

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

TITLE 104 CARRIAGE OF DANGEROUS GOODS

SECTION 7 ELECTRICITY

CHAPTERS

- A APPROACH
- B DOCUMENTS, REGULATIONS AND STANDARDS
- C MATERIALS AND MANUFACTURING
– See Part II, Title 11, Section 7
- D PRINCIPLES OF INSTALLATION
- E BASIC DESIGN PRINCIPLES
- F DESIGN AND INSTALLATION OF THE ELECTRICAL POWER SYSTEM
– See Part II, Title 11, Section 7
- G DESIGN AND INSTALLATION OF THE ELECTRICAL POWER DISTRIBUTION SYSTEM
– See Part II, Title 11, Section 7
- H DESIGN AND INSTALLATION OF THE POWER CONSUMERS – LIGHT AND MOTORS
– See Part II, Title 11, Section 7
- I SYSTEMS WITH VOLTAGES ABOVE 1 KV UP TO 15 KV
– See Part II, Title 11, Section 7
- T TEST OF ELECTRICAL INSTALLATIONS
– See Part II, Title 11, Section 7

CONTENTS

CHAPTER A.....5

APPROACH.....5

A1. APPLICATION5

 100. *Scope*.....5

 200. *Installation types*.....5

A2. DEFINITIONS5

 100. *Terms*5

CHAPTER B6

DOCUMENTS, REGULATIONS AND STANDARDS ..6

B2. REGULATIONS.....6

 100. *Statutory requirements*.....6

B3. STANDARDS AND UNITS.....6

 100. *Normas*.....6

 200. *Units*.....6

CHAPTER D.....6

CONSTRUCTION PRINCIPLES.....6

D1. SHIP CONSTRUCTION.....6

 100. *and 200 Application*6

 300. *Hazardous areas*.....6

D2. INSTALLATIONS.....8

 600. *Electrical equipment in hazardous areas and areas where explosives are stored*.....8

 700. *Installation of electrical equipment in hazardous areas*.....9

 800. *Protection by overpressure*9

 900. *Portable electrical equipment*.....10

CHAPTER E.....11

BASIC PRINCIPLES FOR DIMENSIONING.....11

E2. TYPES OF PROTECTION.....11

 100. *General conditions*.....11

 200. *Degrees of protection*.....11

 300. *Types and location of electrical equipment for the carriage of various classes of dangerous goods* ...11

CHAPTER A APPROACH

CHAPTER CONTENTS

A1. APPLICATION

A2. DEFINITIONS

A1. APPLICATION

100. Scope

101. This Title 104 Section 7 gives additional requirements to those of Part II, Title 11, Section 7 and is applicable to the electrical installations on the following types of ships and cargo spaces:

- a. ships and cargo spaces not specifically designed for the carriage of freight containers but intended for the carriage of dangerous goods in packaged form including goods in freight containers and portable tanks;
- b. purpose-built container ships and cargo spaces intended for the carriage of dangerous goods in freight containers and portable tanks;
- c. ro/ro ships and ro/ro cargo spaces intended for the carriage of dangerous goods;
- d. ships and cargo spaces intended for the carriage of solid dangerous goods in bulk and materials hazardous only in bulk (MHB);
- e. ships and cargo spaces intended for the carriage of dangerous goods, other than liquids and gases in bulk, in shipborne barges.

102. Dangerous goods, for which safety measures may be required with respect to the electrical equipment, are specified in the IMO documents and grouped into the classes as per Part II, Title 104, Section 1. The list below indicates which goods are for carriage in packaged form and which are for carriage in bulk form:

List of dangerous goods, for which safety measures may be required with respect to the electrical equipment, grouped into the following classes.

a. Dangerous goods in packaged form

- a.1. Class 1 Explosives, except goods in division 1.4, compatibility group S of the IMDG Code
- a.2. Class 2.1 All flammable gases, compressed, liquefied or dissolved under pressure

- a.3. Class 3 All flammable liquids having a flashpoint from $-18\text{ }^{\circ}\text{C}$ up to $23\text{ }^{\circ}\text{C}$ (closed-cup test)
- a.4. Class 6.1 All toxic substances having a flashpoint below $23\text{ }^{\circ}\text{C}$ (closed-cup test)
- a.5. Class 8 All corrosive liquids having a flashpoint $23\text{ }^{\circ}\text{C}$ and below (closed-cup test)

b. Solid dangerous goods in bulk

- b.1. Class 4.1 Flammable solids
- b.2. Class 4.2 Substances liable to spontaneous combustion
- b.3. Class 4.3 Substances which, in contact with water, emit flammable gases
- b.4. Class 5.1 Oxidizing substances
- b.5. Class 9 Miscellaneous dangerous substances, that is, any other substance which experience has shown, or may show, to be of such a dangerous character that the provisions of this part will apply to it.

c. **MHB Materials** which, when carried in bulk, present sufficient hazards to require specific precautions

200. Installation types

– See Title 11, Item A1.200

A2. DEFINITIONS

100. Terms

101 In addition to the definitions in Part II, Title 11, Section 7, subchapter A2, the terms employed in the present Title 104 Section 7 have the following definitions:

102. **Hazardous area:** area in which an explosive atmosphere is likely to occur in normal operation, (comparable with zone 1 as defined in IEC 60092-502)

NOTE An explosive atmosphere may exist due to gas and/or dust.

103. **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)

CHAPTER B DOCUMENTS, REGULATIONS AND STANDARDS

CHAPTER CONTENTS

B1. DOCUMENTATION
- See Title 11, Section 7

B2. REGULATIONS

B3. STANDARDS AND UNITS

B2. REGULATIONS

100. Statutory requirements

101. In addition to the requirements of Part II, Title 11, Section 7, B2, the requirements of NORMAM 01 (Brazilian Maritime Authority regulations for vessels destined for navigation in the open sea), Chapter 5, Section I “Carriage of Dangerous Goods” are to be applied. The following international IMO regulations are to be applied where relevant:

IMSBC Code – International Maritime Solid Bulk Cargoes Code – international code regulating the transportation of solid dangerous goods by sea

SOLAS, Chapter II-2, Regulation 19, “Carriage of dangerous goods”

SOLAS, Chapter VI, Part A and B, “General provisions” (deals with the carriage of solid bulk cargoes)

SOLAS, Chapter VII, Part A, “Carriage of dangerous goods in solid form in bulk”

IMO MSC/Circ.608/Rev.1, “Interim Guidelines for Open Top Containerships”

IACS UI SC 109, 110 and 111, “Open top container holds – Water supplies – Ventilation – Bilge pumping”

B3. STANDARDS AND UNITS

100. Normas

101. In addition to the requirements of Part II, Title 11, Section 7, B3, the following standards are to be applied:

IEC 60092-Part 506: Special features – Ships carrying specific dangerous goods and materials hazardous only in bulk

200. Units

– See Part II, Title 11, Section 7

CHAPTER D CONSTRUCTION PRINCIPLES

CHAPTER CONTENTS

D1. SHIP CONSTRUCTION

D2. INSTALATIONS -

D1. SHIP CONSTRUCTION

100. and 200 Application

– See Title 11

300. Hazardous areas

301. Any electrical apparatus permitted in the hazardous areas defined in Subchapter A2 above, requires special precautions with respect to its construction, certification, and use and, when applicable, its installation.

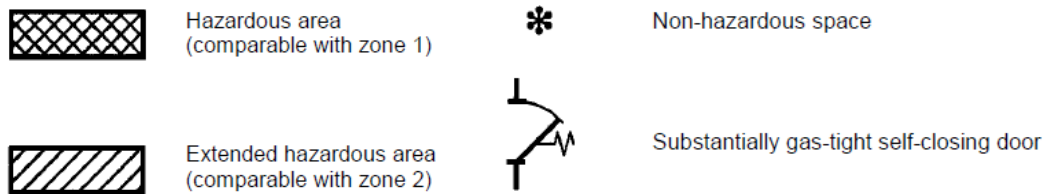
302. The spaces are categorized as hazardous only when dangerous goods are carried.

303. All appropriate measures should be taken to prevent flammable gas and/or dust entering spaces adjacent to the hazardous areas.

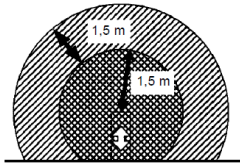
304. The hazardous area for the present Title 104, Section 7 shall be categorized in accordance with IEC 60092-506-Annex B, as per Table T.D1.304.1 below:

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TABLE T.D1.304.1– HAZARDOUS AREAS FOR DANGEROUS GOODS



Item	Class of cargo	Typical Examples	Hazardous areas
A	<p>Bulk Classes 4.1, 4.2, 4.3, 9 and MHB capable of creating explosive dust atmosphere</p> <p>Packaged Classes 1, 2.1, 3, 6.1* and 8*, as defined in A1.102 above</p>		<p>Hazardous areas (comparable with zone 1):</p> <ul style="list-style-type: none"> - closed cargo spaces, and closed or opened Ro-Ro cargo spaces; - permanently fixed magazines
B	<p>Bulk Classes 4.1, 4.2, 4.3, 9 and MHB capable of creating explosive dust atmosphere</p> <p>Packaged Classes 2.1, 3, 6.1* and 8*, as defined in A1.102 above</p>		<p>Hazardous areas (comparable with zone 1)</p> <ul style="list-style-type: none"> - permanently fixed magazines - ventilation ducts (pipes with open ends, such as bilge pipes, ventilation), if any, serving the spaces with dangerous goods in bulk of the corresponding classes identified in items B and C.
C	<p>Bulk Class 4.3 capable of creating explosive gas atmosphere</p> <p>Packaged Classes 2.1, 3, 6.1* and 8*, as defined in A1.102 above</p>		<p>Hazardous areas (comparable with zone 1):</p> <ul style="list-style-type: none"> - enclosed or semi-enclosed spaces having a direct opening (e.g. by doors or flaps) into any of the areas as identified in items A or B (*)
D	<p>Bulk Class 4.3 capable of creating explosive gas atmosphere</p> <p>Packaged Classes 2.1, 3, 6.1* and 8*, as defined in A1.102 above</p>	 <p>Natural ventilation</p>	<p>Extended hazardous areas (comparable with zone 2):</p> <ul style="list-style-type: none"> - Enclosed or semi-enclosed spaces having a direct opening into any of the areas identified in A or B which are provided with the closing arrangements shown in the scheme in this item D, and inside the airlock itself
E	<p><i>Guidance</i> <i>This item is not for class of cargo, but for Item 6 of the IEC 2003 € standard</i> <i>End of guidance</i> Installation of electrical equipment in hazardous areas</p>	 <p>Pressurized space - Visual and acoustic alarm at a manned position in case of loss of pressure</p>	<ul style="list-style-type: none"> - Space protected by overpressure in accordance with Item D2.800
F	<p>Bulk Class 4.3 capable of creating explosive gas atmosphere</p> <p>Packaged Classes 2.1, 3, 6.1* and 8*, as defined in A1.102 above</p>	 <p>Natural ventilation</p>	<p>Extended hazardous areas (comparable with zone 1 and 2):</p> <ul style="list-style-type: none"> - Enclosed or semi-enclosed spaces having a direct opening into any of the areas identified in A or B which are provided with the closing arrangements indicated in this item D and inside the air lock itself

G	<p>Bulk Class 4.3 capable of creating explosive gas atmosphere</p> <p>Packaged Classes 2.1, 3, 6.1* and 8*, as defined in A1.102 above</p>		<p>Hazardous areas (comparable with zone 2):</p> <ul style="list-style-type: none"> - areas on open deck, or semi-enclosed spaces on open deck, within 1,5 m of any exhaust ventilation outlet of a hazardous area - Areas of 1,5 m surrounding open or semi-enclosed spaces of Zone 1
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(*) Unless appropriate measures are taken to prevent flammable gas or dust entering such spaces as indicated in items D, E or F;

D2. INSTALLATIONS

100. to 500

-See Title 11, Section 7, Subchapter D2

600. Electrical equipment in hazardous areas and areas where explosives are stored

601. to 603. See Part II, Title 11, Section 7, Subchapter D2.

604. **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.D2.604.1.(IEC 60092-506)

TABLE T.D2.604.1 – 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

¹⁾ 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 section 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.

²⁾ 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]

605. **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.D2.605.1.

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

TABLE T.D2.605.1 – 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.

(IEC 60092-502, 6.2.3 and Table 3)

700. Installation of electrical equipment in hazardous areas

701. Electrical equipment and wiring shall not be fitted in hazardous areas and in areas where explosives are stored unless it is essential for the safety and operation of the ship.

702. In areas which are classified as hazardous when dangerous goods are carried, electrical equipment which is not essential for the safety and operation of the ship and which is not of a type approved for use in the hazardous areas, shall be completely disconnected, and protected against unauthorized re-connection. Disconnection shall be made outside the hazardous areas and be effected with isolating links or lockable switches.

702. All cables and electrical equipment shall be protected against mechanical damage.

703. Cable penetrations of decks and bulkheads shall be sealed against passage of gas.

704. Cable joints in cargo spaces shall be avoided where possible. Where joints are unavoidable, they shall be enclosed in metal-clad or impact strength plastic junction boxes of certified-safety type (categorized per risk production specified in Clause 5 of IEC 60092-506) or heat-shrink or encapsulated-crimp sleeve cable joints.

705. Cables shall be either:

- a. enclosed in screwed heavy gauge steel drawn or seam-welded and galvanized conduit, or
- b. protected by electrically continuous metal sheathing or metallic wire armour braid or tape.

(IEC 60092-506)

800. Protection by overpressure

801. Where a space has an opening into an adjacent hazardous space or area, it may be made into a non-hazardous space in accordance with the following requirements as indicated in Table T.D1.304.1, item E.

802. A minimum overpressure of 25 Pa (0,25 mbar) with respect to the adjacent, 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.

803. During initial start-up or after shut-down, 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 vapours is below 30 % of the lower explosive limit. The place of measurement should be judiciously chosen to determine the highest concentration of gas.

804. Monitoring shall be provided to ensure the satisfactory functioning of pressurization of spaces having an opening into a more hazardous zone.

805. Where a flow monitoring device (required by D2.702 above) is used to indicate failure of pressurization, it should be verified that either the pressurization level is maintained with any door or other opening open, or an alarm is given if any door or opening is not closed.

806. In the event of the loss of overpressure, the following protective measures shall apply to electrical equipment not protected for use in hazardous areas (for dangerous goods defined in A1.102.a))

- a. suitable alarm (visible and audible);
- b. immediate action to restore pressurization;
- c. programmed disconnection of power supply if the pressurization cannot be restored for an extended

period or if the concentration of flammable gas is rising to a dangerous level.

[IEC 60092-506]

900. Portable electrical equipment

901. Portable electrical equipment shall normally have its own self-contained electrical source of energy, except for intrinsically safe circuits, and shall be certified-safe type as specified in D2.700 for the appropriate risk, unless specifically allowed by the appropriate authority (for example, portable bilge pumps).
(IEC 60092-506)

TABLE T.D2.701.1 – SOLID BULK CARGOES

Electrical equipment for use in hazardous areas

Requirements for the electrical equipment, taking into account the expected risk due to dust or explosive gas atmosphere. Other risks, such as corrosion and toxic gases, may have to be considered separately IEC 60092-506 Table A1.

Dangerous goods	IMO class	Dominant risk ^{a)}	Degrees of protection against explosive dust atmosphere	Protection against explosive gas atmosphere	
				Apparatus group	Temperature class
Aluminium dross	MHB	H ₂	–	IIC	T2
Aluminium ferrosilicon powder	4,3	H ₂	–	IIC	T2
Aluminium silicon powder uncoated	4,3	H ₂	–	IIC	T2
Ammonium nitrate fertilizers					
– Type A	5,1	2)	–	–	–
– Type B	9	2)	–	–	–
Coal	MHB	Dust Methane	IP5X	IIA	T4
Direct reduced iron	MHB	H ₂	–	IIC	T2
Ferrophosphorus (no briquettes)	MHB	H ₂	–	IIC	T1
Ferrosilicon	4,3	H ₂	–	IIC	T1
Iron oxide, spent	4,2	Dust	IP5X	IIA	T2
Iron sponge, spent					
Seed cake, expellers	4,2	Hexane	–	IIA	T3
Silicomanganese	MHB	H ₂	–	IIC	T1
Sulphur	4,1	Inherent	IP5X	–	T4
Zinc ashes	4,3	H ₂	–	IIC	T2
Zinc dross					
Zinc residues					
Zinc skimmings					
NOTE Provision shall be made to disconnect all electrical circuits terminating within cargo spaces, in accordance with 5.1.					
a) This column relates only to the possible evolution of substances which will affect the installation of electrical equipment and cables.					

TABLE T.D2.701.2 – PACKAGED CARGOES

Classes of dangerous goods	Temperature Class	Gas Group	Ingress Protection	Ex Protection
Class 1 except class 1.4S	T5		IP 64	
Classes 2.1, 3.1, 3.2, 6.1, 8	T3	IIB		Ex(ia), Ex(ib), Ex(d), Ex(p), Ex(p), Ex(m), Ex(s)

CHAPTER E
BASIC PRINCIPLES FOR DIMENSIONING

E2. TYPES OF PROTECTION

CHAPTER CONTENTS

- E1. OPERATIONAL CONDITIONS
– See Part II, Title 11, Section 7
- E2. TYPES OF PROTECTION
- E3. DISTRIBUTION SYSTEMS FOR VOLTAGE
AND FREQUENCY
- See Part II, Title 11, Section 7

100. General conditions

101. a 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 various classes of dangerous goods

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 VARIOUS CLASSES OF DANGEROUS GOODS

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	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.