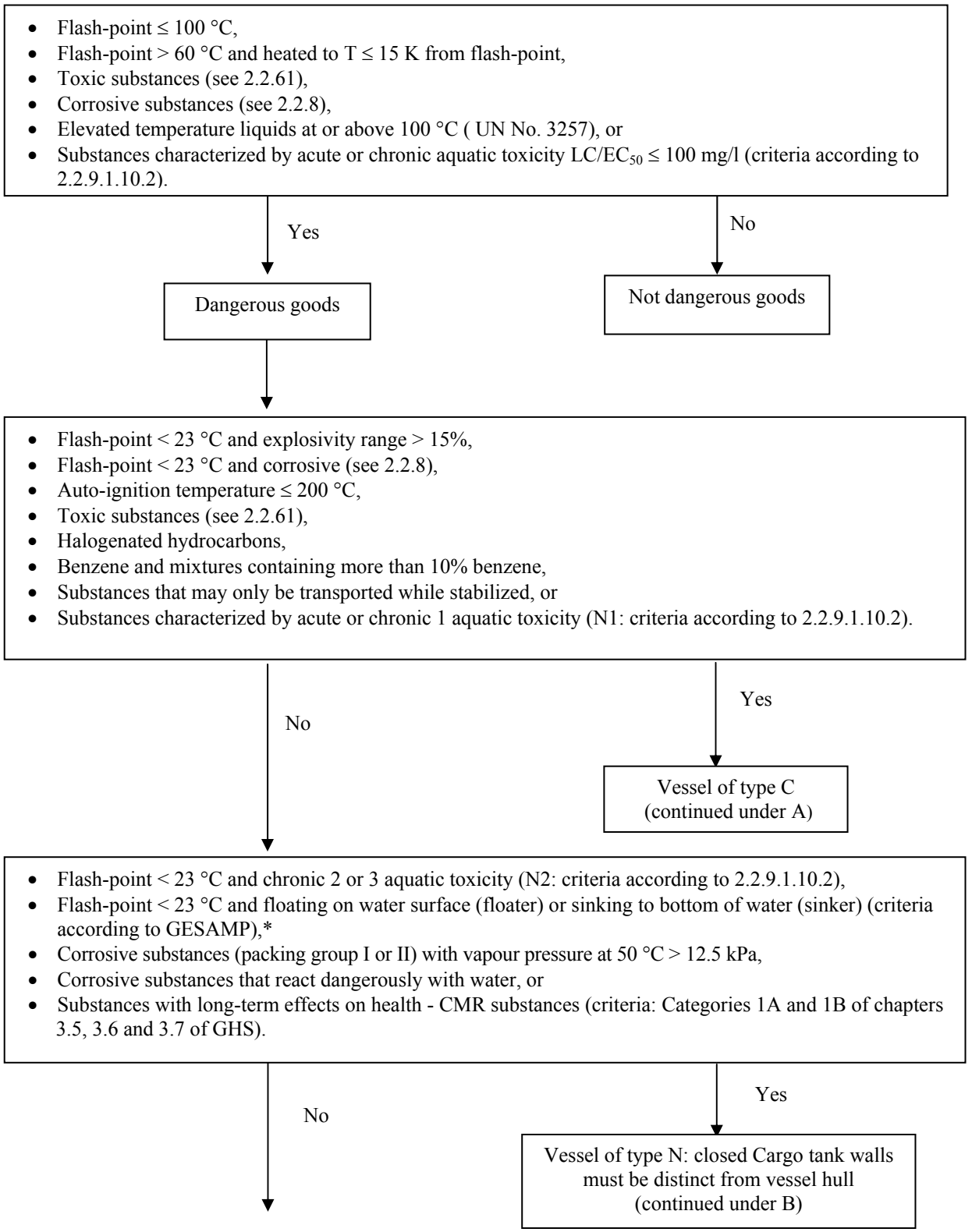
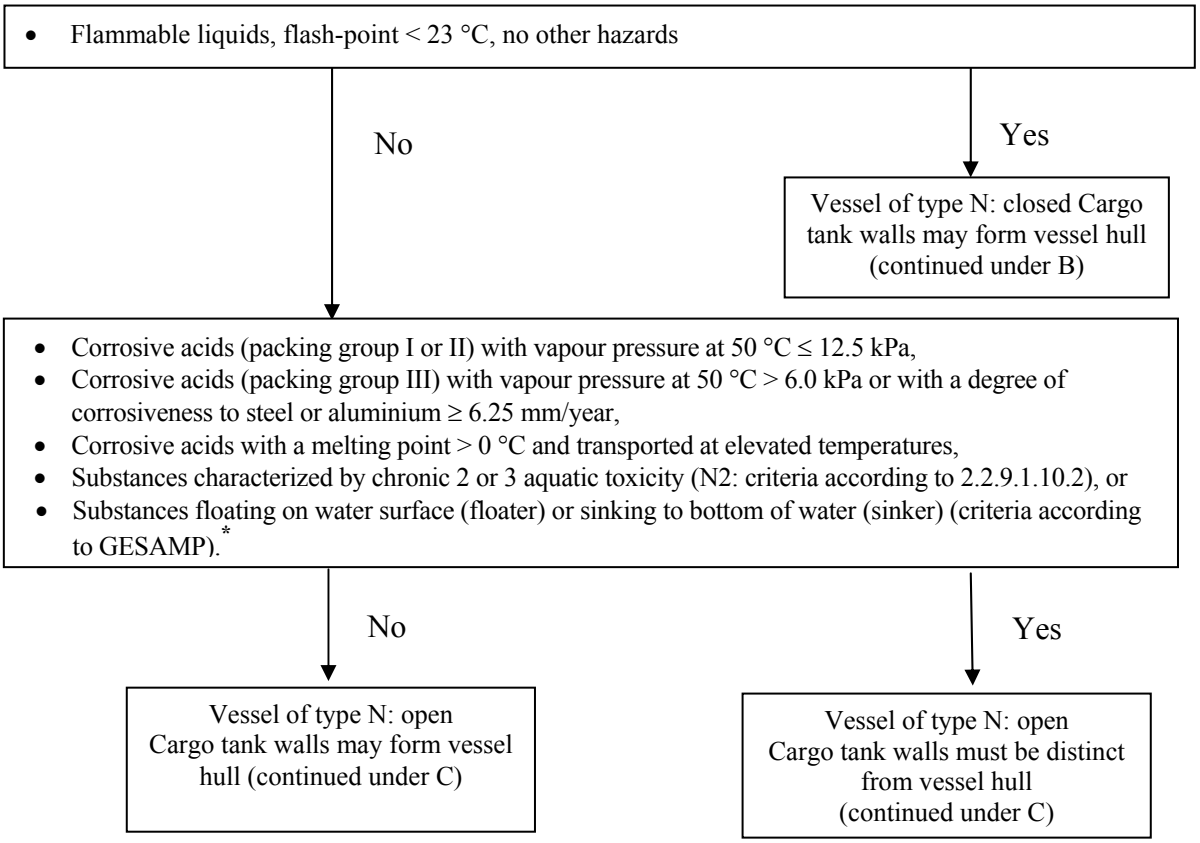
Flowchart for classification of liquids of Classes 3, 6.1, 8 and 9 for carriage in tanks in inland navigation



** IMO publication: "The Revised GESAMP Hazard Evaluation Procedure for Chemical Substances Carried by Ships", GESAMP Reports and Studies No. 64, IMO, London, 2002.*



Elevated temperature substances

Irrespective of the above classifications, for substances that must be transported at elevated temperatures, the type of cargo tank shall be determined on the basis of the transport temperature, using the following table:

Maximum transport temperature T in °C	Type N	Type C
T ≤ 80	Integral cargo tank	Integral cargo tank
80 < T ≤ 115	Independent cargo tank, remark 25	Independent cargo tank, remark 26
T > 115	Independent cargo tank	Independent cargo tank

Remark 25 = remark No. 25 in column (20) of the list of substances contained in Chapter 3.2, Table C.

Remark 26 = remark No. 26 in column (20) of the list of substances contained in Chapter 3.2, Table C.

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* *IMO publication: "The Revised GESAMP Hazard Evaluation Procedure for Chemical Substances Carried by Ships", GESAMP Reports and Studies No. 64, IMO, London, 2002.*

Scheme A: Criteria for cargo tank equipment in vessels of type C

Cargo tank equipment	Cargo tank internal pressure at liquid temperature of 30 °C and gaseous phase temperature of 37.8 °C > 50 kPa	Cargo tank internal pressure at liquid temperature of 30 °C and gaseous phase temperature of 37.8 °C > 50 kPa	Cargo tank internal pressure unknown, owing to absence of certain data
With refrigeration (No. 1 in column (9))	Refrigerated		
Pressure tank (400 kPa)	Non-refrigerated	Cargo tank internal pressure at 50 °C > 50 kPa without water spraying	Boiling point ≤ 60°C
High-velocity vent valve opening pressure: 50 kPa, with water-spraying system (No. 3 in column (9))		Cargo tank internal pressure at 50 °C > 50 kPa with water spraying	60 °C < boiling point ≤ 85°C
High-velocity vent valve opening pressure as calculated, but at least 10 kPa		Cargo tank internal pressure at 50 °C ≤ 50 kPa	
High-velocity vent valve opening pressure: 50 kPa			85 °C < boiling point ≤ 115°C
High-velocity vent valve opening pressure: 35 kPa			Boiling point > 115°C

Scheme B: Criteria for equipment of vessels of type N with closed cargo tanks

Cargo tank equipment	Class 3, flash-point < 23°C				Corrosive substances	CMR substances
Pressure tank (400 kPa)	175 kPa ≤ $P_{d\,50}$ < 300 kPa without refrigeration					
High-velocity vent valve opening pressure: 50 kPa	175 kPa ≤ $P_{d\,50}$ < 300 kPa, with refrigeration (No. 1 in column (9))	110 kPa ≤ $P_{d\,50}$ < 175 kPa without water spraying				
High-velocity vent valve opening pressure: 10 kPa			110 kPa ≤ $P_{d\,50}$ < 150 kPa with water spraying (No. 3 in column (9))	$P_{d\,50}$ < 110 kPa	Packing group I or II with $P_{d\,50}$ > 12.5 kPa or reacting dangerously with water	High-velocity vent valve opening pressure: 10 kPa; with water spraying when vapour pressure > 10 kPa (calculation of the vapour pressure according to the formula for column 10, except that v_a = 0.03)

Scheme C: Criteria for equipment of vessels of type N with open cargo tanks

Cargo tank equipment	Classes 3 and 9	Flammable substances	Corrosive substances
With flame-arrester	60 °C < flash-point ≤ 100 °C or elevated temperature substances of Class 9	Flash-point > 60 °C transported while heated to ≤ 15 K below flash-point or at or above their flash-point	Flammable substances or acids, transported while heated
Without flame-arrester			Non-flammable substances

Column (9): Cargo tank equipment for substances transported in a molten state

- **Possibility of heating the cargo (number 2 in column (9))**

  A possibility of heating the cargo shall be required on board:

  - When the melting point of the substance to be transported is + 15 °C or greater, or
  - When the melting point of the substance to be transported is greater than 0 °C but less than + 15 °C and the outside temperature is no more than 4 K above the melting point. In column (20), reference shall be made to remark 6 with the temperature derived as follows: melting point + 4 K

- **Heating system on board (number 4 in column (9))**

  A cargo heating system shall be required on board:

  - For substances that must not be allowed to solidify owing to the possibility of dangerous reactions on reheating, and
  - For substances that must be maintained at a guaranteed temperature not less than 15 K below their flash-point

Column (10): Determination of opening pressure of high-velocity vent valve in kPa

For vessels of type C, the opening pressure of the high-velocity vent valve shall be determined on the basis of the internal pressure of the tanks, rounded up to the nearest 5 kPa

To calculate the internal pressure, the following formula shall be used:

$$P_{\max} = P_{Ob\max} + \frac{k \cdot v_a \left(P_0 - P_{Da}\right)}{v_a - \alpha \cdot \delta_t + \alpha \cdot \delta_t \cdot v_a} - P_0$$

$$k = \frac{T_{D\max}}{T_a}$$

In this formula:

P_{max}	:	Maximum internal pressure in kPa
P_{Obmax}	:	Absolute vapour pressure at maximum liquid surface temperature in kPa
P_{Da}	:	Absolute vapour pressure at filling temperature in kPa
P_0	:	Atmospheric pressure in kPa
v_a	:	Free relative volume at filling temperature compared with cargo tank volume
α	:	Cubic expansion coefficient in K^{-1}
δ_t	:	Average temperature increase of the liquid due to heating in K
T_{Dmax}	:	Maximum gaseous phase temperature in K
T_a	:	Filling temperature in K
k	:	Temperature correction factor
t_{Ob}	:	Maximum liquid surface temperature in °C

In the formula, the following basic data are used:

P_{Obmax} : At 50 °C and 30 °C

P_{Da} : At 15 °C

P_0 : 101.3 kPa

v_a : 5% = 0.05

δ_t : 5 K

T_{Dmax} : 323 K and 310.8 K

T_a : 288 K

t_{Ob} : 50 °C and 30 °C

Column (11): Determination of maximum degree of filling of cargo tanks

If, in accordance with the provisions under A above:

- Type G is required: 91%; however, in the case of deeply refrigerated substances: 95%
- Type C is required: 95%
- Type N is required: 97%; however, in the case of substances in a molten state and of flammable liquids with 175 kPa $\leq P_{v50} <$ 300 kPa: 95%

Column (12): Relative density of substance at 20 °C

These data are provided for information only.

Column (13): Determination of type of sampling device

1 = *closed*:	−	Substances to be transported in pressure cargo tanks
	−	Substances with T in column (3b) and assigned to packing group I
	−	Stabilized substances to be transported under inert gas
2 = *partly closed*:	−	All other substances for which type C is required
3 = *open:*	−	All other substances

Column (14): Determination of whether a pump-room is permitted below deck

No	−	All substances with T in column (3b) with the exception of substances of Class 2
Yes	−	All other substances

Column (15): Determination of temperature class

Flammable substances shall be assigned to a temperature class on the basis of their auto-ignition point:

Temperature class	Auto-ignition temperature T of flammable liquids and gases in °C
T1	T > 450
T2	300 < T ≤ 450
T3	200 < T ≤ 300
T4	135 < T ≤ 200
T5	100 < T ≤ 135
T6	85 < T ≤ 100

When anti-explosion protection is required and the auto-ignition temperature is not known, reference shall be made to temperature class T4, considered safe

Column (16): Determination of explosion group

Flammable substances shall be assigned to an explosion group on the basis of their maximum experimental safe gaps. The maximum experimental safe gaps shall be determined in accordance with standard IEC 60079-1-1.

The different explosion groups are as follows:

Explosion group	Maximum experimental safe gap in mm
II A	> 0.9
II B	≥ 0.5 to ≤ 0.9
II C	< 0.5

When anti-explosion protection is required and the relevant data are not provided, reference shall be made to explosion group II B, considered safe

Column (17): Determination of whether anti-explosion protection is required for electrical equipment and systems

Yes
- Substances with a flash-point ≤ 60 °C
- Substances that must be transported while heated to a temperature less than 15 K from their flash-point
- Flammable gases

No
- All other substances

Column (18): Determination of whether personal protective equipment, escape devices, portable flammable gas detectors, portable toximeters or ambient-air-dependent breathing apparatus is required

- PP: For all substances of Classes 1 to 9;
- EP: For all substances
  - of Class 2 with letter T or letter C in the classification code indicated in column (3b),
  - of Class 3 with letter T or letter C in the classification code indicated in column (3b),
  - of Class 4.1,

- of Class 6.1, and
- of Class 8,
- CMR substances of Category 1A or 1B according to GHS;

- EX: For all substances for which anti-explosion protection is required;

- TOX: For all substances of Class 6.1,
  For all substances of other classes with T in column (3b),
  For CMR substances of Category 1A or 1B according to GHS;

- A: For all substances for which EX or TOX is required

Column (19): Determination of the number of cones or blue lights

For all substances of Class 2 with letter F in the classification code indicated in column (3b):	1 cone/light
For all substances of Classes 3 to 9 with letter F in the classification code indicated in column (3b) and assigned to packing group I or II:	1 cone/light
For all substances of Class 2 with letter T in the classification code indicated in column (3b)	2 cones/lights
For all substances of Classes 3 to 9 with letter T in the classification code indicated in column (3b) and assigned to packing group I or II:	2 cones/lights

Column (20): Determination of additional requirements and remarks

***Remark 1*:** Reference shall be made in column (20) to remark 1 for transport of UN No. 1005 AMMONIA, ANHYDROUS.

***Remark 2*:** Reference shall be made in column (20) to remark 2 for stabilized substances that react with oxygen.

***Remark 3*:** Reference shall be made in column (20) to remark 3 for substances that must be stabilized.

***Remark 4*:** Reference shall be made in column (20) to remark 4 for substances that must not be allowed to solidify owing to the possibility of dangerous reactions on reheating.

***Remark 5*:** Reference shall be made in column (20) to remark 5 for substances liable to polymerization.

***Remark 6*:** Reference shall be made in column (20) to remark 6 for substances liable to crystallization and for substances for which a heating system or possibility of heating is required and the vapour pressure of which at 20 ºC is greater than 0.1 kPa.

***Remark 7*:** Reference shall be made in column (20) to remark 7 for substances with a melting point of + 15 ºC or greater.

***Remark 8*:** Reference shall be made in column (20) to remark 8 for substances that react dangerously with water.

***Remark 9*:** Reference shall be made in column (20) to remark 9 for transport of UN No. 1131 CARBON DISULPHIDE.

***Remark 10*:** *No longer used*.

***Remark 11*:** Reference shall be made in column (20) to remark 11 for transport of UN No. 1040 ETHYLENE OXIDE WITH NITROGEN.

***Remark 12*:** Reference shall be made in column (20) to remark 12 for transport of UN No. 1280 PROPYLENE OXIDE and UN No. 2983 ETHYLENE OXIDE AND PROPYLENE OXIDE MIXTURE.

***Remark 13*:** Reference shall be made in column (20) to remark 13 for transport of UN No. 1086 VINYL CHLORIDE, STABILIZED.

***Remark 14*:** Reference shall be made in column (20) to remark 14 for mixtures or N.O.S. entries which are not clearly defined and for which type N is stipulated under the classification criteria.

***Remark 15*:** Reference shall be made in column (20) to remark 15 for substances that react dangerously with alkalis or acids such as sodium hydroxide or sulphuric acid.

***Remark 16*:** Reference shall be made in column (20) to remark 16 for substances that may react dangerously to local overheating.

***Remark 17*:** Reference shall be made in column (20) to remark 17 when reference is made to remark 6 or 7.

***Remark 18*:** *No longer used*.

***Remark 19*:** Reference shall be made in column (20) to remark 19 for substances that must under no circumstances come into contact with water.

***Remark 20*:** Reference shall be made in column (20) to remark 20 for substances the transport temperature of which must not exceed a maximum temperature in combination with the cargo tank materials. Reference shall be made to this maximum permitted temperature immediately after the number 20.

***Remark 21*:** *No longer used*.

***Remark 22*:** Reference shall be made in column (20) to remark 22 for substances for which a range of values or no value of the density is indicated in column (11).

***Remark 23*:** Reference shall be made in column (20) to remark 23 for substances the internal pressure of which at 30 ºC is less than 50 kPa and which are transported with water spraying.

***Remark 24*:** Reference shall be made in column (20) to remark 24 for transport of UN No. 3257 ELEVATED TEMPERATURE LIQUID, N.O.S.

***Remark 25*:** Reference shall be made in column (20) to remark 25 for substances that must be transported while heated in a type 3 cargo tank.

***Remark 26*:** Reference shall be made in column (20) to remark 26 for substances that must be transported while heated in a type 2 cargo tank.

***Remark 27*:** Reference shall be made in column (20) to remark 27 for substances for which the reference N.O.S. or a generic reference is made in column (2).

***Remark 28*:** Reference shall be made in column (20) to remark 28 for transport of UN No. 2448 SULPHUR, MOLTEN.

***Remark 29*:** Reference shall be made in column (20) to remark 29 for substances for which the vapour pressure or boiling point is indicated in column (2).

***Remark 30*:** Reference shall be made in column (20) to remark 30 for transport of UN Nos. 1719, 1794, 1814, 1819, 1824, 1829, 1830, 1832, 1833, 1906, 2240, 2308, 2583, 2584, 2677, 2679, 2681, 2796, 2797, 2837 and 3320 under the entries for which open type N is required.

***Remark 31*:** Reference shall be made in column (20) to remark 31 for transport of substances of Class 2 and UN Nos. 1280 PROPYLENE OXIDE and 2983 ETHYLENE OXIDE AND PROPYLENE OXIDE MIXTURE of Class 3.

***Remark 32*:** Reference shall be made in column (20) to remark 32 for transport of UN No. 2448 SULPHUR, MOLTEN, of Class 4.1.

***Remark 33*:** Reference shall be made in column (20) to remark 33 for transport of UN Nos. 2014 and 2984 HYDROGEN PEROXIDE, AQUEOUS SOLUTION, of Class 5.1.

***Remark 34*:** Reference shall be made in column (20) to remark 34 for transport of substances for which hazard 8 is mentioned in column (5) and type N in column (6).

***Remark 35*:** Reference shall be made in column (20) to remark 35 for substances for which a direct refrigeration system is not allowed.

***Remark 36*:** Reference shall be made in column (20) to remark 36 for substances for which an indirect refrigeration system is not allowed.

***Remark 37*:** Reference shall be made in column (20) to remark 37 for substances for which the cargo storage system must be capable of resisting the full vapour pressure of the cargo at the upper limits of the ambient design temperatures, whatever the system adopted for the boil-off gas.

***Remark 38*:** Reference must be made in column (20) to remark 38 for mixtures with an initial boiling point above 60 ºC in accordance with ASTMD 86-01.

Remark 39: Reference shall be made in column (20) to remark 39 for the carriage of UN No. 2187 CARBON DIOXIDE, REFRIGERATED LIQUID of Class 2.

3.2.4 Modalities for the application of section 1.5.2 on special authorizations concerning transport in tank vessels

3.2.4.1 Model special authorization under section 1.5.2

Special authorization
under 1.5.2 of ADN

Under 1.5.2 of ADN, the transport in tank vessels of the substance specified in the annex to this special authorization shall be authorized in the conditions referred to therein.

Before transporting the substance, the carrier shall be required to have it added to the list referred to in 1.16.1.2.5 of ADN by a recognized classification society.

This special authorization shall be valid .....
(places and/or routes of validity)

It shall be valid for two years from the date of signature, unless it is repealed at an earlier date.

Issuing State: .....

Competent authority: .....

Date: .....

Signature: .....

3.2.4.2 Application form for special authorizations under section 1.5.2

For applications for special authorizations, please answer the following questions and points.* Data are used for administrative purposes only and are treated confidentially.

Applicant

.....
(Name) (Company)

.....

( ) .....

.....
(Address)

Summary of the application

Authorization for transport in tank vessels of ..... as a substance of Class .....

Annexes
(with brief description)

Application made:

At: .....

Date: .....

Signature: .....
(of the person responsible for the data)

1. General data on the dangerous substance

1.1 Is it a pure substance □, a mixture □, a solution □ ?

1.2 Technical name (if possible ADN nomenclature or possibly the IBC Code).

1.3 Synonym.

1.4 Trade name.

1.5 Structure formula and, for mixtures, composition and/or concentration.

1.6 Hazard class and, where applicable classification code, packing group.

1.7 UN No. or substance identification number (if known).

* *For questions not relevant to the subject of the application, write "not applicable".*

2. Physico-chemical properties

2.1 State during transport (e.g. gas, liquid, molten, ...).

2.2 Relative density of liquid at 20 º C or at the transport temperature if the substance is to be heated or refrigerated during transport.

2.3 Transport temperature (for substances heated or refrigerated during transport).

2.4 Melting point or range ..... º C.

2.5 Boiling point or range ..... º C.

2.6 Vapour pressure at 15 º C ....., 20 º C ....., 30 º C ....., 37.8 º C ....., 50 º C .....,
(for liquefied gases, vapour pressure at 70 º C .....), (for permanent gases, filling pressure at 15 º C .....).

2.7 Cubic expansion coefficient ….. K^{-1}

2.8 Solubility in water at 20 º C
Saturation concentration …… mg/l

or

Miscibility with water at 15 º C

□ Complete □ partial □ none
(If possible, in the case of solutions and mixtures, indicate concentration)

2.9 Colour.

2.10 Odour.

2.11 Viscosity ….. mm^2/s.

2.12 Flow time (ISO 2431-1996) .....s.

2.13 Solvent separation test ..... .

2.14 pH of the substance or aqueous solution (indicate concentration).

2.15 Other information.

3. Technical safety properties

3.1 Auto-ignition temperature in accordance with IEC 60079-4 (corresponds to DIN 51 794) ..... º C; where applicable, indicate the temperature class in accordance with EN 50 014: 1994.

3.2 Flash-point

For flash-points up to 175 º C

Closed-cup test methods - non-equilibrium procedure

ABEL method: EN ISO 13736:1997

ABEL-PENSKY method: DIN 51755-1:1974 and DIN 51755-2:1978 or AFNOR method: M07-019

PENSKY-MARTENS method: EN ISO 2719:2004
LUCHAIRE apparatus: French standard AFNOR T 60-103:1968

TAG method: ASTM D 56-02

Closed-cup test methods - equilibrium procedure

Rapid equilibrium procedure: EN ISO 3679:2004; ASTM D 3278-96:2004

Closed-cup equilibrium procedure: EN ISO 1523:2002; ASTM D 3941-90:2001

For flash-points above 175 º C

In addition to the above-mentioned methods, the following open-cup test method may be applied:

CLEVELAND method: EN ISO 2592:2002; ASTM D 92-02b

3.3 Explosion limits:

Determination of upper and lower explosion limits in accordance with EN 1839:2004.

3.4 Maximum safe gap in accordance with IEC 60079-1:2003 .....

3.5 Is the substance stabilized during transport? If so, provide data on the stabilizer:

.....

3.6 Decomposition products in the event of combustion on contact with air or under the influence of an external fire:

3.7 Is the substance fire intensifying?

3.8 Abrasion (corrosion) ..... mm/year.

3.9 Does the substance react with water or moist air by releasing flammable or toxic gases? Yes/no.
Gases released: .....

3.10 Does the substance react dangerously in any other way?

3.11 Does the substance react dangerously when reheated?
Yes/no

4. Physiological hazards

4.1 LD_{50} and/or LC_{50} value. Necrosis value (where applicable, other toxicity criteria in accordance with 2.2.61.1 of ADN).

CMR properties according to Categories 1A and 1B of chapters 3.5, 3.6 and 3.7 of GHS

4.2 Does decomposition or reaction produce substances posing physiological hazards? (Indicate which substances where known)

4.3 Environmental properties (see 2.4.2.1 of ADN)

Acute toxicity:

LC_{50} 96 hr for fish ..... mg/l

EC_{50} 48 hr for crustacea ..... mg/l

E_rC_{50} 72 hr for algae ..... mg/l

Chronic toxicity:

NOEC ..... mg/l

BCF ..... mg/l or log K_{ow} .....

Easily biodegradable ..... yes/no

5. Data on hazard potential

5.1 What specific damage is to be expected if the hazard characteristics produce their effect?

- ☐ Combustion
- ☐ Injury
- ☐ Corrosion
- ☐ Intoxication in the event of dermal absorption
- ☐ Intoxication in the event of absorption by inhalation
- ☐ Mechanical damage
- ☐ Destruction
- ☐ Fire
- ☐ Abrasion (corrosion to metals)
- ☐ Environmental pollution

6. Data on the transport equipment

6.1 Are particular loading requirements envisaged/necessary (what are they)?

7. Transport of dangerous substances in tanks

7.1 With which materials is the substance to be carried compatible?

8. Technical safety requirements

8.1 Taking into account the current state of science and technology, what safety measures are necessary in the light of the hazards posed by the substance or liable to arise in the course of the transport process as a whole?

8.2 Additional safety measures

Use of stationary or mobile techniques to measure flammable gases and flammable liquid vapours

Use of stationary or mobile techniques (toximeters) to measure concentrations of toxic substances

3.2.4.3 Criteria for assignment of substances

A. Columns (6), (7) and (8): Determination of the type of tank vessel

1. Gases (criteria according to 2.2.2 of ADN)

–	Without refrigeration:	type G	pressure
–	With refrigeration:	type G	refrigerated

2. Halogenated hydrocarbons

Substances that may only be transported in a stabilized state

Toxic substances (see 2.2.61.1 of ADN)

Flammable (flash-point < 23 ºC) and corrosive substances (see 2.2.8 of ADN)

Substances with an auto-ignition temperature ≤ 200 ºC

Substances with a flash-point < 23 ºC and an explosivity range > 15 % at 20 ºC

Benzene and mixtures of non-toxic and non-corrosive substances containing more than 10% benzene

Environmentally hazardous substances, Acute or Chronic Category 1 (group N1 in accordance with 2.2.9.1.10.2)

– Cargo tank internal pressure > 50 kPa at the following temperatures: liquid 30 ºC, gaseous phase 37.8 ºC

● Without refrigeration:	type C	pressure (400 kPa)
● With refrigeration:	type C	refrigerated

– Cargo tank internal pressure ≤ 50 kPa at the following temperatures: liquid 30 ºC, gaseous phase 37.8 ºC but with cargo tank internal pressure > 50 kPa at 50 ºC

● Without water spraying:	type C	pressure (400 kPa)
● With water spraying:	type C	with high-velocity vent valve opening pressure of 50 kPa

– Cargo tank internal pressure ≤ 50 kPa at the following temperatures: liquid 30ºC, gaseous phase 37.8 ºC with cargo tank internal pressure ≤ 50 kPa at 50ºC

	type C	with high-velocity vent valve opening pressure as calculated, but at least 10 kPa

2.1 Mixtures for which type C is required in accordance with the criteria referred to in 2 above but for which certain data are lacking

In cases where the internal pressurization of the tank cannot be calculated owing to a lack of data, the following criteria may be used

–	Initial boiling point ≤ 60 ºC	type C	(400 kPa)
–	60 ºC < initial boiling point ≤ 85 ºC	type C	with high-velocity vent valve opening pressure of 50 kPa and with water spraying
–	85 ºC < initial boiling point ≤ 115 ºC	type C	with high-velocity vent

			valve opening pressure of 50 kPa
–	115 ºC < initial boiling point	type C	with high-velocity vent valve opening pressure of 35 kPa

3. Substances which are flammable only (see 2.2.3 of ADN)

–	Flash-point < 23 ºC with 175 kPa ≤ Pv 50 < 300 kPa		
	• Without refrigeration:	closed type N	pressure (400 kPa)
	• With refrigeration:	closed type N	refrigerated with high-velocity vent valve opening pressure of 50 kPa
–	Flash-point < 23 ºC with 150 kPa ≤ Pv 50 < 175 kPa:	closed type N	with eductor opening pressure of 50 kPa
–	Flash-point < 23 ºC with 110 kPa ≤ Pv 50 < 150 kPa		
	• Without water spraying:	closed type N	with high-velocity vent valve opening pressure of 50 Pa
	• With water spraying:	closed type N	with high-velocity vent valve opening pressure of 10 kPa
–	Flash-point < 23 ºC with Pv 50 < 110 kPa:	closed type N	with high-velocity vent valve opening pressure of 10 kPa
–	Flash-point ≥ 23 ºC but ≤ 60 ºC:	open type N	with flame-arrester
–	Substances with a flash-point > 60 ºC heated to less than 15 K from the flash-point, N.O.S. (...):	open type N	with flame-arrester
–	Substances with a flash-point > 60 ºC heated to or above the flash-point, N.O.S. (...):	open type N	with flame-arrester

4. Corrosive substances (see 2.2.8 of ADN)

–	**Corrosive substances liable to produce corrosive vapours**		
	• Substances assigned to packing group I or II in the list of substances and having a vapour pressure[1] greater than 12.5 kPa (125 mbar) at 50 ºC or • Substances liable to react dangerously with water (for example acid chlorides) • Substances containing gases in solution	closed type N	cargo tank walls must be distinct from vessel hull; high-velocity vent valve/safety valve opening pressure of 10 kPa

[1] *If the data are available, the sum of the partial pressures of the dangerous substances may be used in place of the vapour pressure.*

− **Corrosive acids:**		
● Substances assigned to packing group I or II in the list of substances and having a vapour pressure[1] of 12.5 kPa (125 mbar) or less at 50 ºC or	open type N	cargo tank walls must be distinct from vessel hull
● Substances assigned to packing group III in the list of substances and having a vapour pressure[1] of > 6.0 kPa (60 mbar) at 50 ºC or	open type N	cargo tank walls must be distinct from vessel hull
● Substances assigned to packing group III in the list of substances because of their degree of corrosiveness to steel or aluminium or	open type N	cargo tank walls must be distinct from vessel hull
● Substances with a melting point greater than 0 ºC and transported at elevated temperatures	open type N	cargo tank walls must be distinct from vessel hull
● Flammable substances	open type N	with flame-arresters
● Elevated temperature substances	open type N	with flame-arresters
● Non-flammable substances	open type N	without flame-arresters
− **All other corrosive substances:**		
● Flammable substance	open type N	with flame-arresters
● Non-flammable substances	open type N	without flame-arresters
5. Environmentally hazardous substances (see 2.2.9.1 of ADN)		
● Chronic 2 and 3 (group N2 in accordance with 2.2.9.1.10.2)	open type N	cargo tank walls must be distinct from vessel hull
● Acute 2 and 3 (group N3 in accordance with 2.2.9.1.10.2)	open type N	_____
6. Substances of Class 9, UN No. 3257	open type N	independent cargo tanks
7. Substances of Class 9, Identification No. 9003	open type N_____	
Flash-point > 60 ºC and ≤ 100 ºC:	open type N _____	

[1] *If the data are available, the sum of the partial pressures of the dangerous substances may be used in place of the vapour pressure.*

8. Substances that must be transported at elevated temperatures

For substances that must be transported at elevated temperatures, the type of cargo tank shall be determined on the basis of the transport temperature, using the following table:

Maximum transport temperature T in °C	Type N	Type C
T ≤ 80	2	2
80 < T ≤ 115	1 + remark 25	1 + remark 26
T > 115	1	1

1 = cargo tank type: independent tank

2 = cargo tank type: integral tank

Remark 25 = remark No. 25 in column (20) of the list of substances contained in Chapter 3.2, Table C.

Remark 26 = remark No. 26 in column (20) of the list of substances contained in Chapter 3.2, Table C.

9. Substances with long-term effects on health - CMR substances (Categories 1A and 1B in accordance with the criteria of chapters 3.5, 3.6 and 3.7 of GHS[2]), provided that they are already assigned to Classes 2 to 9 by virtue of other criteria

C carcinogenic

M mutagenic

R toxic to reproduction

closed type N	cargo tank walls must be distinct from vessel hull; high-velocity vent valve opening pressure of at least 10 kPa, with water-spray system, if the internal pressurization of the tank is more than 10 kPa (calculation of the vapour pressure according to the formula for column 10, except that $v_a = 0.03$)

10. Substances that float on the water surface ('floaters') or sink to the bottom of the water ('sinkers') (criteria in accordance with GESAMP),[3] provided that they are already assigned to Classes 3 to 9 and that type N is required on that basis

open Type N	cargo tank walls must be distinct from vessel hull

B. Column (9): Determination of state of cargo tank

(1) Refrigeration system

Determined in accordance with A.

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[2] *Since there is no official international list of CMR substances of Categories 1A and 1B, pending the availability of such a list, the list of CMR substances of Categories 1 and 2 in Directives 67/548/EEC and 88/379/EEC of the Council of the European Union, as amended, shall apply.*

[3] *IMO publication: "The Revised GESAMP Hazard Evaluation Procedure for Chemical Substances Carried by Ships", GESAMP Reports and Studies No. 64, IMO, London, 2002.*

(2) Possibility of heating the cargo

A possibility of heating the cargo shall be required:

- When the melting point of the substance to be transported is + 15 ºC or greater, or
- When the melting point of the substance to be transported is greater than 0 °C but less than + 15 °C and the outside temperature is no more than 4 K above the melting point. In column (20), reference shall be made to remark 6 with the temperature derived as follows: melting point + 4 K.

(3) Water-spray system

Determined in accordance with A.

(4) Cargo heating system on board

- For substances that must not be allowed to solidify owing to the possibility of dangerous reactions on reheating, and
- For substances that must be maintained at a guaranteed temperature of not less than 15 K below their flash-point.

C. Column (10): Determination of opening pressure of high-velocity vent valve in kPa

For vessels of type C, the opening pressure of the high-velocity vent valve shall be determined on the basis of the internal pressure of the tanks, rounded up to the nearest 5 kPa.

To calculate the internal pressure, the following formula shall be used:

$$P_{\max} = P_{Ob\max} + \frac{k \cdot v_a \left(P_0 - P_{Da}\right)}{v_a - \alpha \cdot \delta_t + \alpha \cdot \delta_t \cdot v_a} - P_o$$

$$k = \frac{T_{D\max}}{T_a}$$

In this formula:

P_{max} : Maximum internal pressure in kPa

P_{Obmax} : Absolute vapour pressure at maximum liquid surface temperature in kPa

P_{Da} : Absolute vapour pressure at filling temperature in kPa

P_0 : Atmospheric pressure in kPa

v_a : Free relative volume at filling temperature compared with cargo tank volume

α : Cubic expansion coefficient in K^{-1}

δ_t : Average temperature increase of the liquid due to heating in K

T_{Dmax} : Maximum gaseous phase temperature in K

T_a : Filling temperature in K

k : Temperature correction factor

t_{Ob} : Maximum liquid surface temperature in °C

In the formula, the following basic data are used:

P_{Obmax} : At 50 °C and 30 °C

P_{Da} : At 15 °C

P_0 : 101.3 kPa

v_a : 5% = 0.05

δ_t : 5 K

T_{Dmax} : 323 K and 310.8 K

T_a : 288 K

t_{Ob} : 50 °C and 30 °C

D. Column (11): Determination of maximum degree of filling of cargo tanks

If, in accordance with the provisions under A above:

−	Type G is required:	91%	however, in the case of deeply refrigerated substances: 95%
−	Type C is required:	95%	
−	Type N is required:	97%	however, in the case of substances in a molten state and of flammable liquids with 175 kPa $\leq P_{v50} <$ 300 kPa: 95%.

E. Column (13): Determination of type of sampling device

1 = *closed*:	-	Substances to be transported in pressure cargo tanks
	-	Substances with T in column (3b) and assigned to packing group I
	-	Stabilized substances to be transported under inert gas.
2 = *partly closed*:	-	All other substances for which type C is required
3 = *open*:	-	All other substances

(F) Column (14): Determination of whether a pump-room is permitted below deck

No	-	All substances with letter T in the classification code indicated in column (3b) with the exception of substances of Class 2.
Yes	-	All other substances

(G) Column (15): Determination of temperature class

Flammable substances shall be assigned to a temperature class on the basis of their auto-ignition point:

Temperature class	Auto-ignition temperature T of flammable liquids and gases in °C
T1	T > 450
T2	300 < T ≤ 450
T3	200 < T ≤ 300
T4	135 < T ≤ 200
T5	100 < T ≤ 135
T6	85 < T ≤ 100

When anti-explosion protection is required and the auto-ignition temperature is not known, reference shall be made to temperature class T4, considered safe.

(H) Column (16): Determination of explosion group

Flammable substances shall be assigned to an explosion group on the basis of their maximum experimental safe gaps. The maximum experimental safe gaps shall be determined in accordance with standard IEC 60079-1-1.

The different explosion groups are as follows:

Explosion group	Maximum experimental safe gap in mm
II A	> 0.9
II B	≥ 0.5 to ≤ 0.9
II C	< 0.5

When anti-explosion protection is required and the relevant data are not provided, reference shall be made to explosion group II B, considered safe.

(I) Column (17): Determination of whether anti-explosion protection is required for electrical equipment and systems

Yes
- Substances with a flash-point ≤ 60 °C.
- Substances that must be transported while heated to a temperature less than 15 K from their flash-point.
- Flammable gases

No
- All other substances

(J) Column (18): Determination of whether personal protective equipment, escape devices, portable flammable gas detectors, portable toximeters or ambient-air-dependent breathing apparatus is required

- PP: For all substances of Classes 1 to 9;
- EP: For all substances
  - of Class 2 with letter T or letter C in the classification code indicate in column (3b);
  - of Class 3 with letter T or letter C in the classification code indicated in column (3b);
  - of Class 4.1;
  - of Class 6.1;
  - of Class 8; and

  for CMR substances of Category 1A or 1B according to chapters 3.5, 3.6 and 3.7 of GHS;
- EX: For all substances for which anti-explosion protection is required;
- TOX: For all substances of Class 6.1;
  For all substances of other classes with T in column (3b);
  For CMR substances of Category 1A or 1B according to chapters 3.5, 3.6 and 3.7 of GHS;
- A: For all substances for which EX or TOX is required.

(K) Column (19): Determination of the number of cones or blue lights

For all substances of Class 2 with letter F in the classification code indicated in column (3b): 1 cone/light

For all substances of Classes 3 to 9 with letter F in the classification code indicated in column (3b) and assigned to packing group I or II:	1 cone/light
For all substances of Class 2 with letter T in the classification code indicated in column (3b):	2 cones/lights
For all substances of Classes 3 to 9 with letter T in the classification code indicated in column (3b) and assigned to packing group I or II:	2 cones/lights

(L) Column (20): Determination of additional requirements and remarks

***Remark 1*:** Reference shall be made in column (20) to remark 1 for transport of UN No. 1005 AMMONIA, ANHYDROUS.

***Remark 2*:** Reference shall be made in column (20) to remark 2 for stabilized substances that react with oxygen.

***Remark 3*:** Reference shall be made in column (20) to remark 3 for substances that must be stabilized.

***Remark 4*:** Reference shall be made in column (20) to remark 4 for substances that must not be allowed to solidify owing to the possibility of dangerous reactions on reheating.

***Remark 5*:** Reference shall be made in column (20) to remark 5 for substances liable to polymerization.

***Remark 6*:** Reference shall be made in column (20) to remark 6 for substances liable to crystallization and for substances for which a heating system or possibility of heating is required and the vapour pressure of which at 20 ºC is greater than 0.1 kPa.

***Remark 7*:** Reference shall be made in column (20) to remark 7 for substances with a melting point of + 15 ºC or greater.

***Remark 8*:** Reference shall be made in column (20) to remark 8 for substances that react dangerously with water.

***Remark 9*:** Reference shall be made in column (20) to remark 9 for transport of UN No. 1131 CARBON DISULPHIDE.

***Remark 10*:** *No longer used*.

***Remark 11*:** Reference shall be made in column (20) to remark 11 for transport of UN No. 1040 ETHYLENE OXIDE WITH NITROGEN.

***Remark 12*:** Reference shall be made in column (20) to remark 12 for transport of UN No. 1280 PROPYLENE OXIDE and UN No. 2983 ETHYLENE OXIDE AND PROPYLENE OXIDE MIXTURE.

***Remark 13*:** Reference shall be made in column (20) to remark 13 for transport of UN No. 1086 VINYL CHLORIDE, STABILIZED.

***Remark 14*:** Reference shall be made in column (20) to remark 14 for mixtures or N.O.S. entries which are not clearly defined and for which type N is stipulated under the classification criteria.

***Remark 15*:** Reference shall be made in column (20) to remark 15 for substances that react dangerously with alkalis or acids such as sodium hydroxide or sulphuric acid.

***Remark 16*:** Reference shall be made in column (20) to remark 16 for substances that may react dangerously to local overheating.

***Remark 17*:** Reference shall be made in column (20) to remark 17 when reference is made to remark 6 or 7.

***Remark 18*:** *No longer used*.

***Remark 19*:** Reference shall be made in column (20) to remark 19 for substances that must under no circumstances come into contact with water.

***Remark 20*:** Reference shall be made in column (20) to remark 20 for substances the transport temperature of which must not exceed a maximum temperature in combination with the cargo tank materials. Reference shall be made to this maximum permitted temperature immediately after the number 20.

***Remark 21*:** *No longer used*.

***Remark 22*:** Reference shall be made in column (20) to remark 22 for substances for which a range of values or no value of the density is indicated in column (11).

***Remark 23*:** Reference shall be made in column (20) to remark 23 for substances the internal pressure of which at 30 ºC is less than 50 kPa and which are transported with water spraying.

***Remark 24*:** Reference shall be made in column (20) to remark 24 for transport of UN No. 3257 ELEVATED TEMPERATURE LIQUID, N.O.S.

***Remark 25*:** Reference shall be made in column (20) to remark 25 for substances that must be transported while heated in a type 3 cargo tank.

***Remark 26*:** Reference shall be made in column (20) to remark 26 for substances that must be transported while heated in a type 2 cargo tank.

***Remark 27*:** Reference shall be made in column (20) to remark 27 for substances for which the reference N.O.S. or a generic reference is made in column (2).

***Remark 28*:** Reference shall be made in column (20) to remark 28 for transport of UN No. 2448 SULPHUR, MOLTEN.

***Remark 29*:** Reference shall be made in column (20) to remark 29 for substances for which the vapour pressure or boiling point is indicated in column (2).

***Remark 30*:** Reference shall be made in column (20) to remark 30 for transport of UN Nos. 1719, 1794, 1814, 1819, 1824, 1829, 1830, 1832, 1833, 1906, 2240, 2308, 2583, 2584, 2677, 2679, 2681, 2796, 2797, 2837 and 3320 under the entries for which open type N is required.

***Remark 31*:** Reference shall be made in column (20) to remark 31 for transport of substances of Class 2 and UN Nos. 1280 PROPYLENE OXIDE and 2983 ETHYLENE OXIDE AND PROPYLENE OXIDE MIXTURE of Class 3.

***Remark 32*:** Reference shall be made in column (20) to remark 32 for transport of UN No. 2448 SULPHUR, MOLTEN, of Class 4.1.

***Remark 33*:** Reference shall be made in column (20) to remark 33 for transport of UN Nos. 2014 and 2984 HYDROGEN PEROXIDE, AQUEOUS SOLUTION, of Class 5.1.

***Remark 34*:** Reference shall be made in column (20) to remark 34 for transport of substances for which hazard 8 is mentioned in column (5) and type N in column (6).

***Remark 35*:** Reference shall be made in column (20) to remark 35 for substances for which a direct refrigeration system is not allowed.

***Remark 36*:** Reference shall be made in column (20) to remark 36 for substances for which an indirect refrigeration system is not allowed.

***Remark 37*:** Reference shall be made in column (20) to remark 37 for substances for which the cargo storage system must be capable of resisting the full vapour pressure of the cargo at the upper limits of the ambient design temperatures, whatever the system adopted for the boil-off gas.

***Remark 38*:** Reference must be made in column (20) to remark 38 for mixtures with an initial boiling point above 60 ºC in accordance with ASTMD 86-01.

Remark 39: Reference shall be made in column (20) to remark 39 for the carriage of UN No. 2187 CARBON DIOXIDE, REFRIGERATED LIQUID of Class 2.