IEC 60730-2-6

Edition 3.0 2015-04

INTERNATIONAL STANDARD

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

IEC 60730-2-6:2015-04(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

More than 60 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IEC 60730-2-6

Edition 3.0 2015-04

INTERNATIONAL STANDARD

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 97.120

ISBN 978-2-8322-2587-5

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

AUTOMATIC ELECTRICAL CONTROLS –

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

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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

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.

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.

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.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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

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.

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:

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.

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:

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.

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.

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.

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.

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.

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.

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

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.

Annexes

The annexes of Part 1 are applicable except as follows:

Annex H
(normative)

Requirements for electronic controls

This annex of Part 1 is applicable except as follows:

H.2 Terms and definitions

Additional definitions:

H.2.101.1
permanent operation
continuous monitoring of the protective function during the **operation** of the appliance or **system** for longer than 24 h

Note 1 to entry: 24 h is considered the typical time interval between a first and a second **fault**.

H.2.101.2
non-permanent operation
continuous monitoring of the protective function during the **operation** of the appliance or **system** for less than 24 h

Note 1 to entry: 24 h is considered the typical time interval between a first and a second **fault**.

H.6 Classification

H.6.18 According to classes of control functions

H.6.18.2 *Addition:*

NOTE 101 In general, pressure cut-outs perform class B or C **control** functions.

H.6.18.3 *Addition:*

NOTE 101 In general, pressure cut-outs used on closed water heater systems perform class C **control** functions.

H.7 Information

Additional requirements to Table 1:

	Information	Clause or subclause	Method
104	The output condition of pressure cut-outs, Type 2 **operating controls** and Type 2 limiters after **operation** [101]	H.26.2.103 H.26.2.104 H.26.2.105	X
105	Frequency of the **defined state** test function	H.27.1.2.2.2 H.27.1.2.3.2 H.27.1.2.3.3	X
106	The **control** is for **permanent operation** or **non-permanent operation**	H.2.101.1 H.2.101.2 H.27.1.2.2.2 H.27.1.2.3.2	X
107	Conditions of test when requested by the manufacturer for integrated and incorporated **electronic controls**.	H.23.1.2	

Add the following additional note:

[101]	For example, conducting or non-conducting, as applicable.

H.11 Constructional requirements

H.11.12 Controls using software

H.11.12.2.6 *Replace the second paragraph by the following new note:*

NOTE The values declared in Table 1, requirement 71 may be specified in the applicable appliance standard.

H.11.12.2.7 *Addition:*

NOTE 101 The responses declared in Table 1, requirement 72 may be specified in the applicable appliance standard.

H.23 Electromagnetic compatibility (EMC) requirements – Emission

H.23.1.2 Radio frequency emission

Addition:

Integrated and incorporated **controls** are not subjected to the tests of this subclause, as the results of these tests are influenced by the incorporation of the **control** into the equipment and the use of measures to **control** emissions used therein. They may, however, be carried out under declared conditions if so requested by the manufacturer.

H.26 Electromagnetic compatibility (EMC) requirements – Immunity

H.26.2

Addition:

After each test, one or more of the following criteria shall apply, as permitted in Table H.101.

Additional subclauses:

H.26.2.101 The **control** shall remain in its current condition and thereafter shall continue to operate as declared within the limits verified in Clause 15, if applicable.

H.26.2.102 The **control** shall assume the condition declared in Table 1, requirement 104 and thereafter shall operate as in H.26.2.101.

H.26.2.103 The **control** shall assume the condition declared in Table 1, requirement 104 such that it cannot be **reset** automatically or manually. The output waveform shall be sinusoidal or as declared in Table 1, requirement 53 for normal **operation**.

H.26.2.104 The **control** shall remain in the condition declared in Table 1, requirement 104. A non-self-resetting **control** shall be such that it can only **reset** manually. After the pressure which caused cut-out to occur is removed, it shall operate as in H.26.2.101 or shall remain in the declared condition as in H.26.2.103.

H.26.2.105 The **control** may return to its initial state and thereafter shall operate as in H.26.2.101.

If a **control** is in the condition declared in Table 1, requirement 104, it may **reset** but shall resume the declared condition again if the pressure which caused it to operate is still present.

H.26.2.106 The outputs and functions shall be as declared in Table 1, requirement 58a or requirement 58b and the **control** shall comply with the requirement of 17.5.

Table H.101 – Compliance criteria

Applicable Clause H.26 tests	**Compliance criteria permitted**					
Pressure cut-outs, Type 2 pressure limiters and Type 2 **pressure operating controls**	H.26.2.101	H.26.2.102	H.26.2.103	H.26.2.104	H.26.2.105	H.26.2.106[a]
H.26.4 to H.26.14 inclusive	[b]	[b]	[b]	[c]	[c]	[d]
Other pressure **controls**	H.26.2.101	H.26.2.102	H.26.2.103	H.26.2.104	H.26.2.105	H.26.2.106[a]
H.26.8, H.26.9	[d]				[d]	[d]

[a] This compliance criterion is permitted only for integrated or incorporated **controls**, since the acceptability of the output must be judged in the appliance.

[b] Permitted when the disturbance is applied before **operation**.

[c] Permitted when the disturbance is applied after **operation**.

[d] Permitted for other than pressure cut-outs.

H.26.5 Voltage dips, voltage interruptions and voltage variations in the power supply network

H.26.5.2 Voltage variation test

H.26.5.2.2 Test procedure

Replacement of last paragraph:

*The **control** is subjected to each of the specified voltage test cycles three times with 10 s intervals between each test cycle. For a **control** declared under Table 1, requirement 104, each test cycle is performed three times when the **control** is in the declared condition and three times when it is not.*

H.26.8 Surge immunity test

H.26.8.3 Test procedure

Additional paragraph:

H.26.8.3.101 *For **controls** declared under Table 1, requirement 104, three pulses each are applied with the **control** in the declared condition and two are applied when it is not.*

H.26.9 Electrical fast transient/burst test

H.26.9.3 Test procedure

Additional subclause:

H.26.9.3.101 *For a **control** declared under Table 1, requirement 104, the test is performed with the **control** in the declared condition and when it is not.*

H.26.10 Ring wave immunity test

H.26.10.5 Test procedure

Additional subclause:

H.26.10.5.101 *For **controls** declared under Table 1, requirement 104, three of the tests are performed when the **control** is in the declared condition and two are performed when it is not.*

H.26.12 Radio-frequency electromagnetic field immunity

H.26.12.2 Immunity to conducted disturbances

H.26.12.2.2 Test procedure

Additional subclause:

H.26.12.2.2.101 *For **controls** declared under Table 1, requirement 104, sweeping is performed when the **control** is in the declared condition and when it is not.*

H.26.12.3 Immunity to radiated disturbances

H.26.12.3.2 Test procedure

Additional subclause:

H.26.12.3.2.101 *For **controls** declared under Table 1, requirement 104, sweeping is performed when the **control** is in the declared condition and when it is not.*

H.26.13 Test of influence of supply frequency variations

H.26.13.3 Test procedure

Additional subclause:

H.26.13.3.101 *For **controls** declared under Table 1, requirement 104, the test shall be performed when the **control** is in the declared condition and when it is not.*

H.26.14 Power frequency magnetic field immunity test

H.26.14.3 Test procedure

Additional subclause:

H.26.14.3.101 *For **controls** declared under Table 1, requirement 104, the test shall be performed when the **control** is in the declared condition and when it is not.*

H.26.15 Evaluation of compliance

H.26.15.2

Addition:

See Table H.101 for compliance criteria.

H.26.15.4

Addition:

See Table H.101 for compliance criteria.

H.27 Abnormal operation

This clause of Part 1 is applicable except as follows:

H.27.1.1.3

Replacement:

This subclause of Part 1 is applicable except item c).

H.27.1.2.2 Class B control function

This clause of Part 1 is applicable except as follows:

H.27.1.2.2.2 First fault

Replace item b) as follows:

b) the **control** shall react within the **fault reaction time** (see Table 1, requirement 91) by proceeding to the **defined state** provided that a subsequent restart under the same **fault** conditions results in the **system** returning to the same **defined state** condition;

Replace item c) as follows:

c) for **systems** with **non-permanent operation** only, the **control** shall continue to operate as intended, the **fault** shall be detected during the next start-up sequence. The compliance criteria shall be a) or b).

NOTE Requirements for **systems** with **permanent operation** are under consideration.

Replace item d) as follows:

d) the **control** shall continue to operate as intended.

Replace the last two paragraphs with the following:

The **fault reaction time** shall be declared by the manufacturer (see Table 1, requirement 91).

For **permanent operation** as declared by the manufacturer (see Table 1, requirement 106), item c) is under consideration.

For a **control** function, where a mechanical actuator is part of a circuit that characterizes the **defined state**, a test up to, but not including, the switching contacts is sufficient. If the test of the **defined state** fails, the **control** shall initiate the **safety shut-down**. Frequency of test is as declared by the manufacturer (see Table 1, requirement 105). Internal **faults** of the components of the checking circuits are not considered.

H.27.1.2.2.3 Fault introduced during defined state

Not applicable.

H.27.1.2.3 Class C control function

This clause of Part 1 is applicable except as follows:

H.27.1.2.3.2 First fault

Replace item b) as follows:

b) the **control** reacting within the **fault reaction time** (see Table 1, requirement 91) by proceeding to **defined state** provided that subsequent restart under the same **fault** condition results in the **system** returning to the **defined state** condition;

Replace item c) follows:

c) for **systems** with **non-permanent operation**, the **control** shall continue to operate as intended, the **fault** shall be detected during the next start-up sequence. The compliance criteria shall be a) or b).

NOTE Requirements for **systems** with **permanent operation** are under consideration.

Replace item d) as follows:

d) The **control** shall continue to operate as intended.

Replace the last sentence with the following:

The **fault reaction time** shall be declared by the manufacturer (see Table 1, requirement 91).

For **permanent operation** as declared by the manufacturer (see Table 1, requirement 106), item c) is under consideration.

For a **control** function, where a mechanical actuator is part of a circuit that characterizes the **defined state**, a test up to, but not including, the switching contacts is sufficient. If the test of the **defined state** fails, the **control** shall initiate the **safety shut-down**. Frequency of test is as declared by the manufacturer (see Table 1, requirement 105). Internal **faults** of the components of the checking circuits are not considered.

H.27.1.2.3.3 Second fault

Replace second sentence and items a) and b) with the following:

During assessment, for **systems** with **non-permanent operation**, the second **fault** shall only be considered to occur when a start-up sequence has been performed after the first **fault**. For **systems** with **permanent operation**, the second **fault** occurs 24 h after the first **fault**.

Replace the last two sentences with the following:

The **fault reaction time**, as well as the applicability of c), shall be as declared by the manufacturer.

For a **control** function, where a mechanical actuator is part of a circuit that characterizes the **defined state**, a test up to, but not including, the switching contacts is sufficient. If the test of the **defined state** fails, the **control** shall initiate the safety shut-down. Frequency of test is as declared by the manufacturer (see Table 1, requirement 105). Internal **faults** of the components of the checking circuits are not considered.

H.27.1.2.4 Faults during defined state

Replacement:

Under consideration.

Additional annexes:

Annex AA
(normative)

Number of cycles

AA.1 Number of cycles for independently mounted controls

Type	Automatic action		Manual action	
	with load	no load	with load	no load
Self-resetting cut-out	100 000	-	-	-
Non-self-resetting cut-out	1 000[a]	5 000	1 000[a]	5 000
Self-resetting limiter[c]	6 000[b]	-	-	-
Non-self-resetting limiter	6 000	-	6 000	-
Pressure operating control[c]	6 000	-	-	-
Manual	-	-	6 000	-

[a] Break only.

[b] 100 000 for gas appliances and furnace applications.

[c] 30 000 cycles for refrigeration applications.

AA.2 Cycling rate for independently mounted controls

(See 17.8 and 17.9)

Type	Number of cycles of operation [a]			
	First	Maximum cycles per min	Last	Maximum cycle per min
Self-resetting cut-out	75 000	6	25 000	1[b]
Self-resetting limiter[d]	-	-	6 000	1[b]
Pressure operating control	-[c]	-[c]	6 000	1[b]

[a] Magnetic, manual and motor-operated switches or the like, and switches that snap with lost motion and do not creep may be tested at the rate of six cycles per minute.

[b] For all **controls**, the test is to be conducted with (50 ± 20) % “ON” time, using a slow rate of change.

[c] 30 000 cycles for refrigeration and water heater applications. The first 24 000 at six cycles per minute; the last 6 000 at one cycle per minute.

[d] For gas appliances and furnace applications, same as for self-resetting cut-outs.

Annex BB
(informative)

Stainless steel for bellows, bourdon tubes or similar elements

Table BB.1 – Stainless steel for bellows, bourdon tubes or similar elements *(1 of 3)*

Material Class	Code	/ Symbol	C	Si	Mn	P	S	Cr	Mo	Ni	Others
A	Germany		≤	≤	≤	≤	≤				
	1.4401	/ X5 CrNiMo 18 10	0,07	1,00	2,00	0,045	0,030	16,5-18,5	2-2,5	10,5-13,5	-
	1.4436	/ S5 CrNiMo 18 12	0,07	1,00	2,00	0,045	0,030	16,5-18,5	2,5-3	11-14	-
	1.4541	/ X10 CrNiTi 18 9	0,08	1,00	2,00	0,045	0,030	17-19	-	9-12	T1≥ 5xC≤0,80
	France										
		/ Z6 CND 17, 11	0,07	1,00	2,00	0,040	0,030	16-18	2-2,5	10-12,5	-
		/ Z6 CND 17, 12	0,07	1,00	2,00	0,040	0,030	16-18	2,5-3	11-13	-
		/ Z6 CND 17, 12B	0,08	1,00	2,00	0,040	0,030	16-18	2-2,5	11-13	B: 0,001-0,006
	321 F00/01/05	/ Z6 CNT 18,10	0,08	1,00	2,00	0,040	0,030	17-19	-	9-11	Ti≥ 5xC≤0,60
	Italy										
	UNI 6902/6903	/ X5 CrNiMo 17 12	0,06	1,00	2,00	0,045	0,030	16-16,5	2-2,5	10,5-13,5	-
	UNI 6902/6903	/ X5 CrNiMo 17 13	0,06	1,00	2,00	0,045	0,030	16-18,5	2,5-3	11-14	-
	UNI 6902/6903	/ X5 CrNiMo 18 11	0,08	1,00	2,00	0,045	0,030	17-19	-	9-12	T: 5xC≤0,08
	Japan										
	JIS G 4303	/ SUS 316	0,08	1,00	2,00	0,045	0,030	16-18	2-3	10-14	-
	JIS G 4304	/ SUS 321	0,08	1,00	2,00	0,045	0,030	17-19	-	9-13	Ti ≥ 5xc

Table BB.1 *(2 of 3)*

Material Class	Code / Symbol	C	Si	Mn	P	S	Cr	Mo	Ni	Others
A	United Kingdom									
	85 1449/2 ‘82 / 316 S31	0,07	1,00	2,00	0,045	0,030	16,5-18,5	2-2,5	10,5-13,5	-
	85 1449/2 ‘82 / 316 S33	0,07	1,00	2,00	0,045	0,030	16,5-18,5	2,5-3	11-14	-
	85 1501/3 ‘73 / 916 S16 (8458)	0,07	0,2-1	0,5-2	0,045	0,030	16,5-18,5	2,5-3	10-13	-
	85 1501/3 ‘73 / 321 S12	0,08	0,2-1	0,5-2	0,045	0,030	17-10	-	9-12	Ti: 5xC ≤ 0,70
	85 1501/3 ‘73 / 321 S49	0,04-0,09	0,2-1	0,5-2	0,040	0,030	17-19	-	9-12	Ti: 5xC ≤ 0,70
	85 1501/3 ‘73 / 321 S87	0,08	0,2-1	0,5-2	0,045	0,030	17-19	-	9-12	Ti: 5xC ≤0,70
	Sweden									
	SS 14 / 2347	0,05	1,00	2,00	0,045	0,030	16-18,5	2-2,5	10,5-14	-
	SS 14 / 3443	0,05	1,00	2,00	0,045	0,030	16-18,5	2,5-3	10,5-14	-
	SS 14 / 2337	0,08	1,00	2,00	0,045	0,030	17-19	-	9-12	Ti ≥ 5x C≤0,80
	USSR	≤	≤	≤	≤	≤				
	/08 Ch18N10Y	0,08	0,08	2,00	0,035	0,020	17-19	0,30	9-11	W≤0.20 Cu≤0.30 Ti: 5xC-0,70
	GOST /09 Ch18N10T	0,07-0,1	0,08	1-2	0,035	0,020	17-19	-	9-11	Ti: 5xC-0,70
	GOST /12 Ch18N10T	0,12	0,08	2,00	0,035	0,020	17-19	0,30	9-11	W≤0.20 Cu≤0.30 Ti: 5xC-080
	USA									
	UNS/S31800, AISI/316, SAE/30316	0,08	1,00	2,00	0,045	0,030	16-18	2-3	10-14	-
	UNS/S32100, AISO/321, SAE/30321	0,08	1,00	2,00	0,045	0,030	17-19	-	9-12	Ti: 5xC-080

Table BB.1 *(3 of 3)*

Material Class	Code / Symbol	C	Si	Mn	P	S	Cr	Mo	Ni	Others
B	Germany									
	1.4310 / X12 CrNi 17 7	0,08-0, 14	1,50	2,00	0,045	0,030	16-18	≤0,80	6,5-9	-
	France									
	301 F 20 / Z12XN17,07	0,08-0,15	1,00	2,00	0,040	0,030	16-18	-	6-8	-
	/ Z12XN17,08	0,08-0,15	1,00	2,00	0,040	0,030	16-18	-	6,5-8,5	-
	301 F 20 / Z12XN18,07	0,08-0,15	2,00	2,00	0,040	0,030	17-19	-	6,5-8,5	Cu≤0,50
	Italy									
	UNI 6902/6903 / X12 CrNi 1707	0,15	1,00	2,00	0,045	0,030	16-18	-	6-8	-
	Japan									
	JIS G 4305 / SUS 301	0,15	1,00	2,00	0,045	0,030	16-18	-	6-8	-
	United Kingdom									
	85 1449/2 '82 / 301 S21	0,15	1,00	2,00	0,045	0,030	16-18	-	6-8	-
	Scandinavia									
	SS 14 / 2331	0,12	1,00	2,00	0,045	0,030	17-19	-	7-9,5	-
	USSR									
	No equivalent indicated									
	USA									
	USN/S 30 100; AISI/301; SAE/30301	0,15	1,00	2,00	0,045	0,030	16-18	-	6-8	-

NOTE 1 Code USSR (e.g. Russian Federation, Ukraine, Belarus, etc.)

NOTE 2 Code Scandinavia (e.g. Norway, Finland, etc.)

Annex CC
(informative)

Deviation and drift requirements for pressure operating controls

The following requirements are normative for USA and Canada for **pressure operating controls** general purpose type applications

Maximum rated operating pressure	**Deviation** [a] **%**	**Drift** [a] **%**
Maximum **set point** of 25 Pa water column	+100 –50	+20 –20
Maximum **set point** greater than 25 Pa and less than 2,5 KPa water column	±20	±20
Maximum **set point** greater than 2,5 kPa but less than 6,9 kPa water column	±10	±10
Maximum **set point** greater than 6,9 kPa water column	±5	±5

[a] Closer tolerances are applicable for end application use as declared in the product standard, or specific safety applications such as air/gas ratio controller.

Bibliography

The bibliography of Part 1 applies except as follows:

Addition:

IEC 60079 (all parts), *Explosive atmospheres*

ISO 22967:2010, *Forced draught gas burners*

ISO 22968:2010, *Forced draught oil burners*

ISO 23550:2011, *Safety and control devices for gas burners and gas-burning appliances – General requirements*

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch