

**PART II RULES FOR THE CONSTRUCTION  
AND CLASSIFICATION OF VESSELS  
IDENTIFIED BY THEIR MISSIONS**

**TITLE 32 OIL TANKERS**

**SECTION 7 ELECTRICITY**

CHAPTERS

- A APPROACH
- B DOCUMENTS, REGULATIONS AND STANDARDS
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## CHAPTER A APPROACH

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#### A1. APPLICATION

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### A1. APPLICATION

#### 100. Scope

101. The present Title 32, Section 7, contains additional requirements for the electrical systems given in Part II, Title 11, Section 7, for the purpose of special needs associated with the design and installation of OIL TANKERS of service notation K2 and K3.

### A2. DEFINITIONS

#### 100. Terms

101. The terms employed in the present Section are additional to those mentioned in Part II, Title 11, Section 7, and have the following definitions:

102. **Flash point:** the lowest temperature at which a liquid fuel emits vapor in sufficient concentration to form an flammable mixture with air near the liquid surface. The flash points specified in this Title 32 are determined by the closed cup test.

103. **Hazardous area:** area in which an explosive gas atmosphere is or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of electrical apparatus;

a. **Zone 0:** area in which an explosive gas atmosphere is present continuously or is present for long periods;

- a.1. Interior of storage tanks of recovered oil and vents;
- a.2. Inside the recovered oil pumps and piping.
- a.3. Cofferdams, adjacent to the recovered oil tanks, containing piping flanges and valves for recovered oil.

b. **Zone 1:** area in which an explosive gas atmosphere is likely to occur in normal operation;

- b.1. Compartments enclosed or semi-closed containing cargo pumps, cargo piping or that are not of fully welded construction;

b.2. Zones or compartments on the open deck, or compartments partially closed on the open deck, within a range of 3 meters from the

equipment to remove oil, scantlings or any other openings in the cargo tanks and of any pumps, valves, flanges for handling of removed oil which are not in the pump room;

b.3. Any enclosed compartments that have a direct opening to the zones and compartments mentioned above.

c. **Zone 2:** area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, is likely to do so only infrequently and will exist for a short period only;

c.1. Zones on open decks or semi-enclosed spaces on open decks on all cargo tanks, including ballast wing tanks, plus the areas situated 1.5 meters forward and aft, and 1.5 meters high from the deck.

c.2. Any compartments adjacent to cargo tanks, except in the cases for which:

c.3. The tank is made of welded steel construction;

c.4. The compartment is equipped with forced ventilation capable of providing at least 20 changes per hour, and

c.5. the ventilation system above has characteristics such that this ventilation can be maintained and ensure

d. **Extended hazardous area:** area in which an explosive atmosphere is not likely to occur in normal operation and, if it does occur, is likely to do so only infrequently and will exist for a short period only (and comparable with zone 2 as defined in IEC 60092-502).

d.1. that there is no formation of gas pockets.

**CHAPTER B  
DOCUMENTS, REGULATIONS AND STANDARDS**

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- B1. DOCUMENTATION TO THE RBNA
  - B2. REGULATION  
See Part II, Title 32, Section 1
  - B3. STANDARDS AND UNITS  
See Part II, Title 11, Section 7, B.3
- 

**B1. DOCUMENTATION TO THE RBNA**

**100. Submission of documents**

101. The present Subchapter B1 gives additional documents to the list in Part II, Title 11, Section 7, B1, which are specific for the electrical systems of oil recovery vessels.

102. For electrical systems on oil recovery vessels, the following shall be documented:

- a. General arrangement showing all hazardous areas and location of electrical equipment;
- b. Specifications of cables, equipment, etc. in hazardous areas
- c. Single line distribution system diagrams for the whole installation.
- d. Calculations on load balance, including emergency consumption and battery capacities
- e. Diagrams of control and alarm circuits related to the support of oil recovery systems;
- f. Diagrams and arrangement of the communication systems.

**CHAPTER D  
PRINCIPLES OF DESIGN AND CONSTRUCTION  
FOR ELECTRICAL SYSTEMS SERVING OIL  
RECOVERY SYSTEMS**

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- D1. INSTALLATIONS ON BOARD  
See Part II, Title 11, Section 7
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**D2. INSTALLATION OF EQUIPMENT IN  
HAZARDOUS AREAS**

**100. Electrical equipment in hazardous areas**

101. **Selection with respect to ignition temperature of the gas or vapour:** The electrical apparatus shall be so selected that its maximum surface temperature will not reach the ignition temperature of any gas or vapour, or mixture of gases or vapours, which can be present. The surface temperature considered may be that of an internal or external part, according to the type of protection of the apparatus. Symbols for the temperature classes which may be marked on the electrical apparatus have the meaning indicated in table T.D2.101.1 (IEC 60092-502).

**TABLE T.D2.101.1 – RELATIONSHIP BETWEEN THE TEMPERATURE CLASSES AND IGNITION TEMPERATURE\***

Temperature class of electrical apparatus	Ignition temperature of gas or vapour
T1	>450 °C
T2	>300 °C
T3	>200 °C
T4	>135 °C
T5	>100 °C
T6	>85 °C

\*Derived from IEC 60079-14

<sup>1)</sup> Generally, the ignition temperature of a mixture is taken to be equal to that of the component having the lowest ignition temperature, or is determined by test. However, it is recognized that the properties of certain categories of cargo are sufficiently well established to allow selection of equipment without individual analysis or test; for example equipment of temperature class T3 may be accepted for use in hazardous areas on crude oil or oil products tankers without analysis or test of particular cargoes.

<sup>2)</sup> For certain categories of chemical cargoes, equipment of temperature class T4, T5 or T6 may be required.

(IEC 60092-502, 6.2.3 and Table 3)

**102. Selection with respect to the classification of gas or vapour:** Flameproof enclosures and intrinsically-safe electrical apparatus, apparatus incorporating flameproof or intrinsically-safe components, or otherwise tested or certified for particular groups, shall be selected according to IEC 60079-12. Apparatus marked for particular gases shall be selected only where no other flammable gas can be present. Symbols for the groups which may be marked on

the apparatus are listed against representative gases in Table T.D2.102.1.

NOTE 2 – For certain categories of chemical cargoes and liquefied gases, equipment of groups IIB and IIC may be required. (IEC 60092-502 and 60092-506).

**TABLE T.D2.102.1 – RELATIONSHIPS BETWEEN APPARATUS GROUP AND REPRESENTATIVE GASES\***

Apparatus group	Representative gas
IIA	Propane
IIB	Ethylene
IIC	Hydrogen

\*Derived from IEC 60079-1

NOTE - Gases generally are allocated to various groups upon determination of the maximum experimental safe gap or the minimum ignition current. These are related to the maximum gaps permissible in flameproof enclosures and the maximum currents permitted in intrinsically-safe circuits; both reduce progressively from group IIA to group IIC. See IEC 60079-12.

**200. Installation of electrical equipment in hazardous areas**

201. Electrical equipment and wiring shall not be fitted in hazardous areas unless it is essential for the safety and operation of the ship.

202. The wiring system and its components shall be suitable for the hazardous area environment, including chemical and corrosion factors.

203. All cables, other than those of intrinsically-safe circuits, installed in zone 0, zone 1 areas shall be sheathed with at least one of the following:

a. a non-metallic impervious sheath in combination with braiding or other metallic covering;

b. copper or stainless steel sheath (for mineral insulated cables only). Aluminum sheathed cables may be considered for special applications.

204. Cables of intrinsically-safe circuits shall have a metallic shielding with at least a nonmetallic external impervious sheath.

205. Where intrinsically-safe circuits may be subjected to disturbances by magnetic or electric fields, special attention shall be given to transposition or other means so that these fields do not adversely affect the intrinsic safety of the circuit.

206. Where cables are subject to lengthy immersion in the cargo, the construction of the cables shall be such as to withstand the substances to which they can be exposed, or

the cables are to be enclosed in casings (such as metallic pipes) capable of withstanding such substances.

207. The use of flexible cables for movable electrical equipment shall be restricted. Where they are necessary, they are to be constructed and installed to a standard acceptable to the appropriate authority and are to meet the requirements of IEC 60079-14, as far as applicable.

208. All metallic protective coverings of power and lighting cables, other than single-core cables for circuits rated in excess of 20 A, where permitted by IEC 60092-401, passing through a hazardous zone, or connected to equipment in such a zone, shall be earthed at their ends. The metallic covering of all other cables shall be earthed at least at one end.

209. Cables shall enter an explosion protected enclosure only by means of a gland or equivalent device capable of maintaining the integrity of the enclosure.

210. The connection of cables to all other apparatus shall be made in accordance with the relevant type of protection.

211. Cable joints are permitted to be in zones 1 and 2 provided they are carried out to the satisfaction of the appropriate authority. Except for intrinsically-safe circuits, cable joints are not permitted to be in zone 0.

(IEC 60092-502)

### 300. Protection by overpressure

301. Where a space has an opening into an adjacent, more hazardous space or area, it may be made into a less hazardous space or non-hazardous space in accordance with the following requirements as indicated in Tables T.D2.301.1 and T.D2.301.2.

301. A minimum over-pressure of 25 Pa (0,25 mbar) with respect to the adjacent, more hazardous, space or area shall be maintained at all points inside the space and its associated ducts at which leaks are liable to occur, all doors and windows being closed.

NOTE – This over-pressure will prevent the ingress of the external atmosphere for wind speed up to approximately 3,5 m/s.

302. During initial start-up, or after shutdown, and whatever the classification of the hazardous area, it is necessary, before energizing any electrical apparatus within the space which is not suitably protected for the classification of the space in the absence of pressurization, to:

a. either ensure that the internal atmosphere is non-hazardous, or proceed with prior purging of sufficient duration that the internal atmosphere may be considered as non-hazardous, and

b. pressurize the space.

NOTE – The atmosphere is considered non-hazardous when, at all points in the space, the equipment enclosures and any associated ducts, the concentration of explosive gases or vapors is below 30 % of the lower explosive limit. The place of measurement should be judiciously chosen to determine the highest concentration of gas.

303. A differential pressure monitoring device or a flow monitoring device, or both, shall be provided for monitoring the satisfactory functioning of pressurization of spaces having an opening into a more hazardous zone.

NOTE – A fan motor running or a fan rotation monitoring device indication will not satisfy this requirement.

304. Where a flow monitoring device is used to indicate failure of pressurization, it is either to be verified that the pressurization level required by D2.301 is maintained with any door or other opening open, or an alarm is to be given if any door or opening is not closed.

305. In the event of the loss of overpressure, the protective measures indicated in Table T.D2.305.1 shall apply.

(IEC 60092-502)

### 400. Movable equipment

401. Movable equipment, if accepted by the appropriate authority to be used in a hazardous area, is to be of a certified safe type, suitable for portable or transportable use and selected in accordance with this Subchapter.

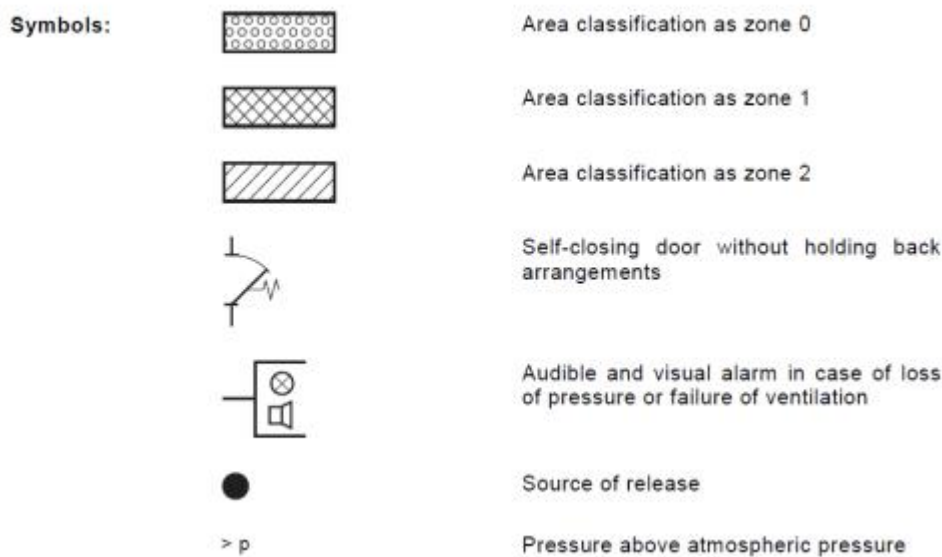
NOTE – Hand-held (portable) equipment should meet the drop test requirements of IEC 60079-0.



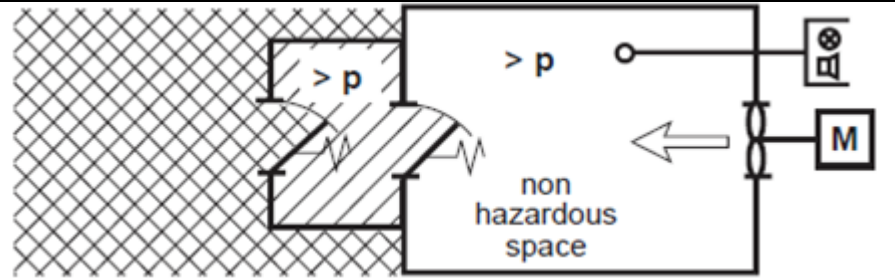
**TABLE T.D2.301.1 – SPACES WITHOUT SOURCE OF RELEASE AND SEPARATED BY DOOR(S) FROM THE ZONES MENTIONED IN THE COLUMN**

Protected by overpressure		
	Separated by one door <sup>1)</sup>	Separated by two doors <sup>2)</sup>
Zone 1	Zone 2 (Table T.D2.301.1 – item 1)	Non-hazardous area (Table T.D2.301.1 – item 3)
Zone 2	Non-hazardous area (Table T.D2.301.1 – item 2)	Non-hazardous area (one door is sufficient)
<sup>1)</sup> Door capable of maintaining the overpressure. <sup>2)</sup> Two doors forming an air-lock capable of maintaining the overpressure.		

**TABLE T.D2.301.2 – HAZARDOUS AREA CLASSIFICATION – SPACES WITHOUT SOURCE OF RELEASE, PROTECTED BY OVERPRESSURE RELATIVE TO SURROUNDING HAZARDOUS AREA AND SEPARATED BY DOOR(S)**



Item	Typical examples	Remarks
1		Pressurized space
2		Pressurized space

Item	Typical examples	Remarks
3		Pressurized spaces

**TABLE T.D2.305.1 – PROTECTIVE MEASURES TO BE TAKEN IN THE EVENT OF FAILURE OF PRESSURIZATION**

Classification of the space <sup>1)</sup>	Electrical equipment installed		
	Equipment suitable for use in zone 1	Equipment suitable for use in zone 2	Equipment not protected for any hazardous area
<b>Zone 1</b>	No action necessary	<ul style="list-style-type: none"> <li>– Suitable alarm (visible and audible)</li> <li>– Immediate action to restore pressurization</li> <li>– Programmed disconnection of power supplies if the pressurization cannot be restored for an extended period or if the concentration of flammable gas rises to a dangerous level</li> </ul>	<ul style="list-style-type: none"> <li>– Suitable alarm (visible and audible)</li> <li>– Immediate action to restore pressurization</li> <li>– Automatic interruption of the power supplies as rapidly as practicable within a prescribed delay time with regard to the needs of a programmed shut-down</li> </ul>
<b>Zone 2</b>	No action necessary	No action necessary	<ul style="list-style-type: none"> <li>– Suitable alarm (visible and audible)</li> <li>– Immediate action to restore pressurization</li> <li>– Programmed disconnection of power supply if the pressurization cannot be restored for an extended period or if the concentration of flammable gas rises to a dangerous level</li> </ul>

<sup>1)</sup> Classification of the space or are into which the opening leads

**CHAPTER E  
BASIC PRINCIPLES FOR DIMENSIONING**

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- E1. OPERATIONAL AND ENVIRONMENTAL CONDITIONS  
See Part II, Title 11, Section 7
- E2. TYPES OF PROTECTION
- E3. CLASSES OF INSULATIONS  
See Part II, Title 11, Section 7
- E4. DISTRIBUTION SYSTEMS, VOLTAGES AND FREQUENCIES  
See Part II, Title 11, Section 7
- E5. ESSENTIAL SERVICES  
See Part II, Title 11, Section 7

**E2. TYPES OF PROTECTION**

See Part II, Title 11, Section 7 See Part II, Title 11, Section 7

**100. General conditions**

101. to 103 See Part II, Title 11, Section 7.

**200. Degrees of protection**

– See Part II, Title 11, Section 7

**300. Types and location of electrical equipment for the carriage of recovered oil.**

301. The present requirements are additional to those of Part II, Title 11, Section 7, Subchapter E2. The requirements are based upon IEC Standard 60079-14, Section 5.

302. For electrical equipment installed in Zone 1 and Zone 2 hazardous areas, only the following types are permitted:

**TABLE T.E2.302.1 – TYPE AND LOCATION OF ELECTRICAL EQUIPMENT FOR THE CARRIAGE OF OIL PRODUCTS**

Zone	Equipment protection level (*)	Degree of protection	Code	Reference standard
1	-	Any type that may be considered for Zone 0		
		Through runs of cable		
	Ga	Intrinsically safe	Ex(ia)	IEC 60079-11
		Encapsulated	Ex(ma)	ABNT NBR 60079-18
	Gb	Flame proof enclosure	Ex(d)	ABNT NBR 60079-1
		Increased safety	Ex(e)	ABNT NBR 60079-7
		Intrinsically safe	Ex(ib)	IEC 60079-11
		Encapsulated	Ex(m) Ex(mb)	ABNT NBR 60079-18
		Pressurized	Ex(p)	ABNT NBR 60079-2
Sand filled		Ex(q)	ABNT NBR 60079-5	
2	-	Any type that may be considered for Zone 1		
	Gc	Intrinsically safe	Ex(ic)	IEC 60079-11
		Encapsulated	Ex(mc)	ABNT NBR 60079-18
		Not ignited	Ex(n) Ex(nA)	ABNT NBR 60079-15
		Restricted “breathing”	Ex(nR)	ABNT NBR 60079-15
		Energy restriction	Ex(nL)	ABNT NBR 60079-15
		Sparking apparatus in which the contacts are protected in a suitable way	Ex(nC)	ABNT NBR 60079-15
		Pressurized	Ex(pZ)	ABNT NBR 60079-2
FISCO – Fieldbus intrinsically safe concept			ABNT NBR 60079-27	

(\*) EPL – Equipment Protection Level

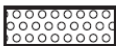





EPL a – with very high level of protection and thus a very high degree of safety

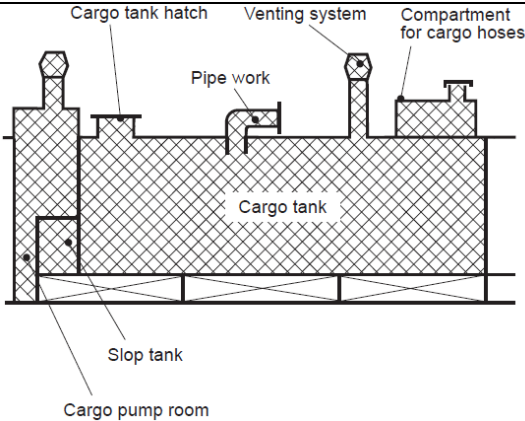
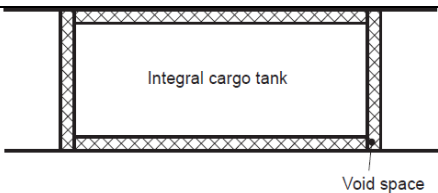
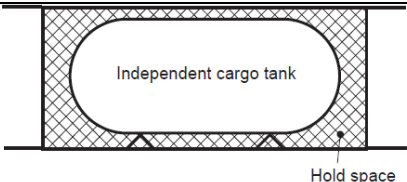
EPL b – with high level of protection and therefore a high degree of safety

EPL c – with normal level of protection and therefore a conventional degree of safety

303. When apparatus incorporates a number of types of protection, it is to be ensured that all are suitable for use in the zone in which it is located.

**TABLE T.A2.103.1 – EXAMPLES OF HAZARDOUS AREA CLASSIFICATION –OIL TANKERS CARRYING FLAMMABLE LIQUIDS OTHER THAN LIQUEFIED GASES HAVING A FLASHPOINT NOT EXCEEDING 60 °C, FOR EXAMPLE, CRUDE OIL, OIL PRODUCTS**

Symbols:		Area classification as zone 0
		Area classification as zone 1
		Area classification as zone 2
		Self-closing door without holding back arrangements
		Audible and visual alarm in case of loss of pressure or failure of ventilation
		Source of release
	> p	Pressure above atmospheric pressure

Hazardous Zone	Spaces		Example
	Item N°	Description	
<b>Spaces in zone 0</b>			
<b>0</b>	1	The interiors of cargo (recovered oil) tanks, slop tanks, any pipework of pressure-relief or other venting systems for cargo and slop tanks, pipes and equipment containing the cargo or developing flammable gases or vapours.	
<b>Spaces in zone 1</b>			
<b>1</b>	2	Void spaces adjacent to, above or below integral cargo (recovered oil) tanks	
<b>1</b>	3	Hold spaces containing independent cargo (recovered oil) tanks	

Hazardous Zone	Spaces		Example
	Item N°	Description	
1	4	Cofferdams and permanent (for example, segregated) ballast tanks adjacent to cargo Tanks	
1	5	Cargo (recovered oil) pump rooms	
1	6	Enclosed or semi-enclosed spaces, immediately above cargo (recovered oil) tanks (for example, between decks) or having bulkheads above and in line with cargo tank bulkheads, unless protected by a diagonal plate acceptable to the appropriate authority.	
1	7	Spaces, other than cofferdam, adjacent to and below the top of a cargo (recovered oil) tank (for example, trunks, passageways and hold)	
1	8	Areas on open deck, or semi-enclosed spaces on open deck, within 3 m of any cargo (recovered oil) tank outlet, gas or vapour outlet (see note), cargo manifold valve, cargo valve, cargo pipe flange, cargo pump-room ventilation outlets and cargo tank openings for pressure release provided to permit the flow of small volumes of gas or vapour mixtures caused by thermal variation. NOTE – Such areas are, for example, all areas within 3 m of cargo tank hatches, sight ports, tank cleaning openings, ullage openings, sounding pipes, cargo vapour outlets.	
1	9	Areas on open deck, or semi-enclosed spaces on open deck above and in the vicinity of any cargo (recovered oil) gas outlet intended for the passage of large volumes of gas or vapour mixture during cargo loading and ballasting or during discharging, within a vertical cylinder of unlimited height and 6 m radius centred upon the centre of the outlet, and within a hemisphere of 6 m radius below the outlet.	
1	10	Areas on open deck, or semi-enclosed spaces on open deck, within 1,5 m of cargo (recovered oil) pump room entrances, cargo pump room ventilation inlet, openings into cofferdams or other zone 1 spaces.	
1	11	Areas on open deck within spillage coamings surrounding cargo (recovered oil) manifold valves and 3 m beyond these, up to a height of 2,4 m above the deck.	

Hazardous Zone	Spaces		Example
	Item N°	Description	
1	12	Areas on open deck over all cargo (recovered oil) tanks (including all ballast tanks within the cargo tank area) where structures are restricting the natural ventilation and to the full breadth of the ship plus 3 m fore and aft of the forward-most and aft-most cargo tank bulkhead, up to a height of 2,4 m above the deck.	
1	13	Compartments for cargo (recovered oil) hoses	
1	14	Enclosed or semi-enclosed spaces in which pipes containing cargoes (recovered oil) are located.	
		<b>Spaces in zone 2</b>	
2	15	Areas of 1,5 m surrounding open or semi-enclosed spaces of zone 1 if not otherwise specified in this Chapter.	
2	16	Spaces 4 m beyond the cylinder and 4 m beyond the sphere defined in item 10 9	
2	17	Areas on open deck extending to the coamings fitted to keep any spills on deck and away from the accommodation and service areas and 3 m beyond these up to a height of 2,4 m above the deck	
2	18	Areas on open deck over all cargo (recovered oil) tanks (including all ballast tanks within the cargo tank area) where unrestricted natural ventilation is guaranteed and to the full breadth of the ship plus 3 m fore and aft of the forward-most and aft-most cargo tank bulkhead, up to a height of 2,4 m above the deck surrounding open or semi-enclosed spaces of zone 1	

Hazardous Zone	Spaces		Example
	Item N°	Description	
2	19	<p>Spaces forward of the open deck areas to which reference is made in 12 and 18 16, below the level of the main deck, and having an opening on to the main deck or at a level less than 0,5 m above the main deck, unless:</p> <p>a. the entrances to such spaces do not face the cargo tank area and, together with all other openings to the spaces, including ventilating system inlets and exhausts, are situated at least 5 m from the foremost cargo tank and at least 10 m measured horizontally from any cargo tank outlet or gas or vapour outlet; and</p> <p>b. the spaces are mechanically ventilated.</p>	

**TABLE T.A2.201.2 T.A2.103.2 - EXAMPLES OF HAZARDOUS AREA CLASSIFICATION – OIL TANKERS SHIPS CARRYING FLAMMABLE LIQUIDS HAVING A FLASHPOINT EXCEEDING 60 °C – UNHEATED CARGOES AND CARGOES HEATED TO TEMPERATURE ( $T_H$ ) BELOW, AND NOT WITHIN 15 °C, OF THEIR FLASHPOINT (FP):  $T_H < FP - 15 °C$**

Symbols: see Table T.A2.201.1 T.A2.103.1

Hazardous Zone	Spaces		Example
	Item N°	Description	
		<b>Spaces in zone 0</b>	
2	21	The interiors of cargo (recovered oil) tanks, slop tanks, any pipework of pressure-relief or other venting systems for cargo and slop tanks, pipes and equipment containing the cargo.	
<p><i>Note: Cargoes heated to temperature (<math>T_H</math>) above their flashpoint (FP) and cargoes heated to temperature within 15 °C of their flashpoint: <math>T_H \geq FP - 15 °C</math> - The requirements of Table T.A2.201.2 T.A2.103.1 are applicable.</i></p>			