident:

- Misdeclared cargoes in the CTU.
- Improper packing inside the CTU.
- Improper segregation of two types of hazardous materials.

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# Case Study 3 – Released Pollutants

Containers dropped releasing pesticides into cargo hold – **specialist clean-up and tests.**


The cause of an incident:

-Mishandling of CTU by gantry crane operator

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# Case Study 4 – CTU with Li-ion Batteries on Fire

Fire risks associated with Li-ion batteries and Li-ion batteries contained in equipment:

- **Short Circuit (internal /external) due to Poor Packaging**
- **Mechanical Damage / Abuse**
- **Thermal Runaway in Li-ion Batteries Caused by Manufacturing / Design Defect or Physical Damage**
- Hydrogen Gas Production in Li-ion Batteries
- Flammable Compounds in Li-ion Batteries
- Electrical Fire Risks / Overcharge
- Over Discharge
- Fire Risks due to Contact with Water
- Exposure to Extreme Temperatures

# Li-ion Batteries Regulations

| ID Number | Proper Shipping Name and Description | Hazard Class |
|---|---|---|
| UN2794 | Batteries, Wet, Filled with Acid | 8 |
| UN2795 | Batteries, Wet, Filled with Alkali | 8 |
| UN2800 | Batteries, Wet, Nonspillable | 8 |
| UN3028 | Batteries, Dry, Containing Potassium Hydroxide Solid | 8 |
| UN3090 | Lithium Metal Batteries | 9 |
| UN3091 | Lithium Metal Batteries Contained in Equipment or Lithium Metal Batteries Packed with Equipment | 9 |
| UN3292 | Batteries, Containing Sodium | 4.3 |
| UN3480 | Lithium Ion Batteries | 9 |
| UN3481 | Lithium Ion Batteries Contained in Equipment or Lithium Ion Batteries Packed with Equipment | 9 |

Stowing and Handling:

- Category A
(on deck or under deck)

- Stowage Code SW19

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# Issues Onboard the Vessel

- Misdeclared cargoes.
- Crew not adequately trained for chemical spills.
- No chemical spill kit present onboard the vessel but just SOPEP spill kit.
- No PPE such as PP / Tyvek suits or respirator masks suitable for dealing. with volatile organic compounds in the event of toxic fumes release.
- Improper packing and securing of the cargo in the containers.
- Lack of familiarity with the IMDG Code and emergency procedures onboard.

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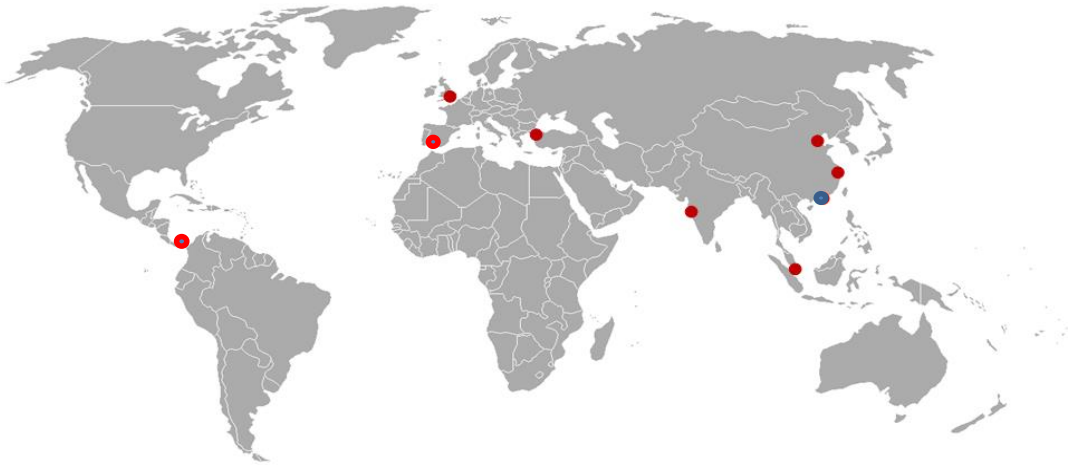

## *Thank You!*

***Asia – Europe – Middle East – North & South America***

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