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## Chapter 2: International Classification of Dangerous Goods

### Objectives

- This chapter will explain UN Transport regulations, its history and basis as model regulations for international classification system for other modes of transport.
- The linkage into the ASEAN Protocol 9 framework on the international carriage of dangerous goods in ASEAN will also be explained.
- 9 classes of dangerous goods classification shall be key content in this chapter. Other relevant basic terms such as Class, Division, Packaging Group (PG), UN Number (UNNO) and Proper Shipping Names (PSN) will also be covered.
- As supplement knowledge in classification of substances or mixtures that have more than one hazard, the explanation on precedence of hazard characteristics will be given.
- Basic hazard communication such as Labelling requirements, Dangerous Goods Declaration (DGD) or Multi-modal Dangerous Goods Form shall be explained.

### 1. Introduction

#### 1.1 United Nations Recommendations on the Transport of Dangerous Goods (UNTDG/UNRTDG)

These Recommendations have been developed by the United Nations Economic and Social Council's Committee of Experts on the Transport of Dangerous Goods in the light of technical progress, the advent of new substances and materials, the exigencies of modern transport systems and, above all, the requirement to ensure the safety of people, property and the environment. They are addressed to governments and international organizations concerned with the regulation of the transport of dangerous goods. They do not apply to the bulk transport of dangerous goods in sea-going or inland navigation bulk carriers or tank-vessels, which is subject to special international or national regulations.

The recommendations concerning the transport of dangerous goods are presented in the form of "Model Regulations on the Transport of Dangerous Goods", which are presented as annex in the textbook. The Model Regulations aim at presenting a basic scheme of provisions that will allow uniform development of national and international regulations governing the various modes of transport; yet they remain flexible enough to accommodate any special requirements that might have to be met. It is expected that governments, intergovernmental organizations and other international organizations, when revising or developing regulations for which they are responsible, will conform to the principles laid down in these Model Regulations, thus contributing to worldwide harmonization in this field. Furthermore, the new structure, format and content should be followed to the greatest extent possible in order to create a more user-friendly approach, to facilitate the work of enforcement bodies and to reduce the administrative burden. Although

only a recommendation, the Model Regulations have been drafted in the mandatory sense (i.e., the word "shall" is employed throughout the text rather than "should") in order to facilitate direct use of the Model Regulations as a basis for national and international transport regulations.

The scope of the Model Regulations should ensure their value for all who are directly or indirectly concerned with the transport of dangerous goods. Amongst other aspects, the Model Regulations cover principles of classification and definition of classes, listing of the principal dangerous goods, general packing requirements, testing procedures, marking, labelling or placarding, and transport documents. There are, in addition, special requirements related to particular classes of goods. With this system of classification, listing, packing, marking, labelling, placarding and documentation in general use, carriers, consignors and inspecting authorities will benefit from simplified transport, handling and control and from a reduction in time-consuming formalities. In general, their task will be facilitated and obstacles to the international transport of such goods reduced accordingly. At the same time, the advantages will become increasingly evident as trade in goods categorized as "dangerous" steadily grows.

The first version was published by the Committee in 1956 whereas subsequent revisions and amendments have been regularly published. Since its cover page is colored in orange, it is most commonly called and recognized as "The Orange Book". The latest version of the textbook is 18<sup>th</sup> Revised Edition which was issued in 2013.

The soft file of the UNTDG or the Orange book is available for free download at the United Nations Economic Commission for Europe (UNECE) web site as per the web link: [http://www.unece.org/trans/danger/publi/unrec/rev18/18files\\_e.html](http://www.unece.org/trans/danger/publi/unrec/rev18/18files_e.html)

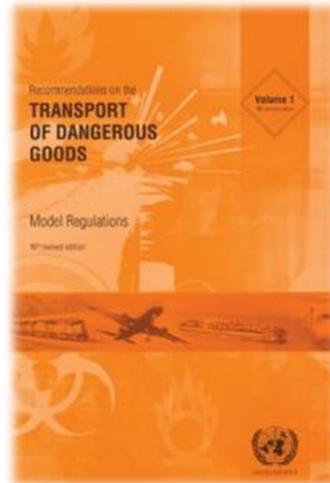


Figure 2-1: United Nations Recommendations on the Transport of Dangerous Goods (UNTDRG/UNRTDRG) – The Orange Book

## 1.2 International Transport Regulations of Dangerous Goods

Transport of dangerous goods is regulated in order to prevent, as far as possible, accidents to persons or property and damage to the environment, the means of transport employed or to other goods. At the same time, regulations should be framed so as not to impede the movement of such goods, other than those too dangerous to be accepted for transport. With this exception, the aim of regulations is to make transport feasible by eliminating risks or reducing them to a minimum. It is a matter therefore of safety no less than on of facilitating transport.

The Model Regulations are addressed to all modes of transport and acts as the model regulations both internationally and regionally. Those transport regulations are regulated under different units of United Nations with different purposes and regulatory responsibilities.

The summary of all other United Nations units in relationship with the applicable international transport regulations of dangerous goods is as below:

1) International Atomic Energy Agency (IAEA): The IAEA is widely known as the world's "Atoms for Peace" organization within the United Nations family. Set up in 1957 as the world's centre for cooperation in the nuclear field, the Agency works with its Member States and multiple partners worldwide to promote the safe, secure and peaceful use of nuclear technologies. Therefore the transport for all types of radioactive materials under all modes of transport is regulated in compliance with IAEA.

2) United Nations Environment Programme (UNEP), established in 1972, is the voice for the environment within the United Nations system. UNEP acts as a catalyst, advocate, educator and facilitator to promote the wise use and sustainable development of the global environment. UNEP work encompasses assessing global, regional and national environmental conditions and trends, developing international and national environmental instruments, strengthening institutions for the wise management of the environment. In specific concern of dangerous goods, UNEP impose stringent control of hazardous waste movements through the global mandatory enforcement of "Basel Convention".

3) International Civil Aviation Organization (ICAO) is a UN specialized agency, created in 1944 upon the signing of the Convention on International Civil Aviation (Chicago Convention). ICAO works with the Convention's 191 Member States and global aviation organizations to develop international Standards and Recommended Practices (SARPs) which States reference when developing their legally-enforceable national civil aviation regulations. ICAO developed Technical Instructions for the Safe Transport of Dangerous Goods by Air (Doc 9284 or ICAO TI) for regulating the transport of dangerous goods by air. The broad principles governing the international transport of dangerous goods by air are contained in Annex 18 to the Convention on International Civil Aviation - The Safe Transport of Dangerous Goods by Air. The Technical Instructions amplify the basic provisions of Annex 18

and contain all the detailed instructions necessary for the safe international transport of dangerous goods by air.

Dangerous goods can be carried safely by air transport providing certain principles are adopted. These principles have been used in developing the Technical Instructions. They are intended to facilitate transport while providing a level of safety such that dangerous goods can be carried without placing an aircraft or its occupants at risk, providing all the requirements are fulfilled. They try to ensure that should an incident occur it cannot lead to an accident.

4) The International Air Transport Association (IATA) is the trade association for the world's airlines, representing some 240 airlines or 84% of total air traffic. IATA support many areas of aviation activity and help formulate industry policy on critical aviation issues. Based on the regulatory concept of ICAO TI, IATA Dangerous Goods Regulations (IATA DGR) has been developed as the trusted source to help all airlines, airports, terminals, operators, freight forwarders and shippers to prepare and document dangerous shipments. Recognized by the world's airlines for over 50 years, the IATA DGR is the most complete, up-to-date, and user-friendly reference for air transport safety and compliance of dangerous goods.

5) The International Maritime Organization (IMO) is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine pollution by ships. As a specialized agency of the United Nations, IMO is the global standard-setting authority for the safety, security and environmental performance of international shipping. Its main role is to create a regulatory framework for the shipping industry that is fair and effective, universally adopted and universally implemented.

In connection with the SOLAS (the Safety of Life At Sea) and MARPOL (the Prevention of Pollution from Ships) conventions, International Maritime Dangerous Goods Code (IMDG Code) has been mandated as international regulations for maritime transport of dangerous goods by sea.

There are also other applicable regional transport regulations of dangerous goods which are strictly and specifically mandated in the Europe. These regulations have also become the regional model of inland transport regulations for dangerous goods in other areas such as South East Asia countries (ASEAN). The brief details of all regulations regulated by the United Nations Economic Commission for Europe (UNECE) are described below:-

1) European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) is the regulations enforced for the transport of Dangerous Goods by road in Europe. Under ASEAN framework Agreement on the Facilitation of Goods in Transit, it is stated under Protocol 9: Dangerous Goods for ASEAN member states to apply ADR for transit transport operators in the ASEAN region for harmonized and integrated regional regulations for dangerous goods.

2) European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN) is the applicable regulations enforced for regional transport of dangerous goods by inland waterways in the Europe.

3) Regulations concerning the International Carriage of Dangerous Goods by Rail (RID) define rules and procedures for regional transport compliance of dangerous goods by rail in the Europe.

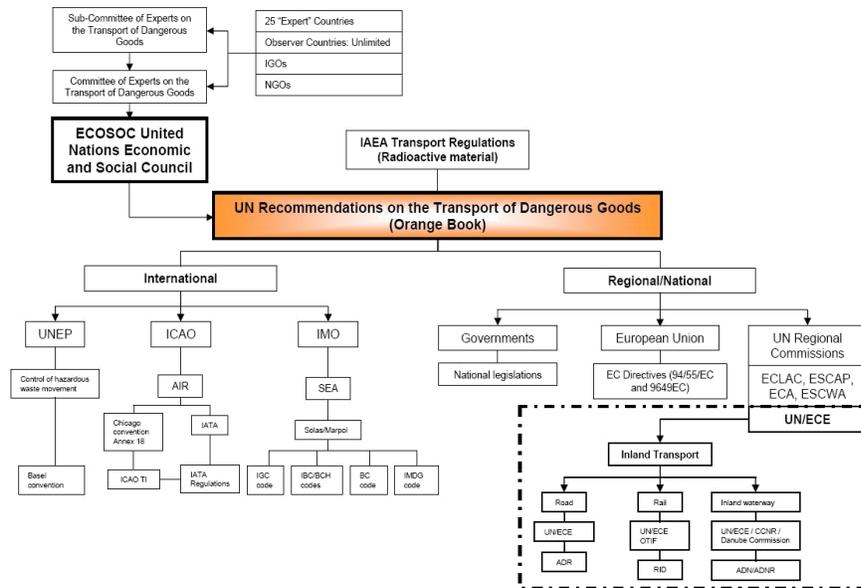


Figure 2-2: Relationship Structure of UNTDG as model regulations with other mandated international and regional regulations of dangerous goods transport

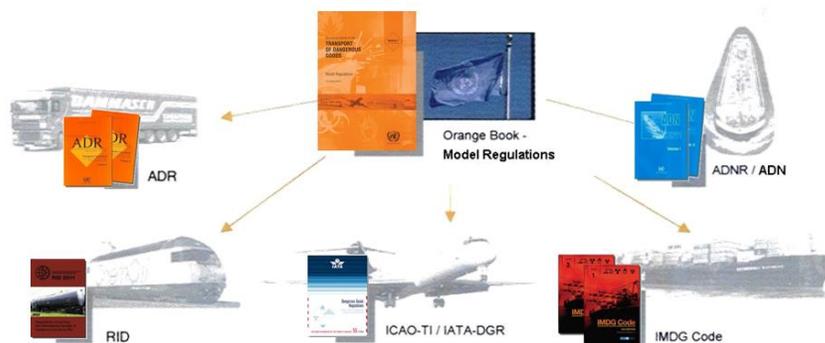


Figure 2-3: Orange Book and its relationship to dangerous goods regulations for other modes of transport

### 1.3 ASEAN Protocol 9

As stated earlier that even there is no direct relationship for mandate of European regional regulations to ASEAN countries for the transport of dangerous goods, the ASEAN and its member states has mutually agreed upon the Protocol 9: Dangerous

Goods to be an integral part of the ASEAN Framework Agreement on the Facilitation of Goods in Transit for ratification or acceptance by the Contracting Parties. Several definitions such as Dangerous Goods, Means of Transport, Transit Transport, UN Model Regulations, ADR, Restructured ADR, Transit Transport Operators have been defined to cover the responsibilities by the Contracting Parties to apply the provisions of this Protocol to the movement of dangerous goods in transit transport on designated road (or inter-state highway) transit transport routes as specified in Protocol 1 of the Agreement.

This means that the ASEAN member states that ratified or accepted the Protocol 9 must enforce the ADR-like regulations in each own country according to the details specified in Protocol 9.

#### **1.4 Classification of Dangerous Goods**

The common rule and working procedure with dangerous goods normally concern with the hazard classification (the ability to classify or identify the hazard class) and the hazard communication (the ability to communicate such hazard to the other parties).

According to UN Model Regulations, substances (including mixtures and solutions) and articles are assigned to one of the nine classes according to the hazard or the most predominant of the hazards they present. Some of these classes are subdivided into divisions. These classes and divisions are:

Class 1: Explosives

Class 2: Gases

Class 3: Flammable liquids

Class 4: Flammable solids; substances liable to spontaneous combustion; substances which, in contact with water, emit flammable gases

Class 5: Oxidizing 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 including environmentally hazardous substances

The numerical order of the classes and divisions is not that of the degree of danger. "Flammable" has the same meaning as "inflammable".

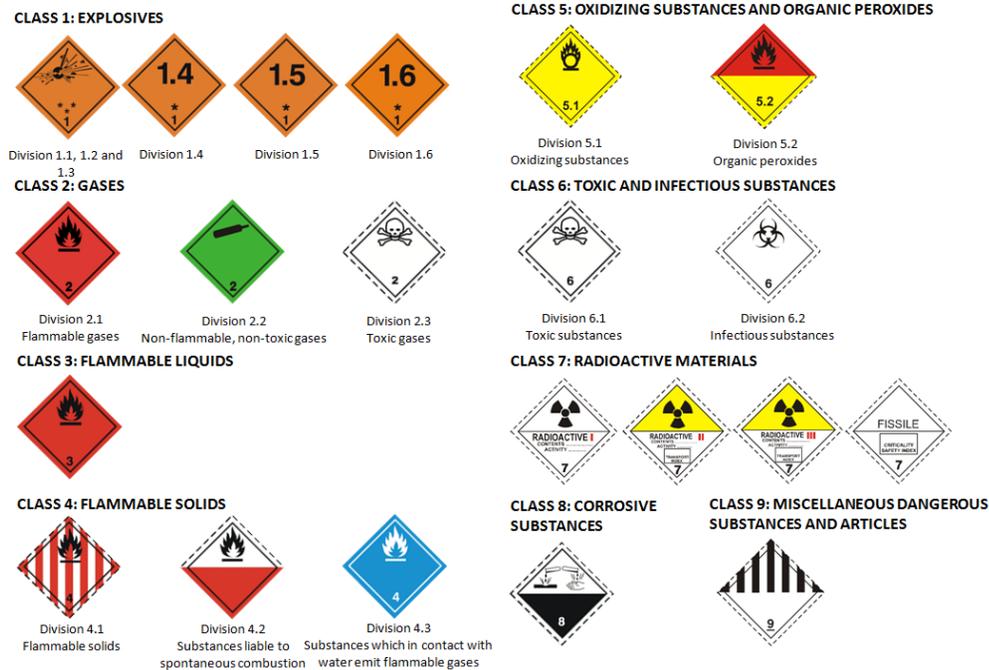


Figure 2-4: Hazard Classification and Labels of Dangerous Goods

### Class 1: Explosives

- (a) Explosive substance is a solid or liquid substance (or a mixture of substances) which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic substances are included even when they do not evolve gases;
- (b) Pyrotechnic substance is a substance or a mixture of substances designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative self-sustaining exothermic chemical reactions;
- (c) Explosive article is an article containing one or more explosive substances;
- (d) Phlegmatized means that a substance (or “phlegmatizer”) has been added to an explosive to enhance its safety in handling and transport. The phlegmatizer renders the explosive insensitive, or less sensitive, to the following actions: heat, shock, impacts, percussion or friction. Typical phlegmatizing agents include, but are not limited to: wax, paper, water, polymers (such as chlorofluoropolymers), alcohol and oils (such as petroleum jelly and paraffin).

Class 1 is divided into six divisions as follows:

Division 1.1: Substances and articles which have a mass explosion hazard (a mass explosion is one which affects almost the entire load virtually instantaneously);

Division 1.2: Substances and articles which have a projection hazard but not a mass explosion hazard;

Division 1.3: Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.

This division comprises substances and articles:

- (i) which give rise to considerable radiant heat; or
- (ii) which burn one after another producing minor blast or projection effects or both;

Division 1.4: Substances and articles which present no significant hazard

This division comprises substances and articles which present only a small hazard in the event of ignition or initiation during transport. The effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire shall not cause virtually instantaneous explosion of almost the entire contents of the package;

Division 1.5: Very insensitive substances which have a mass explosion hazard

This division comprises substances which have a mass explosion hazard but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions of transport;

Division 1.6: Extremely insensitive articles which do not have a mass explosion hazard

This division comprises articles which contain only extremely insensitive substances and which demonstrate a negligible probability of accidental initiation or propagation.

## **Class 2: Gases**

A gas is a substance which:

- (a) at 50°C has a vapour pressure greater than 300 kPa; or
- (b) is completely gaseous at 20°C at a standard pressure of 101.3 kPa.

The transport condition of gas is described according to its physical state as:

(a) Compressed gas - a gas which, when packaged under pressure for transport, is entirely gaseous at -50°C; this category includes all gases with a critical temperature less than or equal to -50°C;

(b) Liquefied gas - a gas which, when packaged under pressure for transport, is partially liquid at temperature above -50°C. A distinction is made between:

High pressure liquefied gas – a gas with a critical temperature between -50°C and +65°C and

Low pressure liquefied gas – a gas with a critical temperature above +65°C

(c) Refrigerated liquefied gas - a gas which, when packaged for transport, is made partially liquid because of its low temperature; or

(d) Dissolved gas – a gas which, when packaged under pressure for transport, is dissolved in liquid phase solvent.

(e) Adsorbed gas – a gas which when packaged for transport is adsorbed onto a solid porous material resulting in an internal receptacle pressure of less than 101.3 kPa at 20°C and less than 300 kPa at 50°C.

The class 2 comprises compressed gases, liquefied gases, dissolved gases, refrigerated liquefied gas, mixtures of one or more gases with one or more vapours of substances of other classes, article charged a gas and aerosols.

Substances of Class 2 are assigned to one of three divisions based on the primary hazard of the gas during transport.

### **Division 2.1: Flammable Gases**

Gases which at 20°C and a standard pressure of 101.3 kPa:

- (i) are ignitable when in a mixture of 13% or less by volume with air; or
- (ii) have a flammable range with air of at least 12 percentage points regardless of the lower flammable limit. Flammability should be determined by tests or calculation in accordance with methods adopted by the International Organization for Standardization see ISO standard 10156:2010). Where insufficient data are available to use these methods, tests by a comparable method recognized by a national competent authority may be used.

### **Division 2.2: Non-flammable, non-toxic gases**

Gases which:

- (i) are Asphyxiant - gases which dilute or replace the oxygen normally in the atmosphere; or
- (ii) are oxidizing - gases which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does (means pure gas or gas mixtures with an oxidizing power greater than 23.5% as determined by a method specified in ISO 10156: 2010); or
- (iii) do not come under the other classes.

### **Division 2.3: Toxic gases**

Gases which:

- (i) are known to be so toxic or corrosive to humans as to pose a hazard to health; or
- (ii) are presumed to be toxic or corrosive to humans because they have a LC50 (Lethal Concentration) value equal to or less than 5,000 ml/m<sup>3</sup> (ppm).

Note: Gases meeting the above criteria owing to their corrosivity are to be classified as toxic with a subsidiary corrosive risk.

**Precedence of gases**

Gases and gas mixtures with hazards associated with more than one division take the following precedence:

- (a) Division 2.3 takes precedence over all other classes;
- (b) Division 2.1 takes precedence over class 2.2

**Class 3: Flammable liquids**

Class 3 includes the following substances:

- (a) Flammable liquids
- (b) Liquid desensitized explosives

Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example paints, varnishes, lacquers, etc., but not including substances otherwise classified on account of their other dangerous characteristics), which give off a flammable vapour at temperature of not more than 60°C, closed cup test or not more than 65.6°C open-cup test, normally referred to as the flashpoint. This also includes:

1. Liquids offered for transport at temperatures at or above their flashpoint; and
2. Substances transported or offered for transport at elevated temperatures in a liquid state and give off a flammable vapour at a temperatures at or below the maximum transport temperature.

Liquid desensitized explosives are explosive substances which are dissolved or suspended in water or other liquid substances, to form an homogeneous liquid mixture to suppress their explosive properties. Entries in the Dangerous Goods List for liquid desensitized explosives are: UN 1204, UN 2059, UN 3064, UN 3343, UN 3357 and UN 3379.

Hazard grouping based on flammability

Packing Group	Flashpoint (closed cup)	Initial boiling point
I (high danger)	-	<35°C
II (medium danger)	<23°C	>35°C
III (low danger)	>23 to <60°C	>35°C

**Class 4: Flammable solids**

Class 4 is divided into 3 divisions as follows:-

**Division 4.1 Flammable solids:** Solids which, under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction; self-reactive substances (solids and liquids) which are liable to undergo a strongly exothermic reaction; solid desensitized explosives which may explode if not diluted sufficiently;

**Division 4.2 Substances liable to spontaneous combustion:** Substances which are liable to spontaneous heating under normal conditions encountered in transport, or to heating up in contact with air, and being then liable to catch fire;

**Division 4.3 Substances which, in contact with water, emit flammable gases:** Substances which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

**Division 4.1: Flammable solids, self-reactive substances and solid desensitized explosives**

Division 4.1 includes the following types of substances:

- (a) Flammable solids
- (b) Self-reactive substances
- (c) Solid desensitized explosives

**Division 4.1: Flammable solids**

Flammable solids are readily combustible solids and solids which may cause fire through friction.

Readily combustible solids means powdered, granular, or pasty substances which are dangerous if they can be easily ignited by brief contact with an ignition source such as, a burning match, and if the flame spreads rapidly. The danger may come not only from the fire but also from toxic combustion products. Metal powders are especially dangerous because of the difficulty of extinguishing a fire, since normal extinguishing agents such as carbon dioxide or water can increase the hazard.

**Division 4.1: Self-reactive substances**

Self-reactive substances are thermally unstable substances liable to undergo a strongly exothermic decomposition even without participation of oxygen (air).

Self-reactive substances are classified into seven types according to the degree of danger they present. The types of self-reactive substance range from type A, which may not be accepted for transport in the packaging in which it is tested, to type G, which is not subject to the provisions for self-reactive substances of Division 4.1.

The classification of types B to F is directly related to the maximum quantity allowed in one packaging.

**Division 4.1 Solid desensitized explosives**

Solid desensitized explosives are explosive substances which are wetted with water or alcohols or are diluted with other substances, to form a homogeneous solid mixture to suppress their explosive properties..

**Division 4.2: Substances liable to spontaneous combustion**

Division 4.2 includes:

(a) Pyrophoric substances, which are substances, including mixtures and solutions (liquid or solid), which even in small quantities ignite within 5 minutes of coming into contact with air. These are the Division 4.2 substances are the most liable to spontaneous combustion; and

(b) Self-heating substances, which are substances, other than pyrophoric substances, which in contact with air without energy supply, are liable to self-heating. These substances will ignite only when in large amounts (kilograms) and after long periods of time (hours or days).

Self-heating of a substance is a process where the gradual reaction of that substance with oxygen (in air) generates heat. If the rate of heat production exceeds the rate of heat loss, then the temperature of the substance will rise which, after an induction time, may lead to self-ignition and combustion.

**Division 4.3: Substances which, in contact with water, emit flammable gases**

The substances in this division are either liquids or solids which, by interaction with water are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

Certain substances, in contact with water, may emit flammable gases that can form explosive mixtures with air. Such mixtures are easily ignited by all ordinary sources of ignition, for example naked lights, sparking hand tools or unprotected light bulbs. The resulting blast wave and flames may endanger people and the environment.

**Class 5: Oxidizing substances and organic peroxides**

Class 5 is divided into two divisions as follows:

Division 5.1 Oxidizing substances: Substances which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material. Such substances may be contained in an article;

Division 5.2 Organic peroxides: Organic substances which contain the bivalent -O-O- structure and may be considered derivatives of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. Organic peroxides are thermally unstable substances which may undergo exothermic self-accelerating decomposition. In addition, they may have one or more of the following properties:

- (i) be liable to explosive decomposition;
- (ii) burn rapidly;
- (iii) be sensitive to impact or friction;
- (iv) react dangerously with other substances;
- (v) cause damage to the eyes.

#### **Division 5.1: Oxidizing substances**

Oxidizing substances: Substances which, while in themselves not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material. Such substances may be contained in an article;

Oxidizing Solids: Tests are performed to measure the potential for the solid substance to increase the burning rate or burning intensity of a combustible substance when the two are thoroughly mixed.

Oxidizing Liquids: A test is performed to measure the potential for a liquid substance to increase the burning rate or burning intensity of a combustible substance or for spontaneous ignition to occur when the two are thoroughly mixed.

#### **Division 5.2: Organic peroxides**

Organic peroxides are liable to exothermic decomposition at normal or elevated temperatures. The decomposition can be initiated by heat, contact with impurities (such as acids, heavy-metal compounds, amines), friction or impact. The rate of decomposition increases with temperature and varies with the organic peroxide formulation. Decomposition may result in the evolution of harmful, or flammable, gases or vapours. For certain organic peroxides the temperature should be controlled during transport. Some organic peroxides may decompose explosively, particularly if confined. This characteristic may be modified by the addition of diluents or by the use of appropriate packagings. Many organic peroxides burn vigorously.

Contact of organic peroxides with the eyes is to be avoided. Some organic peroxides will cause serious injury to the cornea, even after brief contact, or will be corrosive to the skin.

### **Class 6: Toxic and Infectious substances**

Class 6 is divided into two divisions as follows:

**Division 6.1 Toxic substances**

These are substances liable either to cause death or serious injury or to harm human health if swallowed or inhaled, or by skin contact.

**Division 6.2 Infectious substances**

These are substances known or reasonably expected to contain pathogens. Pathogens are defined as micro-organisms (including bacteria, viruses, rickettsiae, parasites, fungi) and other agents such as prions which can cause disease in humans or animals.

**Division 6.1: Toxic substances**

These are substances liable either to cause death or serious injury or to harm human health if swallowed or inhaled, or by skin contact.

*LD<sub>50</sub> (median lethal dose)* for acute oral toxicity is the statistically derived single dose of a substance that can be expected to cause death within 14 days in 50 per cent of young adult albino rats when administered by the oral route. The LD<sub>50</sub> value is expressed in terms of mass of test substance per mass of test animal (mg/kg).

*LD<sub>50</sub> for acute dermal toxicity* is that dose of the substance which, administered by continuous contact for 24 hours with the bare skin of albino rabbits, is most likely to cause death within 14 days in one half of the animals tested. The number of animals tested shall be sufficient to give a statistically significant result and be in conformity with good pharmacological practice. The result is expressed in milligrams per kg body mass.

*LC<sub>50</sub> for acute toxicity on inhalation* is that concentration of vapour, mist or dust which administered by continuous inhalation to both male and female young adult albino rats for one hour, is most likely to cause death within 14 days in one half of the animals tested.

**Assignment of packing groups**

Substances of Division 6.1, including pesticides, are allocated among the three packing groups according to their degree of toxic hazard in transport as follows:

- (a) Packing group I: Substances and preparations presenting a very severe toxicity risk;
- (b) Packing group II: Substances and preparations presenting a serious toxicity risk;
- (c) Packing group II: Substances and preparations presenting a relatively low toxicity risk.

**Grouping Criteria for Administration through Oral Ingestion, Dermal Contact, Inhalation of Dusts and Mists**

Packing Group	Oral Toxicity LD50 (mg/kg)	Dermal Toxicity LD50 (mg/kg)	Inhalation Toxicity by Dusts and Mists LC50 (mg/l)
I	≤ 5	≤ 50	≤ 0.2
II	> 5 and ≤ 50	> 50 and ≤ 200	> 0.2 and ≤ 2.0
III	> 50 and ≤ 300	> 200 and ≤ 1000	> 2.0 and ≤ 4.0

\*Tear gas substances shall be included in packing group II even if their toxicity data corresponds to packing group III values.

**Division 6.2: Infectious substances**

*Infectious substances* are substances which are known or are reasonably expected to contain pathogens. Pathogens are defined as microorganisms (including bacteria, virus, rickettsiae, parasites, fungi) and other agents such as prions, which can cause disease in humans or animals.

*Biological products* are those products derived from living organisms which are manufactured and distributed in accordance with the requirements of appropriate national authorities, which may have special licensing requirements, and are used either for prevention, treatment, or diagnosis of disease in humans or animals, or for development, experimental or investigational purposes related thereto. They include, but are not limited to, finished or unfinished products such as vaccines.

*Cultures* are the result of a process by which pathogens are intentionally propagated. This definition does not include human or animal patient specimens.

Patient specimens are human or animal materials, collected directly from humans or animals including, but not limited to, excreta, secreta, blood and its components, tissue and tissue fluid swabs, and body parts being transported for purposes such as research, diagnosis, investigational activities, disease treatment and prevention.

Infectious substances shall be classified in Division 6.2 and assigned to UN 2814, UN 2900, UN 3291 or UN 3373 as appropriate.

Infectious substances are divided into the following categories.

Category A: (UN 2814/UN 2900) An infectious substance which is transported in a form that when exposure to it occurs, is capable of causing permanent disability, life threatening or fatal disease in otherwise healthy humans or animals.

Category B: (UN 3373) An infectious substance which does not meet the criteria for inclusion in Category A. Infectious substance in Category B shall be assigned to UN 3373.

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*The proper shipping name of UN 3373 is “BIOLOGICAL SUBSTANCE, CATEGORY B”.*

**Class 7: Radioactive materials**

Radioactive material means any material containing radio nuclides where both the activity concentration and the total activity in the consignment exceed the values specified in 2.7.2.2.1 - 2.7.2.2.6.<sup>1</sup>

**Class 8: Corrosive substances**

Class 8 substances (corrosive substances) are substances which, by chemical reaction, will cause severe damage when in contact with living tissue, or, in the case of leakage, will materially damage, or even destroy, other goods or the means of transport.

**Assignment of Packing Groups**

Substances and preparations of Class 8 are divided among the three packing groups according to their degree of hazard in transport as follows:

- (a) Packing group I: Very dangerous substances and preparations;
- (b) Packing group II: Substances and preparations presenting medium danger;
- (c) Packing group III: Substances and preparations presenting minor danger.

Packing groups are assigned to corrosive substances in accordance with the following criteria:

(a) Packing group I is assigned to substances that cause full thickness destruction of intact skin tissue within an observation period of up to 60 minutes starting after an exposure time of 3 minutes or less.

(b) Packing group II is assigned to substances that cause full thickness destruction of intact skin tissue within an observation period of up to 14 days starting after an exposure time of more than 3 but not more than 60 minutes.

Packing groups are assigned to corrosive substances in accordance with the following criteria:

(c) Packing group III is assigned to substances that:

(i) cause full thickness destruction of intact skin tissue within an observation period of up to 14 days starting after an exposure time of more than 60 minutes but not more than 4 hours; or

(ii) are judged not to cause full thickness destruction of intact skin tissue but which exhibit a corrosion rate on either steel or aluminium surfaces exceeding 6.25 mm a year at a test temperature of 55°C when tested on both materials.

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<sup>1</sup> Please refer to the UN Model Regulations for more specific information.

**Table summarizing the different packing groups of Class 8**

Packing Group	Exposure Time	Observation Period	Effect
I	<= 3 min	<= 60 min	Full thickness destruction of intact skin
II	> 3 min <= 1 h	<= 14 d	Full thickness destruction of intact skin
III	> 1 h <= 4 h	<= 14 d	Full thickness destruction of intact skin
III	-	-	Corrosion rate on either steel or aluminium surfaces exceeding 6.25 mm a year at a test temperature of 55 when tested on both materials

**Class 9: Miscellaneous dangerous substances and articles**

Class 9 substances and articles (miscellaneous dangerous substances and articles) are substances and articles which, during transport present a danger not covered by other classes.

Assignment of Class 9:-

- Substances which, on inhalation as fine dust, may endanger health (ie. Blue/Brown/White Asbestos)
- Substances evolving flammable vapour
- Lithium batteries (UN 3090 and UN 3091 Lithium Metal Batteries & UN 3480 and UN 3481 Lithium Ion Batteries)
- Capacitors (UN 3499)
- Live-saving appliances (& airbag inflators/modules & seat-belt pretensioner)
- Substances and articles which, in the event of fire, may form dioxins
- Substances transported or offered for transport at elevated temperatures (UN 3257 – Liquids at or above 100°C and below its flashpoint, UN 3258 – Solids at or above 240 °C)
- Environmentally hazardous substances (aquatic environment) (UN 3082 – Liquids, UN 3077 – Solids) More explanation notes are given in the subsequent paragraphs.
- Genetically modified micro-organism (GMMOs) and genetically modified organisms (GMOs) (UN 3245)
- Other substances or articles presenting a danger during transport, but not meeting the definitions of another class

**Environmentally hazardous substances**

These designations are used for substances and mixtures which are dangerous to the aquatic environment that do not meet the classification criteria of any other class or another substance within Class 9. These designations may also be used for wastes not otherwise substance to these Regulations but which are covered under the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal and for substances designated to be environmentally hazardous substances by the competent authority of the country of origin, transit or destination

which do not meet the criteria for an environmentally hazardous substance according to these Regulations or for any other hazard Class.

**UN Packing Group (PG)**

For packing purposes, substances other than those of Classes 1, 2 and 7, division 5.2 and 6.2 and other than self-reactive substances of Division 4.1 are assigned to three packing groups in accordance with the degree of danger they present:

- Packing group I: (PG I)      Substances presenting high danger
- Packing group II: (PG II)    Substances presenting medium danger
- Packing group III: (PG III)   Substances presenting low danger

**UN Numbers and Proper Shipping Names (PSN)**

Dangerous goods are assigned to UN numbers and proper shipping names according to their hazard classification and their compositions.

Each entry in the Dangerous Goods List is characterized by a UN number. This list also contains relevant information for each entry, such as hazard class, subsidiary risk(s) (if any), packing group (where assigned), packing and tank transport requirements, etc. Entries in the Dangerous Good List are of the following four types

(a) Single entries for well-defined substances or articles e.g.

- UN 1090                      ACETONE
- UN 1194                      ETHYL NITRITE SOLUTION

(b) Generic entries for well-defined group of substances or articles e.g.

- UN 1133                      ADHESIVES
- UN 1266                      PERFUMERY PRODUCT
- UN 2757                      CARBAMATE PESTICIDE, SOLID, TOXIC
- UN 3101                      ORGANIC PEROXIDE, TYPE B, LIQUID

(c) Specific n.o.s. entries covering a group of substances or articles of a particular chemical or technical nature e.g.

- UN 1477                      NITRATES, INORGANIC, N.O.S. (not otherwise specified)
- UN 1987                      ALCOHOLS, N.O.S.

(d) General n.o.s. entries covering a group of substances or articles meeting the criteria of one or more classes or divisions e.g.

- UN 1325                      FLAMMABLE SOLID, ORGANIC, N.O.S.
- UN 1993                      FLAMMABLE LIQUID, N.O.S.

**Certain principles when assigning UN numbers and Proper Shipping Names**

1. A mixture or solution meeting the classification criteria of these Regulations composed of a single predominant substance identified by name in the Dangerous Goods List and one or more substances not subject to these Regulations and/or traces of one or more substances identified by name in the Dangerous Goods List, shall be assigned the UN number and proper shipping name of the predominant substance named in the Dangerous Goods List unless:

- (a) The mixture or solution is identified by name in the Dangerous Goods List
- (b) The name and description of the substance named in the Dangerous Goods List specially indicate that they apply only to the pure substance;
- (c) The hazard class or division, subsidiary risk(s), packing group, or physical state of the mixture or solution is different from that of the substance named in the Dangerous Goods List; or
- (d) The hazard characteristics and properties of the mixture or solution necessitate emergency response measures that are different from those required for the substance identified by name in the Dangerous Goods List.

In those other cases, except the one described in (a), the mixture or solution shall be treated as a dangerous substance not specifically listed by name in the Dangerous Goods List.

2. For a solution or mixture when the hazard class, the physical state or the packing group is changed in comparison with the listed substance, the appropriate N.O.S. entry shall be used including its packaging and labelling provisions.

3. A mixture or solution containing one or more substances identified by name in these Regulations or classified under a N.O.S. entry and one or more substances is not subject to these Regulations if the hazard characteristics of the mixture or solution are such that they do not meet the criteria (including human experience criteria) for any class.

**Precedence of hazard characteristics**

The table below shall be used to determine the class of a substance, mixture or solution having more than one risk, when it is not named in the Dangerous Goods List. For goods having multiple risks which are not specifically listed by name in the Dangerous Goods List, the most stringent packing group denoted to the respective hazards of the goods takes precedence over other packing groups, irrespective of the precedence of hazard table. The precedence of hazard characteristics of the following have not been dealt with in the Precedence of hazards Table as these primary characteristics also take precedence:

- (a) Substances and article of class 1;
- (b) Gases of Class 2;
- (c) Liquid desensitized explosives of Class 3;

- (d) Self-reactive substances and solid desensitized explosives of Division 4.1;
- (e) Pyrophoric substances of Division 4.2;
- (f) Substances of Division 5.2
- (g) Substances of Division 6.1 with a packing group I inhalation toxicity
- (h) Substances of Division 6.2
- (i) Material of Class 7

2.0.3.3 Precedence of hazards

Class or Division and Packing Group	4.2	4.3	5.1 I	5.1 II	5.1 III	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
3 I <sup>a</sup>		4.3				3	3	3	3	3	-	3	-	3	-
3 II <sup>a</sup>		4.3				3	3	3	3	8	-	3	-	3	-
3 III <sup>a</sup>		4.3				6.1	6.1	6.1	3 <sup>b</sup>	8	-	8	-	3	-
4.1 II <sup>a</sup>	4.2	4.3	5.1	4.1	4.1	6.1	6.1	6.1	4.1	4.1	-	8	-	4.1	4.1
4.1 III <sup>a</sup>	4.2	4.3	5.1	4.1	4.1	6.1	6.1	6.1	4.1	-	8	-	8	-	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	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	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						5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5.1 II						6.1	5.1	5.1	5.1	8	8	5.1	5.1	5.1	5.1
5.1 III						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

<sup>a</sup> Substances of Division 4.1 other than self-reactive substances and solid desensitized explosives and substances of Class 3 other than liquid desensitized explosives.

<sup>b</sup> 6.1 for pesticides.

- Denotes an impossible combination.

For hazards not shown in this table, see 2.0.3.

Figure 2-5: Precedence of Hazards Table

## Marking and Labelling

### Marking

The proper shipping name for the dangerous goods and the corresponding UN number preceded by the letters “UN”, shall be displayed on each package. The UN number and the letters “UN” shall be at least 12 mm high, except for packages of 30 liters capacity or less or of 30 kg maximum net mass and for cylinders of 60 liters water capacity when they shall be at least 6 mm in height and except for packages of 5 liters or 5 kg or less when they shall be of an appropriate size. In the case of unpackaged articles the marking shall be displayed on the article, on its cradle or on its handling, storage or launching device. A typical packaging marking is:

Corrosive liquid, acidic, organic, n.o.s. (Caprylyl chloride) UN 3265

A package markings required are as below:

- (a) Shall be readily visible and legible;

- (b) Shall be able to withstand open weather exposure without a substantial reduction in effectiveness;
- (c) Shall be displayed on a background of contrasting colour on the external surface of the package; and
- (d) Shall not be located with other package markings that could substantially reduce their effectiveness.

**Labelling**

Labels identifying primary and subsidiary risks shall conform to models Nos. 1 to 9 as below:

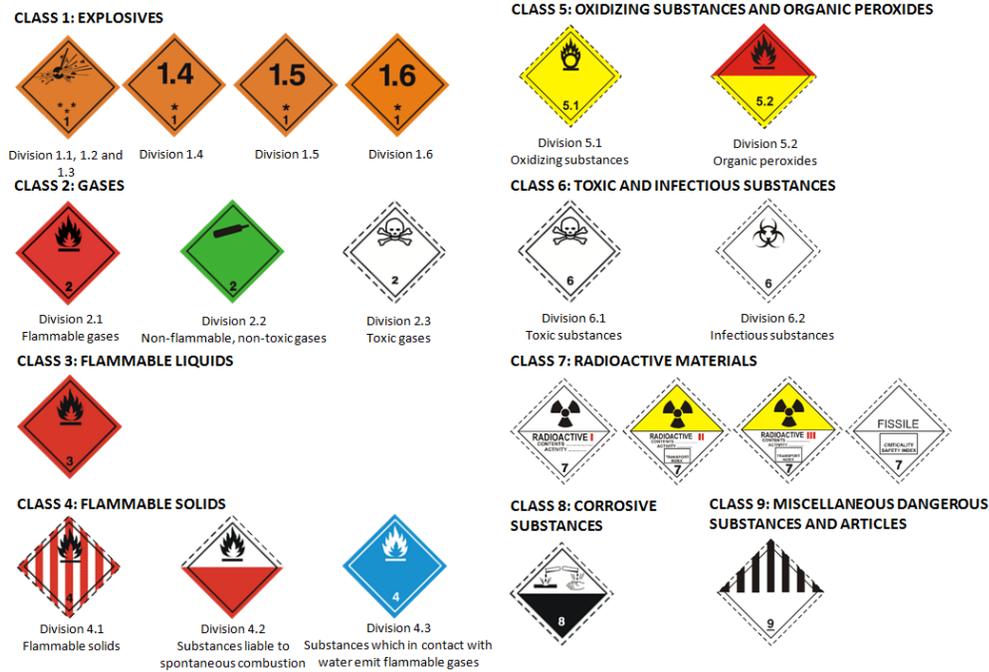
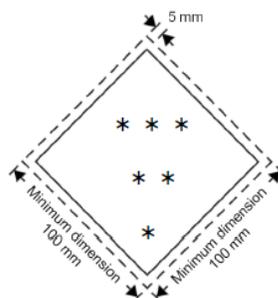


Figure 2-4: Hazard Classification and Labels of Dangerous Goods

Label shall be configured as shown below:



Class/division label

- \* The class or, for divisions 5.1 and 5.2, the Division number shall be shown in the bottom corner
- \*\* Additional text/numbers/letters shall (if mandatory) or may (if optional) be shown in this bottom half
- \*\*\* The class or division symbol or, for divisions 1.4, 1.5 and 1.6, the division number and for Model No 7E the word "FISSILE" shall be shown in this top half

Figure 2-6: Labeling of dangerous goods package

Labels shall be displayed on a background of contrasting color, or shall have either a dotted or solid outer boundary line.

The labels should be in the form of a square set at an angle of 45 degrees (diamond-shaped). The minimum dimensions shall be 100 mm x 100 mm and the minimum width of the line inside the edge forming the diamond shall be 2 mm. The line inside the edge shall be parallel and 5 mm from the outside of that line to the edge of the label. The line inside the edge on the upper half of the label shall be the same colour as the symbol and the line inside the edge on the lower half of the label shall be the same colour as the class or division number in the bottom corner. Where dimensions are not specified, all features shall be in approximate proportion to those shown.

If the size of the package so requires the dimensions may be reduced, provided the symbols and other elements of the label remain clearly visible. The line inside the edge shall remain 5 mm to the edge of the label. The minimum width of the line inside the edge shall remain 2 mm.

All labels should be able to withstand open weather exposure without a substantial reduction in effectiveness.

### **Special marking provisions for environmentally hazardous substances**

Packaging containing environmentally hazardous substances shall be durably marked with the environmentally hazardous substance mark.

The environmentally hazardous substance mark shall be as shown below:



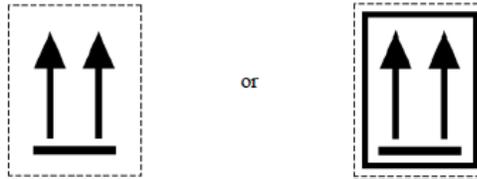
Figure 2-7: Environmentally hazardous substance mark

The marking shall be in the form of a square set at an angle of 45 degrees (diamond-shaped). The symbol (fish and tree) shall be black on white or suitable contrasting background. The minimum dimensions shall be 100 mm x 100 mm and the minimum width of line forming the diamond shall be 2 mm. If the size of the package so requires, the dimensions/line thickness may be reduced, provided the marking remains clearly visible. Where dimensions are not specified, all features shall be in approximate proportion to those shown.

### **Orientation Arrows**

If not stated by as exception in Regulations, the package of Dangerous Goods shall be legibly marked with orientation arrows which are similar to the illustration shown below or with those meeting the specifications of ISO 780:1997. The orientation

arrows shall appear on two opposite vertical sides of the package with the arrows pointing in the correct upright direction. They shall be rectangular and of a size that is clearly visible commensurate with the size of the package. Depicting a rectangular border around the arrows is optional.



Two black or red arrows on white or suitable contrasting background.  
 The rectangular border is optional  
 All features shall be in approximate proportion to those shown.

Figure 2-8: Orientation Arrows

### Placarding and Marking of Cargo Transport Units

Placards shall be affixed to the exterior surface of cargo transport units to provide a warning that the contents of the unit are dangerous goods and present risks. Placards shall correspond to the primary risk of goods contained in the cargo transport unit.

Placards shall be displayed on a background of contrasting color, or shall have either a dotted or solid outer boundary line.

Placard shall also be displayed for those subsidiary risks for which a subsidiary risk label is required. However, cargo transport units containing goods of more than one class need not bear a subsidiary risk placard if the hazard represented by that placard is already indicated by primary risk placard.

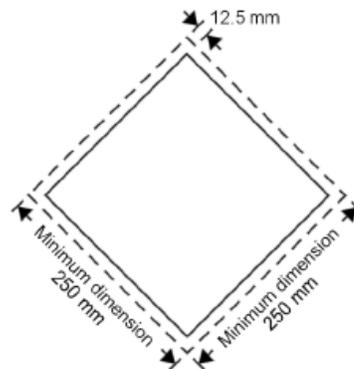


Figure 2-9: Placards for Cargo Transport Units

The placard shall be in the form of a square set at angle of 45 degrees (diamond-shaped). The minimum dimensions shall be 250 mm x 250 mm (to the edge of the placard). The line inside the edge shall be parallel and 12.5 mm from the outside of that line to the edge of the placard. The symbol and line inside the edge shall correspond in colour to the label for the class or division of the dangerous goods in

question. The class or division symbol/numeral shall be positioned and sized in proportion in Figure 2-4 for the corresponding class or division of the dangerous goods in question. The placard shall display the number of the class or division (and for good in Class 1, the compatibility group letter) of the dangerous goods in question in the manner prescribed in Figure 2-4 for the corresponding label, in digits not less than 25 mm high. Where dimensions are not specified, all features shall be in approximate proportion to those shown.

**Display of UN Numbers**

The UN number for the goods shall be displayed in black digits not less than 65 mm high, either:

- (a) Against a white background in the area below the pictorial symbol and above the class or division number and the compatibility group letter in a manner that does not obscure or detract from the other required label elements or
- (b) On an orange rectangular panel not less than 120 mm high and 300 mm wide, with a 10 mm black border, to be placed immediately adjacent to each placard.

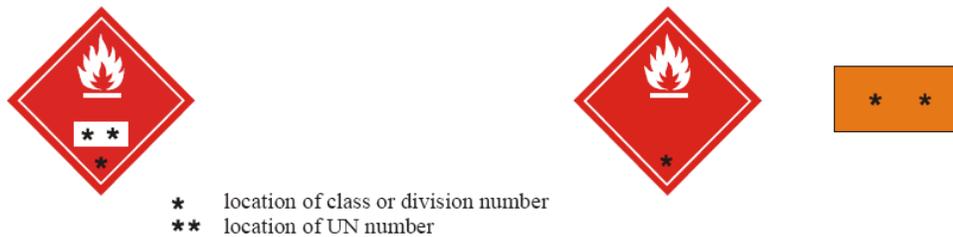


Figure 2-10: Display UN Numbers

**Elevated temperature substances**

Cargo transport units containing a substance that is transported or offered for transport in a liquid state at a temperature equal to or exceeding 100 °C or in a solid state at a temperature equal to or exceeding 240°C shall bear on each side and on each end the mark shown below:

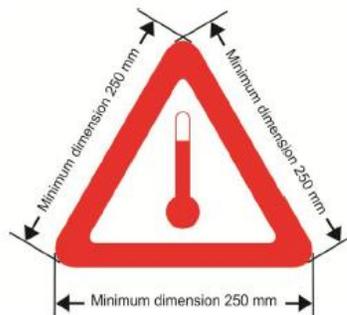


Figure 2-11: Mark for carriage at elevated temperature

The marking shall be an equilateral triangle. The colour of the mark shall be red. The minimum dimension of the sides shall be 250 mm. Where dimensions are not specified, all features shall be in approximate proportion to those shown.

### **Environmentally hazardous substance mark**

A cargo transport unit containing environmentally hazardous substances shall be marked on at least two opposing sides of the unit and in any case in such a position as may be seen by all those involved in the loading or unloading processes, with the environmentally hazardous substance mark to be affixed for placards.

### **Documentation**

The consignor who offers dangerous goods for transport shall give to the carrier the information applicable to those dangerous goods, including any additional information and documentations as specified in these Regulations. This information may be provided on a dangerous goods transport document or, with the agreement of the carrier, by EDP or EDI techniques.

When a paper document is used, the consignor shall give the initial carrier a copy of the dangerous goods transport document, completed and signed as required in this Chapter.

When the dangerous goods transport information is given to the carrier by EDP or EDI techniques, the consignor shall be able to produce the information without delay as a paper document, with the information in the sequence required.

If both dangerous goods and non-dangerous goods are listed in one document, the dangerous goods shall be listed first, or otherwise be emphasized.

A dangerous goods transport document may consist of more than one page, provided pages are consecutively numbered. The information on a dangerous goods transport document shall be easy to identify, legible and durable.

### **Guidance on filling information in the dangerous goods transport document**

#### **1. Consignor, consignee and date**

The name and address of the consignor and the consignee of the dangerous goods shall be included on the dangerous goods transport document. The date the dangerous good transport document or an electronic copy of it was prepared or given to the initial carrier shall be included.

#### **2. Dangerous Goods Description**

The dangerous goods transport document shall contain the following information for each dangerous substance, material or article offered for transport:

- (a) The UN number preceded by the letters "UN";
- (b) The proper shipping name including the technical name enclosed in parenthesis

- (c) The primary hazard class or, when assigned, the division of the goods. The words “Class” or “Division” may be included preceding the primary hazard class or division numbers;
- (d) Subsidiary hazard class or division number(s) corresponding to the subsidiary risk label(s) required to be applied, when assigned, shall be entered following the primary hazard class or division and shall be enclosed in parenthesis. The words “Class” or “Division” may be included preceding the subsidiary hazard class or division numbers;
- (e) Where assigned, the packing group for the substance or article which may be preceded by “PG” (e.g. “PG II”).

**3. Sequence of dangerous goods description**

The five elements of the dangerous goods description as stated above shall be shown in the order listed above (i.e. (a), (b), (c),(d),(e)) with no information interspersed, except as provided in these Regulations. Examples of dangerous goods description are:

UN 1098 ALLYL ALCOHOL 6.1(3) I  
UN 1098, ALLYL ALCOHOL, Division 6.1 (Class 3), PG I

**Note:** *In addition to the requirements of these Regulations, other elements of information may be required by the competent authority or for certain modes of transport (e.g. flash point for sea transport). Unless permitted or required by these Regulations, additional information shall be placed after the dangerous goods description.*

**Multimodal Dangerous Goods Form**

The example of Multimodal Dangerous Goods Form is as below:

The form is titled "MULTIMODAL DANGEROUS GOODS FORM" and includes the following sections:

- 1. Shipper/Consignee/Receiver:** Fields for name, address, and telephone number.
- 2. Shipper's reference:** Field for reference number.
- 3. Shipper's address:** Fields for street, city, and country.
- 4. Freight Forwarder's reference:** Field for reference number.
- 5. Consignee:** Field for name.
- 6. Carrier to be employed by the contract:** Field for carrier name.
- 7. Description of goods:** A large text area for describing the dangerous goods, including hazard labels and handling instructions.
- 8. Additional handling information:** Field for specific handling requirements.
- 9. Transport information:** Fields for mode of transport (air, sea, road, rail), origin, and destination.
- 10. Container/vehicle and date:** Fields for container/vehicle ID and date.
- 11. Date:** Field for the date of completion.
- 12. Number and kind of packages, description of goods:** Fields for quantity, weight, and description.
- 13. Container/vehicle and date:** Fields for container/vehicle ID and date.
- 14. Consignee/vehicle and date:** Fields for consignee/vehicle ID and date.
- 15. Date:** Field for the date of completion.
- 16. Shipper's name:** Field for shipper's name.
- 17. Consignee's name:** Field for consignee's name.
- 18. Date:** Field for the date of completion.
- 19. Signature of shipper:** Field for shipper's signature.
- 20. Signature of consignee:** Field for consignee's signature.

Figure 2-12: Multimodal Dangerous Goods Form

## 2. Conclusion

Understanding how dangerous goods are classified is a mandatory requirement prior to handling and transporting them locally, regionally and internationally. United Nations has designed the globally recognized model regulations with regular updates and revisions called “UN Model Regulations” or commonly known as “The Orange Book” which cover the internationally recognized concepts of handling dangerous goods for transport in general and also cascade those concepts and updates reflecting in other dangerous goods regulations in sea, air, road, rail, inland waterway mode of transports.

UN Model regulations also act as the key principle covering a wide range of contents:

- General Provisions, definitions, training and security
- Classification (9 Classes)
- Dangerous Goods List, Special Provisions and Exceptions
- Appendices
- Alphabetical Index of Substances and Articles
- Packing and Tank Provision
- Consignment Procedures
- Requirements for the Construction and Testing of Packagings, Intermediate Bulk Containers (IBCs), Large Packagings, Portable Tanks, Multiple-Element Gas Containers (MEGCs) and Bulk Containers
- Provisions concerning Transport Operations

This training guidebook is intended to give the quick overview of key summaries on basic knowledge (majorly on hazard classification and hazard communication) that people in the transport and logistics industry should be aware of. It covers the 9 classes of dangerous goods classification and some specific terms such as class, division, UN numbers, proper shipping names and packing group. It also gives some additional guidance when classifying the mixtures of multiple hazards on how to run the precedence of primary and secondary risks based on hazard properties. The hazard communication mainly focuses on marking, labelling and placarding on both dangerous goods packages and cargo transport units (CTUs). The last portion also covers on how the dangerous goods transport document should be declared in the form of multimodal dangerous goods form.

It is however still lack of certain and specific handling information which the readers are highly recommended to refer to the full text of UN Model Regulations for deeper level of information.

Handling dangerous goods is a sensitive issue and requires the specialized expertise of knowledge. In several modes of transport, mishandling or inappropriate management of dangerous goods may harm the human health and environment in which undesirable incidents may happen and be difficult to control.

## References

1. United Nations Economic and Social Council's Committee of Experts (UNECE) (2013) Recommendations on the Transport of Dangerous Goods Model Regulations: Volume I & II 18<sup>th</sup> Revised Edition, New York and Geneva: United Nations
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3. <http://www.unep.org/>
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7. <http://www.iata.org/about/Pages/index.aspx>
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