INTERNATIONAL STANDARD

IEC 60092-502

Fifth edition
1999-02

Electrical installations in ships –

Part 502: Tankers – Special features

Installations électriques à bord des navires –

Partie 502: Navires-citernes – Caractéristiques spéciales

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSTALLATIONS IN SHIPS –

Part 502: Tankers – Special features

FOREWORD

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International Standard IEC 60092-502 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

This fifth edition cancels and replaces the fourth edition published in 1994.

The text of this standard is based on the following documents:

FDIS	Report on voting
18/853/FDIS	18/862/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

Annexes A, B, C, D and E are for information only.

A bilingual version of this standard may be issued at a later date.

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INTRODUCTION

This standard introduces the zonal concept for hazardous area classification and permits the use of earthed distribution systems.

It should be noted, however, that it is not in full concurrence with the requirements for electrical installations in hazardous areas given in Clause 10.2 of the IBC Code[1)] and Clause 10.2 of the IGC Code[2)] and the system earthing requirements of Regulations II-1/45.4.1 and 45.4.3 of SOLAS[3)].

Until the International Maritime Organization has decided upon corresponding amendments to the Codes and to SOLAS, users of this standard are advised to ask the appropriate authority to consider equivalence in accordance with the “Equivalents” provisions of Clause 1.4 of the IBC Code and Clause 1.4 of the IGC Code and Regulation I/5 of SOLAS.

1) International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (1994 edition).

2) International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (1993 edition).

3) SOLAS – the International Convention for the Safety of Life at Sea, 1974, and its Protocol of 1978 (Consolidated edition, 1997).

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ELECTRICAL INSTALLATIONS IN SHIPS –

Part 502: Tankers – Special features

1 Scope

This part of IEC 60092 deals with the electrical installations in tankers carrying liquids which are flammable, either inherently, or due to their reaction with other substances, or flammable liquefied gases.

The requirements in other parts of IEC 60092 also apply to tankers, unless otherwise mentioned in this standard.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60092. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60092 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(426):1990, *International Electrotechnical Vocabulary (IEV) – Chapter 426: Electrical apparatus for explosive atmospheres*

IEC 60079-0:1983, *Electrical apparatus for explosive gas atmospheres – Part 0: General requirements*

IEC 60079-1:1990, *Electrical apparatus for explosive gas atmospheres – Part 1: Construction and verification test of flameproof enclosures of electrical apparatus*

IEC 60079-2:1983, *Electrical apparatus for explosive gas atmospheres – Part 2: Electrical apparatus, type of protection 'p'*

IEC 60079-4:1975, *Electrical apparatus for explosive gas atmospheres – Part 4: Method of test for ignition temperature*

IEC 60079-5:1997*, Electrical apparatus for explosive gas atmospheres – Part 5: Powder filling 'q'*

IEC 60079-6:1995, *Electrical apparatus for explosive gas atmospheres – Part 6: Oil-immersion 'o'*

IEC 60079-7:1990, *Electrical apparatus for explosive gas atmospheres – Part 7: Increased safety 'e'*

IEC 60079-10:1968, *Electrical apparatus for explosive gas atmospheres – Part 10: Classification of hazardous areas*

IEC 60079-11:1991, *Electrical apparatus for explosive gas atmospheres – Part 11: Intrinsic safety 'i'*

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IEC 60079-12:1978, *Electrical apparatus for explosive gas atmospheres – Part 12: Classification of mixtures of gases or vapours with air according to their maximum experimental safe gaps and minimum igniting currents*

IEC 60079-14:1996, *Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installation in hazardous areas (other than mines)*

IEC 60079-15:1987, *Electrical apparatus for explosive gas atmospheres – Part 15: Electrical apparatus with type of protection 'n'*

IEC 60079-17:1990, *Electrical apparatus for explosive gas atmospheres – Part 17: Inspection and maintenance of electrical installations in hazardous areas (other than mines)*

IEC 60079-18:1992, *Electrical apparatus for explosive gas atmospheres – Part 18: Encapsulation 'm'*

IEC 60079-19:1993, *Electrical apparatus for explosive gas atmospheres – Part 19: Repair and overhaul for apparatus used in explosive atmospheres (other than mines or explosives)*

IEC 60092-101:1994, *Electrical installations in ships – Part 101: Definitions and general requirements*

IEC 60092-201:1994, *Electrical installations in ships – Part 201: System design – General*

IEC 60092-202:1994, *Electrical installations in ships – Part 202: System design – Protection*

IEC 60092-350:1988, *Electrical installations in ships – Part 350: Low-voltage shipboard power cables – General construction and test requirements*

IEC 60092-401:1980, *Electrical installations in ships – Part 401: Installation and test of completed installation*

3 Definitions

For the purpose of this part of IEC 60092, the following definitions apply.

3.1
certified safe-type equipment
electrical equipment of a type for which a national or other appropriate authority has carried out the type verifications and tests necessary to certify the safety of the equipment with regard to explosion hazard when used in an explosive gas atmosphere

3.2
encapsulation "m"
a type of protection in which the parts which could ignite an explosive atmosphere by either sparking or heating are enclosed in a compound in such a way that this explosive atmosphere cannot be ignited [IEC 60078-18, 3.1]

3.3
enclosed space
any space within which, in the absence of artificial ventilation, the ventilation will be limited and any explosive atmosphere will not be dispersed naturally

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3.4
enclosure
all the walls which surround the live parts of electrical apparatus including doors, covers, cable entries, rods, spindles and shafts, ensuring the protection of the electrical apparatus [IEV 426-04-01, modified]

3.5
explosion protected enclosure
enclosure, the mechanical integrity of which is considered essential for, and is examined in detail for, its certification or acceptance for use in a hazardous area

3.6
explosive limits

3.6.1
lower explosive limit (LEL)
concentration of flammable gas, vapour or mist in air, below which an explosive gas atmosphere will not be formed [IEV 426-02-09]

3.6.2
upper explosive limit (UEL)
concentration of flammable gas, vapour or mist in air, above which an explosive gas atmosphere will not be formed [IEV 426-02-10]

3.7
explosive gas atmosphere
mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour or mist, in which, after ignition, combustion spreads throughout the unconsumed mixture [IEV 426-02-03]

3.8
flameproof enclosure "d"
type of protection of electrical apparatus in which the enclosure will withstand an internal explosion of a flammable mixture which has penetrated into the interior, without suffering damage and without causing ignition, through any joints or structural openings in the enclosure, of an external explosive atmosphere consisting of one or more of the gases or vapours for which it is designed [IEV 426-06-01]

NOTE – IEC 60079-1 specifies the constructional features and test requirements for apparatus using this method of protection.

3.9
flammable gas or vapour
gas or vapour which, when mixed with air in certain proportions, will form an explosive gas atmosphere [IEC 60079-10, 2.14]

3.10
flammable liquid
liquid capable of producing a flammable vapour or mist under any foreseeable operating conditions [IEC 60079-10. 2.13 modified]

3.11
flammable material
material consisting of flammable gas, vapour, liquid and/or mist [IEC 60079-10, 2.12 modified]

3.12
flammable mist
droplets of flammable liquid, dispersed in air, so as to form an explosive atmosphere [IEC 60079-10, 2.15]

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3.13
flashpoint
lowest liquid temperature at which, under certain standardised conditions, a liquid gives off vapours in quantity such as to be capable of forming an ignitable vapour/air mixture
[IEV 426-02-14]

NOTE – Differing values of flashpoint may be obtained under open-cup or closed-cup test conditions; for the purposes of this standard, only the flashpoint obtained under closed-cup conditions is considered.

3.14
gas-tight
attribute of a physical barrier which prevents any significant quantity of flammable gas or vapour from entering into an adjoining area

3.15
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 [IEV 426-03-01]

3.15.1
zone 0
area in which an explosive gas atmosphere is present continuously or is present for long periods [IEV 426-03-03]

3.15.2
zone 1
area in which an explosive gas atmosphere is likely to occur in normal operation
[IEV 426-03-04]

3.15.3
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
[IEV 426-03-05 modified]

3.16
ignition temperature (of an explosive gas atmosphere)
lowest temperature of a heated surface at which, under specific conditions according to IEC 60079-4, the ignition of a flammable material in the form of a gas or vapour in mixture with air will occur [IEV 426-03-01 modified]

3.17
increased safety "e"
type of protection applied to electrical apparatus that does not produce arcs or sparks in normal service, in which additional measures are applied so as to give increased security against the possibility of excessive temperatures and the occurrence of arcs and sparks [IEC 60078-7, 3.1]

NOTE – IEC 60079-7 specifies the constructional features and test requirements for apparatus using this method of protection.

3.18
intrinsically-safe circuit "i"
circuit in which no spark or any thermal effect produced in the test conditions prescribed (which include normal operation and specified fault conditions) is capable of causing ignition of a given explosive gas atmosphere [IEV 426-11-01 modified]

NOTE – IEC 60079-11 specifies the constructional features and test requirements for apparatus using this method of protection.

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3.19
liquefied gas
A liquid formed by pressurisation and/or cooling of a gas having a vapour pressure exceeding 2,8 bar absolute at a temperature of 37,8 °C

3.20
non-hazardous area
area in which an explosive gas atmosphere is not expected to be present in quantities such as to require special precautions for the construction, installation and use of electrical apparatus [IEV 426-03-02]

3.21
oil immersion "o"
type of protection in which the electrical apparatus or parts of the electrical apparatus are immersed in a protective liquid in such a way that an explosive atmosphere which may be above the liquid or outside the enclosure cannot be ignited

3.22
open space
space in an open air situation without stagnant areas where vapours are rapidly dispersed by wind and natural convection. Typical air velocities should rarely be less than 0,5 m/s and should frequently be above 2 m/s

3.23
opening
any aperture, or door, window or panel not designed to prevent the passage of gas or vapour

3.24
pressurisation "p"
technique of guarding against the ingress of the external atmosphere, which may be explosive, into an enclosure by maintaining a protective gas therein at a pressure above that of the external atmosphere [IEC 60079-2, 2.2]

NOTE – IEC 60079-2 gives guidance on the design, construction and use of electrical apparatus protected by this technique.

3.25
protection "n"
type of protection applied to electrical apparatus such that, in normal operation, it is not capable of igniting a surrounding explosive gas atmosphere and a fault capable of causing ignition is not likely to occur [IEC 60079-15, 3.1]

NOTE – IEC 60079-15 specifies the constructional features and test requirements for apparatus using this method of protection.

3.26
purging
passing of sufficient volume of protective gas through a pressurized enclosure and its ducts before the application of voltage to the apparatus to reduce any explosive gas atmosphere to a concentration well below the lower explosive limit [IEV 426-09-03]

3.27
sand-filled apparatus "q"
an apparatus is considered "sand-filled" when all its live parts are entirely embedded in a mass of powdery material [IEV 426-07-01 modified]

NOTE – IEC 60079-5 specifies the constructional features and test requirements for apparatus using this method of protection.

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3.28
semi-enclosed space
space limited by decks and/or bulkheads in such a manner that the natural conditions of ventilation in the spaces are notably different from those obtained on open deck

3.29
source of release
point or location from which a gas, vapour, mist or liquid may be released into the atmosphere so that an explosive atmosphere may be formed under normal operating conditions, for example valves and flanges in cargo piping systems [IEV 426-03-06 modified]

3.30
tanker
sea-going cargo ship constructed or adapted for the carriage of liquid cargoes in bulk

3.31
ventilation

3.31.1
natural ventilation
movement of air and its replacement with fresh air due to the effects of wind and/or temperature gradients [IEV 426-03-07]

3.31.2
artificial ventilation
movement of air and its replacement with fresh air by artificial means (for example fans) and applied to a general area [IEV 426-03-08 modified]

4 Area classification

4.1 General

4.1.1 Basic principles

4.1.1.1 Area classification is a method of analyzing and classifying the areas where explosive gas atmospheres may occur. The object of the classification is to allow the selection of electrical apparatus able to be operated safely in these areas. Where it is necessary to use electrical apparatus in an area in which there may be an explosive gas atmosphere and it is not possible to eliminate:

a) any possibility of an explosive gas atmosphere occurring around any source of ignition, or,

b) any source of ignition,

then measures shall aim at reducing the likelihood of the occurrence of either or both of the above factors so that the likelihood of coincidence is so small as to be acceptable.

4.1.1.2 In order to facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones 0, 1 and 2 according to IEC 60079-10 and the guidance given in this standard.

4.1.1.3 The likelihood of the presence of an explosive gas atmosphere and hence the type of zone depends mainly on the source of release and rate at which the released substance is dispersed by natural or artificial ventilation. Pressurisation and other factors such as the provision of an inert atmosphere may also affect the type of zone.

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4.1.1.4 Area classification shall be carried out at an early stage of planning, before any construction work starts and the results documented in drawings showing the different zones.

NOTE 1 – Small pockets of non-hazardous areas within a general hazardous area or between hazardous areas should not be defined, unless such a pocket is a special feature of the design, for example an enclosure protected by pressurisation. Likewise small pockets of zone 2 should not be defined in or between zone 1 hazardous areas.

NOTE 2 – It is not necessary to determine the hazardous area that would arise from each individual source of release when this would not influence the overall zone boundary.

NOTE 3 – At completion of design and again at completion of construction, the area classification shown on the drawings should be reviewed against the actual sources of possible release and any structural changes. If necessary, modification to drawings and installation should be made.

NOTE 4 – Where any alteration is proposed to cargo containment system, cargo pumping or piping arrangements or ventilation arrangements, the impact on area classification should be reviewed. If necessary, modifications to drawings and installation should be made, and a further review, together with any necessary modification, carried out upon completion of the alteration.

4.1.1.5 Spaces and areas not mentioned in this standard, but considered by the appropriate authority, as a result of the application of the principles of IEC 60079-10, to present an equivalent risk of the presence of an explosive gas atmosphere as defined for zones 0, 1 and 2, shall be considered as these zones.

4.1.1.6 Examples of hazardous area classification are given in annexes A to E.

4.1.2 Substances capable of creating an explosive gas atmosphere

A hazardous area may arise from the presence of any of the following:

a) flammable liquid having a flashpoint (closed-cup test) not exceeding 60 °C;

b) flammable liquid having a flashpoint exceeding 60 °C, heated or raised by ambient conditions to a temperature within 15 °C of its flashpoint;

c) flammable gas, in gaseous or liquid state.

d) substances (for example acids) reacting with other products/materials to evolve flammable gases.

4.1.3 Sources of release

The following are examples of some sources of release:

a) venting and other openings to cargo tanks, slop tanks and cargo piping;

b) piping systems and equipment, containing liquid or gas, having flanged joints or glands or other openings through which leakage may occur under normal operating conditions.

4.1.4 Separation by gastight boundaries

4.1.4.1 A space separated by gastight boundaries from a hazardous area may be classified as zones 0, 1, 2, or considered as non-hazardous, taking into account the sources of release inside that space and its conditions of ventilation as indicated in 8.3, in accordance with table 1.

A bulkhead or other such boundary having penetrations, for example a bolted, gasketted plate or cargo pump drive shaft seal, may be considered to remain gastight, provided that the sealing and securing arrangements and provisions to prevent opening other than under gas-free conditions, are acceptable to the appropriate authority.

4.1.4.2 Tanks, continuous fully welded pipes without flanges, joints, glands, etc., containing liquid or gas are not considered as sources of release, although account may need to be taken of the possibility of an escape of gas, vapour, mist or liquid under abnormal conditions, for example seepage through a cargo tank bulkhead.

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Table 1 – Spaces separated by one gastight boundary from the zones mentioned in the column

	With source of release [1]		Without source of release	
	With ventilation [2]	Without ventilation	With ventilation [2]	Without ventilation
Zone 0	Zone 1 for example cargo pump room (see annex A, clause A.1)	Zone 0 for example cofferdams with cargo pipe flanges (see annex A, clause A.4)	Zone 2 for example ballast pump rooms adjacent to cargo tanks (see annex A, clause A.7)	Zone 1 for example cofferdam, void space (see annex A, clause A.10)
Zone 1	zone 2 for example rooms with cargo pipe flanges, (see annex A, clause A.2)	zone 1 for example rooms with cargo pipe flanges (see annex A, clause A.5)	Non-hazardous areas (see annex A clause A.8)	Non-hazardous areas (see annex A, clause A.11)
Zone 2	Zone 2 for example rooms with cargo pipe flanges (see annex A, clause A.3)	Zone 1 for example rooms with cargo pipe flanges (see annex A, clause A.6)	Non-hazardous areas (see annex A, clause A.9)	Non-hazardous areas (see annex A, clause A.12)

[1] The following are examples of some sources of release:
– venting and other openings to cargo tanks, slop tanks and cargo piping;
– seals of cargo pumps, cargo compressors and process equipment;
– seals of valves and flanges and other connections and pipe fittings.

[2] Where the area classification of a space is dependent upon its ventilation, the arrangements shall be such that discontinuities in ventilation are not expected to occur for long periods and there is no accumulation of gas or vapour in the vicinity of any source of release, or where electrical equipment is installed.

4.1.5 Openings, access and ventilation conditions affecting the extent of hazardous area

See table 2 and clause 8.

4.1.5.1 Access doors or other openings shall not be provided between an area intended to be considered as non-hazardous and a hazardous area, or between a space intended to be considered as zone 2 and a zone 1 space except where required for operational reasons. Where access doors or other openings are provided for operational reasons, 4.1.5.2, 4.1.5.3, 4.1.5.4 or 4.1.5.5 apply.

4.1.5.2 For spaces where the access doors or similar means of access are closable and capable of maintaining an over-pressure, the following provisions apply:

a) An enclosed space with access to any zone 1 location may be considered as zone 2 if:
   – the space is ventilated by over-pressure in accordance with 8.4, and
   – the access is fitted with a self-closing door without holding back arrangements, capable of maintaining the over-pressure, opening into the zone 2 space (if the door is hinged).

b) An enclosed space with access to any zone 2 location may be considered non-hazardous if:
   – the space is ventilated by over-pressure in accordance with 8.4, and
   – the access is fitted with a self-closing door without holding back arrangements, capable of maintaining the over-pressure, opening into the non-hazardous space (if the door is hinged).

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c) An enclosed space with access to any zone 1 location may be considered non-hazardous if:
   – the access is fitted with two doors forming an air-lock, both self-closing and without holding back arrangements, capable of maintaining the over-pressure in each of the spaces, and
   – the space and the air-lock are ventilated by over-pressure in accordance with 8.4.

d) Notices, warning that the doors are to be kept closed, are to be fitted whenever any of the above arrangements are adopted.

4.1.5.3 For spaces where the access doors or similar means of access are closable and gas-tight, the following provisions apply:

a) an enclosed space with access to any zone 1 location may be considered as zone 2 if:
   – the access is fitted with two doors forming an air-lock, both gas-tight, self-closing and without holding back arrangements;
   – the space and the air-lock have artificial ventilation in accordance with 8.3, and

b) an enclosed space with access to any zone 2 location may be considered non-hazardous if:
   – the access is fitted with two doors forming an air-lock, both gas-tight, self-closing and without holding back arrangements;
   – the space and the air-lock have artificial ventilation in accordance with 8.3, and

c) notices, warning that the doors are to be kept closed, are to be fitted whenever any of the above arrangements is adopted.

4.1.5.4 Enclosed spaces with ventilation or semi-enclosed spaces with openings or doors not forming an air-lock to a hazardous area shall be designated as the same hazardous zone as the area in which the openings or doors are located.

4.1.5.5 Enclosed spaces without ventilation with openings or doors to a hazardous area shall be designated as the same hazardous zone as the area in which the openings or doors are located, or as a more hazardous zone.

4.1.5.6 Certain areas and rooms may, if so indicated by the circumstances, be classified as a more hazardous zone than set out in these examples.

4.1.5.7 In the event of loss of the protection by over-pressure or loss of ventilation the requirements of 8.4 or 8.3, respectively, shall be complied with.

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Table 2 – Spaces without source of release and separated by door(s) from the zones mentioned in the column

	Protected by over-pressure relative to the surrounding hazardous area		Not protected by over-pressure relative to the surrounding hazardous area but artificially ventilated		Not protected by over-pressure relative to the surrounding hazardous area and not artificially ventilated	
	Separated by one door [1]	Separated by two doors [2]	Separated by one gastight door [3]	Separated by two gastight doors [4]	Separated by one door [5]	Separated by two doors [5]
Zone 1	Zone 2 (see annex A, clause A.13)	Non-hazardous area (see annex A, clause A.15)	Zone 1 (see annex A, clause A.16)	Zone 2 (see annex A, clause A.18)	Zone 1 (see annex A, clause A.20)	Zone 1 (see annex A, clause A.20)
Zone 2	Non-hazardous area (see annex A, clause A.15)	Non-hazardous area (one door is sufficient)	Zone 2 (see annex A, clause A.17)	Non-hazardous area (see annex A, clause A.19)	Zone 2 (see annex A, clause A.21)	Zone 2 (see annex A, clause A.21)

[1] Door capable of maintaining the over-pressure.

[2] Two doors forming an air-lock capable of maintaining the over-pressure.

[3] Watertight doors or fire doors class A are considered as gastight.

[4] Two gastight doors forming a ventilated air-lock.

[5] Any type of doors; see 4.1.5.5.

4.2 Tankers carrying flammable liquids other than liquefied gases having a flashpoint not exceeding 60 °C, for example crude oil, oil products, chemical products

Hazardous areas which normally apply on these types of tankers include the following, for which informative examples are given in annex B.

4.2.1 Hazardous areas zone 0

The interiors of cargo 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.

4.2.2 Hazardous areas zone 1

4.2.2.1 Void spaces adjacent to, above or below integral cargo tanks

4.2.2.2 Hold spaces containing independent cargo tanks

4.2.2.3 Cofferdams and permanent (for example, segregated) ballast tanks adjacent to cargo tanks

4.2.2.4 Cargo pump rooms

4.2.2.5 Enclosed or semi-enclosed spaces, immediately above cargo 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.

4.2.2.6 Spaces, other than cofferdam, adjacent to and below the top of a cargo tank (for example, trunks, passageways and hold)

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4.2.2.7 Areas on open deck, or semi-enclosed spaces on open deck, within 3 m of any cargo 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.

4.2.2.8 Areas on open deck, or semi-enclosed spaces on open deck above and in the vicinity of any cargo 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.

4.2.2.9 Areas on open deck, or semi-enclosed spaces on open deck, within 1,5 m of cargo pump room entrances, cargo pump room ventilation inlet, openings into cofferdams or other zone 1 spaces.

4.2.2.10 Areas on open deck within spillage coamings surrounding cargo manifold valves and 3 m beyond these, up to a height of 2,4 m above the deck.

4.2.2.11 Areas on open deck over all cargo 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.

4.2.2.12 Compartments for cargo hoses.

4.2.2.13 Enclosed or semi-enclosed spaces in which pipes containing cargoes are located.

4.2.3 Hazardous areas zone 2

4.2.3.1 Areas of 1,5 m surrounding open or semi-enclosed spaces of zone 1 as specified in 4.2.2, if not otherwise specified in this standard .

4.2.3.2 Spaces 4 m beyond the cylinder and 4 m beyond the sphere defined in 4.2.2.8.

4.2.3.3 The spaces forming an air-lock as defined in 4.1.5.2.c).

4.2.3.4 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.

4.2.3.5 Areas on open deck over all cargo 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

4.2.3.6 Spaces forward of the open deck areas to which reference is made in 4.2.2.11 and 4.2.3.5, 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:

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

b) the spaces are mechanically ventilated.

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4.3 Tankers carrying flammable liquids having a flashpoint exceeding 60 °C

4.3.1 Unheated cargoes and cargoes heated to temperature (T_H) below, and not within 15 °C, of their flashpoint (FP)

Hazardous areas which normally apply on these types of tankers include the following, for which informative examples are given in annex C.

4.3.1.1 Hazardous areas zone 2

The interiors of cargo tanks, slop tanks, any pipework of pressure-relief or other venting systems for cargo and slop tanks, pipes and equipment containing the cargo.

4.3.2 Cargoes heated to temperature (T_H) above their flashpoint (FP) and cargoes heated to temperature within 15 °C of their flashpoint: $T_H \geq$ FP –15 °C

4.3.2.1 The requirements of 4.2 are applicable.

4.4 Tankers carrying flammable liquefied gases

Hazardous areas which normally apply on these types of tankers include the following, for which informative examples are given in annex D.

4.4.1 Hazardous areas zone 0

Areas as specified in 4.2.1, interbarrier spaces and, only where the cargo tank requires a secondary barrier, in 4.2.2.2.

4.4.2 Hazardous areas zone 1

4.4.2.1 Areas as specified in 4.2.2.1, 4.2.2.2, 4.2.2.3, 4.2.2.4 and cargo compressor rooms, 4.2.2.5, 4.2.2.6, 4.2.2.7 and cargo compressor room ventilation outlets, 4.2.2.8, 4.2.2.9 and cargo compressor room entrances or cargo compressor room ventilation inlets, 4.2.2.10, 4.2.2.11, 4.2.2.12 and 4.2.2.13.

4.4.2.2 A space separated from a hold space, where cargo is carried in a cargo tank requiring a secondary barrier, by a single gastight boundary.

4.4.2.3 Enclosed or semi-enclosed spaces in which pipes containing cargo products for boil-off gas fuel burning systems are located, unless special precautions approved by the appropriate authority are provided to prevent product gas escaping into such spaces.

NOTE – A fully welded double walled pipe containing a flammable gas would not be considered as changing the area classification of the spaces and areas through which it passes if adequate means were provided to detect and take action to prevent the continuation of any leakage into the annular space.

4.4.3 Hazardous areas zone 2

4.4.3.1 Areas as specified in 4.2.3.1, 4.2.3.2, 4.2.3.3, 4.2.3.4, 4.2.3.5 and 4.2.3.6.

4.4.3.2 An area within 2,4 m of the outer surface of a cargo tank where such surface is exposed to the weather.

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4.5 Tankers carrying cargoes (for example acids) reacting with other products/materials to evolve flammable gases

Hazardous areas which normally apply on these types of tankers include the following, for which informative examples are given in annex E.

4.5.1 Hazardous areas zone 1

Areas as specified in 4.2.1, 4.2.2.4 and 4.2.2.12.

4.5.2 Hazardous areas zone 2

a) Areas of 1,5 m surrounding openings of zone 1 spaces as specified in 4.5.1, if not otherwise specified in this standard.

b) Areas as specified in 4.2.2.1, 4.2.2.2, 4.2.2.3, 4.2.2.5, 4.2.2.6, 4.2.2.13.

c) Areas as specified in 4.2.2.7 and 4.2.2.10 but with the distances of 2,4 m and 3 m reduced to 1,5 m, and areas as specified in 4.2.2.8 but with the distance of 6 m reduced to 3 m.

5 Electrical systems

5.1 Sources of electrical power

The main and emergency sources of electrical power and associated transforming equipment, if any, the main and emergency switchboards, the transitional source of emergency power, if any, and the emergency lighting switchboard, shall be installed only in locations which are non-hazardous and are not dependent upon mechanical ventilation or over-pressure for their classification.

5.2 Distribution systems

5.2.1 Distribution systems shall comply with the provisions of IEC 60092-201.

Both insulated and earthed distribution systems are permitted; systems with a hull or structure return, other than those noted under 5.2.2, are not permitted.

5.2.2 The following systems are permitted to be of hull or structure return type:

– limited and locally earthed systems outside any hazardous area;

– intrinsically-safe systems;

– impressed current cathodic protective systems.

5.2.3 The neutral and any conductor required for protection against electric shock shall not be connected together or combined in a single conductor in a hazardous area.

5.3 Electrical protection

5.3.1 Protection arrangements shall comply with the provisions of IEC 60092-202, subject to the additional requirements set out below.

5.3.2 For both insulated and earthed distribution systems a device, or devices, shall be installed to continuously monitor the insulation to earth and to give an audible and visual alarm at a manned position in the event of an abnormally low level of insulation resistance and/or high level of leakage current.

This clause does not apply to the systems mentioned in 5.2.2.

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5.3.3 Where any circuit, other than an intrinsically-safe circuit, passes into any zone 0 area, the circuit shall be disconnected automatically and/or shall be prevented from being energised in the event of an abnormally low level of insulation resistance and/or high level of leakage current.

5.3.4 Where a circuit passes into any zone 0 area, the protective systems shall be arranged so that manual intervention is necessary for the reconnection of the circuit after disconnection as the result of a short-circuit, overload or earth-fault condition.

5.4 Equipotential bonding

5.4.1 To avoid the possibility of dangerous sparking between metallic parts in the event of an electrical fault, exposed and extraneous conductive parts, other than those exempted by 5.4.2, are to be connected to earth.

NOTE 1 – The means by which parts are earthed may include conduits, metal cable sheaths, metal armouring and metallic parts of structure, but should not include neutral conductors.

NOTE 2 – Special consideration should be given to the temperature rise, under fault conditions, of earthing conductors in zone 1 and zone 0 areas.

NOTE 3 - Special consideration should be given to potential equalisation between electrically separate structures, for example between the fixed structure and machinery on anti-vibration mounts.

5.4.2 The following are exempted from the requirements of 5.4.1:

– items as listed in Section Two of IEC 60092-401, 3.1, with the exception of apparatus exempted only by virtue of being supplied at safety voltage;

– certified safe type apparatus not intended to be earthed.

5.5 Static electricity

5.5.1 Account shall be taken of the effects of static electricity.

5.5.2 To avoid the hazard of an incendive discharge due to the build-up of static electricity resulting from the flow of liquid/gases/vapours, the resistance between any point on the surface of the cargo and slop tanks, piping systems and equipment, and the hull of the ship is not to be greater than 10^6 Ω.

NOTE 1 – This value of resistance may be achieved without the use of bonding straps where cargo and slop tanks, piping systems and equipment are directly, or via their supports, either welded or bolted to the hull of the ship.

NOTE 2 – It will be generally necessary initially to achieve a resistance value below 10^6 Ω, to allow for deterioration in service.

NOTE 3 – The manufacture or construction of non-metallic pipes should allow the dissipation of static charge.

5.5.3 Bonding straps are required for cargo and slop tanks, piping systems and equipment which are not permanently connected to the hull of the ship, for example:

– independent cargo tanks;

– cargo tanks, piping systems which are electrically separated from the hull of the ship;

– pipe connections arranged for the removal of spool pieces.

5.5.4 Where bonding straps are required, they are to be:

– clearly visible so that any shortcomings can be clearly detected;

– designed and sited so that they are protected against mechanical damage and that they are not affected by high resistivity contamination, for example corrosive products or paint;

– easy to install and replace.

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5.5.5 Where tanks or piping systems for poorly conductive fluids, other than cargo, are located in a hazardous area, 5.5.2, 5.5.3 and 5.5.4 shall also apply to these tanks and systems.

5.5.6 For fans installed in a hazardous area or serving a space that would be classified hazardous in the absence of ventilation, electrostatic charges both in the rotating body and the casing are to be prevented by the use of antistatic materials and satisfactory earthing, ensuring that the resistance between any point on the surface of the unit and the hull of the ship is not greater than 10^6 Ω.

5.6 Lightning protection

5.6.1 Account shall be taken of the risks due to lightning attachment.

5.6.2 Consideration should be given to the risk and effects of lightning attachment to high level gas or vapour vents, or adjacent structures.

NOTE – See IEC 60092-401 and IEC 60079-14.

5.7 Cathodically protected metallic parts

No impressed current cathodic protection shall be provided for metallic parts in hazardous areas, unless it is specially designed for this application and acceptable to the appropriate authority.

5.8 Electromagnetic radiation

Electrical equipment which emits electromagnetic radiation is to have its level of radiated power or field strength limited to safe values acceptable to the appropriate authority.

6 Electrical equipment

6.1 General

General requirements for equipment are stated in other parts of IEC 60092, and provisions set out below are additional requirements for equipment in hazardous areas as defined by this part of the standard.

6.2 Selection of electrical equipment

In order to select the appropriate electrical apparatus for hazardous areas, the following information is required:

– classification of the hazardous area, see 6.2.1;
– location on the ship, see 6.2.2;
– the ignition temperature of the gas or vapour involved, see 6.2.3;
– where applicable, the gas or vapour classification in relation to the grouping of the electrical apparatus, see 6.2.4;
– external influences and ambient temperature, see 6.2.5 and 6.2.6.

NOTE 1 – For some types of protection, for example pressurisation, oil-immersion, sand-filling and increased safety, gas or vapour classification may not be required.

NOTE 2 – Where the hazard results from the reaction of the cargo with other materials, the ignition temperature and grouping of the evolved gas may determine the requirements for the selection of electrical apparatus.

NOTE 3 – Consideration should be given to limiting the use of sand-filled and oil-immersed apparatus. These types of protection may not remain effective if the motion of the vessel reduces the depth of cover of electrical parts due to movement of the filling material.

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6.2.1 Area classification

Electrical apparatus shall be selected according to the category of hazardous zone in which it is to operate.

Clause 4 provides guidance for the area classification; 6.5 details the types of protection that may be considered for apparatus for each zone.

6.2.2 Location on the ship

Electrical apparatus shall, additionally, in certain locations, be limited to specific types of protection and/or functions recognised by the appropriate authority as essential in, and suitable for, these locations.

It shall be ensured, in particular, that the arrangements allow the requirements of clause 9 for inspection and maintenance (in accordance with IEC 60079-17) to be met.

6.2.3 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 3.

Table 3 – 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 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.

[2] For certain categories of chemical cargoes, equipment of temperature class T4, T5 or T6 may be required.

6.2.4 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.

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Symbols for the groups which may be marked on the apparatus are listed against representative gases in table 4.

NOTE 1 – IEC 60079-12 states that mixtures of gases should generally be allocated to a group only after a special determination of their relevant properties. However, in the absence of such a special determination, a mixture may be allocated to the group of the component having the most onerous requirements. It is also recognised, as in the case of ignition temperature, that the properties of certain cargoes allow the selection of equipment without individual analysis; for example equipment of group IIA may be accepted for use in hazardous areas on crude oil or products tankers without analysis or test of particular cargoes.

NOTE 2 – For certain categories of chemical cargoes and liquefied gases, equipment of groups IIB and IIC may be required.

Table 4 – 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.	

6.2.5 External influences

Electrical apparatus shall be protected against the external influences (for example chemical, mechanical and thermal stresses) to which it may be subjected. This protection shall be such that the type of protection against ignition of potentially explosive atmospheres is maintained when the electrical apparatus is used under the specified external influences.

NOTE – See IEC 60092-101, annex B, for guidance on external influences.

6.2.6 Ambient temperature

6.2.6.1 The electrical apparatus shall, in general, be suitable for an ambient air temperature range from –25 °C to +45 °C.

6.2.6.2 If the marking of the electrical apparatus does not include an ambient air temperature range, this is understood to be from –20 °C to +40 °C.

6.2.6.3 If it is established, to the satisfaction of an appropriate authority, that the safe operation of equipment will not be impaired, it may be used at ambient air temperatures outside the range specified in 6.2.6.2, or that for which the equipment is marked.

6.3 Certified safe type equipment

Where equipment is required by 6.5 to be of a certified safe type, evidence is to be furnished that the equipment has been certified by an appropriate authority to confirm its safety with regard to explosion hazard when used in the relevant explosive atmosphere.

6.4 Electrical equipment of the type “n” and that which ensures the absence of sparks and arcs and of “hot spots” during its normal operation

6.4.1 Electrical apparatus having type “n” protection shall be constructed in accordance with IEC 60079-15.

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6.4.2 Electrical apparatus of the type which ensures the absence of sparks and arcs and of "hot spots" during its normal operation, may be considered suitable, subject to its being considered acceptable for use in the flammable atmosphere(s) concerned by the appropriate authority.

6.5 Electrical equipment in hazardous areas

6.5.1 Electrical equipment or cables shall not normally be installed in hazardous areas.

Where essential for operational purposes, the types of equipment specified in 6.5.2, 6.5.3 and 6.5.4.and the cables required for operation of the equipment may be considered, according to the zone in which they are located.

Through runs of cables may be accepted, where permitted by 6.5.3 and 6.5.4, if alternative routes are impracticable.

The equipment shall be located in the least hazardous area practicable.

6.5.2 Only the following equipment may be consider*e*d for zone 0:

a) certified intrinsically-safe apparatus of category "ia";

b) simple electrical apparatus and components (for example thermocouples, photocells, strain gauges, junction boxes, switching devices), included in intrinsically-safe circuits of category "ia", not capable of storing or generating electrical power or energy in excess of the limits given in IEC 60079-14 and acceptable to the appropriate authority.

   NOTE – Consideration may need to be given to matters such as the integrity of the insulation from earth of the circuit, the suitability of any plastics or light metals incorporated in the construction of the apparatus or component, and (except in the cases of switches, plugs and sockets, and terminals) the maximum surface temperature of any part of the apparatus.

   Apparatus reliant upon voltage or current limiting or suppression devices for remaining within the limits set by IEC 60079-14, is excluded from the category of "simple apparatus".

c) other electrical apparatus specifically designed and certified by the appropriate authority for use in zone 0; for precautions against operation under conditions of earth fault or failure of electrical insulation, see 5.3.4;

d) submersible electrically-driven pumps, having at least two independent methods of shutting down automatically in the event of low liquid level.

   The construction and installation of the pump and associated cabling, and the means by which it is prevented from being energized when not submerged or in an atmosphere incapable of supporting combustion, are to be acceptable to the appropriate authority.

   For precautions against operation under earth fault or insulation failure conditions, see 5.3.4.

6.5.3 Only the following equipment may be considered for zone 1:

a) any type that may be considered for zone 0;

b) certified intrinsically-safe apparatus of category "ib";

c) simple electrical apparatus and components (for example thermocouples, photocells, strain gauges, junction boxes, switching devices), included in intrinsically-safe circuits of category "ib", not capable of storing or generating electrical power or energy in excess of the limits given in IEC 60079-14, 13.21, and acceptable to the appropriate authority;

d) certified flameproof (type "d");

e) certified pressurized (type "p");

   NOTE – Automatic shutdown may be required in compliance with IEC 60079-2, when values of over-pressure and/or protective gas flow fall below minimum prescribed values.

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f) certified increased safety (type “e”);

NOTE – Additional protection (for example air-purging prior to starting) may be required to counter the risk of air-gap sparking in induction motors of 3 kV and above.

g) certified encapsulated (type “m”);

h) certified sand filled (type “q”):

NOTE – The humidity found in a normal marine environment may change the properties of the filling material.

i) certified oil-immersed apparatus (type “o”) only when required by the application and permitted by the appropriate authority;

j) certified specially (type “s”);

k) hull fittings containing the terminals or shell-plating penetrations for anodes or electrodes of an impressed current cathodic protection system, or transducers such as those for depth-sounding or log systems, provided that such fittings are of gastight construction or are housed within a gastight enclosure, and are not located adjacent to a cargo tank bulkhead. The design of such fittings or their enclosures and the means by which cables enter, and any testing to establish their gas-tightness, are to be to the satisfaction of the appropriate authority;

l) through runs of cable.

6.5.4 The following equipment may be considered for zone 2:

a) any type that may be considered for zone 1;

b) tested specially for zone 2 (for example type “n” protection);

c) pressurized, and acceptable to the appropriate authority;

d) having an enclosure filled with a liquid dielectric, or encapsulated, and acceptable to the appropriate authority;

e) the type which ensures the absence of sparks and arcs and of “hot spots” during its normal operation.

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

6.6 Movable equipment

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 6.2.

NOTE – Hand-held (portable) equipment should meet the drop test requirements of IEC 60079-0, 22.4.3.2 and 22.4.3.3.

7 Installation

7.1 General

7.1.1 In addition to the requirements stated in other parts of IEC 60092, electrical installations in hazardous areas shall comply, as far as applicable, with IEC 60079-14 and with the requirements stated below

7.1.2 The installation shall comply with any special conditions that may apply to the safe use of the electrical apparatus, particularly, any stated in the certification documentation of the apparatus.

7.1.3 Where in this clause any special type of installation is specified, the use of any other method of installation is admissible provided it is shown to the satisfaction of an appropriate authority that it is not less safe.

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7.2 Selection of apparatus

7.2.1 Selection of electrical apparatus shall be in accordance with 6.2.

7.3 Wiring system – general

7.3.1 For the construction and testing of cables see IEC 60092-350.

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

7.4 Cable wiring systems

7.4.1 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). Aluminium sheathed cables may be considered for special applications.

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

7.4.3 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.

7.4.4 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.

7.4.5 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.

7.4.6 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.

7.5 Connection of cables

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

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

7.6 Cable joints

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.

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8 Ventilation and pressurisation

8.1 General

8.1.1 The probability of accumulation of gases in an area depends on the potential discharge within the area and the ventilation of the area.

8.1.2 The following main ventilation conditions are recognised:

8.1.2.1 Natural ventilation

Examples of spaces and areas which may have such ventilation are:

– open deck area;
– enclosed or semi-enclosed spaces with openings for natural ventilation, for example compartment for cargo hoses.

8.1.2.2 Artificial ventilation

Examples of spaces which may have such ventilation are:

– cargo pump rooms and cargo compressor rooms.

8.1.2.3 Pressurisation by means of artificial ventilation

Examples of spaces which may be pressurized are:

– rooms protected by air-locks.

8.1.2.4 No ventilation

Examples of spaces which may have no ventilation are:

– cofferdams;
– hold spaces containing independent cargo tanks;
– void spaces;
– other enclosures or rooms having no permanent opening (i.e. to be opened with tools only).

8.1.3 The ventilation provided to ensure the safety and comfort of persons will not necessarily be regarded as sufficient for removal of gases to avoid accumulation for the purpose of this standard.

NOTE – For personnel protection, the following ventilation rates should be provided:

– for hazardous spaces not containing a source of release: at least 6 air changes per hour;
– for hazardous spaces containing sources of release: at least 30 air changes per hour.

8.1.4 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 by pressurisation designed and operated in accordance with the requirements given in 8.2 and 8.4.

8.1.5 Spaces, other than those protected by pressurisation, which are normally dependent upon ventilation for their area classification, will not change their zone even if the ventilation is not continuous (see also 8.3.1).

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8.2 Design principles

8.2.1 Any ducting used for the ventilation of hazardous spaces shall be separate from that used for the ventilation of non-hazardous spaces.

8.2.2 Where artificial ventilation is applied to spaces which are not separated by gastight boundaries it shall be such that the hazardous enclosed spaces are maintained with under-pressure in relation to the less hazardous spaces, and non-hazardous enclosed spaces are maintained in over-pressure in relation to the adjacent hazardous spaces.

8.2.3 Air inlets for hazardous enclosed spaces shall be taken from areas which, in the absence of the considered inlet, would be non-hazardous. Where the inlet duct passes through a more hazardous space, the inlet duct is to have over-pressure in relation to this space unless the mechanical integrity and gas-tightness of the duct is considered by the appropriate authority to be such that no pressure differential is required to ensure that gases will not leak into the duct.

8.2.4 Air outlets from hazardous enclosed spaces shall be located in an open area which, in the absence of the considered outlet, would be of the same or lesser hazard than the ventilated space.

8.2.5 Air inlets for non-hazardous enclosed spaces shall be taken from non-hazardous areas at least 1,5 m from the boundaries of any hazardous area. Where the inlet duct passes through a hazardous area the inlet duct is to have over-pressure in relation to this area unless the mechanical integrity and gas-tightness of the duct is considered by the appropriate authority to be such that no pressure differential is required to ensure that gases will not leak into the duct.

Air outlets from non-hazardous enclosed spaces shall be located in a non-hazardous open area.

8.3 Ventilation related to area classification

8.3.1 Where the area classification of a space is dependent upon its ventilation the arrangements shall be such that discontinuities in ventilation are not expected to occur for long periods.

NOTE – See also the requirements for availability of ventilation given in IEC 60079-10.

8.3.2 The arrangements shall ensure that there is no accumulation of gas or vapour in the vicinity of any source of release, or where electrical equipment is installed.

8.3.3 Failure of artificial ventilation shall be alarmed (audible and visual) at a manned station.

NOTE – Initiation of an alarm by a fan motor running or fan rotation monitoring device will not satisfy this requirement.

8.4 Protection by over-pressure

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 (see also table 2).

8.4.1 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.

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

8.4.3 A differential pressure monitoring device or a flow monitoring device, or both, shall be provided for monitoring the satisfactory functioning of pressurisation 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.

8.4.4 Where a flow monitoring device is used to indicate failure of pressurisation, it is either to be verified that the pressurisation level required by 8.4.1 is maintained with any door or other opening open, or an alarm is to be given if any door or opening is not closed.

8.4.5 In the event of the loss of over-pressure, the protective measures indicated in table 5 shall apply.

Table 5 – Protective measures to be taken in the event of failure of pressurization

Classification of the space[1)]	**Electrical equipment installed**		
	Equipment suitable for use in zone 1	**Equipment suitable for use in zone 2**	**Equipment not protected for any hazardous area**
Zone 1	No action necessary	– Suitable alarm (visible and audible) – Immediate action to restore pressurisation – Programmed disconnection of power supplies if the pressurisation cannot be restored for an extended period or if the concentration of flammable gas rises to a dangerous level	– Suitable alarm (visible and audible) – Immediate action to restore pressurisation – 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
Zone 2	No action necessary	No action necessary	– Suitable alarm (visible and audible) – Immediate action to restore pressurisation – Programmed disconnection of power supply if the pressurisation cannot be restored for an extended period or if the concentration of flammable gas rises to a dangerous level

[1)] Classification of the space or area into which the opening leads.

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9 Inspection and maintenance

9.1 General

In addition to the requirements stated in other parts of IEC 60092, electrical installations in hazardous areas shall be inspected, tested and maintained in accordance with the recommendations of IEC 60079-17 and the requirements stated below.

9.2 Inspection and testing

Alarms, monitoring and interlocks associated with pressurized equipment and spaces shall be periodically tested to ensure correct operation.

9.3 Isolation of apparatus

9.3.1 Where equipment has a warning label giving a delay time to allow any surface temperature or stored electrical energy to decay to a level below which it is incapable of causing ignition, or requiring that the apparatus be opened only under gas-free conditions, the requirements of the label are to be observed.

9.3.2 Where, for the purpose of electrical testing, it is essential to restore the supply before the apparatus is re-assembled, this work shall be undertaken only on the issue of a gas-free certificate confirming that adequate control measures have been taken and that tests have been made and will be repeated at a frequency sufficient to ensure that the safe conditions are maintained

9.4 Maintenance

9.4.1 Maintenance shall be carried out as necessary to ensure that an electrical installation is in a proper condition at all times.

9.4.2 Where any repair or overhaul of apparatus is found to be required, this is to be carried out in accordance with IEC 60079-19.

9.4.3 Following any modification, additions or adjustment, the items concerned shall be inspected and tested to ascertain that requirements stipulated in this standard are complied with.

9.5 Qualifications of personnel

9.5.1 Inspection and maintenance of installations shall be carried out only by experienced personnel whose training has included instruction on the various types of protection of apparatus and installation practices to be found on the vessel.

9.5.2 Appropriate refresher training shall be given to such personnel on a regular basis.

10 Documentation

10.1 Area classification

10.1.1 Area classification of a tanker shall be documented on area classification drawings; sources of release shall be detailed on the drawings, or on an accompanying schedule.

The drawings shall include plans and section view*s* of process equipment, and type and extent of zones. In addition, spaces held at over-pressure/under-pressure, ventilation openings, air-locks, bulkheads, structures, etc. shall be indicated. Other conditions which may affect the extent of zones shall also be indicated.

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10.1.2 The different types and levels of ventilation and pressurisation shall be documented.

10.2 Equipment

10.2.1 All electrical equipment located in hazardous areas and in the spaces which may become hazardous on loss of pressurisation shall be, together with any associated safe-area apparatus (such as zener safety barriers) required for the protection of the equipment, listed on a schedule.

The schedule shall include the following details:

– location;
– zonal classification of location;
– type of equipment;
– manufacturer;
– type reference;
– test authority and certificate number, or, reference and date of manufacturer's declaration;
– type of protection (as listed in 6.5);
– apparatus group;
– temperature class;
– ambient temperature range for which equipment is suitable;
– ingress protection (IP) rating.

NOTE – Type of protection, apparatus group and temperature class will, typically, be given together in the form of the apparatus "coding" for example ExdIIBT4; this may be followed by an indication of any extension of the normal ambient temperature range (to which 6.2.6.2 refers), for example (T_{amb} = 60 °C)

10.2.2 For certified safe type equipment for use in zone 0 or in zone 1 guarantees concerning the safety of its operation in the flammable atmosphere shall be supplied in the form of test certificates of conformity or equivalent documentation issued by independent and competent authorities.

10.2.3 Electrical equipment for use in zone 2, in general should comply with 10.2.2 with regard to certification. Where no test certificate is required, a manufacturer's declaration or a certificate issued by an appropriate authority shall be provided to confirm at least the standard to which the equipment is constructed.

For electrical equipment of the type which ensures the absence of sparks and arcs and of "hot-spots" during its normal operation, the manufacturer shall provide a declaration that the equipment is of this type, giving the maximum surface temperature in normal running conditions.

The manufacturer's declaration or the certificate shall also give any further information considered by the appropriate authority to be required in order to verify the suitability of the equipment for its intended application.

NOTE – Information might be required in respect of matters such as impact resistance, security of electrical connections, clearances of rotating parts, surface conductivity of plastics parts, etc., where not addressed by the standards to which the equipment is constructed.

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10.3 Installation

10.3.1 It shall be documented that all equipment, cables, etc., have been installed in accordance with installation procedures and guidelines issued by the manufacturer of the equipment, cables, etc., and any special conditions for safe use given by the certification or approval documentation of the equipment (where of safe type), and that the installation has been carried out in accordance with the provisions set out in clause 7.

10.3.2 For spaces protected by pressurisation, it shall be documented that:

– the construction of the space and the protective measures have been examined, and any testing considered necessary by the appropriate authority has been carried out, to confirm that purging can be effected; the documentation shall state the purge time required at the minimum flow rate of the ventilation system;
– the minimum over-pressure required by clause 8 can be maintained with the minimum flow rate of the pressurisation system with all the openings closed (or open, if ventilation flow rate only is monitored), in normal working conditions;
– any required shutdown and/or alarm signal(s) is (are) initiated upon ventilation over-pressure or flow rate falling below the prescribed values.

10.3.3 For spaces other than those protected by pressurisation, where area classification depends on mechanical ventilation, it shall be documented that:

– any testing considered necessary by the appropriate authority has been carried out to confirm that the ventilation flow rate is adequate and that the arrangements leave no stagnant air, leading to an accumulation of gas or vapour;
– any required ventilation failure alarm operates correctly.

10.3.4 For apparatus for which safety in hazardous areas depends upon the correct operation of protective devices, (such as the overload protection relay for an Exe motor, or the thermal cutout of a heater), and/or the operation of an alarm (such as the loss of pressurisation alarm for an Exp control panel), it shall be documented, that:

– the devices have the correct settings or rating;
– any testing considered necessary by the appropriate authority to confirm the correct operation of the arrangements has been carried out.

10.3.5 For apparatus for which safety in hazardous areas depends upon the correct fusing of its electrical supply or limitation of the prospective fault level of the supply (such as Ex s or Ex m apparatus), it shall be documented that fuse-links of the correct characteristics are installed, or that the prospective fault level does not exceed that permitted.

10.3.6 For equipment permitted only by virtue of the provision of appropriate interlocking and shutdown arrangements, such as submerged cargo pumps, it shall be documented that any testing considered necessary by the appropriate authority to confirm the correct operation of those arrangements has been carried out.

10.3.7 For installation of electrical equipment and electrical systems with the type of protection “i”, it shall be documented that the installation has been examined and that the necessary tests have been carried out to ensure that the equipment and associated wiring are installed correctly in accordance with the manufacturer’s documentation.

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10.4 Maintenance

Maintenance procedures and records for electrical equipment located in and associated with hazardous areas shall be documented.

Documentation shall include the date of inspection, details of any maintenance procedure found necessary, and the date when such maintenance was completed. The company(ies) and name(s) of the person(s) who carried out the inspection and maintenance work shall also be recorded.

10.5 Administration of the documentation

Documentation shall always be kept updated and available in a location known to the operating personnel.

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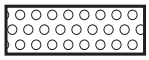
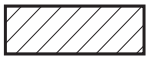
Annex A
(informative)

Examples of hazardous area classification – Basic principles

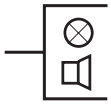
Symbols:


Area classification as zone 0


Area classification as zone 1


Area classification as zone 2

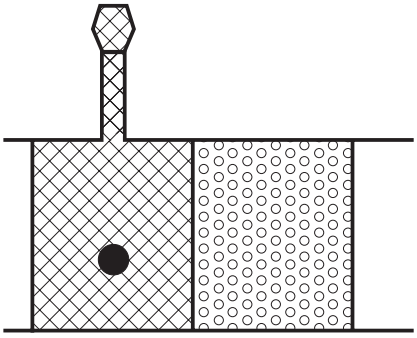
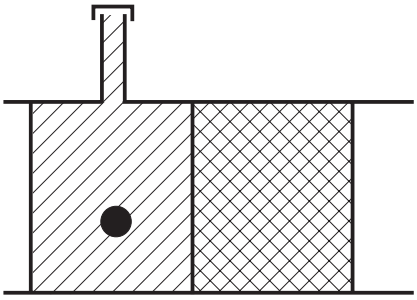

Self-closing door without holding back arrangements


Audible and visual alarm in case of loss of pressure or failure of ventilation


Source of release

> p

Pressure above atmospheric pressure

Item	Subclause	Typical examples	Remarks
A.1	4.1.4.1, table 1		
A.2	4.1.4.1, table 1		

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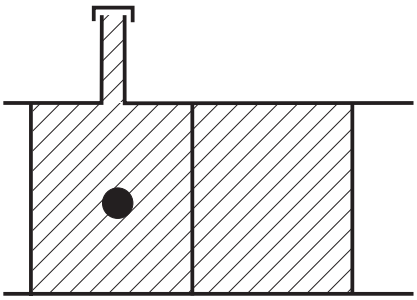
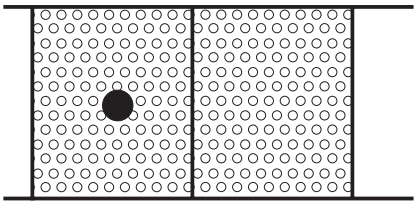
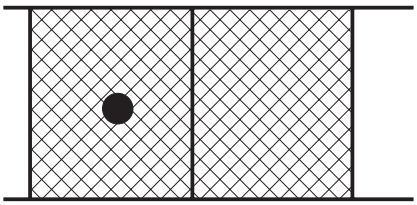
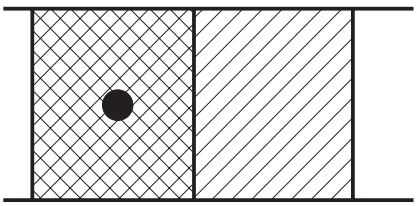
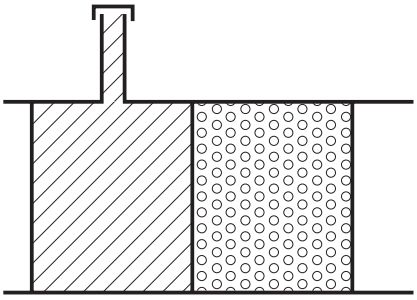
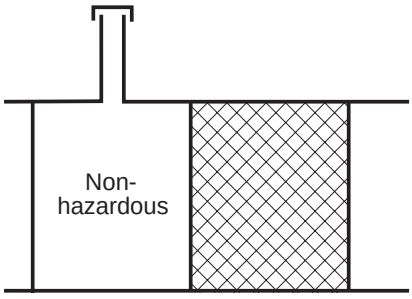
A.3	4.1.4.1, table 1		
A.4	4.1.4.1, table 1		
A.5	4.1.4.1, table 1		
A.6	4.1.4.1, table 1		
A.7	4.1.4.1, table 1		
A.8	4.1.4.1, table 1		

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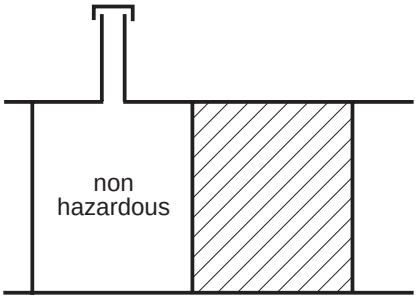
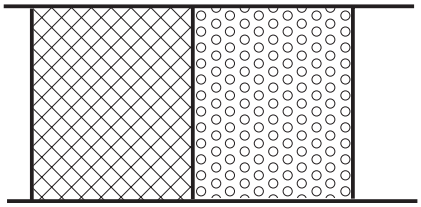
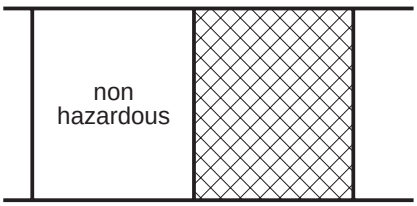
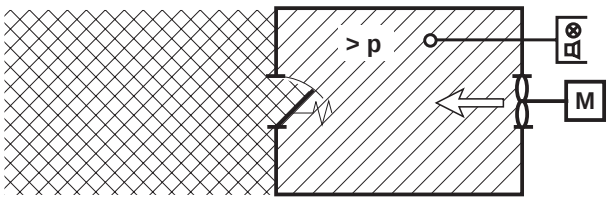
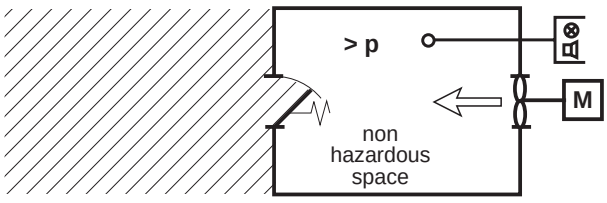
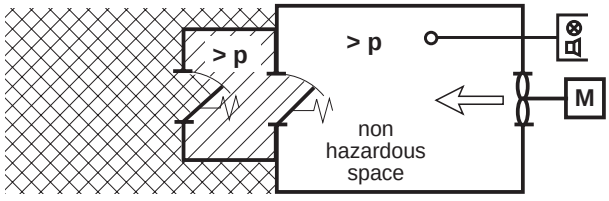
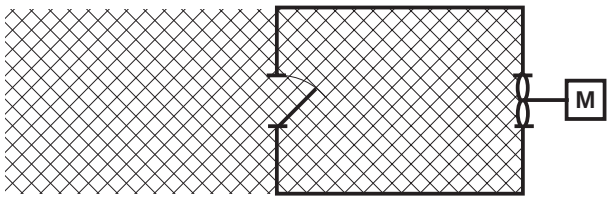
A.9	4.1.4.1, table 1		
A.10	4.1.4.1, table 1		
A.11	4.1.4.1, table 1		
A.12	4.1.4.1, table 1		
A.13	4.1.5.2 a), table 2		Pressurized space
A.14	4.1.5.2 b), table 2		Pressurized space
A.15	4.1.5.2 c), table 2		Pressurized spaces
A.16	4.1.5.4, table 2		With or without door With natural or artificial ventilation

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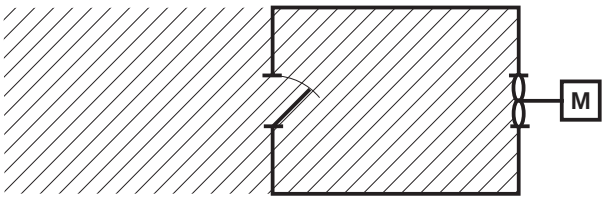
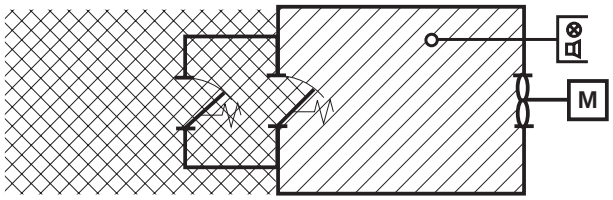
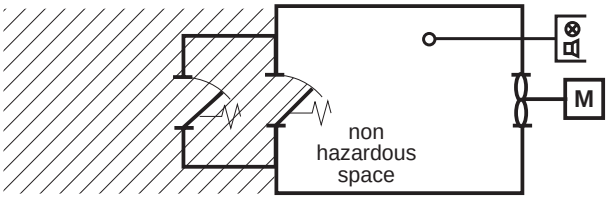
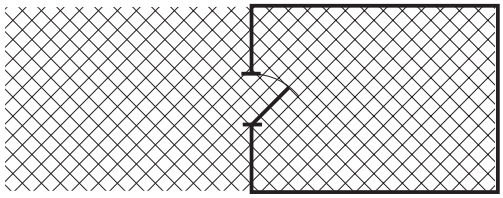
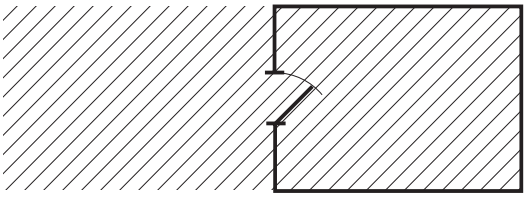
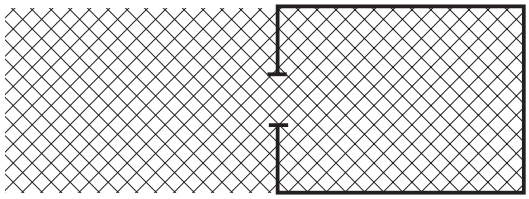
A.17	4.1.5.4, table 2		With or without door With natural or artificial ventilation
A.18	4.1.5.3 a), table 2		Airlock to be ventilated
A.19	4.1.5.3 b), table 2		Airlock to be ventilated
A.20	4.1.5.5, table 2		With one or two doors
A.21	4.1.5.5, table 2		With one or two doors
A.22	4.1.5.5		Or more hazardous zone

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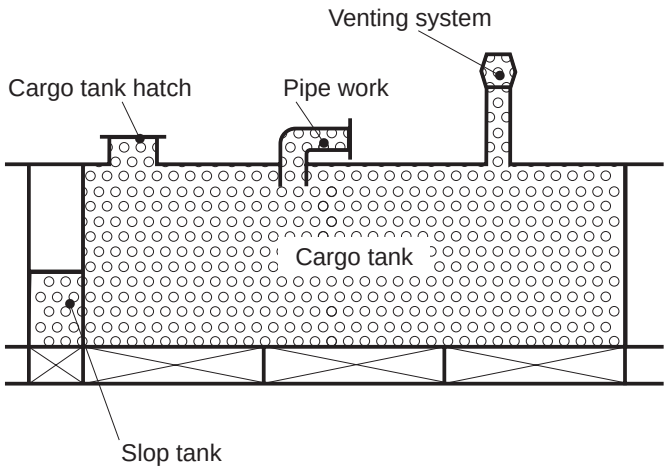
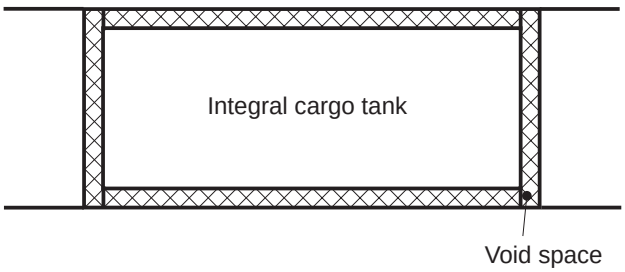
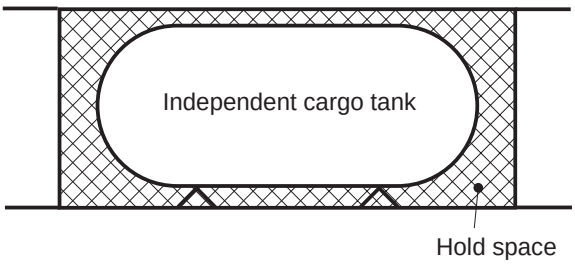
Annex B
(informative)

Examples of hazardous area classification –

Tankers carrying flammable liquids other than liquefied gases having a flashpoint not exceeding 60 °C, for example, crude oil, oil products, chemical products

Symbols: see annex A

Item	Subclause	Typical examples	Remarks
B.1	4.2.1		
B.2	4.2.2.1		
B.3	4.2.2.2		

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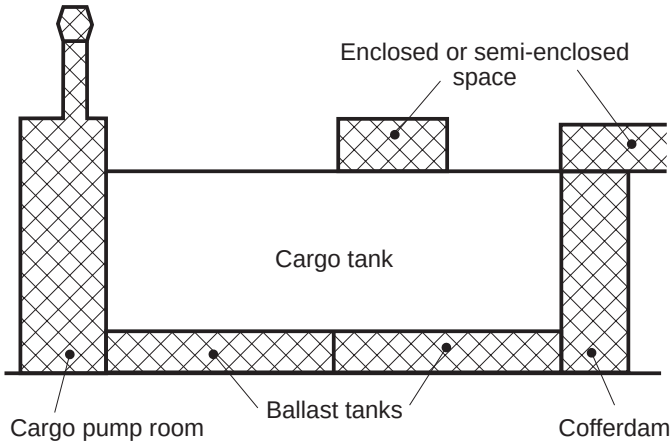
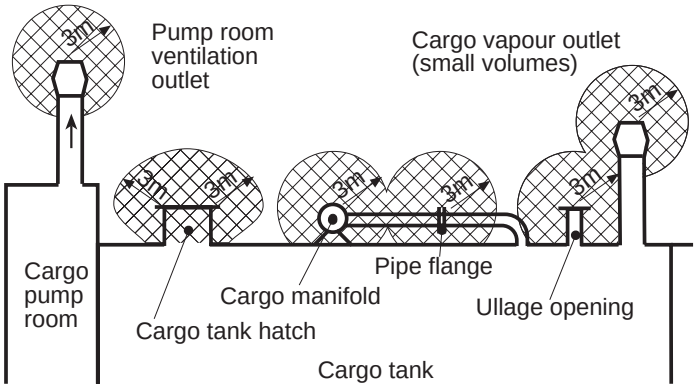
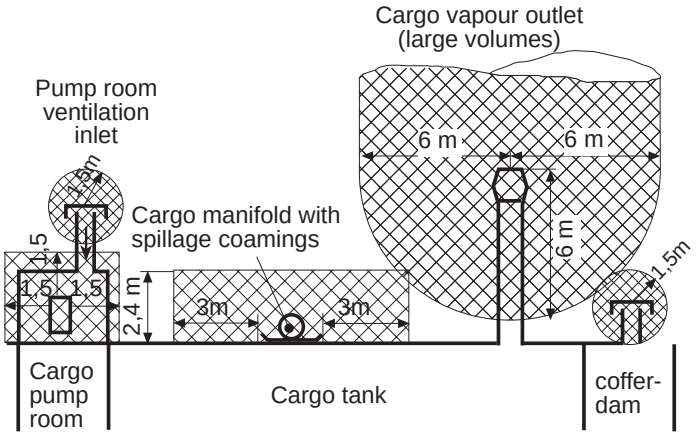
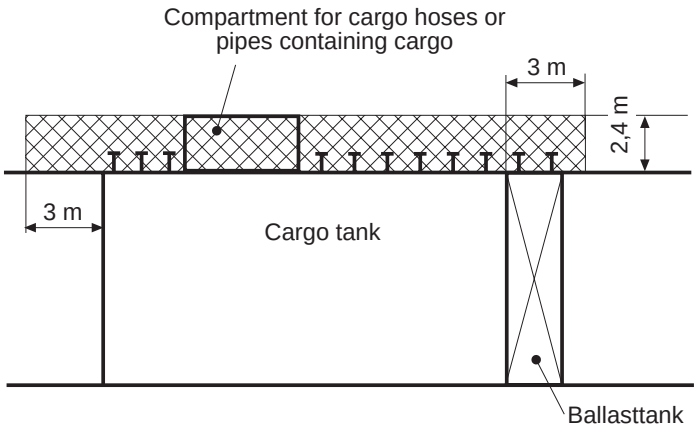
B.4	4.2.2.3 4.2.2.4 4.2.2.5 4.2.2.6		
B.5	4.2.2.7		Cargo vapour outlet caused by thermal variation
B.6	4.2.2.8 4.2.2.9 4.2.2.10		Cargo vapour outlet caused by loading, ballasting or discharging
B.7	4.2.2.11 4.2.2.12 4.2.2.13		When natural ventilation is restricted

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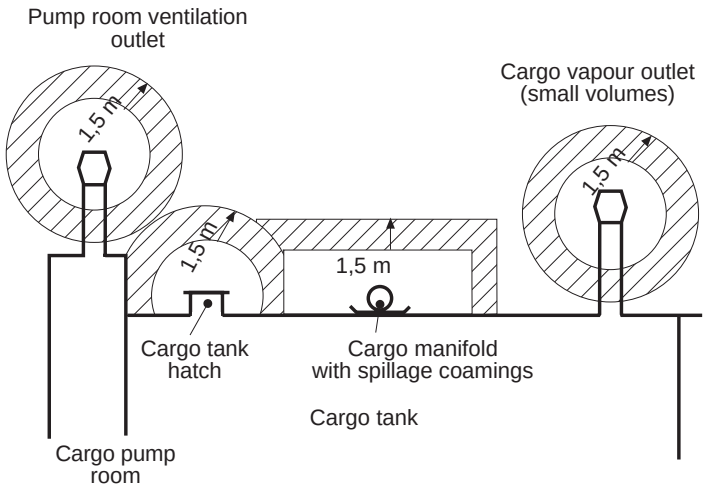
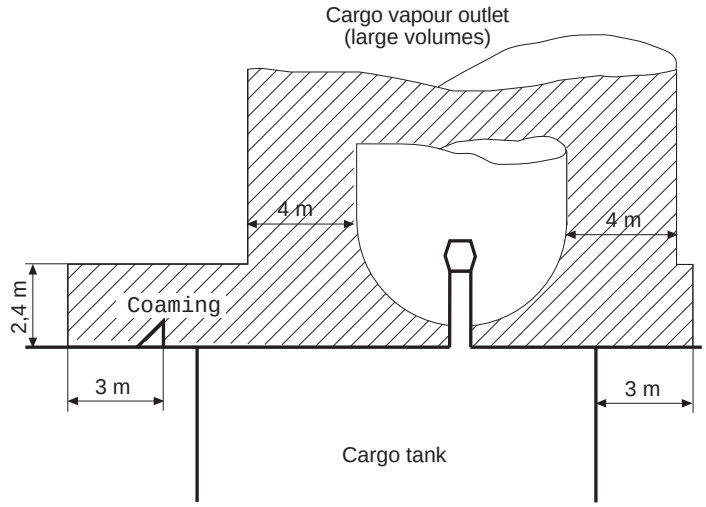
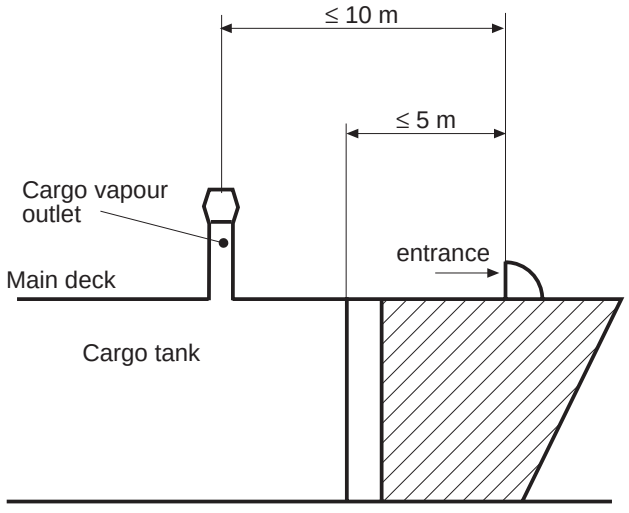
B.8	4.2.3.1		Cargo vapour outlet caused by thermal variation
B.9	4.2.3.2 4.2.3.4 4.2.3.5		Cargo vapour outlet caused by loading, ballasting or discharging
B.10	4.2.3.6		Space not mechanically ventilated and opening less than 0,5 m above main deck

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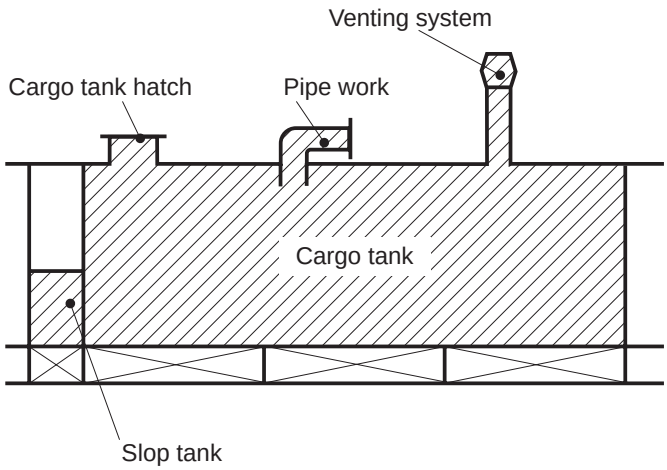
Annex C
(informative)

Examples of hazardous area classification –
Tankers 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 annex A

Item	Subclause	Typical examples	Remarks
C.1	4.3.1.1		

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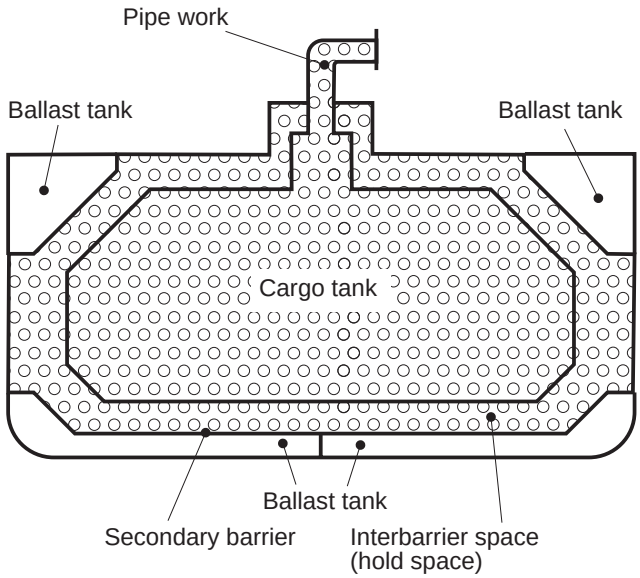
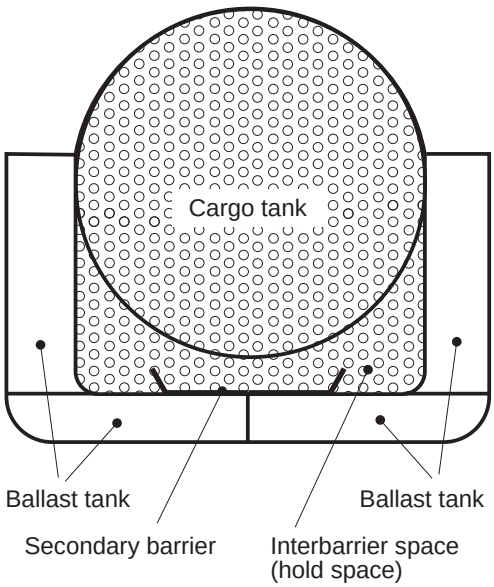
Annex D
(informative)

Examples of hazardous area classification – Tankers carrying flammable liquefied gases

Symbols: see annex A

Item	Subclause	Typical examples	Remarks
D.1	4.4.1	 	Where secondary barrier is required
D.2	4.4.2.1	see annex B	

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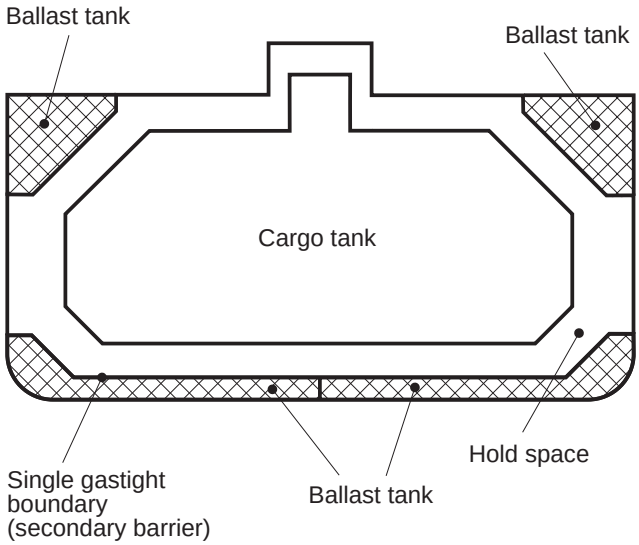
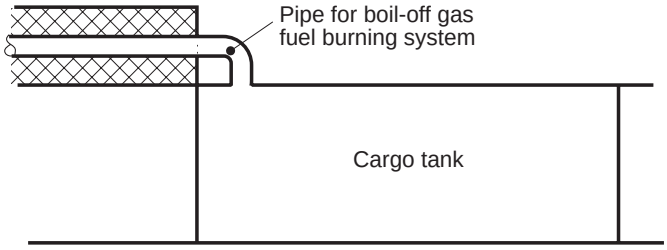
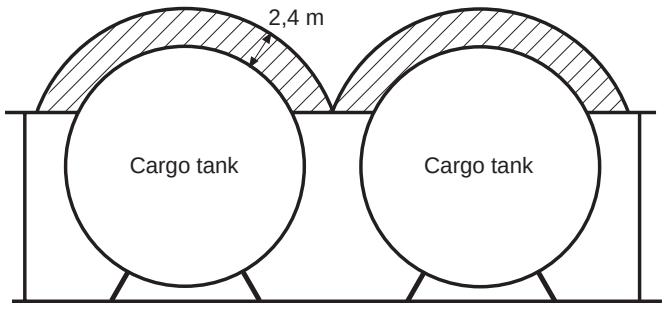
D.3	4.4.2.2		Where secondary barrier is required
D.4	4.4.2.3		Unless special precautions are provided
D.5	4.4.3.1	see annex B	
D.6	4.4.3.2		Outer surface of the cargo tank is taken to be the outer surface of insulation

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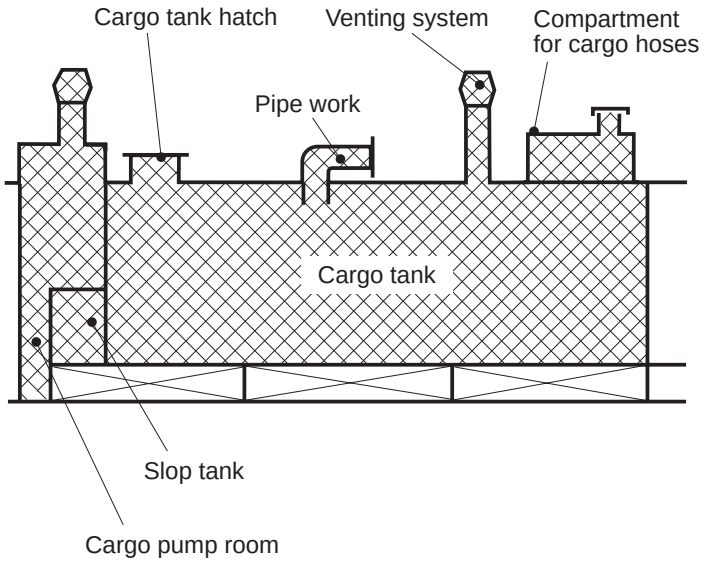
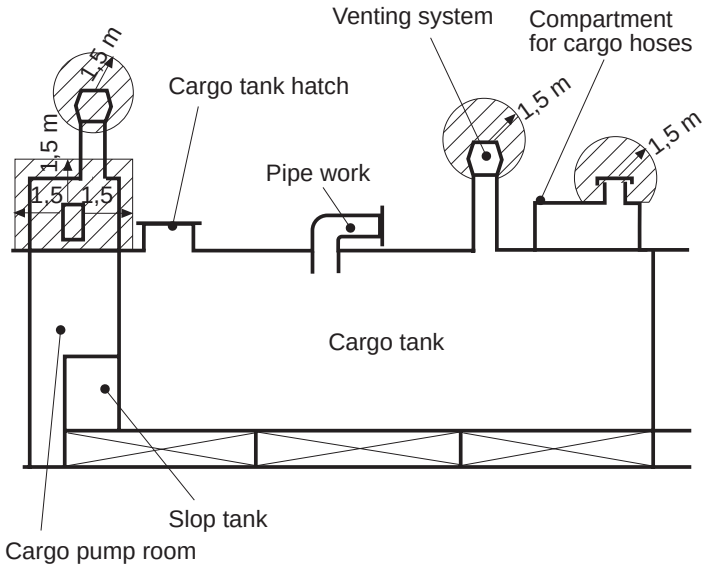
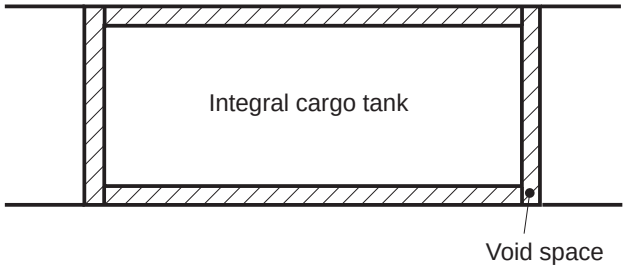
Annex E
(informative)

Examples of hazardous area classification –

Tankers carrying cargoes (for example acids) reacting with other products/materials to evolve flammable gases

Symbols: see annex A

Item	Subclause	Typical examples	Remarks
E.1	4.5.1		
E.2	4.5.2 a)		
E.3	4.5.2 b)		

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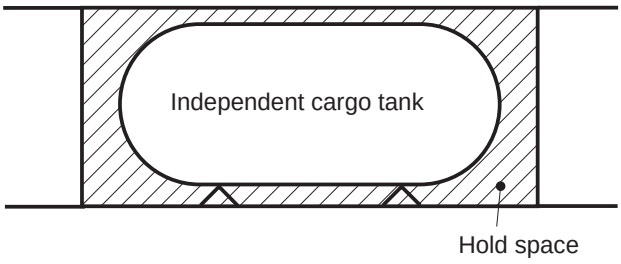
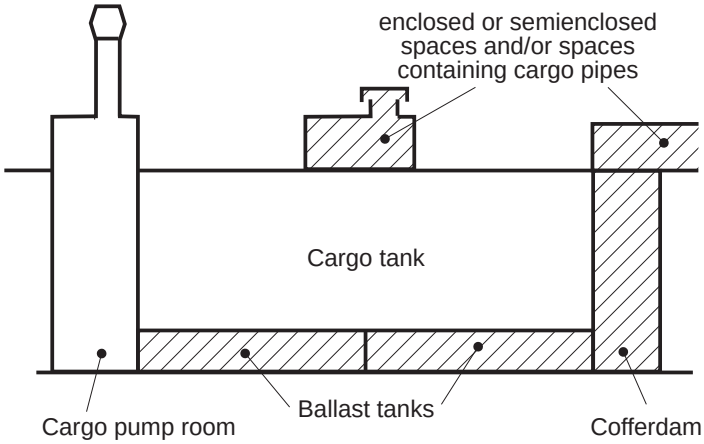
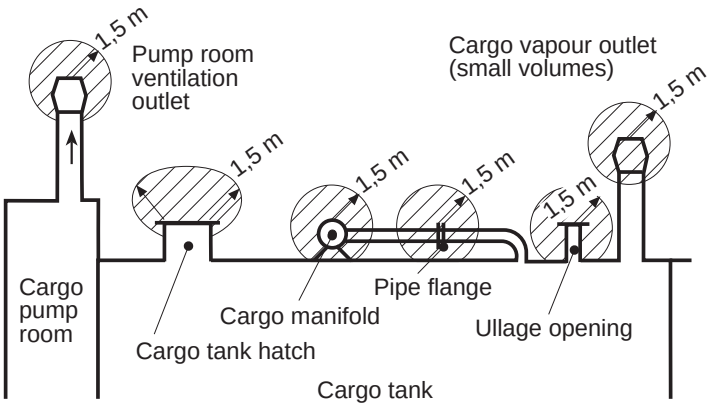
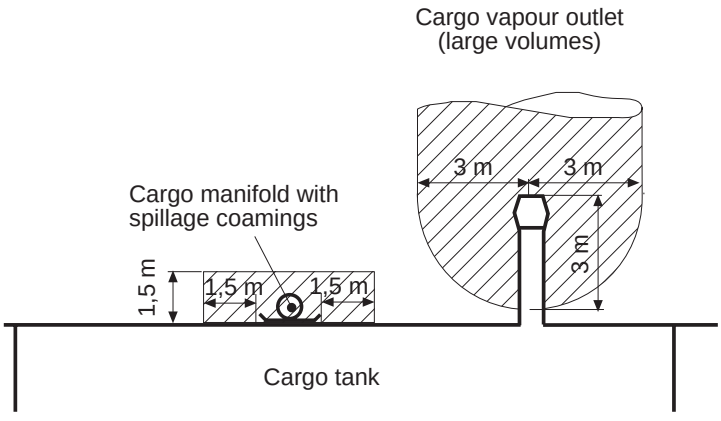
E.4	4.5.2 b)		
E.5	4.5.2 b)		
E.6	4.5.2 c)		Cargo vapour outlet caused by thermal variation
E.7	4.5.2 c)		Cargo vapour outlet caused by loading, ballasting or discharging

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Q2 Please tell us in what capacity(ies) you bought the standard *(tick all that apply).* I am the/a:

purchasing agent ❑
librarian ❑
researcher ❑
design engineer ❑
safety engineer ❑
testing engineer ❑
marketing specialist ❑
other.....

Q3 I work for/in/as a: *(tick all that apply)*

manufacturing ❑
consultant ❑
government ❑
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education ❑
military ❑
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Q4 This standard will be used for: *(tick all that apply)*

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specifications ❑
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certification ❑
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thesis ❑
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other.....

Q5 This standard meets my needs: *(tick one)*

not at all ❑
nearly ❑
fairly well ❑
exactly ❑

Q6 If you ticked NOT AT ALL in Question 5 the reason is: *(tick all that apply)*

standard is out of date ❑
standard is incomplete ❑
standard is too academic ❑
standard is too superficial ❑
title is misleading ❑
I made the wrong choice ❑
other .....

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(3) average,
(4) above average,
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(6) not applicable

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other .....

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