UL 60730-2-6

STANDARD FOR SAFETY

Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements

UL Standard for Safety for Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, UL 60730-2-6

Third Edition, Dated December 22, 2016

Summary of Topics

This revision of ANSI/UL 60730-2-6 dated November 30, 2021 adopts the first amendment of IEC 60730-2-6 issued September 2019.

Please note that the national difference document incorporates all of the U.S. national differences for UL 60730-2-6. This standard is an adoption of IEC 60730-2-6, Edition 3 including amendment 1, published by the IEC, September 2019.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated August 27, 2021.

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UL 60730-2-6

Standard for Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements

Prior to the first edition of UL 60730-2-6, the requirements for the products covered by this Standard were included in UL 8730-2-6.

First Edition – February, 2002
Second Edition – October, 2013

Third Edition

December 22, 2016

This ANSI/UL Standard for Safety consists of the Third Edition including revisions through November 30, 2021.

The most recent designation of ANSI/UL 60730-2-6 as an American National Standard (ANSI) occurred on November 30, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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Preface (UL)

This UL Standard is based on IEC Publication 60730-2-6: third edition including Amendment 1, Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements. IEC publication 60730-2-6 is copyrighted by the IEC.

This UL Standard 60730-2-6, Standard for Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, is to be used in conjunction with the fifth edition of UL 60730-1. The requirements for electric actuators are contained in this Part 2 Standard and UL 60730-1.

Requirements of this Part 2 Standard, where stated, amend the requirements of UL 60730-1.

Where a particular subclause of UL 60730-1 is not mentioned in UL 60730-2-6, the UL 60730-1 subclause applies.

Note – Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.

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NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60730-2-6, Automatic Electrical Controls – Part 2-6: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, copyright 2019, are indicated by notations (differences) and are presented in bold text.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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.

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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.

This Consolidated version of IEC 60730-2-6 bears the edition number 3.1. It consists of the third edition (2015-04) [documents 72/980/FDIS and 72/992/RVD] and its amendment 1 (2019-09) [documents 72/1180/FDIS and 72/1186A/RVD]. The technical content is identical to the base edition and its amendment.

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

This third 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 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.

The committee has decided that the contents of the base publication and its amendment 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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

101DV DE *Addition to the part 2:*

The numbering system in the Standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

102DV DE *Modification of the paragraph starting with, "In this publication"*

– words in SMALL ROMAN CAPITALS in the text are defined in clause 2.

103DV D2 *Modification of the of the 6th paragraph after item (9) by replacing it with the following paragraph:*

This part 2-6 is intended to be used in conjunction with the latest edition of UL 60730-1 and its revisions.

No Text on This Page

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 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.

1.1DV D2 *Modification of the first paragraph of 1.1 of the part 2 by adding the following:*

This part of IEC 60730 applies to automatic electrical pressure SENSING CONTROLS 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.

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 *Deleted*

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.

4.3.1.101DV D2 *Modification of 4.3.1.101 of the part 2 by adding the following note:*

NOTE – The number of cycles and cycle rates specified in Table AA.1DV and Table AA.101DV apply for independently mounted, integrated and incorporated pressure controls.

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 6.3	D
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	D
Additional requirements:			
101	PRESSURE MEDIUM	2.3.101, 11.4.101, 18.101	X
102	OPERATING DIFFERENTIAL	2.3.26, 15.4	D
103	MAXIMUM WORKING PRESSURE	2.3.29, 11, 17, 18	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).			

Table 1DV D2 *Replacement of Table 1 of the part 2:*

Table 1DV

Requirement	Information	Clause or subclause	Method
	Modification:		
	Replace the following items by:		
6	**Purpose of control**	**2.2.101 to 2.2.103, 4.3.5, 6.3**	**D**
26	**Number of cycles of ACTUATION (M) for each MANUAL ACTION [101A)]**	**6.10, Annex AA**	**X**
27	**Number of automatic cycles (A) for each AUTOMATIC ACTION [101A)]**	**6.11, Annex AA**	**X**
34	**Not applicable**		
37	**See additional notes [102A), 103A)]**	**4, 15, 17**	**X**
44	**Not applicable**		
48	**Operating pressure [104A)]**	**2.3.11**	**D**
	(or pressures)	**15**	
	Additional items:		

Table 1DV Continued on Next Page

Table 1DV Continued

Requirement	Information	Clause or subclause	Method
101	PRESSURE MEDIUM	2.3.101	X
102	OPERATING DIFFERENTIAL	2.3.26	D
103	MAXIMUM WORKING PRESSURE	2.3.29	D
104A	A low voltage (0 – 30 volt) cut-out to be wired with NEC Class 1 wiring methods		D
105A	Date code of manufacturing for INDEPENDENTLY MOUNTED CONTROLS [105A)]		C

Addition to Note 4:

For pressure sensing controls, limits of activating quantity are specified either in the applicable household appliance part 2, by the appliance manufacturer or as declared by the pressure sensing control manufacturer (see 17.7 and 17.8).

Additional notes:

[101A)] The minimum number of cycles for independently mounted, integrated and INCORPORATED CONTROLS are indicated in Annex AA.

[102A)] For Type 2 controls, the required deviations and DRIFT tolerances are indicated in Table AA.101DV.

[103A)] Deviation and DRIFT applies to a SPDT cutout terminal which is de-energized on pressure rise.

[105A)] The date code shall be the date or other dating period of manufacture not exceeding any three consecutive months. The date of manufacture may be abbreviated; or may be in a nationally accepted conventional code or in a code affirmed by the manufacturer, provided that the code:

a) Does not repeat in less than 20 years, and

b) Does not require reference to the product records of the manufacturer to determine when the product was manufactured.

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.

11.6.101DV D2 *Addition to the part 2:*

If the function or calibration of the control is affected by being placed out of level, the control shall be provided with a leveling indicator such as a bubble, pendulum, or a horizontal or vertical line. When attached as intended, the control shall resist a torque of 11,3 N-m (8,5 lbf·ft) without moving.

11.6.102DV D2 *Addition to the part 2:*

If a control requires a mounting bracket to conform to this standard, the bracket shall be furnished with the control. The bracket shall be marked with a part number and its use shall be indicated on the control. This marking may be placed inside the control COVER.

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.

11.11.103DV.1 DE *Modification of 11.11.103 of the part 2 by adding the following note after the first paragraph:*

NOTE – "Unsafe leakage of a hazardous fluid" is the leakage of a fluid due to failure of any part of the control that would result in a risk of injury to persons.

11.11.103DV.2 DE *Modification of 11.11.103 of the part 2 by adding the following note after the third paragraph:*

NOTE – These requirements do not apply to a seal, diaphragm or gasket that is resistant to the action of the sensed fluid.

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.

11.11.104DV D2 *Addition of 11.11.104DV.1 – 11.11.104DV.10 to the part 2:*

11.11.104DV.1 After being subjected to the conditions described in 11.11.104DV.2 – 11.11.104DV.4, a brass part containing more than 15 percent zinc shall show no evidence of cracking when examined using 25X magnification.

11.11.104DV.2 Each test sample is to be subjected to the physical stresses normally imposed on or within a part as the result of assembly with other components. Such stresses are to be applied to the sample prior to and maintained during the test. Samples with threads, intended to be used for installing the product in the field, are to have the threads engaged and tightened to the torque specified in Table 11.11.104DV.2.1. Teflon tape or pipe compound are not to be used on the threads.

Table 11.11.104DV.2.1 D2 *Addition to the part 2:*

Table 11.11.104DV.2.1
Torque requirements for threaded connections

Nominal thread size, inches	Torque N·m	(lb·ft)
1/8	27	(20)
1/4	34	(25)
3/8	50,8	(37,5)
1/2	67,8	(50)
3/4	101,7	(75)
1	135,6	(100)
1-1/4	163,8	(121)
1-1/2	175,1	(129)
2	186,4	(137)
2-1/2	197,7	(146)
3	203,4	(150)

11.11.104DV.3 Three samples are to be degreased and then continuously exposed in a set position for 10 days to a moist ammonia-air mixture maintained in a glass chamber approximately 305 by 305 by 305 mm (12 by 12 by 12 inch) having a glass COVER.

11.11.104DV.4 Approximately 600 mL of aqueous ammonia having a specific gravity of 0,94 is to be maintained at the bottom of the glass chamber below the samples. The samples are to be positioned 38,1 mm (1-1/2 inch) above the aqueous ammonia solution and supported by an inert tray. The moist ammonia-air mixture in the chamber is to be maintained at atmospheric pressure and at a temperature of 34 ±2°C (91 ±4°F).

11.11.104DV.5 An elastomeric part shall be in accordance with the requirements for the Accelerated Air Oven Aging Test in the Standard for Gaskets and Seals, UL 157.

11.11.104DV.6 An elastomeric part intended to be in contact with LP-Gas, manufactured and natural gases, fuel oils and kerosene or gasoline shall be in accordance with the requirements for the Immersion Test in the Standard for Gaskets and Seals, UL 157.

11.11.104DV.7 A cut-out or limiter incorporating a transformer, relay, or the like shall be supplied by a one-side grounded system with a voltage rating not exceeding 120 volts nominal. A switch or protective device shall be connected in the ungrounded supply conductor circuit.

11.11.104DV.8 A mercury switch shall be enclosed. Wire leads shall be as short as possible and terminate at eyelets or the equivalent, or in soldered connections at terminal plates on the supporting box or shall be fastened so that no strain is placed on the mechanism.

11.11.104DV.9 An INDEPENDENTLY MOUNTED CONTROL with manual reset shall be resettable from the exterior of the enclosure.

11.11.104DV.10 Connections for piping shall be threaded in accordance with the Standard for General Purpose (Inch) Pipe Threads, ANSI/ASME B1.20.1-1983.

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.

11.11.105DV DE *Modification of 11.11.105 of the part 2 by adding the following:*

External fluid leakage shall be limited to the levels specified in 18.101.

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.

11.11.106DV DE *Modification of 11.11.106 of the part 2:*

Replace, "...pressure, following the endurance test, and the control conforms to one of the following: "with"... pressure, following the endurance test. If leakage occurs, the control shall conform to one of the following:"

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 and operating differential 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.

15.4DV D2 *Modification of 15.4 of the part 2 by adding:*

For Type 2 pressure SENSING CONTROLS, see Table AA.101DV in Annex AA.

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 declared maximum working pressure and OPERATING DIFFERENTIAL.

17.2.3.1DV D2 *Modification to 17.2.3.1 of the UL part 1 by adding the following:*

208 V for controls rated at any voltage between 200 to 208 volts.

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.

17.16.102DV DE *Modification of 17.16.102 of the part 2:*

17.16.102DV.1 For 17.7 and 17.8, revise "..by the manufacturer in 7.2." to "..by the manufacturer in accordance with Table 7.2."

17.16.102DV.2 For 17.9, delete "as specified in 17.16.102."

17.16.102DV.3 For the first paragraph beginning "17.10 to 17.13," replace "limit controls" with "limiters."

17.16.102DV.4 For the second paragraph beginning "17.10 to 17.13" replace "limit control" with "limiter."

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.

17.16.103DV DE *Modification of 17.16.103 of the part 2:*

For 17.7 and 17.8, replace "7.2" with "accordance with Table 7.2."

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.

18.101DV.1 DE *Modification of 18.101 of the part 2:*

Delete "under consideration."

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**