



**Economic and Social
Council**

Distr.
GENERAL

ECE/TRANS/WP.15/AC.2/26/Add.1
26 August 2008

ENGLISH
Original: ENGLISH and FRENCH

ECONOMIC COMMISSION FOR EUROPE

INLAND TRANSPORT COMMITTEE

Working Party on the Transport of Dangerous Goods

Joint Meeting of Experts on the Regulations annexed to the
European Agreement concerning the International Carriage
of Dangerous Goods by Inland Waterways (ADN)*

**EUROPEAN AGREEMENT CONCERNING THE INTERNATIONAL CARRIAGE
OF DANGEROUS GOODS BY INLAND WATERWAYS (ADN)**

Draft amendments to the Regulations annexed to the ADN*

Note by the secretariat

Addendum

PART 1

- 1.1.2.1 (b)** In the fourth indent, replace "means of transport" by "vehicles or wagons".
- 1.1.2.5** Replace "this part" by "ADN" and "this chapter" by "these Regulations".
- 1.1.3.2 (d)** Insert at the end "(e.g. fire extinguishers), including spare parts".
- 1.1.3.3** Replace "vessels or the vehicles" by "vessels, vehicles or wagons".
- 1.1.3.6.1 (b)** Delete "(tank-containers, tank vehicles, etc.)".

* Meeting organized jointly by the Economic Commission for Europe and the Central Commission for the Navigation of the Rhine (CCNR).

1.1.4.1 (a) Delete "of these Regulations".

1.1.4.1 (b) Delete "of these Regulations".

1.1.4.2.1 (c) Replace "of this Annex" by "of these Regulations" twice.

1.1.4.6.1 Replace "of the Agreement" by "of ADN".

1.2.1 Definitions

- "Bulk containers": at the end replace "wagons/vehicles" by "vehicles or wagons".
- "Capacity of shell or shell compartment": Does not apply to English version.
- "Cargo area": replace "3.00 m" by "3 m".
- "Cargo pump-room": delete "- see *Classification of zones*".
- "Cargo residues": replace by "Cargo residues, see *Slops*".
- "Cargo tank (condition)": delete "or vapours" after "gas".
- "Carriage": insert "wagons," after "vehicles,".
- "Carriage in bulk": in the NOTE, insert "or RID" after "ADR".
- "Classification of zones": Replace text in parenthesis by "(see Directive 1999/92/CE)".
- "Composite IBC with plastics inner lining": Does not apply to English version.
- "Container": in the NOTE, replace "or vehicles" by ", vehicles or wagons".
- "Dangerous reaction": in indent (e), insert "and cargo tanks" after "tanks".
- "Explosion group": amend the text in parenthesis to read "(...EN 50014:1994)" and place at the end of the definition.
- "Filler": in (a) insert ", tank wagon" after "battery-vehicle" and in (c) insert "a wagon," after "vehicle,".
- "Fixed tank": insert "or to a wagon (which then becomes a tank-wagon)" after "a tank- vehicle)" and "or wagon" after "vehicle" at the end.
- "Full load": insert ", of a wagon" after "vehicle".
- "Gas": Does not apply to English version.

- "Gas return piping": delete "and vapours".
- "Intermediate bulk container (IBC)": insert "of ADR" after "Chapter 6.1".
In NOTE 2, replace the second "ADR" by "ADN".
- "ISO (standard)": reformat the address to read "(ISO, 1 rue de Varembe, CH-1204, Geneva 20)".
- "Liquid": replace the first three dashes by (a), (b), (c).
- "Loader": insert ", vehicle, wagon or large container" after "vessel".
- "Mass of package": replace "containers and tanks" by "containers, tanks, vehicles and wagons".
- "Overpack": delete the NOTE.
- "Package": place the third paragraph after the first paragraph (it becomes the second paragraph). In the new third paragraph, insert "wagons," after "vehicles," "battery-wagons," after "battery vehicles," and ", tank wagons" after "tank vehicles".
- "Stripping system": insert "remains and" before "residues".
- "Tank": modify the listing to read as follows:
"...tank container, portable tank, demountable tank, fixed tank or tank-wagon, as defined ...". Insert "battery wagons" before "or MEGCs".
- "Tank record": modify the list to read "... a tank, a battery-vehicle, a battery-wagon or an MEGC ...".
- "Temperature class": insert ":1994" after "EN 50014" and move text in parenthesis to the end.
- "Types of protection": insert ":1994" after "EN 50014".
- "Type of vessel": insert the following definitions:

"Closed Type N: a tank vessel intended for the carriage of liquids in closed cargo tanks."

"Open Type N with flame arrester: a tank vessel intended for the carriage of liquids in open cargo tanks whose openings to the atmosphere are equipped with a flame arrester capable of withstanding steady burning."

"Open type N : a tank vessel intended for the carriage of liquids in open cargo tanks."

Add the following new definitions:

- "*Citerne amovible*" Does not apply to English version.
- "*Closed wagon* means a wagon with sides and a fixed or movable roof".
- "*Open wagon* means a wagon with or without side boards and a tailboard, the loading surfaces of which are open".

1.3.2.2.3 Delete "fire-extinguishing systems and fire extinguishers with the".

1.3.2.2.4 In the second indent, replace "trained" by "instructed" and insert a second sentence to read as follows: "The instruction shall be supplemented by practical exercises."

1.3.2.2.5 Insert "referred to in 5.4.3" after "instructions in writing" [and number this paragraph correctly].

1.4.2.2.1 (g) Amend to read as follows: "provide the master with the required instructions in writing and ascertain that the prescribed equipment is on board the vessel".

1.4.2.3.1 Add a new subparagraph (h) as follows:

"(h) ascertain that, during discharging by means of the on-board pump, it is possible for the shore facility to switch it off."

1.4.2.3.3 Insert "or a wagon" after "vehicle".

1.4.3.1.1 (c) Does not apply to English version.

1.4.3.1.1 (e) Does not apply to English version.

1.4.3.3 (b) Replace "tank vehicles, battery-vehicles, demountable tanks, portable tanks, tank containers, MEGCs, tank wagons and battery wagons" by "tanks".

1.4.3.3 (i) Insert ", wagons" after "vehicles".

1.4.3.3 (k) Insert ", wagons" after "vehicles".

1.4.3.3 (l) Delete and replace by "*(Reserved)*".

1.4.3.3 (t) Modify to read:

"(t) He shall ascertain that the joints provided by him for the connecting flange of the ship/shore connections of the loading and unloading piping consist of a material which is not susceptible to be damaged by the cargo or causes a decomposition of the cargo nor forms harmful or dangerous components with it;"

1.4.3.3 (u) Modify to read:

"(u) He shall ascertain that during the entire duration of loading or unloading a permanent and appropriate supervision is assured."

1.4.3.3 (v) Delete and replace by "(Reserved)".

1.5.2.1.1 Insert "of ADN" after "Article 7".

1.5.2.2.3 Does not apply to English version.

1.6.1.6 Delete and replace by "(Reserved)".

1.6.1.10 Replace "requirements applicable as from 1 January 2003" by "requirements of ADR or RID applicable as from 1 January 2003".

1.6.5 In the title, delete "and wagons". Delete "and RID" and replace "sections" by "section".

1.6.7.1.1 Replace "specific" by "supplementary".

1.6.7.1.2 Delete "1.6.7". In indent (a), replace "the Agreement" by "ADN".

Table 1.6.7.2.1.1

Under "9.1.0.34.1" Modify text in the second column to read: "Position of exhaust pipes".

1.6.7.2.1.2 Replace by "(Deleted)".

1.6.7.2.3 Delete "1.6.7.2.3 *General transitional provisions for tank vehicles*". Renumber 1.6.7.2.3.1 as 1.6.7.2.2.2, 1.6.7.2.3.2 as 1.6.7.2.2.3, 1.6.7.2.3.2.1 as 1.6.7.2.2.4, 1.6.7.2.3.2.2 as 1.6.7.2.2.5 and 1.6.7.2.3.2.3 as 1.6.7.2.2.6

Table 1.6.7.2.3.1 Renumber table 1.6.7.2.3.1 as 1.6.7.2.2.2.

Under "9.3.3.8.1" Delete "in conjunction with 7.2.2.8" after "9.3.3.8.1".

Under "9.3.1.11.2 (d)" Replace "stringers" by "struts".

Under "9.3.1.15" Add a new entry to read as follows:

9.3.1.15	Stability (damaged condition)	N.R.M.
----------	-------------------------------	--------

Under "9.3.1.21.1 (d)" Does not apply to English version.

Under "9.3.2.21.1 (e)" Delete the first entry "Alarm of ...".

Under "9.3.2.21.1 (e)/
9.3.3.21.1 (e)" Delete "Renewal of the certificate of approval after 1 January 2001".

Under "9.3.2.21.1 (f)/
9.3.3.21.1 (f)" Delete the entry.

Under "9.3.3.21.5 (b)" Delete the last entry "Sensor according ...".

Under "9.3.3.21.5 (c)" Delete both entries.

Under "9.3.3.23.2" "Test pressure ...", insert at the end of the third column "On board oil-separator vessels in service before 1 January 1999, a test pressure of 5 kPa (0,05 bar) is sufficient."

Under "9.3.2.25.2 (g)" Insert the following two new entries:

9.3.2.25.2 (g)	Pipes for loading and unloading, and vapour pipes, shall not have flexible connections fitted with sliding seals	N.R.M. after 31-12-2008 On board vessels in service having connections with sliding seals, substances with toxic or corrosive properties (see column (5) of Table C of Chapter 3.2, hazards 6.1 and 8) may no longer be transported following renewal of the certificate of approval after 31-12-2008.
9.3.3.25.2 (h)	Pipes for loading and unloading, and vapour pipes, shall not have flexible connections fitted with sliding seals when substances with corrosive properties (see column (5) of Table C of Chapter 3.2, hazard 8) are transported	N.R.M. after 31-12-2008 On board vessels in service having connections with sliding seals, substances with corrosive properties (see column (5) of Table C of Chapter 3.2, hazard 8) may no longer be transported following renewal of the certificate of approval after 31-12-2008.

Under "9.3.2.3.25.9" Delete "As from 1 January 2003,".

Under "9.3.2.28" Replace the text in the third column by "Renewal of the certificate of approval after 31 December 2004."

Under "9.3.1.31.4" Does not apply to English version.

Under "9.3.3.52.2" Insert in the second column under the existing text "Type N open".

Under "9.3.1.52.3 (a)" In indent (a), replace "P13" by "IP13".

- Under "9.3.1.56.1" In the first entry, insert at the end of the second column "in the cargo area".
- Under "9.3.3.56.1" In the second entry, modify second column to read "Metallic sheath for all the cables in the cargo area".
- 1.6.7.2.3.2.3** (new 1.6.7.2.2.2.6) In the second paragraph, replace "vessels" by "tank vessels".

Table 1.6.7.3

Under "9.3.3.8.1" Delete the entry twice.

- 1.7.1.1** In the last sentence, insert "on the 1996 edition of TS-R-1" after "Explanatory material".
- 1.8.3.11 (b)** In the fourth from last indent, replace "parking" by "berthing". In the last indent, replace "by vessel" by "(vessel)".
- 1.8.3.13** In the last indent, replace "and 1223" with ", 1223, 3475, and aviation fuel classified under UN Nos. 1268 or 1863".

At the end, insert a new paragraph to read as follows:

"Certificates of training as safety advisers issued before 1 January 2009 for UN Nos. 1202, 1203 and 1223 are also valid for UN No. 3475 and aviation fuel classified under UN Nos. 1268 or 1863."

1.8.5.1 At the end, insert "at the latest six months after the occurrence".

1.8.5.3 Under "*Loss of product*", modify to read:

"Loss of product means the release of dangerous goods of:

- (a) Classes 1 or 2 or of packing group I or other dangerous goods not assigned to a packing group in quantities of 50 kg or 50 litres or more;
- (b) Packing group II in quantities of 333 kg or 333 litres or more; or
- (c) Packing group III in quantities of 1,000 kg or 1,000 litres or more.

(rest unchanged)"

Under "*Involvement of authorities*", replace "(roads/railways)" by "(roads/railways/inland waterways)".

1.8.5.4 Amend to read:

"1.8.5.4 Model report on occurrences during the carriage of dangerous goods

Report on occurrences during the carriage of dangerous goods in accordance with ADN, section 1.8.5

Report No.:
 Carrier/Filler/Consignee/Loader:
 Official number of vessel:
 Dry cargo vessel (single-hull, double-hull):
 Tank vessel (type):
 Address:
 Contact name: Telephone:
 Fax/e-mail:

(The competent authority shall remove this cover sheet before forwarding the report)

1. Mode	
Inland waterway	Official number of vessel/name of vessel (optional)
2. Date and location of occurrence	
Year: Month: Day: Time:	
<input type="checkbox"/> Port <input type="checkbox"/> Loading/unloading/transshipment facility Location/Country: or <input type="checkbox"/> Free sector Name of sector: Kilometre point: or <input type="checkbox"/> Structure such as bridge or guide wall	Comments concerning description of location:
3. Conditions of inland waterway	
Water level (reference gauge):	
Estimated speed through water:	
<input type="checkbox"/> High water <input type="checkbox"/> Low water	
4. Particular weather conditions	
<input type="checkbox"/> Rain <input type="checkbox"/> Snow <input type="checkbox"/> Fog <input type="checkbox"/> Thunderstorm <input type="checkbox"/> Storm Temperature: °C	

5. Description of occurrence						
<ul style="list-style-type: none"> <input type="checkbox"/> Collision with bank, structure or berthing installation <input type="checkbox"/> Collision with another cargo vessel (collision/impact) <input type="checkbox"/> Collision with a passenger vessel (collision/impact) <input type="checkbox"/> Contact with the waterway bed, whether or not vessel has run aground <input type="checkbox"/> Fire <input type="checkbox"/> Explosion <input type="checkbox"/> Leak/Location and extent of damage (with additional description) <input type="checkbox"/> Shipwreck <input type="checkbox"/> Capsizing <input type="checkbox"/> Technical fault (optional) <input type="checkbox"/> Human error (optional) <p style="margin-left: 20px;">Additional description of occurrence:</p> <p>.....</p> <p>.....</p> <p>.....</p>						
6. Dangerous goods involved						
UN Number ⁽¹⁾ or Identification number	Class	Packing group if known	Estimated quantity of loss of products (kg or l) ⁽²⁾	Means of containment in accordance with ADN, 1.2.1 ⁽³⁾	Means of containment material	Type of failure of means of containment ⁽⁴⁾
⁽¹⁾ For dangerous goods assigned to collective entries to which special provision 274 applies, also the technical name shall be indicated.				⁽²⁾ For class 7, indicate values according to the criteria in 1.8.5.3.		
⁽³⁾ Indicate the appropriate number: 1 Packaging 2 IBC 3 Large packaging 4 Small container 5 Wagon 6 Vehicle 7 Tank-wagon 8 Tank-vehicle 9 Battery-wagon 10 Battery-vehicle 11 Wagon with demountable tanks 12 Demountable tank 13 Large container 14 Tank container 15 MEGC 16 Portable tank 17 Dry cargo vessel (single-hull, double-hull) 18 Tank vessel (type)				⁽⁴⁾ Indicate the appropriate number: 1 Loss 2 Fire 3 Explosion 4 Structural failure		
7. Cause of occurrence (if clearly known) (optional)						
<ul style="list-style-type: none"> <input type="checkbox"/> Technical fault <input type="checkbox"/> Faulty load securing <input type="checkbox"/> Operational cause <input type="checkbox"/> Other: 						

8. Consequences of occurrence	
<u>Personal injury in connection with the dangerous goods involved:</u>	
<input type="checkbox"/>	Deaths (number:)
<input type="checkbox"/>	Injured (number:)
<u>Loss of product:</u>	
<input type="checkbox"/>	Yes
<input type="checkbox"/>	No
<input type="checkbox"/>	Imminent risk of loss of product
<u>Material/Environment damage:</u>	
<input type="checkbox"/>	Estimated level of damage \leq 50 000 Euros
<input type="checkbox"/>	Estimated level of damage $>$ 50 000 Euros
<u>Involvement of authorities:</u>	
<input type="checkbox"/>	Yes
<input type="checkbox"/>	Evacuation of persons for a duration of at least three hours caused by the dangerous goods involved
<input type="checkbox"/>	Closure of public traffic routes for a duration of at least three hours caused by the dangerous goods involved
<input type="checkbox"/>	No

If necessary, the competent authority may request further relevant information."

1.9.2 Replace "of the Agreement" by "of ADN".

PART 2

2.2.9.1.10.1 In the first line, insert "or in bulk" after "For carriage in packages".

PART 3

3.2.1 In table A, modify entry 3077 to read as follows:

(1)	(2)	(3a)	(3b)	(4)	(5)	(6)	(7a)	(7b)	(8)	(9)	(10)	(11)	(12)	(13)
3077	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S.	9	M7	III	9	274 335 601	LQ 27	E1	T* B**	PP A***			0	*Only in the molten state. **For carriage in bulk see also 7.1.4.1. *** Only in the case of transport in bulk.

3.2.3 In the explanations concerning Table C relating to column (20), under requirement 12, replace the text of paragraph (l) with "*Reserved*".

3.3.1 In SP188 (b) as amended in ECE/TRANS/WP.15/AC.2/26:
At the end of the second sentence, after "case", insert the following text:

", except those manufactured before 1 January 2009 which may be carried in accordance with this special provision and without this marking until 31 December 2010."

PART 5

5.1.3 Insert ", wagons" after "vehicles".

5.1.3.1 Modify the list to read "... tanks (including tank-vehicles, battery-vehicles, battery-wagons, demountable tanks, portable tanks, tank-containers, MEGCs), vehicles, wagons and containers for carriage in bulk ...".

5.1.5.2.2 (c) (New 5.1.5.1.2 (c)) Replace "wagon/vehicle or container or in a single conveyance" by "vessel, vehicle, wagon or container".

5.2.1 In the Note, replace "gas" by "pressure".

5.2.1.6 (a) In footnote 1, in the penultimate indent, delete "The names customary in the trade and mentioned in 2.2.2.3 ... only as a complement".

5.2.1.7.7 Does not apply to English version.

5.2.2.1.7 Insert "and large packages" after "capacity".

5.2.2.1.9 (b) Does not apply to English version.

5.3.1.3 In the title, insert "and wagons" after "vehicles".

5.3.1.3 In the last paragraph, insert "or wagons" after "vehicles" and "or wagon" after "vehicle" twice.

5.3.1.7.4 Insert the following two new sentences at the end: "The dimensions of the placards to be affixed to wagons may be reduced to 150 mm by 150 mm. In this case, the upper dimensions prescribed for the trefoil, lines, figures and letters do not apply."

5.3.2.1.2 In the second paragraph, replace "movable" by "demountable". At the end of the second paragraph, insert the following new sentence: "In the latter case the hazard identification number to be used is that indicated in column (20) of table A of Chapter 3.2 of RID."

5.3.2.3.2 Insert "of ADR or RID" after "Chapter 3.2".

Under numbers 238, 28 and 285, replace "aerosols" by "gas".

5.3.4.1 Replace "sections 5.3.2 and 5.3.3" by "section 5.3.2". In the title of the example, replace "tank container" by "mobile tank".

5.3.4.2 Delete "of section 5.3.2".

5.4.1.1.1 (a) At the end, insert "or substance identification number".

5.4.1.1.1 (c) In the NOTE, insert "in Chapter 3.3" at the end.

5.4.1.1.2 (b) Insert "in parenthesis" after "technical name".
After the indents, in the last paragraph, insert "Table C of" before "Chapter 3.2".

5.4.1.1.2 (c) Replace the second sentence by the following: "When more than one number is given, the numbers following the first one shall be given in brackets."

5.4.1.1.2 After the indents, in the last paragraph, insert "Table C of" before "Chapter 3.2".

5.4.1.1.6.3 (a) Insert ", battery-wagons" after "battery-vehicles" and "or RID" after "of ADR".
At the end, insert "(or RID)" after "Carriage in accordance with 4.3.2.4.3 of ADR".

5.4.1.1.6.3 (b) Insert ", wagons" after "vehicles" and "or RID" after "of ADR". At the end, insert "(or RID)" after "Carriage in accordance with 7.5.8.1 of ADR".

5.4.1.2.1 (d) Insert a new last sentence to read: "It shall be in an official language of the forwarding country and also, if that language is not English, French or German, in English, French or German unless agreements, if any, concluded between the countries concerned in the transport operation provide otherwise."

5.4.1.2.2 Insert ", tank-wagons" after "fixed tanks".

5.4.1.2.3.3 Insert "of ADR" after the second "4.1.7.2.2". At the end, insert a new last sentence to read: "It shall be in an official language of the forwarding country and also, if that language is not English, French or German, in English, French or German unless agreements, if any, concluded between the countries concerned in the transport operation provide otherwise."

5.4.1.2.5.1 (h) Does not apply to English version.

5.4.1.2.5.2 (b) Replace "or vehicle" by " or vehicle or wagon".

5.4.1.4.1 At the end of the first paragraph, delete "the vehicle".

5.4.2 Does not apply to English version.

5.4.3 Amend to read as follows:

"5.4.3 Instructions in writing









5.4.3.1 As an aid during an accident emergency situation that may occur or arise during carriage, instructions in writing in the form specified in 5.4.3.4 shall be carried in the wheelhouse and shall be readily available.















5.4.3.2 These instructions shall be provided by the carrier to the master in the language(s) that the master and the expert can read and understand before the commencement of the journey. The master shall ensure that each member of the crew concerned understands and is capable of carrying out the instructions properly.

5.4.3.3 Before the start of the journey, the members of the crew shall inform themselves of the dangerous goods loaded and consult the instructions in writing for details on actions to be taken in the event of an accident or emergency.

5.4.3.4 The instructions in writing shall correspond to the following four-page model as regards its form and contents.

INSTRUCTIONS IN WRITING <u>Actions in the event of an accident or incident</u>
<p>In the event of an accident or incident that may occur during carriage, the members of the crew shall take the following actions where safe and practicable to do so:</p> <ul style="list-style-type: none"> – Inform all other persons on board about the emergency and keep them away as much as possible from the danger zone. Alert other vessels in the vicinity; – Avoid sources of ignition, in particular, do not smoke or switch on any electrical equipment that is not the "certified safe" type and is not designed for use in emergency response; – Inform the appropriate body, giving as much information about the accident or incident and substances involved as possible; – Keep the transport documents and the loading plan readily available for responders on arrival; – Do not walk into or touch spilled substances and avoid inhalation of fumes, smoke, dusts and vapours by staying up wind; – Where appropriate and safe to do so, tackle small/initial fires; – Where appropriate and safe to do so, use on-board equipment to prevent leakages into the aquatic environment and contain spillages; – Where necessary and safe to do so, secure the ship against drifting; – Where appropriate, move away from the vicinity of the accident or incident, advise other persons to move away and follow the advice of the appropriate body; – Remove any contaminated clothing and used contaminated protective equipment, dispose of it safely and wash the body by appropriate means; – Observe the additional guidance assigned to the hazards of all concerned goods in the following table. For carriage in packages or in bulk, the hazards correspond to the number of the danger label model; for carriage in tank vessels to the data in accordance with 5.4.1.1.2 (c).

Additional guidance to members of the crew on the hazard characteristics of dangerous goods by class and on action subject to prevailing circumstances		
Danger labels and placards, description of the hazards	Hazard characteristics	Additional guidance
(1)	(2)	(3)
Explosive substances and articles  1 1.5 1.6	May have a range of properties and effects such as mass detonation; projection of fragments; intense fire/heat flux; formation of bright light, loud noise or smoke. Sensitive to shocks and/or impacts and/or heat.	Take cover but stay away from windows. Steer the vessel as far away as possible from infrastructure and inhabited areas.
Explosive substances and articles  1.4	Slight risk of explosion and fire.	Take cover.
Flammable gases  2.1	Risk of fire. Risk of explosion. May be under pressure. Risk of asphyxiation. May cause burns and/or frostbite. Containments may explode when heated.	Take cover. Keep out of low areas.
Non-flammable, non-toxic gases  2.2	Risk of asphyxiation. May be under pressure. May cause frostbite. Containments may explode when heated.	Take cover. Keep out of low areas.
Toxic gases  2.3	Risk of intoxication. May be under pressure. May cause burns and/or frostbite. Containments may explode when heated.	Use escape device. Take cover. Keep out of low areas.
Flammable liquids  3	Risk of fire. Risk of explosion. Containments may explode when heated.	Take cover. Keep out of low areas. Prevent leaking substances from running into the aquatic environment.
Flammable solids, self-reactive substances and solid desensitized explosives  4.1	Risk of fire. Flammable or combustible, may be ignited by heat, sparks or flames. May contain self-reactive substances that are liable to exothermic decomposition in the case of heat supply, contact with other substances (such as acids, heavy-metal compounds or amines), friction or shock. This may result in the evolution of harmful and flammable gases or vapours. Containments may explode when heated.	Prevent leaking substances from running into the aquatic environment.
Substances liable to spontaneous combustion  4.2	Risk of spontaneous combustion if packages are damaged or contents spilled. May react vigorously with water.	Spilled substances should be kept dry by covering the spillages

Danger labels and placards, description of the hazards (1)	Hazard characteristics (2)	Additional guidance (3)
Substances which, in contact with water, emit flammable gases   4.3	Risk of fire and explosion in contact with water.	Spilled substances should be kept dry by covering the spillages.
Oxidizing substances  5.1	Risk of ignition and explosion. Risk of vigorous reaction in contact with flammable substances.	Avoid mixing with flammable or combustible substances (e.g. sawdust).
Organic peroxides   5.2	Risk of exothermic decomposition at elevated temperatures, contact with other substances (such as acids, heavy-metal compounds or amines), friction or shock. This may result in the evolution of harmful and flammable gases or vapours.	Avoid mixing with flammable or combustible substances (e.g. sawdust).
Toxic substances  6.1	Risk of intoxication. Risk to the aquatic environment.	Use escape device. Keep out of low areas.
Infectious substances  6.2	Risk of infection. Risk to the aquatic environment.	
Radioactive material   7A 7B   7C 7D	Risk of intake and external radiation.	Limit time of exposure.
Fissile material  7E	Risk of nuclear chain reaction.	Limit time of exposure.
Corrosive substances  8	Risk of chemical burns. May react vigorously with each other, with water and with other substances. Risk to the aquatic environment and sewage system.	Prevent leaking substances from running into the aquatic environment.
Miscellaneous dangerous substances and articles  9	Risk of burns. Risk of fire. Risk of explosion. Risk to the aquatic environment and sewage system.	Prevent leaking substances from running into the aquatic environment.

NOTE: 1. For dangerous goods with multiple risks and for mixed loads, each applicable entry shall be observed.

2. Additional guidance shown above may be adapted to reflect the classes of dangerous goods to be carried and their means of transport.

3. Risks see also entries in the transport document as well as Chapter 3.2, Table C, Column 5.

Equipment for personal and general protection to carry out general actions and hazard specific emergency actions to be carried on board the vessel in accordance with section 8.1.5 of ADN

The equipment required by Chapter 3.2, Table A, Column 9 and Table C, Column 18 shall be carried on board the vessel for all hazards listed in the transport document.

5.5.2.1 Insert "and amount" after "type". Place the last sentence after the first sentence.

5.5.2.2 At the end of the first sentence, replace "container or wagon" by "vehicle, wagon, container or tank".

PART 6

6.1.1 Insert a new reference to Chapter 6.12 as follows:

"Chapter 6.12 Requirements for the construction, equipment, type approval, inspections and tests, and marking of tanks, bulk containers and special compartments for explosives of mobile explosive manufacturing units (MEMUs)".

PART 7

7.1.1.13 Delete "(see also 7.1.6.13)".

7.1.2.19.1 Insert "for the carriage of dangerous goods" after the first "certificate of approval".

7.1.3.15 Replace "Dangerous goods training" by "Expert on board the vessel".

Insert "according to 8.2.1.2" after "an expert".

7.1.3.22.1 Replace "covered" by "closed".

7.1.4.1.1 Class 2: Reverse the order of the first two entries.

Class 3: Replace "Other goods" by "Other goods: total".

Class 5.2: Replace "All other goods: total" by "Other goods: total".

Class 6.1: Replace "All goods of packing group I" by "All goods of packing group I: total" and "All goods of packing group II" by "All goods of packing group II: total".

Class 9: Replace "All goods of packing group II" by "All goods of packing group II: total".

Class 9: after "All goods of packing group II: total", insert the following new entry: "UN No. 3077, for goods carried in bulk and classified as hazardous to the aquatic environment, categories Acute 1 or Chronic 1, in accordance with 2.4.3: 0 kg".

- 7.1.4.1.3** Does not apply to English version.
- 7.1.4.1.5** Amend to read "Where the total net mass of the explosive substances carried and of explosive substances contained in articles carried is not known, the gross mass of the cargo shall apply to the mass mentioned in the table in 7.1.4.1.1 above."
- 7.1.4.3.2** Replace "three" by "two" (twice).
- 7.1.4.3.4** Footnote "X": Insert "or articles" after "substances".
- Footnote ^{1/}: Amend the beginning to read "Packages containing articles assigned to compatibility group B or substances or articles assigned to compatibility group D may be ...".
- 7.1.4.3.6** Move "(UN Nos. 2919 and 3331)" to after "special arrangement".
- 7.1.4.4.2** Second indent: Amend to read:
"– closed vehicles and closed wagons with complete metal walls;"
- 7.1.4.7.2** Delete "local".
- 7.1.4.9** Replace "transfer" by "transshipment" three times.
- 7.1.4.10.1** Amend the second paragraph to read "Packages as well as uncleaned empty packagings, including large packagings and intermediate bulk containers (IBCs), bearing labels conforming to ...".
- 7.1.4.12.2** In the second sentence, insert "of the container or release of content inside the container" after "damage".
- 7.1.4.12.3** Delete "road".
- 7.1.4.13** Replace "decks" by "areas".
- 7.1.4.14.5** Insert "in the protected area" after the first "deck".
- 7.1.4.14.6** Insert "of dangerous goods" after "carriage".
- 7.1.4.14.7.1.1** First line: Insert "and wagons" after "vehicles".
- 7.1.4.14.7.1.3** Insert "driver of the" before "vehicle".

7.1.4.14.7.4.2 Insert ", a wagon" after "vehicle" and "or wagons" after "vehicles".

7.1.4.15.3 Does not apply to English version.

7.1.4.16 Replace "road tank vehicles tank wagons" by "tank vehicles, tank wagons" and delete "local".

7.1.4.53 Replace "limited explosion risk type" by ""limited explosion risk" type".

7.1.5.0.2 Third indent: Insert "Table A of" before "Chapter 3.2".

7.1.5.0.3 Insert "cargo transport" before "units".

7.1.5.0.5 Replace "United Nations Economic commission for Europe" by "UNECE".

7.1.5.1.1 Amend to read: "The competent authorities may impose restrictions on the inclusion of vessels carrying dangerous goods in pushed conveyors of large dimension."

7.1.5.4.1 Insert "(CEVNI)" at the end.

7.1.5.4.2 Replace "7.1.3.15" by "8.2.1.2" and delete "carrying dangerous goods".

7.1.5.4.3 In the last indent, replace "storage tanks" by "storage tanks holding gas or flammable liquids".

7.1.5.4.4 Does not apply to English version.

7.1.5.5 Does not apply to English version.

7.1.5.8.1 Fourth indent: Amend to read "– description of the dangerous goods carried as given in the transport document (information according to 5.4.1.1.1 (a) to (d)) together with the quantity in each case;"

7.1.6.11 ST01: Delete "national".

7.1.6.12 VE03: First indent: Replace "goods" by "substances".
Second indent: Insert "having contained these substances" after "holds".
Third indent: Replace "the holds" by "these holds".

7.1.6.14 HA01: Insert "or articles" after "substances".

HA02: Insert "vertical planes defined by the" before "sides".

HA03: Replace "transport" by "carriage".

HA06: Does not apply to English version.

- 7.1.6.16** Title: Insert "of cargo" after "handling".
- IN03: Insert "hold" before "bilge" or "bilges" three times.
- 7.2.1.21.2** Replace "prescribed in the list of substances of Table C are met" by "required for these substances in Table C of Chapter 3.2 are met".
- 7.2.1.21.3** Replace "prescribed in the list of substances of Table C are met" by "required for these substances in Table C of Chapter 3.2 are met".
- 7.2.1.21.4** Replace "prescribed in the list of substances of Table C are met" by "required for these substances in Table C of Chapter 3.2 are met".
- 7.2.1.21.5** Replace "prescribed in the list of substances of Table C are met" by "required for these substances in Table C of Chapter 3.2 are met".
- 7.2.2.0** NOTE 2: Insert "recognised" before "classification".
- NOTE 3: Insert "recognised" before "classification".
- 7.2.2.0.1** In the NOTE, insert "recognised" before "classification".
- 7.2.2.19.1** Insert "for the carriage of dangerous goods" before ", all vessels".
- 7.2.2.19.3** Replace "9.3.3.52.3, 9.3.3.52.4 to 9.3.3.52.6" by "9.3.3.52.3 to 9.3.3.52.6".
- 7.2.2.21** Replace "on the quay" by "on shore".
- 7.2.3.7.3** In the third indent, insert "and overpressure ventilation systems" at the end.
- 7.2.3.7.4** Insert "during a thunderstorm or" after "interrupted".
- 7.2.3.7.5** Does not apply to English version.
- 7.2.3.8** Delete and replace by "(Reserved)".
- 7.2.3.15** In the last paragraph, delete "holding the certificate".
- 7.2.3.22** In the title, replace "deck, cofferdams, opening" by "deck and cofferdams, openings".
- 7.2.3.25.1** Does not apply to English version.
- 7.2.3.25.2** First indent: Does not apply to English version.
Second indent: Insert "in an emergency" after "water" and in the last paragraph, replace "educators" by "ejectors".

- 7.2.3.25.3** In the second indent, replace "educators" by "ejectors".
- 7.2.3.42.3** Delete "(b)" twice.
- 7.2.4.2.2** Does not apply to English version.
- 7.2.4.11.1** Delete the square brackets and footnote and insert a NOTE to read as follows:
- "NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."*
- In the second sentence, replace the text in parenthesis by "(information according to 5.4.1.1.2 (a) to (d))".
- 7.2.4.11.2** Replace the text in parenthesis by "(information according to 5.4.1.1.2 (a) to (d))".
- 7.2.4.12** Replace the first indent by "Loading: Place of loading and loading berth, date and time, UN number or identification number of the substance, proper shipping name of the substance, the class and packing group if any;".
- 7.2.4.15** Insert a NOTE to read as follows:
- "NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."*
- 7.2.4.15.3** Amend to read as follows: "After additional stripping, cargo tanks and pipes for loading and unloading shall, if necessary, for example before undertaking repairs or maintenance, be cleaned or gas-freed. This cleaning and gas-freeing shall be checked by persons or companies approved by the competent authority. Gas-freeing shall only be carried out in places approved by the competent authority."
- 7.2.4.16.1** Replace "at" by "of".
- 7.2.4.16.3** Replace "cargo" by "loading and unloading".
- 7.2.4.16.6** Replace "operating" by "opening".
- 7.2.4.16.8** In the second paragraph, replace "8.1.5. If this" by "(8.1.5 if this)".
- 7.2.4.16.10** Replace "columns (6) and (7)" by "column (7)".
- 7.2.4.16.13** Amend to read as follows:
- "For the carriage of substances of UN No. 2448, or of goods of Class 5.1 or 8, the bulwark ports, openings in the foot rail, etc., shall not be closed off. Nor

shall they be closed off, during the voyage, in the event of carriage of other dangerous goods."

- 7.2.4.17.1** In the third indent, delete "(b)" three times.
In the fourth indent, delete "(b)" three times.
- 7.2.4.18.1** In the first line, insert "cargo" before "tanks".
- 7.2.4.18.3** Insert "and inerting is required in column (20) of Table C of Chapter 3.2" after "Chapter 3.2".
- 7.2.4.19** Replace "(6) and (7)" by "(6), (7) and (17)".
- 7.2.4.22.1** Replace "relived" by "relieved".
- 7.2.4.22.3** Replace "two blue cones or blue lights" by "one or two blue cones or one or two blue lights".
- 7.2.4.22.5** Insert ", replacing the flame arrester" after "cleaning".
- 7.2.4.25.2** Replace "cargo" by "loading and unloading".
- 7.2.4.25.3** Replace "cargo" by "loading and unloading".
- 7.2.4.28.3** Insert "(0.4 bar)" after "40 kPa" and "(0.3 bar)" after "30 kPa".
- 7.2.4.51.2** Delete "(b)" three times.
- 7.2.4.51.3** Replace "electric corrosion protection against external currents" by "active cathodic corrosion protection".
- 7.2.4.74** Delete "(b)" three times.
- 7.2.5.0.2** Amend the text before the indents to read:
"When more than one marking should apply to a vessel, the first of the options below shall apply:"
- 7.2.5.0.3** Replace "United Nations Economic Commission for Europe" by "UNECE".
- 7.2.5.4.1** Insert "berthed" before "vessels carrying".
- 7.2.5.4.2** Does not apply to English version.
- 7.2.5.4.3** Delete "local".
- 7.2.5.4.4** Delete "local" and replace "7.1.5.4.3" by "7.2.5.4.3".

7.2.5.8.1 In the fourth indent, replace the text in parenthesis by "(information according to 5.4.1.1.2 (a) to (d))".

PART 8

8.1.2.1 (c) Delete "for all dangerous goods on board".

8.1.2.1 (d) Amend to read as follows:
"(d) A copy of the ADN with the latest version of its annexed Regulations which may be a copy which can be consulted by electronic means at any time;"

8.1.2.1 (j) Amend the last sentence to read as follows: "The most recent list or certificate shall be kept on board;"

8.1.2.1 (k) Delete.

8.1.2.1 (l) Delete.

8.1.2.2 (c) Amend the first line to read as follows:

"(c) For vessels complying with the additional requirements for double-hull vessels:"

8.1.2.3 (a) Delete the square brackets and footnote and replace "loading journal" by "cargo stowage plan" and "7.2.4.11" by "7.2.4.11.2".

8.1.2.3 (j) Delete the square brackets and footnote and insert a NOTE to read as follows:

"NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."

8.1.2.3 (l) Amend to read as follows:

"(l) The inspection certificate for the pressure relief and vacuum relief valves prescribed in 8.1.6.5, except for open type N tank vessels, or open type N vessels with flame-arresters."

8.1.2.3 Insert new subparagraphs (n) and (o) as follows:

"(n) For the carriage of refrigerated substances, the instruction required in 7.2.3.28;

(o) The certificate concerning the refrigeration system, prescribed in 9.3.1.27.10."

8.1.2.5 Delete and replace by "(Reserved)".

8.1.5.2 Delete and replace by "(Reserved)".

8.1.6.6 Insert a NOTE to read as follows:

"NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."

8.1.10 Delete the square brackets and footnote and insert a NOTE to read as follows:

"NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."

8.2.2.7 Insert a new paragraph 8.2.2.7.0 as follows:

"8.2.2.7.0 The examination shall be organized by the competent authority or by an examining body designated by the competent authority. The examining body shall not be a training provider.

The examining body shall be designated in writing. This approval may be of limited duration and should be based on the following criteria:

- Competence of the examining body;
- Specifications of the form of the examinations the examining body is proposing;
- Measures intended to ensure that examinations are impartial;
- Independence of the body from all natural or legal persons employing ADN experts."

8.2.2.7.2.5 Amend the third sentence to read as follows:

"The examination shall last a total of 150 minutes, of which 60 minutes for the multiple-choice questions and 90 minutes for the substantive questions."

8.2.2.8 Amend to read as follows:

"8.2.2.8 ADN special knowledge certificate

The issue and renewal of the ADN special knowledge certificate conforming to 8.6.2, shall be the responsibility of the competent authority or a body authorized by the competent authority. Certificates shall be issued to:

- candidates who have attended a basic or specialized training course and have passed the examination;
- candidates who have taken part in a refresher or advanced training course.

The validity of the basic training certificate shall be five years as from the date of the examination.

Candidates who have obtained the 'gases' and/or 'chemicals' specialized training certificate shall be issued with a new certificate containing all the certificates relating to the basic and specialized training courses. The validity of the new certificate shall be five years as from the date of the basic training examination.

If the refresher and advanced training course was not fully completed before the expiry of the period of validity of the certificate, a new certificate shall not be issued until the candidate has completed a further initial basic training course and passed an examination referred to in 8.2.2.7 above.

If a new certificate is issued following attendance at a specialized or refresher and advanced training course, and the previous certificate was issued by another competent authority or by a body authorized by another competent authority, the previous certificate shall be retained and returned to the authority or body that issued it."

8.6.3 Delete question 2 and replace with "(Reserved)" and delete the particulars in Columns "vessel" and "loading/unloading place".

Amend question 17 to read as follows:

	Vessel	Loading/unloading place
17. Is the following system plugged in, in working order and tested?		
Overflow prevention device (only when loading the vessel)	O	O
Device for switching off the on-board pump from the shore facility (only when unloading the vessel)	O	O

8.6.4. Insert a NOTE to read:

"NOTE: It is not necessary to apply this section. The date of application will be defined later."

PART 9

9.1.0 Does not apply to English version.

9.1.0.40.2.1 Insert a new indent (d) as follows:

"(d) FK-5-1-12 (dodecafluoro 2-methylpentane-3-one)."

9.1.0.40.2.4 (b) Insert the following sentence at the end:

"In particular, the extinguishing agent must also be effective beneath the floor."

9.1.0.40.2.5 (c) Does not apply to English version.

9.1.0.40.2.5 (e) Amend (iii) to read as follows:

"(iii) the correct behaviour of the crew in the event of activation and when accessing the space to be protected following activation or diffusion, in particular in respect of the possible presence of toxic substances;"

9.1.0.40.2.10 In (a), insert "general" before "danger".

9.1.0.40.2.13 Insert a new 9.1.0.40.2.13, worded as follows, and renumber the present 9.1.0.40.2.13 as 9.1.0.40.2.14:

"Fire-extinguishing system operating with FK-5-1-12

In addition to the requirements of 9.1.0.40.2.1 to 9.1.0.40.2.9, fire-extinguishing systems using FK-5-1-12 as an extinguishing agent shall comply with the following provisions:

- (a) Where there are several spaces with different gross volumes, every space shall be equipped with its own fire-extinguishing system;
- (b) Every tank containing FK-5-1-12 placed in the space to be protected shall be fitted with a device to prevent overpressure. This device shall ensure that the contents of the tank are safely diffused in the space to be protected if the tank is subjected to fire, when the fire-extinguishing system has not been brought into service;
- (c) Every tank shall be fitted with a device permitting control of the gas pressure;
- (d) The level of filling of tanks shall not exceed 1.00 kg/l. The specific volume of depressurized FK-5-1-12 shall be taken to be 0.0719 m³/kg;
- (e) The volume of FK-5-1-12 in the space to be protected shall be not less than 5.5% of the gross volume of the space. This quantity shall be released within 10 seconds;
- (f) Tanks of FK-5-1-12 shall be fitted with a pressure monitoring device which triggers an audible and visual alarm in the wheelhouse in the event of an unscheduled loss of extinguishing agent. Where there is no wheelhouse, the alarm shall be triggered outside the space to be protected;
- (g) After discharge, the concentration in the space to be protected shall not exceed 10.0%."

9.1.0.40.2.14 (ex. 9.1.0.40.2.13) In the title, insert "Fixed" before "fire-extinguishing system" and in the text, insert "permanently fixed" before "fire-extinguishing systems".

9.1.0.56.3 Replace "245 IEC 66" by "standard IEC-60 245-4:1994".

9.1.0.70 Does not apply to English version.

9.1.0.91.2 (a) Insert a sentence at the end to read "These intervals may be increased if the construction is correspondingly reinforced."

9.1.0.91.3 Amend to read as follows:

"The depth of the double bottom shall be at least 0.50 m. The depth below the suction wells may, however, be locally reduced, but the space between the bottom of the suction well and the bottom of the vessel floor shall be at least 0.40 m. If spaces are between 0.40 m and 0.49 m, the surface area of the suction well shall not exceed 0.5 m².

The capacity of the suction wells must not exceed 0.120 m³."

9.2.0.31.2 Amend to read "Ventilation inlets of the engine rooms and the air intakes of the engines which do not take air in directly from the engine room shall be located not less than 2 m from the protected area."

9.2.0.88.2 Amend to read "The vessel's highest class shall be continued."

9.3.1 Replace "provisions" by "rules for construction".

9.3.1.8.1 Replace "The vessel's class shall be continued." by "The vessel's highest class shall be continued."

9.3.1.8.3 Delete "(b)".

9.3.1.11.1 In (a), insert below the table: "Alternative constructions in accordance with 9.3.4 are permitted."

In (a), insert "in m" after "of the hull" twice, after "cargo area", after "L/2" and after "trunk breadth" and "trunk width". Insert "where:" after "cargo area in m;". In (b) and (c), delete "cargo" after "pressure".

9.3.1.11.2 (a) Replace the text starting with "The cargo tank supports and fastenings" to the end of (a) by:

"The cargo tank supports and fastenings should extend to not less than 10° below the horizontal centreline of the cargo tanks."

In footnote 1, at the end, insert "*Alternative constructions in accordance with 9.3.4 are permitted.*"

- 9.3.1.11.2 (d)** Replace "stringers" by "struts".
- 9.3.1.11.3 (a)** Does not apply to English version.
- 9.3.1.11.8** Replace "personnel" by "persons".
- 9.3.1.12.5** Does not apply to English version.
- 9.3.1.12.6** In the second paragraph, delete "below deck".
- 9.3.1.17.6** In the fifth indent, insert "necessary" before "control of the liquid".
- 9.3.1.18** Insert "(0.035 bar)" after "3.5 kPa".
- 9.3.1.21.1 (e)** At the end, insert "of the gas phase in the cargo tank".
- 9.3.1.21.7** In the second paragraph, insert "and loading" before "operation".
- 9.3.1.21.8** Does not apply to English version.
- 9.3.1.21.9** Replace "at the two points" by "at two points".
- 9.3.1.21.10** Insert "(0.25 bar)" after "25 kPa".
- 9.3.1.22.2** Replace "capable of withstanding the test pressure in accordance with 9.3.1.23.1" by "which comply with the provisions of 9.3.1.23.1".
- 9.3.1.23.1** Does not apply to English version.
- 9.3.1.24.1 (b)** Insert at the end "and shall ensure safety for a minimum time of three times the operation period".
- 9.3.1.25.2** Insert a new subparagraph (g) as follows:
- "(g) Pipes for loading and unloading, and vapour pipes, shall not have flexible connections fitted with sliding seals."
- 9.3.1.25.7** Delete "loading and".
- 9.3.1.27.1** Does not apply to English version.
- 9.3.1.27.4** Replace "two or more" by "several".
- 9.3.1.27.5** In the second sentence, delete "if possible".

9.3.1.27.6 (a) Delete "column (20) of".

9.3.1.28 Delete "over the whole surface".

9.3.1.31.4 Insert "of the substances carried" after "temperature class" and delete "(b)".

9.3.1.32.1 Delete "liquid" twice and replace "0.60 m" by "0.6m".

9.3.1.32.2 Delete "liquid".

9.3.1.34.2 Insert "of engines" after "Exhaust pipes".

9.3.1.40.2.1 Insert a new indent (d) as follows:

"(d) FK-5-1-12 (dodecafluoro 2-methylpentane-3-one)."

9.3.1.40.2.4 (b) Insert the following sentence at the end:

"In particular, the extinguishing agent must also be effective beneath the floor."

9.3.1.40.2.5 (e) Amend (iii) to read as follows:

"(iii) the correct behaviour of the crew in the event of activation and when accessing the space to be protected following activation or diffusion, in particular in respect of the possible presence of toxic substances;"

9.3.1.40.2.9 (c) Does not apply to English version.

9.3.1.40.2.10 In (a), insert "general" before "danger".

9.3.1.40.2.11 Replace "9.1.0.40.2.1 to 9.1.0.40.2.9" by "9.3.1.40.2.1 to 9.3.1.40.2.9".

9.3.1.40.2.13 Insert a new 9.3.1.40.2.13, worded as follows, and renumber present 9.3.1.40.2.13 as 9.3.1.40.2.14:

"Fire-extinguishing system operating with FK-5-1-12

In addition to the requirements of 9.3.1.40.2.1 to 9.3.1.40.2.9, fire-extinguishing systems using FK-5-1-12 as an extinguishing agent shall comply with the following provisions:

- (a) Where there are several spaces with different gross volumes, every space shall be equipped with its own fire-extinguishing system;
- (b) Every tank containing FK-5-1-12 placed in the space to be protected shall be fitted with a device to prevent overpressure. This device shall ensure that the contents of the tank are safely diffused in the space to be protected if the tank is

subjected to fire, when the fire-extinguishing system has not been brought into service;

- (c) Every tank shall be fitted with a device permitting control of the gas pressure;
- (d) The level of filling of tanks shall not exceed 1.00 kg/l. The specific volume of depressurized FK-5-1-12 shall be taken to be 0.0719 m³/kg;
- (e) The volume of FK-5-1-12 in the space to be protected shall be not less than 5.5% of the gross volume of the space. This quantity shall be released within 10 seconds;
- (f) Tanks of FK-5-1-12 shall be fitted with a pressure monitoring device which triggers an audible and visual alarm in the wheelhouse in the event of an unscheduled loss of extinguishing agent. Where there is no wheelhouse, the alarm shall be triggered outside the space to be protected;
- (g) After discharge, the concentration in the space to be protected shall not exceed 10.0%."

9.3.1.40.2.14 (ex. 9.3.1.40.2.13) In the title, insert "Fixed" before "fire-extinguishing system" and in the text, insert "permanently fixed" before "fire-extinguishing systems".

9.3.1.51.1 Replace "electric corrosion protection against external currents" by "active cathodic corrosion protection".

9.3.1.51.2 Does not apply to English version.

9.3.1.56.5 Replace "IEC publication 60 245-4 (1994)" by "standard IEC 60 245-4: 1994".

9.3.2.0.1 (c) Amend to read "(c) Vapour pipes and gas discharge pipes shall be protected against corrosion."

9.3.2.8.1 Replace "The vessel's class shall be continued." by "The vessel's highest class shall be continued."

9.3.2.8.3 Delete "(b)".

9.3.2.11.1 (a) Insert below the table: "Alternative constructions in accordance with 9.3.4 are permitted."

Insert "in m" after "the hull" twice, and after "distance" once.

9.3.2.11.1 (d) Replace "L" by "I".

9.3.2.11.2 (d) Replace "stringers" by "struts".

9.3.2.11.2 (e) Insert a new (e) to read as follows:

"(e) A local recess in the cargo deck, contained on all sides, with a depth greater than 0.1 m, designed to house the loading and unloading pump, is permitted if it fulfils the following conditions:

- The recess shall not be greater than 1 m in depth.
- The recess shall be located not less than 6 m from entrances and openings to accommodation and service spaces outside the cargo area.
- The recess shall be located at a minimum distance from the side plating equal to one quarter of the vessel's breadth.
- All pipes linking the recess to the cargo tanks shall be fitted with shut-off devices fitted directly on the bulkhead.
- All the controls required for the equipment located in the recess shall be activated from the deck.
- If the recess is deeper than 0.5 m, it shall be provided with a permanent gas detection system which automatically indicates the presence of explosive gases by means of direct-measuring sensors and actuates a visual and audible alarm when the gas concentration has reached 20% of the lower explosion limit. The sensors of this system shall be placed at suitable positions at the bottom of the recess. Measurement shall be continuous.
- Visual and audible alarms shall be installed in the wheelhouse and on deck and, when the alarm is actuated, the vessel loading and unloading system shall be shut down. Failure of the gas detection system shall be immediately signalled in the wheelhouse and on deck by means of visual and audible alarms.
- It shall be possible to drain the recess using a system installed on deck in the cargo area and independent of any other system.
- The recess shall be provided with a level alarm device which activates the draining system and triggers a visual and audible alarm in the wheelhouse when liquid accumulates at the bottom.
- When the recess is located above the cofferdam, the engine room bulkhead shall have an 'A-60' fire protection insulation according to SOLAS 74, Chapter II-2, Regulation 3.
- When the cargo area is fitted with a water-spray system, electrical equipment located in the recess shall be protected against infiltration of water.

- Pipes connecting the recess to the hull shall not pass through the cargo tanks."

- 9.3.2.11.3 (a)** In the third sentence, delete "insulated".
- 9.3.2.11.4** In the third paragraph, insert "loading or" before "unloading" and insert at the end "These shut-off devices shall be operable from the deck."
- 9.3.2.11.7** At the end insert a new sub-paragraph as follows: "Alternative constructions in accordance with 9.3.4 are permitted."
- 9.3.2.11.9** Does not apply to English version.
- 9.3.2.11.10** Replace "injured or unconscious personnel" by "an injured or unconscious person".
- 9.3.2.12.6** In the second paragraph, delete "below deck".
- 9.3.2.15.2** Does not apply to English version.
- 9.3.2.17.6** In the fifth indent, insert "necessary" before "control of the liquid".
- 9.3.2.18** Insert "(0.035 bar)" after "3.5 kPa".
- 9.3.2.20.1** Delete "For openings giving access to double-hull spaces on deck the last sentence of 9.3.2.10.3 remains applicable."
- 9.3.2.21.5** Insert a new subparagraph (c) as follows:
- "(c) Vessels which may be delivering products required for operation of vessels shall be equipped with a transshipment facility compatible with European standard EN 12 827:1996 and a rapid closing device enabling refuelling to be interrupted. It shall be possible to actuate this rapid closing device by means of an electrical signal from the overflow prevention system. The electrical circuits actuating the rapid closing device shall be secured according to the quiescent current principle or other appropriate error detection measures. The state of operation of electrical circuits which cannot be controlled using the quiescent current principle shall be capable of being easily checked.
- It shall be possible to actuate the rapid closing device independently of the electrical signal.
- The rapid closing device shall actuate a visual and audible alarm on board."
- 9.3.2.21.7** Insert "(0.05 bar)" after "5 kPa" and "(0.4 bar)" after "40 kPa".
- 9.3.2.22.2** Replace "9.3.2.23.1" by "9.3.2.23.2".

9.3.2.22.5 (a) Does not apply to English version.

9.3.2.22.5 (c) Delete "pressure/".

9.3.2.25.2 Insert a new subparagraph (i), to read as follows:

"(i) Pipes for loading and unloading, and vapour pipes, shall not have flexible connections fitted with sliding seals."

9.3.2.25.7 Insert at the beginning "The pipes for loading and unloading shall be fitted with pressure gauges at the outlet of the pumps."

9.3.2.25.9 In 3, replace "of 50%" by "and 50%".

9.3.2.25.10 Insert a NOTE to read as follows:

"NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."

9.3.2.26.1 Does not apply to English version.

9.3.2.26.4 Replace "(109)" by "(10)".

9.3.2.28 Insert "(0.5 bar)" after "50 kPa".

9.3.2.31.4 Insert "of the substances carried" after "temperature class" and delete "(b)".

9.3.2.32.1 Delete "liquid" twice and replace "0.60 m" by "0.6m".

9.3.2.32.2 Delete "liquid" and replace "0.50 m" by "0.5m".

9.3.2.40.2.1 Insert a new indent (d) as follows:

"(d) FK-5-1-12 (dodecafluoro 2-methylpentane-3-one)."

9.3.2.40.2.4 (b) Insert the following sentence at the end:

"In particular, the extinguishing agent must also be effective beneath the floor."

9.3.2.40.2.5 (e) Amend (iii) to read as follows:

"(iii) the correct behaviour of the crew in the event of activation and when accessing the space to be protected following activation or diffusion, in particular in respect of the possible presence of toxic substances;"

9.3.2.40.2.13 Insert a new 9.3.2.40.2.13, worded as follows, and renumber present 9.3.2.40.2.13 as 9.3.2.40.2.14:

"Fire-extinguishing system operating with FK-5-1-12

In addition to the requirements of 9.3.2.40.2.1 to 9.3.2.40.2.9, fire-extinguishing systems using FK-5-1-12 as an extinguishing agent shall comply with the following provisions:

- (a) Where there are several spaces with different gross volumes, every space shall be equipped with its own fire-extinguishing system;
- (b) Every tank containing FK-5-1-12 placed in the space to be protected shall be fitted with a device to prevent overpressure. This device shall ensure that the contents of the tank are safely diffused in the space to be protected if the tank is subjected to fire, when the fire-extinguishing system has not been brought into service;
- (c) Every tank shall be fitted with a device permitting control of the gas pressure;
- (d) The level of filling of tanks shall not exceed 1.00 kg/l. The specific volume of depressurized FK-5-1-12 shall be taken to be 0.0719 m³/kg;
- (e) The volume of FK-5-1-12 in the space to be protected shall be not less than 5.5% of the gross volume of the space. This quantity shall be released within 10 seconds;
- (f) Tanks of FK-5-1-12 shall be fitted with a pressure monitoring device which triggers an audible and visual alarm in the wheelhouse in the event of an unscheduled loss of extinguishing agent. Where there is no wheelhouse, the alarm shall be triggered outside the space to be protected;
- (g) After discharge, the concentration in the space to be protected shall not exceed 10.0%."

9.3.2.40.2.14 (ex. 9.3.2.40.2.13) In the title, insert "Fixed" before "fire-extinguishing system" and in the text, insert "permanently fixed" before "fire-extinguishing systems".

9.3.2.42.4 Delete "(b)" twice and replace "2.00 m" by "2 m" twice and "6.00 m" by "6 m".

9.3.2.51.1 Replace "electric corrosion protection against external currents" by "active cathodic corrosion protection".

9.3.2.51.2 Does not apply to English version.

9.3.2.56.5 Replace "IEC publication 60 245-4 (1994)" by "standard IEC 60 245-4: 1994".

9.3.3.8.3 Delete "(b)".

9.3.3.11.1 (a) Insert below the table: "Alternative constructions in accordance with 9.3.4 are permitted."

9.3.3.11.1 In (a), insert "in m" after "of the hull" twice, after "cargo area", after "L/2)" and after "trunk breadth" and "trunk width". Insert "where:" after "cargo area in m;". In (c), delete "cargo" after "pressure".

9.3.3.13.1 Insert "single hull" before "vessels".

9.3.3.17.6 In the fifth indent, insert "necessary" before "control of the liquid".

9.3.3.25.2 (f) Insert a NOTE to read as follows:

"NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."

9.3.3.25.2 (g) Insert a NOTE to read as follows:

"NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."

9.3.3.25.2 Insert a new subparagraph (h), to read as follows:

"(h) Pipes for loading and unloading, and vapour pipes, shall not have flexible connections fitted with sliding seals when substances with corrosive properties (see column (5) of Table C of Chapter 3.2, hazard 8) are transported."

9.3.3.25.7 Insert at the beginning "The pipes for loading and unloading shall be fitted with pressure gauges at the outlet of the pumps."

9.3.3.25.10 Insert a NOTE to read as follows:

"NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."

9.3.3.26 Insert a NOTE to read as follows:

"NOTE: It is not necessary to apply this paragraph. The date of application will be defined later."

9.3.3.26.1 Does not apply to English version.

9.3.3.26.4 Does not apply to English version.

9.3.3.31.4 Insert "of the substances carried" after "temperature class" and delete "(b)".

9.3.3.32.1 Delete "liquid" twice and replace "0.60 m" by "0.6m".

9.3.3.32.2 Delete "liquid".

9.3.3.40.2.1 Insert a new indent (d) as follows:

"(d) FK-5-1-12 (dodecafluoro 2-methylpentane-3-one)."

9.3.3.40.2.4 (b) Insert the following new sentence at the end:

"In particular, the extinguishing agent must also be effective beneath the floor.".

9.3.3.40.2.5 (e) Amend (iii) to read as follows:

"(iii) The correct behaviour of the crew in the event of activation and when accessing the space to be protected following activation or diffusion, in particular in respect of the possible presence of toxic substances;"

9.3.3.40.2.13 Insert a new 9.3.3.40.2.13, worded as follows, and renumber present 9.3.3.40.2.13 as 9.3.3.40.2.14:

"Fire-extinguishing system operating with FK-5-1-12

In addition to the requirements of 9.3.3.40.2.1 to 9.3.3.40.2.9, fire-extinguishing systems using FK-5-1-12 as an extinguishing agent shall comply with the following provisions:

- (a) Where there are several spaces with different gross volumes, every space shall be equipped with its own fire-extinguishing system;
- (b) Every tank containing FK-5-1-12 placed in the space to be protected shall be fitted with a device to prevent overpressure. This device shall ensure that the contents of the tank are safely diffused in the space to be protected if the tank is subjected to fire, when the fire-extinguishing system has not been brought into service;
- (c) Every tank shall be fitted with a device permitting control of the gas pressure;
- (d) The level of filling of tanks shall not exceed 1.00 kg/l. The specific volume of depressurized FK-5-1-12 shall be taken to be 0.0719 m³/kg;
- (e) The volume of FK-5-1-12 in the space to be protected shall be not less than 5.5% of the gross volume of the space. This quantity shall be released within 10 seconds;
- (f) Tanks of FK-5-1-12 shall be fitted with a pressure monitoring device which triggers an audible and visual alarm in the wheelhouse in the event of an unscheduled loss of extinguishing agent. Where there is no wheelhouse, the alarm shall be triggered outside the space to be protected;

- (g) After discharge, the concentration in the space to be protected shall not exceed 10.0%."

9.3.3.40.2.14 (ex. 9.3.3.40.2.13) In the title, insert "Fixed" before "fire-extinguishing system" and in the text, insert "permanently fixed" before "fire-extinguishing systems".

9.3.3.42.4 Delete "(b)" twice and replace "2.00 m" by "2 m" twice and "6.00 m" by "6 m".

9.3.3.51.1 Replace "electric corrosion protection against external currents" by "active cathodic corrosion protection".

9.3.3.51.2 Does not apply to English version.

9.3.3.53.3 Amend to read "Independent cargo tanks shall be earthed."

9.3.4 Insert a new section to read as follows:

"9.3.4 *Alternative constructions*

9.3.4.1 *General*

9.3.4.1.1 The maximum permissible capacity of a cargo tank in accordance with 9.3.1.11.1, 9.3.2.11.1 and 9.3.3.11.1 may be exceeded and the minimum distances in accordance with 9.3.1.11.2 a) and 9.3.2.11.7 may be deviated from provided that the provisions of this section are complied with. The capacity of a cargo tank shall not exceed 1000 m³.

9.3.4.1.2 Tank vessels whose cargo tanks exceed the maximum allowable capacity or where the distance between the side wall and the cargo tank is smaller than required, shall be protected through a more crashworthy side structure. This shall be proved by comparing the risk of a conventional construction (reference construction), complying with the ADN regulations with the risk of a crashworthy construction (alternative construction).

9.3.4.1.3 When the risk of the more crashworthy construction is equal to or lower than the risk of the conventional construction, equivalent or higher safety is proven. The equivalent or higher safety shall be proven in accordance with 9.3.4.3.

9.3.4.1.4 When a vessel is built in compliance with this section, a recognised classification society shall document the application of the calculation procedure in accordance with 9.3.4.3 and shall submit its conclusions to the competent authority for approval.

The competent authority may request additional calculations and proof.

9.3.4.1.5 The competent authority shall include this construction in the certificate of approval in accordance with 8.6.1.

9.3.4.2 *Approach*

9.3.4.2.1 The probability of cargo tank rupture due to a collision and the area around the vessel affected by the cargo outflow as a result thereof are the governing parameters. The risk is described by the following formula:

$$R = P \cdot C$$

Wherein: R risk [m^2],

P probability of cargo tank rupture [],

C consequence (measure of damage) of cargo tank rupture [m^2].

9.3.4.2.2 The probability P of cargo tank rupture depends on the probability distribution of the available collision energy represented by vessels, which the victim is likely to encounter in a collision, and the capability of the struck vessel to absorb collision energy without cargo tank rupture. A decrease of this probability can be achieved by means of a more crashworthy side structure.

The consequence C of cargo spillage resulting from cargo tank rupture is expressed as an affected area around the struck vessel.

9.3.4.2.3 The procedure according to 9.3.4.3 shows how tank rupture probabilities shall be calculated as well as how the collision energy absorbing capacity of side structure and a consequence increase shall be determined.

9.3.4.3 *Calculation procedure*

9.3.4.3.1 The calculation procedure shall follow 13 basic steps. Steps 2 through 10 shall be carried out for both the alternative design and the reference design. The following table shows the calculation of the weighted probability of cargo tank rupture:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
							F x G			I x J			L x M	
Identify collision locations and associated weighting factors, Collision scen. I	Loc1	FEA	Eloc1	Calculate probability with CPDF 50%	P50%	wf 50%	Pw50%							
				Calculate probability with CPDF 66%	P66%	wf 66%	Pw66%							
				Calculate probability with CPDF 100%	P100%	wf 100%	Pw100%	+						
							sum	Ploc1	wfloc1	Pwloc1				
	▼													
	Loci	FEA	Eloci	Calculate probability with CPDF 50%	P50%	wf 50%	Pw50%							
				Calculate probability with CPDF 66%	P66%	wf 66%	Pw66%							
				Calculate probability with CPDF 100%	P100%	wf 100%	Pw100%	+						
							sum	Ploci	wfloci	Pwloci				
	▼													
	Locn	FEA	Elocn	Calculate probability with CPDF 50%	P50%	wf 50%	Pw50%							
				Calculate probability with CPDF 66%	P66%	wf 66%	Pw66%							
				Calculate probability with CPDF 100%	P100%	wf 100%	Pw100%	+						
							sum	Plocn	wflocn	Pwlocn	+			
										sum	PscenI	wfscenI	PwscenI	
Identify collision locations and associated weighting factors, Collision scen. II	Loc1	FEA	Eloc1	Calculate probability with CPDF 30%	P30%	wf 30%	Pw30%							
				Calculate probability with CPDF 100%	P100%	wf 100%	Pw100%	+						
							sum	Ploc1	wfloc1	Pwloc1				
		▼												
	Locn	FEA	Elocn	Calculate probability with CPDF 30%	P30%	wf 30%	Pw30%							
				Calculate probability with CPDF 100%	P100%	wf 100%	Pw100%	+						
							sum	Plocn	wflocn	Pwlocn	+			
										sum	PscenII	wfscenII	PwscenII	+
													sum	Pw

9.3.4.3.1.1 *Step 1*

Besides the alternative design, which is used for cargo tanks exceeding the maximum allowable capacity or a reduced distance between the side wall and the cargo tank as well as a more crashworthy side structure, a reference design with at least the same dimensions (length, width, depth, displacement) shall be drawn up. This reference design shall fulfil the requirements specified in section 9.3.1 (Type G), 9.3.2 (Type C) or 9.3.3 (Type N) and shall comply with the minimum requirements of a recognised classification society.

9.3.4.3.1.2 *Step 2*

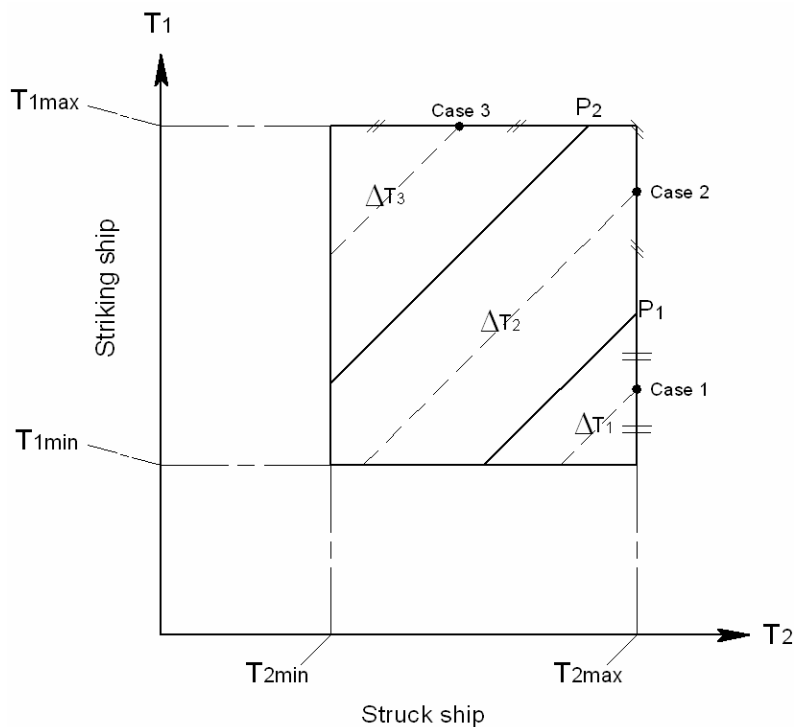
9.3.4.3.1.2.1 The relevant typical collision locations $i=1$ through n shall be determined. The table in 9.3.4.3.1 depicts the general case where there are 'n' typical collision locations.

The number of typical collision locations depends on the vessel design. The choice of the collision locations shall be accepted by the recognised classification society.

9.3.4.3.1.2.2 *Vertical collision locations*

9.3.4.3.1.2.2.1 *Tank vessel type C and N*

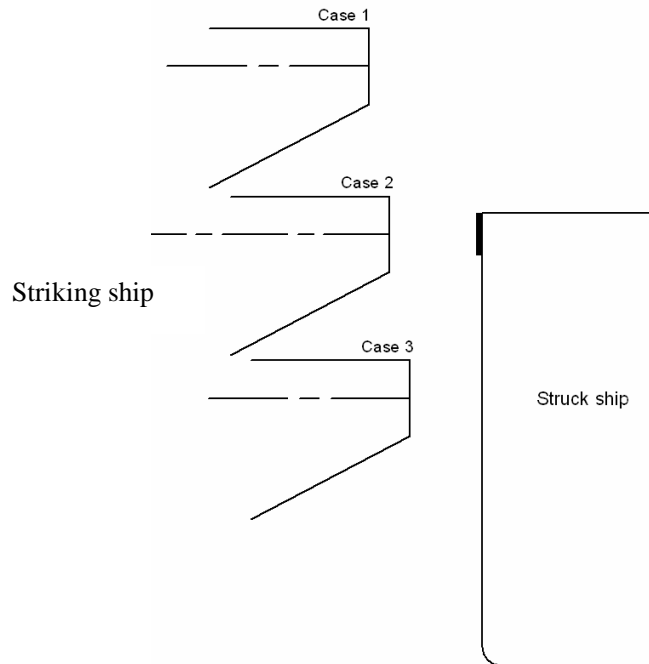
9.3.4.3.1.2.2.1.1 The determination of the collision locations in the vertical direction depends on the draught differences between striking and struck vessel, which is limited by the maximum and minimum draughts of both vessels and the construction of the struck vessel. This can be depicted graphically through a rectangular area which is enclosed by the values of the maximum and minimum draught of both striking and struck vessel (see following figure).



Definition of vertical striking locations

9.3.4.3.1.2.2.1.2 Each point in this area represents a possible draught combination. T_{1max} is the maximum draught and T_{1min} is the minimum draught of the striking vessel, while T_{2max} and T_{2min} are the corresponding minimum and maximum draughts of the struck vessel. Each draught combination has an equal probability of occurrence.

9.3.4.3.1.2.2.1.3 Points on each inclined line in the figure in 9.3.4.3.1.2.2.1.1 indicate the same draught difference. Each of these lines reflects a vertical collision location. In the example in the figure in 9.3.4.3.1.2.2.1.1 three vertical collision locations are defined, depicted by three areas. Point P_1 is the point where the lower edge of the vertical part of the push barge or V-bow strikes at deck level of the struck vessel. The triangular area for collision case 1 is bordered by point P_1 . This corresponds to the vertical collision location "collision at deck level". The triangular upper left area of the rectangle corresponds to the vertical collision location "collision below deck". The draught difference ΔT_i , $i=1,2,3$ shall be used in the collision calculations (see following figure).



Example of vertical collision locations

9.3.4.3.1.2.2.1.4 For the calculation of the collision energies the maximum masses of both striking vessel and struck vessel must be used (highest point on each respective diagonal ΔT_i).

9.3.4.3.1.2.2.1.5 Depending on the vessel design, the recognised classification society may require additional collision locations.

9.3.4.3.1.2.2.2 *Tank vessel type G*

For a tank vessel type G a collision at half tank height shall be assumed. The recognised classification society may require additional collision locations at other heights. This shall be agreed with the recognised classification society.

9.3.4.3.1.2.3 *Longitudinal collision location*

9.3.4.3.1.2.3.1 *Tank vessels type C and N*

At least the following three typical collision locations shall be considered:

- at bulkhead,
- between webs and
- at web.

9.3.4.3.1.2.3.1 *Tank vessel Type G*

For a tank vessel type G at least the following three typical collision locations shall be considered:

- at cargo tank end,
- between webs and
- at web.

9.3.4.3.1.2.4 *Number of collision locations*

9.3.4.3.1.2.4.1 *Tank vessel type C and N*

The combination of vertical and longitudinal collision locations in the example mentioned in 9.3.4.3.1.2.1.3 and 9.3.4.3.1.2.3.1 results in $3 \cdot 3 = 9$ collision locations.

9.3.4.3.1.2.4.2 *Tank vessel type G*

The combination of vertical and longitudinal collision locations in the example mentioned in 9.3.4.3.1.2.2.2 and 9.3.4.3.1.2.3.2 results in $1 \cdot 3 = 3$ collision locations.

9.3.4.3.1.2.4.3 *Additional examinations for tank vessels type G, C and N with independent cargo tanks*

As proof that the tank seatings and the buoyancy restraints do not cause any premature tank rupture, additional calculations shall be carried out. The additional collision locations for this purpose shall be agreed with the recognised classification society.

9.3.4.3.1.3 *Step 3*

9.3.4.3.1.3.1 For each typical collision location a weighting factor which indicates the relative probability that such a typical collision location will be struck shall be determined. In the table in 9.3.4.3.1 these factors are named $w_{floc(i)}$ (column J). The assumptions shall be agreed with the recognised classification society.

The weighting factor for each collision location is the product of the factor for the vertical collision location by the factor for the longitudinal collision location.

9.3.4.3.1.3.2 *Vertical collision locations*

9.3.4.3.1.3.2.1 *Tank vessel type C and N*

The weighting factors for the various vertical collision locations are in each case defined by the ratio between the partial area for the corresponding collision case and the total area of the rectangle shown in the Figure in 9.3.4.3.1.2.2.1.1.

For example, for collision case 1 (see figure in 9.3.4.3.1.2.2.1.3) the weighting factor equals the ratio between the triangular lower right area of the rectangle, and the area of the rectangle between minimum and maximum draughts of striking and struck vessels.

9.3.4.3.1.3.2.2 *Tank vessel type G*

The weighting factor for the vertical collision location has the value 1.0, if only one collision location is assumed. When the recognised classification society requires additional collision locations, the weighting factor shall be determined analogous to the procedure for tank vessels type C and N.

9.3.4.3.1.3.3 *Longitudinal collision locations*

9.3.4.3.1.3.3.1 *Tank vessel type C and N*

The weighting factor for each longitudinal collision location is the ratio between the "calculational span length" and the tank length.

The calculational span length shall be calculated as follows:

(a) collision on bulkhead:

0.2 • distance between web frame and bulkhead, but not larger than 450 mm,

(b) collision on web frame:

sum of 0.2 • web frame spacing forward of the web frame, but not larger than 450 mm, and 0.2 • web frame spacing aft of the web frame, but not larger than 450 mm, and

(c) collision between web frames:

cargo tank length minus the length "collision at bulkhead" and minus the length "collision at web frame".

9.3.4.3.1.3.3.2 *Tank vessel type G*

The weighting factor for each longitudinal collision location is the ratio between the "calculational span length" and the length of the hold space.

The calculational span length shall be calculated as follows:

- (a) collision at cargo tank end:
distance between bulkhead and the start of the cylindrical part of the cargo tank,
- (b) collision on web frame:
sum of $0.2 \cdot$ web frame spacing forward of the web frame, but not larger than 450 mm, and $0.2 \cdot$ web frame spacing aft of the web frame, but not larger than 450 mm, and
- (c) collision between web frames:
cargo tank length minus the length "collision at cargo tank end" and minus the length "collision at web frame".

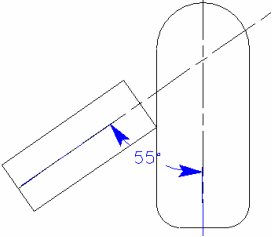
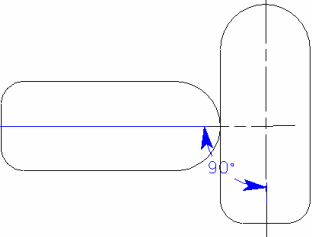
9.3.4.3.1.4 *Step 4*

9.3.4.3.1.4.1 For each collision location the collision energy absorbing capacity shall be calculated. For that matter the collision energy absorbing capacity is the amount of collision energy absorbed by the vessel structure up to initial rupture of the cargo tank (see the table in 9.3.4.3.1, column D: $E_{loc(i)}$). For this purpose a finite element analysis in accordance with 9.3.4.4.2 shall be used.

9.3.4.3.1.4.2 These calculations shall be done for two collision scenarios according to the following table. Collision scenario I shall be analysed under the assumption of a push barge bow shape. Collision scenario II shall be analysed under the assumption of a V-shaped bow.

These bow shapes are defined in 9.3.4.4.8.

Table : Speed reduction factors for scenario I or scenario II with weighting factors

Worst case scenarios		Causes					
		Communication error and poor visibility	Technical error	Human error			
		0,50	0,20	0,30			
I		Push barge-bow, striking angle 55°	0,80	0,66	0,50	0,20	0,30
		V-shaped-bow, striking angle 90°	0,20	0,30	0,50	0,20	0,30

9.3.4.3.1.5 Step 5

9.3.4.3.1.5.1 For each collision energy absorption capacity $E_{loc(i)}$, the associated probability of exceedance is to be calculated, i.e. the probability of cargo tank rupture. For this purpose, the formula for the cumulative probability density functions (CPDF) below shall be used. The appropriate coefficients shall be selected from the Table in 9.3.4.3.1.5.6 for the effective mass of the struck vessel.

$$P_{x\%} = C_1(E_{loc(i)})^3 + C_2(E_{loc(i)})^2 + C_3E_{loc(i)} + C_4$$

with: $P_{x\%}$ probability of tank rupture,
 C_{1-4} coefficients from table in 9.3.4.3.1.5.6,
 $E_{loc(i)}$ collision energy absorbing capacity.

9.3.4.3.1.5.2 The effective mass shall be equal to the maximum displacement of the vessel multiplied by a factor of 1.4. Both collision scenarios (9.3.4.3.1.4.2) shall be considered.

9.3.4.3.1.5.3 In the case of collision scenario I (push barge bow at 55°), three CPDF formulas shall be used:

CPDF 50% (velocity $0.5 V_{max}$),
 CPDF 66% (velocity $2/3 V_{max}$) and
 CPDF 100% (velocity V_{max}).

9.3.4.3.1.5.4 In the case of scenario II (V-shaped bow at 90°), the following two CPDF formulas shall be used:

CPDF 30% (velocity $0.3 V_{max}$) and
CPDF 100% (velocity V_{max}).

9.3.4.3.1.5.5 In the table in 9.3.4.3.1, column F, these probabilities are called *P50%*, *P66%*, *P100%* and *P30%*, *P100%* respectively.

9.3.4.3.1.5.6 Table: Coefficients for the CPDF formulas

Effective mass of struck vessel in tonnes	velocity = $1 \times V_{max}$				range
	coefficients				
	C ₁	C ₂	C ₃	C ₄	
14000	4.106E-05	-2.507E-03	9.727E-03	9.983E-01	$4 < E_{loc} < 39$
12000	4.609E-05	-2.761E-03	1.215E-02	9.926E-01	$4 < E_{loc} < 36$
10000	5.327E-05	-3.125E-03	1.569E-02	9.839E-01	$4 < E_{loc} < 33$
8000	6.458E-05	-3.691E-03	2.108E-02	9.715E-01	$4 < E_{loc} < 31$
6000	7.902E-05	-4.431E-03	2.719E-02	9.590E-01	$4 < E_{loc} < 27$
4500	8.823E-05	-5.152E-03	3.285E-02	9.482E-01	$4 < E_{loc} < 24$
3000	2.144E-05	-4.607E-03	2.921E-02	9.555E-01	$2 < E_{loc} < 19$
1500	-2.071E-03	2.704E-02	-1.245E-01	1.169E+00	$2 < E_{loc} < 12$

Effective mass of struck vessel in tonnes	velocity = $0.66 \times V_{max}$				range
	coefficients				
	C ₁	C ₂	C ₃	C ₄	
14000	4.638E-04	-1.254E-02	2.041E-02	1.000E+00	$2 < E_{loc} < 17$
12000	5.377E-04	-1.427E-02	2.897E-02	9.908E-01	$2 < E_{loc} < 17$
10000	6.262E-04	-1.631E-02	3.849E-02	9.805E-01	$2 < E_{loc} < 15$
8000	7.363E-04	-1.861E-02	4.646E-02	9.729E-01	$2 < E_{loc} < 13$
6000	9.115E-04	-2.269E-02	6.285E-02	9.573E-01	$2 < E_{loc} < 12$
4500	1.071E-03	-2.705E-02	7.738E-02	9.455E-01	$1 < E_{loc} < 11$
3000	-1.709E-05	-1.952E-02	5.123E-02	9.682E-01	$1 < E_{loc} < 8$
1500	-2.479E-02	1.500E-01	-3.218E-01	1.204E+00	$1 < E_{loc} < 5$

Effective mass of struck vessel in tonnes	velocity = $0.5 \times V_{max}$				range
	coefficients				
	C ₁	C ₂	C ₃	C ₄	
14000	2.621E-03	-3.978E-02	3.363E-02	1.000E+00	$1 < E_{loc} < 10$
12000	2.947E-03	-4.404E-02	4.759E-02	9.932E-01	$1 < E_{loc} < 9$
10000	3.317E-03	-4.873E-02	5.843E-02	9.878E-01	$2 < E_{loc} < 8$
8000	3.963E-03	-5.723E-02	7.945E-02	9.739E-01	$2 < E_{loc} < 7$
6000	5.349E-03	-7.407E-02	1.186E-01	9.517E-01	$1 < E_{loc} < 6$
4500	6.303E-03	-8.713E-02	1.393E-01	9.440E-01	$1 < E_{loc} < 6$
3000	2.628E-03	-8.504E-02	1.447E-01	9.408E-01	$1 < E_{loc} < 5$
1500	-1.566E-01	5.419E-01	-6.348E-01	1.209E+00	$1 < E_{loc} < 3$

Effective mass of struck vessel in tonnes	velocity = 0.3 x V _{max}				range
	coefficients				
	C ₁	C ₂	C ₃	C ₄	
14000	5.628E-02	-3.081E-01	1.036E-01	9.991E-01	1<E _{loc} <3
12000	5.997E-02	-3.212E-01	1.029E-01	1.002E+00	1<E _{loc} <3
10000	7.477E-02	-3.949E-01	1.875E-01	9.816E-01	1<E _{loc} <3
8000	1.021E-02	-5.143E-01	2.983E-01	9.593E-01	1<E _{loc} <2
6000	9.145E-02	-4.814E-01	2.421E-01	9.694E-01	1<E _{loc} <2
4500	1.180E-01	-6.267E-01	3.542E-01	9.521E-01	1<E _{loc} <2
3000	7.902E-02	-7.546E-01	5.079E-01	9.218E-01	1<E _{loc} <2
1500	-1.031E+00	2.214E-01	1.891E-01	9.554E-01	0.5<E _{loc} <1

The range where the formula is valid is given in column 6. In case of an E_{loc} value below the range the probability equals P_{x%} = 1.0. In case of a value above the range P_{x%} equals 0.

9.3.4.3.1.6 *Step 6*

The weighted probabilities of cargo tank rupture P_{wx%} (table in 9.3.4.3.1, column H) shall be calculated by multiplying each cargo tank rupture probability P_{x%} (table in 9.3.4.3.1, column F) by the weighting factors wf_{x%} according to the following table:

Table: Weighting factors for each characteristic collision speed

			<i>weighting factor</i>
Scenario I	CPDF 50%	wf50%	0.2
	CPDF 66%	wf66%	0.5
	CPDF 100%	wf100%	0.3
Scenario II	CPDF 30%	wf30%	0.7
	CPDF 100%	wf100%	0.3

9.3.4.3.1.7 *Step 7*

The total probabilities of cargo tank rupture P_{loc(i)} (table in 9.3.4.3.1, column I) resulting from 9.3.4.3.1.6 (step 6) shall be calculated as the sum of all weighted cargo tank rupture probabilities P_{wx%} (table in 9.3.4.3.1, column H) for each collision location considered.

9.3.4.3.1.8 *Step 8*

For both collision scenarios the weighted total probabilities of cargo tank rupture P_{wloc(i)} shall, in each case, be calculated by multiplying the total tank probabilities of cargo tank rupture P_{loc(i)} for each collision location, by the weighting factors wf_{loc(i)} corresponding to the respective collision location (see 9.3.4.3.1.3 (step 3) and table in 9.3.4.3.1, column J).

9.3.4.3.1.9 *Step 9*

Through the addition of the weighted total probabilities of cargo tank rupture $P_{wloc(i)}$, the scenario specific total probabilities of cargo tank rupture P_{scenI} and P_{scenII} (table in 9.3.4.3.1, column L) shall be calculated, for each collision scenario I and II separately.

9.3.4.3.1.10 *Step 10*

Finally the weighted value of the overall total probability of cargo tank rupture P_w shall be calculated by the formula below (table in 9.3.4.3.1, column O):

$$P_w = 0.8 \cdot P_{scenI} + 0.2 \cdot P_{scenII}$$

9.3.4.3.1.11 *Step 11*

The overall total probability of cargo tank rupture P_w for the alternative design is called P_n . The overall total probability of cargo tank rupture P_w for the reference design is called P_r .

9.3.4.3.1.12 *Step 12*

9.3.4.3.1.12.1 The ratio (C_n/C_r) between the consequence (measure of damage) C_n of a cargo tank rupture of the alternative design and the consequence C_r of a cargo tank rupture of the reference design shall be determined with the following formula:

$$C_n/C_r = V_n / V_r$$

With C_n/C_r the ratio between the consequence related to the alternative design, and the consequence related to the reference design,

V_n maximum capacity of the largest cargo tank in the alternative design,

V_r maximum capacity of the largest cargo tank reference design.

9.3.4.3.1.12.2 This formula was derived for characteristic cargoes as listed in the following table.

Table: Characteristic cargoes

	UN	Description
Benzene	1114	Flammable liquid Packing group II Hazardous to health
Acrylonitrile Stabilised ACN	1093	Flammable liquid Packing group I Toxic, stabilised
n-Hexane	1208	Flammable liquid Packing group II
Nonane	1920	Flammable liquid Packing group III
Ammonia	1005	Toxic, corrosive gas Liquefied under pressure
Propane	1978	Flammable gas Liquefied under pressure

9.3.4.3.1.12.3 For cargo tanks with capacities between 380 m³ and 1000 m³ containing flammable, toxic and acid liquids or gases it shall be assumed that the effect increase relates linearly to the increased tank capacity (proportionality factor 1.0).

9.3.4.3.1.12.4 If substances are to be carried in tank vessels, which have been analysed according to this calculation procedure, where the proportionality factor between the total cargo tank capacity and the affected area is expected to be larger than 1.0, as assumed in the previous paragraph, the affected area shall be determined through a separate calculation. In this case the comparison as described in 9.3.4.3.1.13 (step 13) shall be carried out with this different value for the size of the affected area, t.

9.3.4.3.1.13 *Step 13*

Finally the ratio $\frac{P_r}{P_n}$ between the overall total probability of cargo tank rupture P_r for the reference design and the overall total probability of cargo tank rupture P_n for the alternative design shall be compared with the ratio $\frac{C_n}{C_r}$ between the consequence related to the alternative design, and the consequence related to the reference design.

When $\frac{C_n}{C_r} \leq \frac{P_r}{P_n}$ is fulfilled, the evidence according to 9.3.4.1.3 for the alternative design is provided.

9.3.4.4 *Determination of the collision energy absorbing capacity*

9.3.4.4.1 *General*

9.3.4.4.1.1 The determination of the collision energy absorbing capacity shall be carried out by means of a Finite Element Analysis (FEA). The analysis shall be carried out using a customary finite element code (e.g. LS-DYNA¹, PAM-CRASH², ABAQUS³ etc.) capable of dealing with both geometrical and material non-linear effects. The code shall also be able to simulate rupture realistically.

9.3.4.4.1.2 The program actually used and the level of detail of the calculations shall be agreed upon with a recognised classification society.

9.3.4.4.2 *Creating the finite element models (FE models)*

¹ LSTC, 7374 Las Positas Rd, Livermore, CA 94551, USA Tel : +1 925 245-4500.

² ESI Group, 8, Rue Christophe Colomb, 75008 Paris, France

Tel: +33 (0)1 53 65 14 14, Fax: +33 (0)1 53 65 14 12, E-mail: info@esi-group.com.

³ SIMULIA, Rising Sun Mills, 166 Valley Street, Providence, RI 02909-2499 USA

Tel: +1 401 276-4400, Fax: +1 401 276-4408, E-mail: info@simulia.com.

- 9.3.4.4.2.1 First of all, FE models for the more crashworthy design and one for the reference design shall be generated. Each FE model shall describe all plastic deformations relevant for all collision cases considered. The section of the cargo area to be modelled shall be agreed upon with a recognised classification society.
- 9.3.4.4.2.2 At both ends of the section to be modelled all three translational degrees of freedom are to be restrained. Because in most collision cases the global horizontal hull girder bending of the vessel is not of significant relevance for the evaluation of plastic deformation energy it is sufficient that only half beam of the vessel needs to be considered. In these cases the transverse displacements at the centre line (CL) shall be constrained. After generating the FE model, a trial collision calculation shall be carried out to ensure that there is no occurrence of plastic deformations near the constraint boundaries. Otherwise the FE modelled area has to be extended.
- 9.3.4.4.2.3 Structural areas affected during collisions shall be sufficiently finely idealized, while other parts may be modelled more coarsely. The fineness of the element mesh shall be suitable for an adequate description of local folding deformations and for determination of realistic rupture of elements.
- 9.3.4.4.2.4 The calculation of rupture initiation must be based on fracture criteria which are suitable for the elements used. The maximum element size shall be less than 200 mm in the collision areas. The ratio between the longer and the shorter shell element edge shall not exceed the value of three. The element length L for a shell element is defined as the longer length of both sides of the element. The ratio between element length and element thickness shall be larger than five. Other values shall be agreed upon with the recognised classification society.
- 9.3.4.4.2.5 Plate structures, such as shell, inner hull (tank shell in the case of gas tanks), webs as well as stringers can be modelled as shell elements and stiffeners as beam elements. While modelling, cut outs and manholes in collision areas shall be taken into account.
- 9.3.4.4.2.6 In the FE calculation the 'node on segment penalty' method shall be used for the contact option. For this purpose the following options shall be activated in the codes mentioned:
- "contact_automatic_single_surface" in LS-DYNA,
 - "self impacting" in PAMCRASH, and
 - similar contact types in other FE-programs.
- 9.3.4.4.3 *Material properties*

- 9.3.4.4.3.1 Because of the extreme behaviour of material and structure during a collision, with both geometrical and material non-linear effects, true stress-strain relations shall be used:

$$\sigma = C \cdot \varepsilon^n,$$

where

$$n = \ln(1 + A_g),$$

$$C = R_m \cdot \left(\frac{e}{n}\right)^n,$$

A_g = the maximum uniform strain related to the ultimate tensile stress R_m and
 e = the Euler constant.

- 9.3.4.4.3.2 The values A_g and R_m shall be determined through tensile tests.
- 9.3.4.4.3.3 If only the ultimate tensile stress R_m is available, for shipbuilding steel with a yield stress R_{eH} of not more than 355 N/mm² the following approximation shall be used in order to obtain the A_g value from a known R_m [N/mm²] value:

$$A_g = \frac{1}{0.24 + 0.01395 \cdot R_m}$$

- 9.3.4.4.3.4 If the material properties from tensile tests are not available when starting the calculations, minimum values of A_g and R_m , as defined in the rules of the recognised classification society, shall be used instead. For shipbuilding steel with a yield stress higher than 355 N/mm² or materials other than shipbuilding steel, material properties shall be agreed upon with a recognised classification society.

9.3.4.4.4 *Rupture criteria*

- 9.3.4.4.4.1 The first rupture of an element in a FEA is defined by the failure strain value. If the calculated strain, such as plastic effective strain, principal strain or, for shell elements, the strain in the thickness direction of this element exceeds its defined failure strain value, the element shall be deleted from the FE model and the deformation energy in this element will no longer change in the following calculation steps.

- 9.3.4.4.4.2 The following formula shall be used for the calculation of rupture strain:

$$\varepsilon_f(l_e) = \varepsilon_g + \varepsilon_e \cdot \frac{t}{l_e}$$

where

ϵ_g = uniform strain

ϵ_e = necking

t = plate thickness

l_e = individual element length.

- 9.3.4.4.4.3 The values of uniform strain and the necking for shipbuilding steel with a yield stress R_{eH} of not more than 355 N/mm² shall be taken from the following table:

Table

stress states	1-D	2-D
ϵ_g	0.079	0.056
ϵ_e	0.76	0.54
element type	truss beam	shell plate

- 9.3.4.4.4.4 Other ϵ_g and ϵ_e values taken from thickness measurements of exemplary damage cases and experiments may be used in agreement with the recognised classification society.

- 9.3.4.4.4.5 Other rupture criteria may be accepted by the recognised classification society if proof from adequate tests is provided.

- 9.3.4.4.4.6 *Tank vessel type G*

For a tank vessel type G the rupture criterion for the pressure tank shall be based on equivalent plastic strain. The value to be used while applying the rupture criterion shall be agreed upon with the recognised classification society. Equivalent plastic strains associated with compressions shall be ignored.

- 9.3.4.4.5 *Calculation of the collision energy absorbing capacity*

- 9.3.4.4.5.1 The collision energy absorbing capacity is the summation of internal energy (energy associated with deformation of structural elements) and friction energy.

The friction coefficient μ_c is defined as:

$$\mu_c = FD + (FS - FD) \cdot e^{-DC|v_{rel}|}$$

with FD = 0.1,

FS = 0.3,

DC = 0.01

$|v_{rel}|$ = relative friction velocity.

NOTE: Values are default for shipbuilding steel.

9.3.4.4.5.2 The force penetration curves resulting from the FE model calculation shall be submitted to the recognised classification society.

9.3.4.4.5.3 *Tank vessel type G*

9.3.4.4.5.3.1 In order to obtain the total energy absorbing capacity of a tank vessel type G the energy absorbed through compression of the vapour during the collision shall be calculated.

9.3.4.4.5.3.2 The energy E absorbed by the vapour shall be calculated as follows:

$$E = \frac{p_1 \cdot V_1 - p_0 \cdot V_0}{1 - \gamma}$$

with:

γ 1.4

(Note: The value 1.4 is the default value c_p/c_v with, in principle:

c_p = specific heat at constant pressure [J/(kgK)]

c_v = specific heat at constant volume [J/(kgK)])

p_0 pressure at start of compression [Pa]

p_1 pressure at end of compression [Pa]

V_0 volume at start of compression [m³]

V_1 volume at end of compression [m³]

9.3.4.4.6 *Definition of striking vessel and striking bow*

9.3.4.4.6.1 At least two types of bow shapes of the striking vessel shall be used for calculating the collision energy absorbing capacities:

- bow shape I: push barge bow (see 9.3.4.4.8),
- bow shape II: V-shape bow without bulb (see 9.3.4.4.8).

9.3.4.4.6.2 Because in most collision cases the bow of the striking vessel shows only slight deformations compared to the side structure of the struck vessel, a striking bow will be defined as rigid. Only for special situations, where the struck vessel has an extremely strong side structure compared to the striking bow and the structural behaviour of the struck vessel is influenced by the plastic deformation of the striking bow, the striking bow shall be considered as deformable. In this case the structure of the striking bow should also be modelled. This shall be agreed upon with the recognised classification society.

9.3.4.4.7 *Assumptions for collision cases*

For the collision cases the following shall be assumed:

- (a) As collision angle between striking and struck vessel 90° shall be taken in case of a V-shaped bow and 55° in case of a push barge bow; and
- (b) The struck vessel has zero speed, while the striking vessel runs into the side of the struck ship with a constant speed of 10 m/s.

The collision velocity of 10 m/s is an assumed value to be used in the FE analysis.

9.3.4.4.8 *Types of bow shapes*

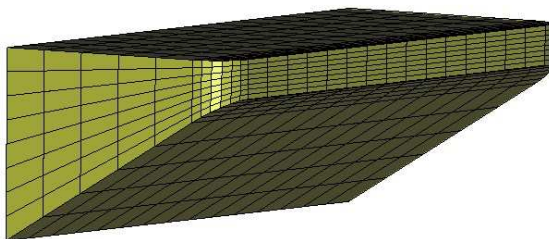
9.3.4.4.8.1 Push barge bow

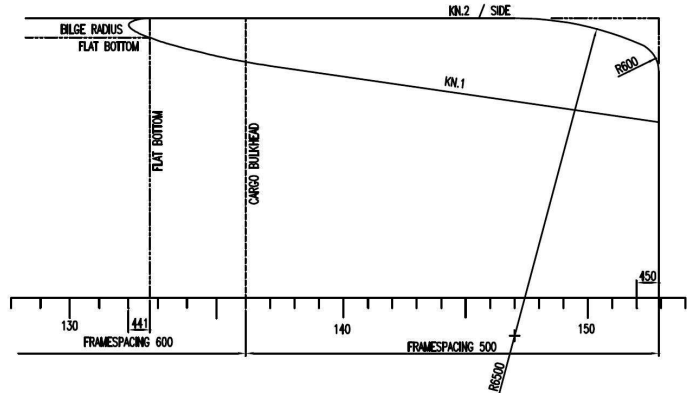
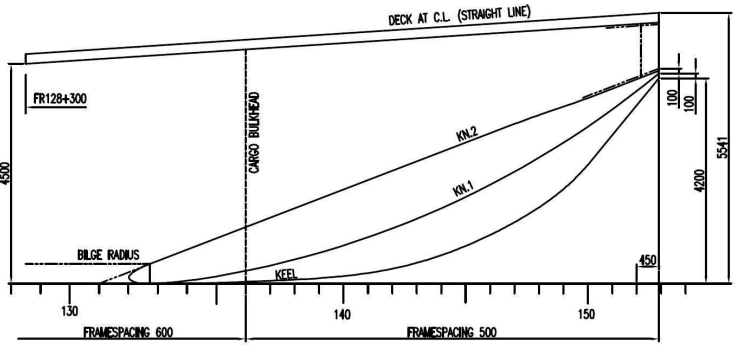
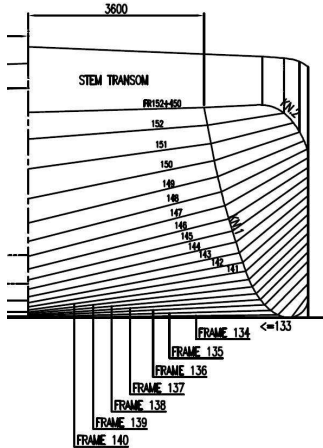
Characteristic dimensions shall be taken from the table below:

frame	half breadths		
	knuckle 1	knuckle 2	deck
145	4.173	5.730	5.730
146	4.100	5.730	5.730
147	4.028	5.730	5.730
148	3.955	5.711	5.711
149	3.883	5.653	5.653
150	3.810	5.555	5.555
151	3.738	5.415	5.415
152	3.665	5.230	5.230
transom	3.600	4.642	4.642

heights			
stem	knuckle 1	knuckle 2	deck
0.769	1.773	2.882	5.084
0.993	2.022	3.074	5.116
1.255	2.289	3.266	5.149
1.559	2.576	3.449	5.181
1.932	2.883	3.621	5.214
2.435	3.212	3.797	5.246
3.043	3.536	3.987	5.278
3.652	3.939	4.185	5.315
4.200	4.300	4.351	5.340

The following figures are intended to provide illustration.





9.3.4.4.8.2 V-bow

Characteristic dimensions shall be taken from the table below:

Reference number	x	y	z
1	0.000	3.923	4.459
2	0.000	3.923	4.852
11	0.000	3.000	2.596
12	0.652	3.000	3.507
13	1.296	3.000	4.535
14	1.296	3.000	4.910
21	0.000	2.000	0.947
22	1.197	2.000	2.498
23	2.346	2.000	4.589
24	2.346	2.000	4.955
31	0.000	1.000	0.085
32	0.420	1.000	0.255
33	0.777	1.000	0.509
34	1.894	1.000	1.997
35	3.123	1.000	4.624
36	3.123	1.000	4.986
41	1.765	0.053	0.424
42	2.131	0.120	1.005
43	2.471	0.272	1.997
44	2.618	0.357	2.493
45	2.895	0.588	3.503
46	3.159	0.949	4.629
47	3.159	0.949	4.991
51	0.000	0.000	0.000
52	0.795	0.000	0.000
53	2.212	0.000	1.005
54	3.481	0.000	4.651
55	3.485	0.000	5.004

The following figures are intended to provide illustration.

