Transportation of Dangerous Goods (TDG) - Segregation of Means of Containment (Road)

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What does Transportation of Dangerous Goods mean by segregation?

The term segregation is used to mean “to put apart from the rest,” “isolate,” or “physically separate from the rest.” Dangerous goods might need to be segregated when:

- the means of transport (e.g., vehicle) will be loaded with more than one type of dangerous good, such as a “mixed load”
- when packages will contain more than one type of dangerous good.

When transporting dangerous goods, there is always a risk of spills. If incompatible substances mix because the packages get damaged in an incident, a chemical reaction may produce enough heat to cause fire or explosion or possibly release dangerous gases. For example, chlorine gas is released when a spill of sodium hypochlorite solution comes into contact with a sulphuric acid spill. Chlorine gas is classified with the following TDG class and subsidiary classes in Schedule I of the TDG Regulations: 2.3 (5.1) (8). Thus, chlorine gas is dangerous because it is toxic, can oxidize other materials, and is corrosive.

When dangerous goods react together, they are referred to as “incompatible dangerous goods”.

Note: The information below is provided as guidance only. Always check with Transport Canada and the TDG Act and Regulations to ensure compliance.

Please also see the following documents in this series:

- Transportation of Dangerous Goods (TDG) – Overview (Road)
- Transportation of Dangerous Goods (TDG) - Training (Road)
- Transportation of Dangerous Goods (TDG) - 9 Classes
- Transportation of Dangerous Goods (TDG) - Classification (Road)
- Transportation of Dangerous Goods (TDG) - "Special Case” and “Special Provision” Exemptions (Road)
- Transportation of Dangerous Goods (TDG) - Dangerous Goods Marks (Road)
- Transportation of Dangerous Goods (TDG) - Means of Containment (Road)
- Transportation of Dangerous Goods (TDG) - Shipping Documents (Road)
- Transportation of Dangerous Goods (TDG) - Emergency Response (Road)
- Transportation of Dangerous Goods (TDG) - Reporting Requirements (Road)

Do all dangerous goods need to be segregated?

Only dangerous goods that are unstable decompose violently or could react dangerously will need to be segregated. Generally, dangerous goods that are unstable are not allowed to be transported in a mixed load or in the same package.

What are dangerous reactions?

Dangerous or violent reactions are generally those that involve:

- Combustion or evolution of considerable heat
- Evolution of flammable, corrosive, toxic, or asphyxiant gases
- Formation of corrosive substances or unstable substances
- Neutralization, which involves the evolution of corrosive mists or heat
- Violent decomposition (e.g., explosives)
- Polymerization with the evolution of heat, increase in volume, and potential rupture of the container

What do the TDG Regulations state about the loading of incompatible dangerous goods?

Except for specific requirements about the loading of explosives, the TDG Regulations do NOT directly address the transportation of incompatible dangerous goods. However, Section 5.4 in Part 5 of the TDG Regulation states:

> **Loading and Securing**
>
> **5.4** A person must load and secure dangerous goods in a means of containment and must load and secure the means of containment on a means of transport in such a way as to prevent, under normal conditions of transport, damage to the means of containment or to the means of transport that could lead to a release of the dangerous goods.
>
> Segregation of dangerous goods is considered good practice as it is part of “safe loading” and “handling”.
>
> The carrier should have a safe operating procedure (SOP) for “load planning” which includes segregation of consignments when multiple consignments will be collected en route. Meanwhile, if a consignor is preparing packages with multiple dangerous goods (e.g., consolidation bins or overpacks), then the consignor’s SOP must include instructions on how to manage the packaging of incompatible dangerous goods.

Are incompatible goods allowed to be in the same package or in an overpack?

Segregation applies to the means of containment (MOC), package, an overpack, and the means of transport (MOT). The general guidance for dangerous goods that are allowed to be shipped (i.e., they are not forbidden) includes the following:

- Incompatible substances must not be combined in the same packaging, overpack or container.
- Packages containing incompatible substances (e.g. Package A and Package B) can be shipped as follows:
  - depending on the nature of the dangerous goods, packages A and B may be allowed to be loaded on the same means of transport as long as they are isolated from each other or
  - if the risk is too high, then the packages must be transported on separate means of transport.

NOTE: Some incompatible dangerous goods may be allowed to be transported together when their quantity is below a specific threshold limit or when limited quantity packaging is used. A threshold limit can be established by a safety engineer and in consultation with the TDG Directorate.

What are effective segregation methods?

The following methods can be used to segregate dangerous goods:

- Loading the materials in separate compartments on the vehicle.
- Overpacking the individual containers with suitably strong material to provide extra protection, and to contain any leakage from the inner receptacles.
- Stowing the containers as far apart as possible on the vehicle, with other inert cargo providing a barrier in between.

Segregation does not necessarily refer to keeping dangerous good package A away from dangerous good package B, such as the opposite side of a truck trailer. An accident with A may cause a release of B, or a reaction from one might affect the other.

When should a means of containment (MOC) be segregated?

A means of containment (MOC) should be segregated according to the carrier's loading plan. The carrier's TDG specialist should determine the incompatibility between the dangerous goods that are intended to be transported. As different consignments are loaded, the loader or driver should follow the safe operating procedure (SOP). The SOP should include information on how to carry out a segregation check:

- Before loading starts in the means of transport of more than one type of dangerous goods identified with two or more different UN numbers.
- Before intermediate storage to avoid unnecessary risks.

Are there software applications for the loading of dangerous goods?

Yes. There are a number of commercial software applications available for loading that take into account the compatibility of dangerous goods. These applications are mode (e.g., air, marine, road) and jurisdiction-specific (e.g., Canada, USA). Thus, when deciding to use an application, the software application needs to be selected carefully.

How does one determine if dangerous goods are incompatible?

Canada's TDG Regulations do not include a compatibility table for dangerous goods (the Regulations do include a compatibility table for consignments that consist of explosives only).

Dangerous Goods Other Than Explosives

Although Canada has not issued a compatibility or segregation chart, a number of different international jurisdictions have compiled such charts in their dangerous goods or hazardous material transport regulations. **Caution** must be used when following these charts as they are based on the dangerous good's TDG class. Accurate compatibility charts are those that are based on the chemical properties of the dangerous goods.

Ideally compatibility charts for loading plans are created by using multiple sources, such as the reactivity section in the dangerous good's Safety Data Sheet (SDS), chemical reference books on reactivity, and consultation with the supplier or shipper. For example, both hydrochloric acid (UN1789) and sodium hydroxide (UN1823 for solids and UN1824 for solutions) are dangerous goods with an assigned TDG Class 8 in Schedule 1 of the TDG Regulations. Although hydrochloric acid and sodium hydroxide are assigned to the same TDG class, they are NOT compatible. If these two dangerous goods come into contact with one another, there will be a generation of considerable heat, which could result in the creation or sputtering of corrosive vapours and mists.

Table 1: Sample segregation and separation chart for road transportation of dangerous goods (1,2,3)

NOTE: The following table is provided as informational only. It is not an interpretation of the TDG Act or regulations. Always consult with TDG professionals and reliable chemical information sources when making your determination regarding compatibility.

Class or Division	1	2.1	2.2	2.3	3	4.1	4.2	4.3 (3)	5.1	5.2	6.1/6.2	7	8	9	Class or Division
Explosives 1	(*)	X	X	X	X	X	X	X	X	X	X	(**)	X	X	Explosives 1
Flammable gases 2.1	(*)	L	S	S	L	L	L	L	L	S	X	(**)	L	X	Flammable gases 2.1
Non-toxic, non-flammable gases 2.2	(*)	L	L	L	L	L	L	L	L	L	L	(**)	L	L	Non-toxic, non-flammable gases 2.2
Poisonous gases 2.3	(*)	X	L	L	X	X	X	X	X	X	L	(**)	X	X	Poisonous gases 2.3
Flammable liquids 3	(*)	L	L	X	L	L	L	L	S	L	X	(**)	L	L	Flammable liquids 3
Flammable solids 4.1	(*)	L	L	X	L	L	L	L	L	L	X	(**)	S	S	Flammable solids 4.1
Spontaneously combustible substances 4.2	(*)	L	L	X	L	L	L	L	L	L	X	(**)	X	S	Spontaneously combustible substances 4.2
Substances which are dangerous when wet 4.3 **See NOTE (3) below**	(*)	L	L	X	L	L	L	L	L	L	X	(**)	S	S	Substances which are dangerous when wet 4.3
Oxidizing substances 5.1	(*)	L	L	X	S	L	L	L	L	L	X	(**)	S	S	Oxidizing substances 5.1
Organic peroxides 5.2	(*)	L	L	X	L	L	L	L	L	L	X	(**)	S	S	Organic peroxides 5.2
Poisons 6.1 or Infectious 6.2	(*)	S	L	L	X	X	X	X	X	X	L	(**)	X	X	Poisons 6.1 or Infectious 6.2
Radioactive materials 7	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)	(**)	Radioactive materials 7
Corrosives 8	(*)	L	L	X	L	S	X	S	S	S	X	(**)	L	L	Corrosives 8
Miscellaneous dangerous substances 9(***)	(*)	X	L	L	L	S	X	S	S	S	X	(**)	L	L	Miscellaneous dangerous substances 9(***)
Class or Division	(*)	**2.1**	**2.2**	**2.3**	**3**	**4.1**	**4.2**	**4.3**	**5.1**	**5.2**	**6.1 / 6.2**	**7**	**8**	**9**	**Class or Division**

(*) See “Table 2” below for the transportation of explosives

(**) See the Packaging and Transport of Nuclear Substances Regulations, 2015

(1) The letter “**X**” indicates that the dangerous goods must not be transported in the same vehicle

The letter "**L**" indicates to load these dangerous goods with caution. Follow your employer's SOP for loading and make sure:

- The primary TDG classes of each dangerous good are compatible with the subsidiary TDG classes of the other dangerous goods that are intended to be loaded together
- The subsidiary TDG classes of all the dangerous goods that are intended to be loaded together are compatible with one another

The letter "**S**" indicates that dangerous may not be loaded, transported, or stored together in the same transport vehicle during the course of transportation unless they are separated in a manner so the dangerous goods will not come into contact with one another in case of an incident where the packages will be leaking. NOTE: Even if separation methods are used, Class 8 (corrosive) liquids may not be loaded above or adjacent to Class 4 (flammable) or Class 5 (oxidizing) materials. However, this requirement does not apply to Class 4 and Class 5 dangerous goods that, when in contact, are known NOT to cause a fire or a dangerous evolution of heat or gas.

(2) Do NOT transport dangerous goods together with food, feeds or other edible materials on the same means of transport (e.g., vehicle).

(3) Unless able to separate properly, do NOT transport Class 4.3 dangerous goods with any aqueous (water-containing) solutions together.

(***) Class 9 dangerous goods have varied properties, and thus, it is best to check the SDS regarding hazards and get advice from the supplier.

Explosives

Explosives are assigned a compatibility group. See Column 3 in Schedule 1. The compatibility groups are described in Appendix 2 of Part 2 in the TDG Regulations. The Table from Section 5.7 in Part 5 of the TDG Regulation lists the explosives compatibility groups that can be transported together. It is reproduced below with some minor modifications of the column titles.

For example: the assigned compatibility group for UN0004 in Schedule 1 is 1.1D. This explosive can be transported together with other explosives that have the following assigned compatibility letter/group: C, D, E, N, S. NOTE: If an explosive (e.g., UN0074) is assigned to the compatibility group "A", then such an explosive cannot be transported with any other explosive.

Table 2: Section 5.7 Compatibility Groups - assignment of compatibility letter for explosives.

Assigned compatibility group with the explosive's TDG class	**Compatibility group for explosives that may be transported together**
A	A
B	B, S
C	C, D, E, N, S
D	C, D, E, N, S
E	C, D, E, N, S
F	F, S
G	G, S
H	H, S
J	J, S
K	K, S
L	L
N	C, D, E, N, S
S	B, C, D, E, f, G, H, J, K, N, S,

Example from Schedule 1 illustrating assignment of compatibility letter for explosives.

Note: The compatibility letter for the dangerous good "UN0029 DETONATORS, NON-ELECTRIC for blasting" is next to the TDG Class (see Column 3 in Schedule 1). The letter "B" next to "1.1" is the compatibility letter.

Column 1 UN Number	Column 2 Shipping Name and Description	Column 3 Class	Column 4 Packing Group / Category	Column 5 Special Provisions	Column 6 6(a) Explosive Limit and Limited quantity Index	Column 6 6(b) Excepted Quantities	Column 7 ERAP Index	Column 8 Passenger Carrying Vessel Index	Column 9 Passenger Carrying Road Vehicle or Passenger Carrying Railway Vehicle Index
UN0029	DETONATORS, NON-ELECTRIC for blasting	1.1B	II	86	0	E0	5000	100	100

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