IEC 60730-2-6

Edition 3.0 2015-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Automatic electrical controls –
Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements

Dispositifs de commande électrique automatiques –
Partie 2-6: Exigences particulières pour les dispositifs de commande électrique automatiques sensibles à la pression y compris les exigences mécaniques

IEC60730-2-6:2015-04(en-fr)

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AUTOMATIC ELECTRICAL CONTROLS –

Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements

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International Standard IEC 60730-2-6 has been prepared IEC technical committee 72: Automatic electrical controls.

This bilingual version (2018-01) corresponds to the monolingual English version, published in 2015-04.

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

a) aligns the text with IEC 60730-1, Edition 5;
b) modifies requirements for Class B control function (H.27.1.2.2);
c) modifies requirements for Class C control function (H.27.1.2.3);
d) modifies requirements for faults during lock-out or safety- shut-down.

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

FDIS	Report on voting
72/980/FDIS	72/992/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.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This part 2 is intended to be used in conjunction with IEC 60730-1. It was established on the basis of the fifth edition (2013) of that publication. Consideration may be given to future editions of, or amendments to, IEC 60730-1.

This part 2 supplements or modifies the corresponding clauses in IEC 60730-1 so as to convert that publication into the IEC standard: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements.

Where this part 2 states "addition", "modification", or "replacement", the relevant requirement, test specification or explanatory matter in part 1 should be adapted accordingly.

Where no change is necessary, this part 2 indicates that the relevant clause or subclause applies.

In the development of a fully international standard, it has been necessary to take into consideration the differing requirements resulting from practical experience in various parts of the world and to recognize the variation in national electrical systems and wiring rules.

The “in some countries” notes regarding differing national practices are contained in the following subclauses:

10.1.4

15.1.101

18.101

Annex CC

In this publication:

1) The following print types are used:
   - Requirements proper: in roman type;
   - *Test specifications: in italic type;*
   - Notes; in small roman type;
   - Words defined in Clause 2: **bold**.
2) Subclauses, notes, tables and figures which are additional to those in part 1 are numbered starting from 101, additional annexes are lettered AA, BB, etc.

A list of all parts of the IEC 60730 series, published under the title *Automatic electrical controls* can be found on the IEC website.

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The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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AUTOMATIC ELECTRICAL CONTROLS –

Part 2-6: Particular requirements for automatic electrical pressure sensing controls including mechanical requirements

1 Scope and normative references

This clause of Part 1 is applicable except as follows:

1.1 Scope

Replacement:

This part of IEC 60730 applies to automatic electrical pressure **sensing controls** with a minimum gauge pressure rating of –60 kPa and a maximum gauge pressure rating of 4,2 MPa, for use in, on or in association with, equipment. The equipment may use electricity, gas, oil, solid fuel, solar thermal energy, etc. or a combination thereof.

NOTE Throughout this standard, the word “equipment” includes “appliances” and “control system”.

This standard is also applicable to individual pressure **sensing controls** utilized as part of a **control system** or pressure **sensing controls** which are mechanically integral with multi-functional controls having non-electrical outputs.

Automatic electrical pressure **sensing controls** for equipment used by the public, such as equipment intended to be used by laymen in shops, in light industry and on farms, are within the scope of this standard.

This standard does not apply to pressure **sensing controls** intended exclusively for industrial process applications unless explicitly mentioned in the relevant equipment standard.

1.1.1 *Replacement*:

This standard applies to inherent safety, **operating values**, **operating sequences** where such are associated with equipment protection, and to the testing of automatic electrical pressure **sensing controls** used in, on or in association with equipment.

This standard is also applicable to the functional safety of low complexity safety related pressure **sensing controls** and **systems**.

This standard is also applicable to pressure **sensing controls** for appliances within the scope of IEC 60335-1.

See also Annex J.

1.1.2 *Addition*:

This standard applies to automatic **electrical controls**, mechanically or electrically operated, responsive to or controlling a pressure or vacuum.

1.1.3 Not applicable.

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1.1.4 *Replacement:*

This standard applies to **manual controls** when such are electrically and/or mechanically integral with pressure **sensing controls**.

NOTE Requirements for manual switches not forming part of an **automatic control** are contained in IEC 61058-1.

1.1.5

Replacement:

This standard applies to a.c. or d.c. powered pressure **sensing controls** with a rated voltage not exceeding 690 V a.c. or 600 V d.c.

1.1.6

Replacement:

This standard does not take into account the **response value** of an **automatic action** of a pressure **sensing control**, if such a **response value** is dependent upon the method of mounting it in the equipment. Where a **response value** is of significant purpose for the protection of the **user**, or surroundings, the value defined in the appropriate equipment standard or as determined by the manufacturer shall apply.

1.1.7

Replacement:

This standard applies also to pressure **sensing controls** incorporating **electronic devices**, requirements for which are contained in Annex H.

This standard applies also to pressure **sensing controls** using NTC or PTC **thermistors**, requirements for which are contained in Annex J.

Additional subclauses:

1.1.101 This standard contains requirements for electrical features of pressure **sensing controls** and requirements for mechanical features that affect their intended **operation**.

NOTE Subclause 18.101, as it pertains to gas and/or oil **controls**, is under consideration pending review or revision of ISO 22967, ISO 22968 and ISO 23550 series, if applicable.

1.1.102 In general, these pressure **sensing controls** are integrated or incorporated with the equipment or are intended to be integrated in, or on the equipment. This standard also covers these **controls** when they are independently mounted. **In-line cord controls** are not covered by this standard.

2 Terms and definitions

This clause of Part 1 is applicable except as follows:

2.2 Definitions of types of control according to purpose

Additional definitions:

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2.2.101
pressure limiter
pressure **sensing control** which is intended to keep a pressure below or above a predetermined value during normal operating conditions and which may have provision for **setting** by the user

Note 1 to entry: A pressure limiter may be of the automatic or of the manual reset type. It does not make the reverse **operation** during the normal **duty cycle** of the equipment.

2.2.102
pressure operating control
pressure **sensing control** set at a high or low pressure, or both, between which limits the equipment is normally intended to operate

2.2.103
pressure cut-out
pressure **sensing control** intended to keep a pressure below or above one particular value during abnormal operating conditions of the equipment and which has no provisions for **setting by the user**

Note 1 to entry: A pressure cut-out may be of the automatic or of the manual reset type.

A pressure cut-out will provide a Type 2 action.

A pressure cut-out may have an adjustable stop intended to be set by the **control manufacturer**, the **equipment manufacturer** or the **installer**.

2.3 Definitions relating to the function of controls

Additional definitions:

2.3.101
pressure medium
medium used to transmit the pressure to the pressure **sensing element**

Note 1 to entry: **Pressure medium** as used in this standard refers to either gases or liquids.

2.3.102
differential pressure
difference in a pressure between any two points in a **system**, between two **systems** or between a **system** and a reference pressure such as atmospheric pressure

Note 1 to entry: An example is the difference in static pressure between the upstream side of an orifice and the downstream side.

2.8 Definitions relating to component parts of controls

Additional definition:

2.8.101
vent
that opening from the atmospheric side of a diaphragm to the atmosphere through which air is discharged or drawn in when the **control** is functioning

3 General requirements

This clause of Part 1 is applicable.

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4 General notes on tests

This clause of Part 1 is applicable except as follows:

4.1 Conditions of test

4.1.7 *Replacement*:

The rates of pressure change declared in Table 1 requirement 37, and used in Clause 17 (i.e. α_1, β_1, α_2, β_2) shall have test tolerances as declared by the manufacturer.

4.3 Instructions for test

4.3.1 According to submission

Additional subclause:

4.3.1.101 The values in Annex AA apply for the testing of independently mounted pressure **sensing controls** in Clause 17. Values for integrated and **incorporated controls** are specified in the appropriate equipment standard.

5 Rating

This clause of Part 1 is applicable.

6 Classification

This clause of Part 1 is applicable except as follows:

6.3.9 – sensing control;

Additional subclause:

6.3.9.101 – pressure sensing;

6.4.3

Additional subclause:

6.4.3.101 – for sensing actions, no increase in the **operating value** as a result of any leakage from the **sensing element** or from parts connecting the **sensing element** to the **switch head** (Type 2.N).

6.8.3 *Replacement*:

For an **independently mounted control** or a **control** integrated or incorporated in an assembly utilizing a non-electrical energy source:

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7 Information

This clause of Part 1 is applicable except as follows:

7.2 Methods of providing information

Table 1 (7.2 of edition 3) – Required information and methods of providing information

Information	Clause or subclause	Method
Modification:		
Replace the following requirements by:		
6 Purpose of **control**	2.2.101 to 2.2.103	
	4.3.5	D
	6.3	
26 Number of cycles of **actuation** (M) for each **manual action**	6.10, Annex AA	X
27 Number of automatic cycles (A) for each **automatic action**	6.11, Annex AA	X
34 Not applicable		
44 Not applicable		
48 Operating pressure (or pressures)	2.3.11, 15, 18	D
Additional requirements:		
101 Pressure medium	2.3.101	X
102 **Operating differential**	2.3.26	D
103 **Maximum working pressure**	2.3.29	D
Addition to Note i:		
For pressure **sensing controls**, limits of activating quantity are specified either in the applicable appliance standard, by the appliance manufacturer or as declared by the pressure **sensing control manufacturer** (see 17.7 and 17.8).		

8 Protection against electric shock

This clause of Part 1 is applicable.

9 Provision for protective earthing

This clause of Part 1 is applicable.

10 Terminals and terminations

This clause of Part 1 is applicable except as follows:

10.1 Terminals and terminations for external copper conductors

10.1.4 *Addition:*

NOTE In the USA, **controls** for **operation** above 50 V shall be provided with suitable wiring terminals or leads for the connection of **fixed wiring** conductors having an ampere rating of no less than:

– 1,25 times the ampere rating of a fixed electric space-heating equipment load;

– 1,25 times the full-load motor current rating of a single motor;

– 1,25 times the combination load of a full-load motor current and 1,25 times a fixed electric space-heating equipment load;

– 1,25 times the full load current of the largest motor plus the full load amperes of the other loads;

– 1,0 times all other loads.

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11 Constructional requirements

This clause of Part 1 is applicable except as follows:

11.4 Actions

Additional subclause:

11.4.101 Type 2.N action

A Type 2.N action shall be so designed that in the event of a leak in the **sensing element**, or in any other part between the **sensing element** and the **switch head**, the declared disconnection or interruption is provided before the sum of the declared operating pressure and **drift** is exceeded.

Compliance is checked by the following test:

*The operating pressure of a Type 2.N **control** shall be measured under the conditions of Clause 15 of Part 1. If the **control** has means for setting, it shall be set to the highest value.*

*After this measurement, a hole is artificially produced in the **sensing element** and the measurement of the operating pressure is repeated.*

*No positive **drift** is allowed beyond the declared value.*

A separate shroud or sleeve may be employed for protection of the sensing element to achieve conformance with Clause 18.

NOTE The test can be replaced by theoretical computations of the physical mode of operation.

11.11 Requirements during mounting, maintenance and servicing

Additional subclauses:

11.11.101 Parts in contact with a diaphragm shall have no sharp burrs, projections or the like which might chafe or abrade the diaphragm.

Compliance is checked by inspection before and after the tests of Clause 17.

11.11.102 An operating spring shall be retained and arranged to prevent abrasion, binding, buckling or interference with its free movement.

Compliance is checked by inspection before and after the tests of Clause 17.

11.11.103 If **failure** of any part of the **control** would allow unsafe leakage of a hazardous fluid, that part shall be made of a material having a melting point (solidus temperature) of not less than 510 °C and a tensile strength of not less than 68 MPa at 204 °C.

Such parts shall not sag, distort, melt, oxidize or show leakage of fluid during any of the tests specified herein.

Compliance is checked by inspection and the tests of Clause 17.

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11.11.104 A part including a sheath, capillary tube, bellows or diaphragm shall be resistant to atmospheric corrosion and attack by the fluid it may normally contact in service, if **failure** of the part will permit external fluid leakage of a combustible fluid or cause the **control** to malfunction.

NOTE Brass alloys containing less than 81 % copper and more than 9 % zinc are not considered resistant to the corrosive effects of fuel oils.

11.11.105 A **control** in which a flexible diaphragm, bellows or similar construction constitutes the only flammable gas or fluid seal shall have the atmospheric side of the diaphragm or bellows enclosed in a casing designed to limit external fluid leakage in the event of a diaphragm or bellows rupture or shall have provisions for connection of a vent pipe or tubing intended to be routed to the outdoors or other safe location.

11.11.106 *A **control** designed to supervise the pressure of fuel oil of 1,00 mm^2/s to 600 mm^2/s viscosity is not required to conform to 18.101 and 18.102, provided three samples of the **control**, when subjected to a 100 000 cycle endurance test, show no evidence of leakage during the test and when subjected to a hydrostatic test of four times the maximum working pressure, following the endurance test, and the **control** conforms to one of the following:*

*a) the bellows, Bourdon tube, diaphragm or similar element is made of stainless steel or material of equivalent resistance to corrosion designated material Class A, if leakage from a ruptured element will be into the **control** enclosure, in which case such leakage is to be released to the exterior of the **control** before entering any opening provided for conduit connection, or*

*b) the bellows, Bourdon tube, diaphragm or similar element is made of stainless steel or material of equivalent resistance to corrosion designated material Class B, if leakage from a ruptured element will be to the exterior of the **control** enclosure only.*

NOTE 1 Suitable Class A and B materials are shown in Annex BB.

NOTE 2 1 mm^2/s = 1 centistoke.

Additional subclauses:

11.101 Construction requirements relating to operating mechanism

11.101.1 If screws and nuts serve to attach operating parts to movable members, they shall be swaged or otherwise locked.

11.101.2 The operating mechanism of a manually operated switch shall not subject parts to damage.

11.101.3 Operating parts shall be separated by barriers or by their physical location from conductors to be connected to the **control** to avoid interference with the movement of such parts by the conductors.

Compliance with 11.101.1 to 11.101.3 inclusive is checked by inspection.

11.102 A pressure cut-out shall not reset, or be resettable manually or otherwise at a value above the maximum or below the minimum operating pressure, whichever is declared.

11.103 A pressure cut-out with a manually operated reset device shall be **trip-free**.

Compliance with 11.102 and 11.103 is checked by inspection.

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12 Moisture and dust resistance

This clause of Part 1 is applicable except as follows:

12.1.1 *Addition*:

The tests in this subclause are not intended to determine the suitability of the seal between the **control** and the equipment.

13 Electric strength and insulation resistance

This clause of Part 1 is applicable.

14 Heating

This clause of Part 1 is applicable except as follows:

14.4.3.1 Not applicable.

15 Manufacturing deviation and drift

This clause of Part 1 is applicable except as follows:

15.1 *Replace the note:*

NOTE For USA and Canada, Annex CC is applicable for general purpose type **controls**.

15.4 *Replacement:*

The operating pressure shall be as declared in Table 1. The allowable deviation and **drift** shall not be applied for the purpose of deliberately exceeding the maximum operating pressure.

15.5.5 *Additional subclause:*

15.5.5.101 *For **controls** which have **set points** which can be set by the **user**, the initial operating pressure shall be determined at the maximum and minimum **set points** and at a **set point** approximately midway between the maximum and minimum. For such **controls**, the maximum variations as specified in 15.4 of this standard are applicable to the maximum **set point**.*

*A 5 % scale error, based on the maximum setting, may be applied to the minimum and midway **set points**. This scale error may be in addition to the maximum variations.*

*The **control** shall be connected to a source of aerostatic or hydrostatic pressure, consistent with its intended use. A pressure within 25 % of the operating pressure (maximum, minimum or midway value) is to be established and the pressure is then increased or decreased at a rate of 10 % of the operating pressure per minute but in no case is the rate of change to exceed 60 Pa/s.*

The test conditions and test apparatus for the initial test and final test, after the endurance tests of Clause 17, shall be the same.

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16 Environmental stress

This clause of Part 1 is applicable.

17 Endurance

This clause of Part 1 is applicable except as follows:

17.1.2.1 *Replacement:*

Compliance with 17.1.1 and 17.1.2 is checked by the test of 17.16.

17.1.3.2 *Addition:*

The tests of Clause 17 shall be conducted at the maximum declared working pressure.

17.16 Test for particular purpose controls

Additional subclauses:

17.16.101 Pressure operating controls

17.1 to 17.5 inclusive are applicable.

17.6 is not applicable.

17.7 and 17.8 are applicable.

17.9 is applicable, but only to slow-make, slow-break **automatic actions**.

17.10 to 17.13 inclusive are applicable but only to those **pressure operating controls** which have a **manual action** (including an **actuating means** providing setting by the **user**).

17.14 is applicable.

17.16.102 Pressure limiter

17.1 to 17.5 inclusive are applicable.

17.6 is not applicable.

17.7 and 17.8 are applicable except that, where necessary, the reset **operation**, if required, is obtained by **actuation**. This **actuation** shall be as specified in 17.4 for accelerated speed, as soon as permitted by the mechanism, or as declared by the manufacturer in Table 1.

17.9 is applicable, but only to slow-make, slow-break **automatic actions**, the same conditions for manual reset for 17.7 and 17.8 being used.

17.10 to 17.13 inclusive are applicable but only to those pressure limiters which have a **manual action** (including an **actuating means** providing setting by the **user**).

17.10 to 17.13 inclusive are not applicable to the normal reset **manual action**, which is tested during the automatic test of 17.7 to 17.9 inclusive. If the pressure limiter has other **manual actions** which are not tested during the automatic test, then these subclauses are applicable.

17.14 is applicable.

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17.16.103 Pressure cut-out

17.1 to 17.5 inclusive are applicable.

17.6 is applicable to actions classified as Type 1.M or 2.M, the value of "X" being as small as practicable.

17.7 and 17.8 are applicable except that the reset **operation**, if required, is obtained by **actuation**. This **actuation** shall be as specified in 17.4 for accelerated speed, as soon as permitted by the mechanism, or as declared by the manufacturer in Table 1.

17.9 is applicable, but only to slow-make, slow-break **automatic actions**, the same conditions for manual reset for 17.7 and 17.8 being used.

17.10 to 17.13 inclusive are not applicable to the normal reset **manual action** which is tested during the automatic test of 17.7 to 17.9 inclusive. If the pressure cut-out has other **manual actions** which are not tested during the automatic tests, then these subclauses are applicable.

17.14 is applicable.

18 Mechanical strength

This clause of Part 1 is applicable except as follows:

Additional subclauses:

18.101 Medium leakage

NOTE 1 Under consideration.

Parts of pressure limiters or pressure cut-outs which are subjected to pressure of a fluid to be supervised shall not leak externally at a rate in excess of 200 cm^3/h, when tested with air or nitrogen at a pressure of 1,5 times the maximum working pressure of the **control**.

To determine compliance, the **control** is to be connected to a **system** capable of supplying clean air or nitrogen at the specified test pressure. Any by-pass or other openings not essential to the **operation** of the **control** during the test are to be sealed. Air or nitrogen is to be admitted and maintained at the specified test pressure. In the case of a diaphragm element, which, in normal usage, is subjected to pressure on both sides of the diaphragm, the test pressure is to be applied to both sides of the diaphragm slowly and without shock to avoid stressing the diaphragm excessively.

Leakage is to be observed by an apparatus capable of indicating accurately a flow rate of 200 cm^3/h for the test fluid employed. A **control** with a maximum working pressure of 35 kPa or more may be considered as conforming to the above if, when the fluid-containing parts of the **control** are submerged in water to a depth of approximately 25 mm while under the test pressure, no bubble indicating leakage is observed within 10 s after the parts are submerged.

To conform to 11.11.105, a **control** shall not allow leakage under conditions of ruptured diaphragm or bellows from an unthreaded vent opening or around pins, stems or linkages passing through the housing in excess of the following rate, when the **control** is tested to its maximum working pressure:

a) 0,03 m^3/h of a 0,64 specific gravity gas for a **control** for use only with fuel gases having specific gravity less than 1,0;

NOTE 2 In the countries members of CENELEC, the leakage rate is 70 l/h.

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b) 0,014 m^3/h of a 1,53 specific gravity gas for a **control** for use with liquified petroleum gases;

NOTE 3 In the countries members of CENELEC, the leakage rate is 70 l/h.

c) 0,001 m^3/h of water for a **control** for use with flammable liquids such as gasoline, kerosene and fuel oils up to 1,2 mm^2/s;

d) 0,002 m^3/h of the lightest grade fuel oil heavier than 1,2 mm^2/s for which a **control** is to be used.

18.102 Strength of parts (hydrostatic)

18.102.1 A pressure **sensing control** employing a Bourdon tube, a flexible metal bellows, a diaphragm or the like rated 2 000 kPa or more, which is not contained within an enclosure, shall withstand for 1 min without bursting a hydraulic pressure equal to four times the maximum working pressure of the **control**.

The **control** under test is to be filled with water to exclude air and is connected to a hydraulic pump. The pressure is to be raised gradually to the required test pressure.

Leakage at a gasket or fitting during this test is permitted provided the leakage does not occur below 50 % of the required test pressure and the test can be continued to four times maximum working pressure.

18.102.2 A pressure **sensing control** employing a Bourdon tube, a flexible metal bellows, a diaphragm or the like that is contained within an enclosure shall comply with 18.102.1 or shall

– withstand for 1 min without visible leakage a hydraulic pressure of two times the maximum working pressure, and
– withstand for 1 min a hydraulic pressure equal to four times the maximum working pressure or, if this pressure cannot be reached without damage to the equipment, at least three times maximum working pressure. Also it shall be demonstrated that the enclosure can either relieve pressure equal to four times maximum working pressure without rupturing in a manner likely to endanger persons or surroundings, or that it can withstand the test pressure.

The test is conducted as in 18.102.1.

18.102.3 A pressure limiter or pressure cut-out shall be capable of withstanding for 1 min without bursting a hydraulic pressure equal to four times the maximum working pressure.

The **control** under test is to be filled with water to exclude air and connected to a hydraulic pump. The pressure is to be raised gradually to the required test pressure.

19 Threaded parts and connections

This clause of Part 1 is applicable.

20 Creepage distances, clearances and distances through solid insulation

This clause of Part 1 is applicable.

21 Resistance to heat, fire and tracking

This clause of Part 1 is applicable

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22 Resistance to corrosion

This clause of Part 1 is applicable.

23 Electromagnetic compatibility (EMC) requirements – Emission

This clause of Part 1 is applicable.

24 Components

This clause of Part 1 is applicable.

25 Normal operation

This clause of Part 1 is applicable.

26 Electromagnetic compatibility (EMC) requirements – Immunity

This clause of Part 1 is applicable.

27 Abnormal operation

This clause of Part 1 is applicable.

28 Guidance on the use of electronic disconnection

This clause of Part 1 is applicable.

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Annexes

The annexes of Part 1 are applicable except as follows:

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