UL 60730-2-5

STANDARD FOR SAFETY

Automatic Electrical Controls for Household and Similar Use, Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems

UL Standard for Safety for Automatic Electrical Controls for Household and Similar Use, Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems, UL 60730-2-5

Third Edition, Dated January 30, 2014

Summary of Topics

The revision of the preface of the Third Edition of UL 60730-2-5, the CSA Group and UL (binational) Safety Standard of Automatic Electrical Controls for Household and Similar Use, Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems, is an editorial update. No changes in requirements are involved.

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.

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First Edition
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Underwriters Laboratories Inc.
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Third Edition

Automatic Electrical Controls for Household and Similar Use, Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems

January 30, 2014

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This national standard is based on IEC 60730-2-5, edition 3.2 (2009), which is based on the third edition (2000), its amendment 1 (2004), and its amendment 2 (2008).

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as "CSA Group") and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This Standard is subject to review five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquires@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Third Edition including revisions through September 30, 2019. The most recent designation of ANSI/UL 60730-2-5 as an American National Standard (ANSI) occurred on January 30, 2014. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the 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

This is the harmonized CSA Group and UL standard for particular requirements for Automatic Electrical Burner Control Systems. It is the first edition ANSI Z21.20 • CAN/CSA-C22.2 No. 60730-2-5 and the third edition of UL 60730-2-5. This edition of ANSI Z21.20 • CAN/CSA-C22.2 No. 60730-2-5 replaces the previous edition published in 2007 as ANSI Z21.20 • CSA C22.2 No. 199, *Automatic Electrical Controls for Household and Similar Use Part 2: Particular Requirements for Automatic Burner Ignition Systems and Components*. This edition of ANSI Z21.20 • CAN/CSA-C22.2 No. 60730-2-5 also replaces CAN/CSA-E730-2-5-94, *Automatic electrical controls for household and similar use – Part 2: Particular requirements for automatic electrical burner control systems* (adopted IEC 730-2-5:1990). This edition of UL 60730-2-5 supersedes the sixth edition of UL 372, Automatic Electrical Controls for Household and Similar Use – Part 2-5: Particular Requirements for Burner Ignition Systems and Components, and the fifth edition of UL 372, Primary Safety Controls for Gas- and Oil-Fired Appliances. This Standard is based on the Standard for Automatic Electrical Controls for Household and Similar Use, Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems, IEC Publication 60730-2-5, edition 3.2: 2009. This harmonized standard has been jointly revised on September 30, 2019. For this purpose, CSA Group and UL are issuing revision pages dated September 30, 2019.

In Canada, for general information on the Standards of the Canadian Electrical Code, Part II, see the preface of CAN/CSA-C22.2 No. 0. In Canada, this Standard applies to equipment that is intended to be installed or used in accordance with CSA C22.1, the *Canadian Electrical Code, Part I*.

This harmonized standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of Industry Associations, are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This Standard was reviewed by the CSA Joint Technical Subcommittee on Standards for Automatic Gas Controls, under the jurisdiction of the Committee on Performance and Installation of Gas Burning Appliances and Related Accessories, Z21/83, and the CSA Technical Committee on Gas Appliances and Related Accessories; it was also reviewed by the CSA Subcommittee on Automatic Controls for Household Use under the jurisdiction of the CSA Technical Committee on Consumer and Commercial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety. It has been formally approved by the Committee on Performance and Installation of Gas Burning Appliances, Z21/83, the CSA Technical Committee on Gas Appliances and Related Accessories, the Interprovincial Gas Advisory Council, and the CSA Technical Committee on Consumer and Commercial Products.

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

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.

Level of harmonization

This standard adopts the IEC text with national differences. This standard is published as an equivalent standard for CSA Group and UL. An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for

example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

All national differences from the IEC text are included in the CSA Group and UL versions of the standard. While the technical content is the same in each organization's version, the format and presentation may differ.

It is the intent and objective of the U.S. and Canadian SDOs and associated industries to avoid the use of single country deviations to the greatest extent possible and practical. Single country deviations should only be used as a last resort when all other options have been explored. Further this includes a commitment to review and reconsider any and all single country revisions at each revision cycle with the intent of finding solutions to remove the single county deviation in the spirit of binational harmonization. A list of work item requests will be recorded between revision cycles and by default removal of all single country deviations will be on the list for the next revision cycle.

Reasons for differences from IEC

National Differences from the IEC are being added in order to address regulatory and safety situations present in Canada and the U.S.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one literal interpretation has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

IEC Copyright

For CSA Group, the text, figures, and tables of International Electrotechnical Commission Publication 60730-2-5, Standard for Automatic Electrical Controls for Household and Similar Use, Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems, edition 3.2, copyright 2009, are used in this standard with the consent of the International Electrotechnical Commission. The IEC Foreword is not a part of the requirements of this Standard but is included for information purposes only.

NATIONAL DIFFERENCES

GENERAL

National Differences from the text of International Electrotechnical Commission (IEC) Publication 60730-2-5, Automatic Electrical Controls for Household and Similar Use, Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems copyright 2009 are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

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.

No Text on This Page

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY OF AUTOMATIC ELECTRICAL CONTROLS FOR HOUSEHOLD AND SIMILAR USE – Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems

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.

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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 60730-2-5 has been prepared by IEC technical committee 72: Automatic controls for household use.

This consolidated version of IEC 60730-2-5 consists of the third edition (2000) [documents 72/430/FDIS and 72/447/RVD], its amendment 1 (2004) [documents 72/632A/FDIS and 72/642/RVD] and its amendment 2 (2008) [documents 72/770/FDIS and 72/773/RVD].

The amendment 2 is based on 60730-2-5, Edition 3 (2000) and its Amendment 1 (2004).

The technical content is therefore identical to the base edition and its amendments and has been prepared for user convenience.

It bears the edition number 3.2.

A vertical line in the margin shows where the base publication has been modified by amendments 1 and 2.

This Part 2-5 is intended to be used in conjunction with IEC 60730-1. It was established on the basis of the third edition (1999) and Amendment 1 (2003) and Amendment 2 (2007) of that publication. Consideration may be given to future editions of, or amendments to, IEC 60730-1.

This part 2-5 supplements or modifies the corresponding clauses in IEC 60730-1 so as to convert that publication into the IEC standard: Safety requirements for automatic electrical burner control systems.

Where this part 2-5 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 2-5 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:

– 2.3.127

– 6.11

– 15.7

– 17.16.102

– H.26.10

– H.26.11.103

– Table H.27.1, Note 7

– H.27.1.3

In this publication:

1) The following print types are used:

   – Requirements proper: in roman type;

   – *Test specifications: in italic type;*

   – EXPLANATORY MATTER: IN SMALLER ROMAN TYPE.

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.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the maintenance result 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.

1.101DV DE *Modification of the 7th paragraph after item (9) of the paragraph starting with "This Part 2-5 is intended to be used" by replacing it with the following paragraph:*

This Part 2-5 is intended to be used in conjunction with UL 60730-1, edition 4 or CAN/CSA-E60730-1, edition 4. Requirements of this Part 2 Standard supplement or modify the requirements of UL 60730-1 and CAN/CSA-E60730-1. Where a particular sub-clause of UL 60730-1 and CAN/CSA-E60730-1 is not mentioned in this Part 2 Standard, that sub-clause applies as far as reasonable.

1.102DV DE *Modification of Item (1) of the paragraph starting with, "In this publication"*

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

1.103DV 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.

AUTOMATIC ELECTRICAL CONTROLS FOR HOUSEHOLD AND SIMILAR USE – Part 2-5: Particular Requirements for Automatic Electrical Burner Control Systems

1 Scope and normative references

This clause of part 1 is applicable except as follows:

1.1 *Replacement:*

This part of IEC 60730 applies to automatic electrical burner control systems for the automatic control of burners for oil, gas, coal or other combustibles for household and similar use including heating, air conditioning and similar use.

This part 2-5 is applicable to a complete burner control system and to a separate programming unit. This part 2-5 is also applicable to a separate electronic high-voltage ignition source and to a separate flame detector.

Separate ignition devices (electrodes, pilot burners, etc.) are not covered by this part 2-5 unless they are submitted as part of a burner control system.

Requirements for separate ignition transformers are contained in IEC 60989 .

1.1DV.1 D2 *Modification of 1.1 by adding the following text to the note:*

Separate ignition devices (electrodes, pilot burners, etc.) are covered by this part 2-5 (Refer to Annex DVKK).

Requirements for separate ignition transformers are covered in Standard for Specialty Transformers, UL 506, and CSA C22.2 No. 13, Standard for Luminous Tube Signs, Oil and Gas Burner Ignition Equipment, Cold-Cathode Interior Lighting.

Throughout this part 2-5, where it can be used unambiguously, the word ″system″ means ″burner control system″ and ″systems″ means ″burner control systems″.

Systems utilizing thermoelectric flame supervision are not covered by this part 2-5.

1.1DV.2 D2 *Modification of 1.1 by adding the following text:*

Devices such as thermoelectric flame supervision, pilot burners, oxygen depletion safety shut-off systems (ODS), thermoelectric safety shut-off devices, fast-acting thermocouples, and other components are covered in Annex DVKK.

1.1.1 This part 2-5 applies to the inherent safety, to the manufacturer's declared operating values, operating times and operating sequences where such are associated with burner safety and to the testing of automatic electrical burner control systems used in, on, or in association with, burners.

Requirements for specific operating values, operating times and operating sequences are given in the standards for appliances and equipment.

Systems for equipment not intended for normal household use, but which nevertheless may be 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 part 2-5.

This part 2-5 applies to systems using NTC or PTC thermistors, additional requirements for which are contained in Annex J.

This part 2-5 does not apply to systems designed exclusively for industrial applications.

1.1.1DV D2 *Modification of 1.1.1 by adding the following text:*

This part 2-5 does apply to systems designed exclusively for industrial applications.

1.1.2 This part 2-5 applies to manual controls when such are electrically and/or mechanically integral with automatic controls.

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

Throughout this part 2-5, the word ″equipment″ means ″appliance and equipment″.

1.2 *Replacement:*

This part 2-5 applies to systems with a rated voltage not exceeding 660 V and with a rated current not exceeding 63 A.

1.2DV DR *Modification of 1.2 by adding the following text:*

The maximum control output voltage is 600 V. The maximum current is unlimited.

The primary input circuit of a system shall be a two-wire, one-side-grounded system, having a voltage rating of not more than a nominal 120 volts. A switch or protective device shall be in the circuit electrically connected to the ungrounded supply conductor.

1.3 *Replacement:*

This part 2-5 does not take into account the response value of an automatic action of a control, if such a response value is dependent upon the method of mounting the control 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 household equipment standard or as determined by the manufacturer applies.

This part 2-5 includes systems responsive to flame properties.

1.4 *Replacement:*

This part 2-5 applies also to systems incorporating electronic devices, requirements for which are contained in Annex H.

1.5 Normative References

This clause of part 1 is applicable except as follows:

Addition:

IEC 60068-2-6:1995,
Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)

IEC 60127-1:2006,
Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links

IEC 60947-1:2007,
Low-voltage switchgear and controlgear – Part 1: General rules

IEC 60947-5-1:2003,
Low-voltage switchgear and controlgear – Part 5-1: Control circuit devices and switching elements – Electromechanical control circuit devices

IEC 60989:1991,
Separating transformers, autotransformers, variable transformers and reactors

1.5DV DC *Modification by adding the following to 1.5:*

IEC 61643-1,
(Low-voltage surge protective devices – Part 1: Surge protective devices connected to low-voltage power distribution systems – Requirements and tests)

ANSI/ASME B1.1-2003,
Unified Inch Screw Threads (UN and UNR Thread Form)

ANSI/ASME B1.20.1-1983 (R1992),
Pipe Threads, General Purpose (Inch)

ANSI Z21.21-2005/CSA 6.5-2005,
Automatic Valves for Gas Appliances

ANSI Z21.78-2005/CSA 6.20-2005,
Combination Gas Controls for Gas Appliances

ANSI Z223.1/NFPA 54-2006,
National Fuel Gas Code

CAN/CSA B140.2.1-M90 (R2005),
Oil Burners; Atomizing Type

CSA B 149.1-10,
Natural Gas and Propane Installation Code

CSA-B149.3-10,
Code for the Field Approval of Fuel-related Components on Appliances and Equipment

CSA C22.2 No. 3-M1988 (R2004),
Electrical Features of Fuel Burning Equipment

CSA C22.2 No. 13-1962 (R2011),
Transformers for Luminous-Tube Signs, Oil- and Gas-Burner Ignition Equipment, Cold-Cathode Interior Lighting

CSA C22.2 No. 66.1,
Low Voltage Transformers – Part 1: General Requirements

UL 506,
Specialty Transformers

UL 1449,
Surge Protective Devices

2 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 BURNER CONTROL SYSTEM:

system which monitors the operation of fuel burners. It includes a programming unit, a flame detector and may include an ignition source and/or ignition device

The various functions of the system may be in one or more housings.

2.2.102 FLAME DETECTOR:

device which provides the programming unit with a signal indicating the presence or absence of flame

It includes the flame sensor and may include an amplifier and a relay for signal transmission. The amplifier and relay may be in its own housing or combined with the programming unit.

2.2.103 FLAME SENSOR:

device which senses the flame and provides the input signal to the flame detector amplifier

Examples are optical sensors and flame electrodes (flame rods).

2.2.104 IGNITION SOURCE:

electrical or electronic system component which provides energy to an ignition device

It may be separated from or incorporated in the programming unit. Examples are ignition transformers and electronic high-voltage generators.

2.2.105 IGNITION DEVICE:

device mounted on or adjacent to a burner for igniting fuel at the burner

Examples are pilot burners, spark electrodes and hot surface igniters.

2.2.106 PROGRAMMING UNIT:

device which controls the burner operation in a declared sequence from start-up to shutdown within declared timings and in response to signals from regulating, limiting and monitoring devices

2.2.107 MULTITRY SYSTEM:

system that allows more than one valve open period during its declared operating sequence

2.3 Definitions relating to the function of controls

2.3.30 T_{MAX}: *Replace "*switch head*" by "*burner control system.*"*

Additional definitions:

2.3.101 AUTOMATIC RECYCLE

automatic repetition of the start-up procedure, without manual intervention, following loss of the supervised flame and subsequent fuel supply shutoff

2.3.102 CONTROLLED SHUTDOWN:

de-energization of the fuel flow means as a result of the opening of a control loop by a control device such as a thermostat. The system returns to the start position.

Controlled shutdown may include additional actions by the system.

2.3.103 FLAME DETECTOR RESPONSE TIME

period of time between the loss of the sensed flame and the signal indicating the absence of flame

2.3.104 FLAME DETECTOR OPERATING CHARACTERISTICS

that function of the flame detector which indicates absence or presence of flame as the output signal of the flame detector relating to the input signal

Normally the input signal is provided by a flame sensor.

2.3.104.1 SIGNAL FOR PRESENCE OF FLAME (S_1)

minimum signal which indicates the presence of flame when there was previously no flame

2.3.104.2 SIGNAL FOR ABSENCE OF FLAME (S_2)

maximum signal which indicates the loss of flame

S_2 is less than S_1.

2.3.104.3 MAXIMUM FLAME SIGNAL (S_{MAX})

maximum signal which does not affect the timings or the sequence

2.3.104.4 SIGNAL FOR VISIBLE LIGHT FLAME SIMULATION (S_3)

minimum signal which indicates the presence of flame during the visible light flame simulation test

S_3 is less than S_2.

2.3.105 SELF-CHECKING FLAME DETECTOR:

flame detector which checks for correct operation of the flame detector and its associated electronic circuitry while the burner is in the running position

2.3.106 FLAME DETECTOR SELF-CHECKING RATE:

frequency of the self-checking function of the flame detector (in number of operations per unit of time)

2.3.107 FLAME FAILURE LOCK-OUT TIME

period of time between the signal indicating absence of flame and lock-out

2.3.108 FLAME FAILURE REIGNITION TIME (RELIGHT TIME):

period of time between the signal indicating absence of flame and the signal to energize the ignition device. During this time period the fuel supply is not shut off

2.3.109 FLAME SIGNAL:

output signal of the flame detector

2.3.110 FLAME SIMULATION:

condition which occurs when the flame detector indicates the presence of flame when in reality no flame is present

2.3.111 IGNITION TIME:

period of time during which the ignition device is energized

2.3.112 LOCK-OUT:

process in which the system goes into one of the following lock-out conditions, following safety shutdown

2.3.112.1 NON-VOLATILE LOCK-OUT:

condition such that a restart can only be accomplished by a manual reset of the system and by no other cause

2.3.112.2 VOLATILE LOCK-OUT: condition such that a restart can be accomplished by either a manual reset of the system or by an interruption of the power supply and its subsequent restoration

2.3.112.3DV D2 *Addition of 2.3.112.3DV with the following text:*

HARD LOCKOUT

The automatic action to end an ignition sequence. Reinitiating another ignition sequence requires a manual operation at the equipment or interruption of the main electrical power supply to the equipment.

2.3.112.4DV D2 *Addition of 2.3.112.4DV with the following text:*

SOFT LOCKOUT

The automatic action to end an ignition sequence. Reinitiating another ignition sequence is accomplished by automatic or manual means either of which may be remote from the equipment.

2.3.113 MAIN FLAME ESTABLISHING PERIOD:

period of time between the signal to energize the main fuel flow means and the signal indicating presence of the main burner flame

2.3.113.1DV D2 *Addition of 2.3.113.1DV with the following text:*

TRIAL FOR IGNITION PERIOD

The period of time between energizing and de-energizing the fuel flow means, if proof of the supervised flame is not established. For systems incorporating interrupted pilot ignition – also considered main burner flame establishing period.

2.3.114 PILOT FLAME ESTABLISHING PERIOD:

period of time between the signal to energize the pilot fuel flow means and the signal indicating presence of the pilot flame

2.3.115 POST-IGNITION TIME:

period of the ignition time between the signal indicating presence of flame and the signal to de-energize the ignition device

2.3.116 PRE-IGNITION TIME:

period of the ignition time between the signal to ignite and the signal to energize the fuel flow means

2.3.117 PROVED IGNITER:

system in which the fuel flow means is energized only after the availability of sufficient energy to ignite the fuel has been verified

Examples are systems using spark supervision and those using proved hot surface igniters.

2.3.117DV DE *Modification of 2.3.117 title with the following text:*

PROVED IGNITER SYSTEM

2.3.117.1 PROVED IGNITER OPERATING VALUE:

signal which indicates that the proved igniter has the energy to ignite the fuel

2.3.117.2 IGNITER PROVING TIME:

period of time between the signal to energize the proved igniter and the signal to energize the fuel flow means

2.3.117.3 IGNITER FAILURE RESPONSE TIME:

period of time between loss of the supervised proved igniter and the signal to de-energize the fuel flow means

2.3.118 PURGE TIME:

period during which air is introduced to displace any remaining air/fuel mixtures or products of combustion from the combustion zone and flue ways

No fuel is admitted during this period.

2.3.118.1 POST-PURGE TIME:

purge time that takes place immediately following the shutting off of the fuel supply

2.3.118.2 PRE-PURGE TIME:

purge time that takes place between initiation of a burner control sequence and the admission of fuel to the burner

2.3.118.3DV D2 ***Addition of 2.3.118.3DV with the following text:***

INTER-PURGE TIME

On a multitry system, the purge time that takes place between the end of a trial for ignition period and reactivation of the ignition means if proof of the supervised flame is not established.

Inter-purge time is normally provided for burners where air for combustion is mechanically introduced for ventilation of the combustion chamber and flue passages before reenergizing the ignition means.

2.3.119 RE-IGNITION (RELIGHT):

process by which, following loss of the flame signal, the ignition device will be re-energized without interruption of the fuel flow means

2.3.120 RECYCLE TIME:

period of time between the signal to de-energize the fuel flow means following the loss of flame and the signal to begin a new start-up procedure

2.3.121 RUNNING POSITION:

this position denotes that the main burner flame is established and supervised

2.3.122 SAFETY SHUTDOWN: de-energization of the main fuel flow means as the result of the action of a limiter, a cut-out or the detection of an internal fault of the system

Safety shutdown may include additional actions by the system.

2.3.123 START POSITION:

position which denotes that the system is not in the lock-out condition and has not yet received the start signal, but can proceed with the start-up sequence if required

2.3.124 START SIGNAL:

a signal, for example, from a thermostat, which releases the system from its start position

2.3.125 START-UP LOCK-OUT TIME:

period of time between the signal to energize the fuel flow means and lock-out

For systems which control two separate fuel flow means, two different start-up lock-out times are possible (first and second start-up lock-out times).

2.3.126 WAITING TIME:

period between the start signal and the signal to energize the ignition device. For burners without fans, natural ventilation of the combustion chamber and the flue passages normally takes place during this time

2.3.127 VALVE OPEN PERIOD:

for multitry systems, the period of time between the signal to energize the fuel flow means, and the signal to de-energize the fuel flow means, if proof of the supervised burner flame is not established

In the USA, this period is referred to as the "trial-for-ignition period".

2.3.127DV DE *Modification of 2.3.127 by adding the following text to the title and note:*

VALVE OPEN PERIOD / TRIAL-FOR-IGNITION PERIOD

In the USA and Canada, this period is referred to as the "trial-for-ignition period."

2.3.128 VALVE SEQUENCE PERIOD

for multitry systems, the sum of all valve opening periods prior to lock-out, if proof of the supervised burner flame is not established

2.3.129 SYSTEM RESTART:

process by which, after a safety shutdown, a full start-up procedure is automatically repeated

2.3.130DV D2 *Addition of the 2.3.130DV with the following text:*

SAFE START CHECK

an action during each start-up sequence, where the system checks for a flame signal before any fuel valve is energized.

2.5 Definitions of types of control according to construction

Additional definitions:

2.5.101 SYSTEM FOR PERMANENT OPERATION:

system which is intended to remain in the running position for longer than 24 h without interruption

2.5.102 SYSTEM FOR NON-PERMANENT OPERATION

system which is intended to remain in the running position for less than 24 h

Additional definitions:

2.101 Definitions relating to type of burner (see 6.101)

2.101.1 CONTINUOUS IGNITION:

a type of ignition which, once placed in operation, is intended to remain energized continuously until it is manually interrupted

2.101.2 CONTINUOUS PILOT:

a pilot which, once placed in operation, is intended to remain ignited continuously until it is manually interrupted

2.101.3 DIRECT IGNITION:

a type of ignition which is applied directly to the main burner, without the use of a pilot

2.101.4 EXPANDING PILOT:

form of continuous pilot where the pilot flame is increased or expanded when required to ignite the main burner and reduced either immediately after main burner ignition, or after the main flame is shut off

2.101.5 FULL RATE START:

condition in which the main burner ignition and subsequent flame supervision occur at full fuel rate

2.101.6 INTERMITTENT IGNITION:

a type of ignition which is energized when an appliance is called on to operate and which remains continuously energized during each period of main burner operation. The ignition is de-energized when the main burner operating cycle is completed

2.101.7 INTERMITTENT PILOT:

a pilot which is automatically ignited when an appliance is called on to operate and which remains continuously ignited during each period of main burner operation. The pilot is automatically extinguished when each main burner operating cycle is completed

2.101.8 INTERRUPTED IGNITION:

a type of ignition which is energized prior to the admission of fuel to the main burner and which is de-energized when the main flame is established

2.101.9 INTERRUPTED PILOT:

a pilot which is automatically ignited prior to the admission of fuel to the main burner and which is automatically extinguished when the main flame is established

2.101.10 LOW RATE START:

condition in which main burner ignition occurs at low fuel rate. Once ignition at low fuel rate occurs and the flame is proved, full main burner fuel rate may be admitted

2.101.11 PILOT:

flame, smaller than the main flame, which is utilized to ignite the main burner or burners

2.101.12DV D2 *Addition of 2.101.12DV with the following text:*

ON DEMAND PILOT

a pilot which, once placed into operation, is intended to remain ignited for a predetermined period of time following an automatic or manual operation of the main burner gas valve. The pilot is automatically extinguished when no automatic or manual operation of the main burner gas valve occurs during the predetermined period of time.

2.101.13DV D2 *Addition of 2.101.13DV with the following text:*

FLAME FAILURE RESPONSE TIME

the period of time between loss of the supervised ignition source or the supervised main burner flame and the action to shut off the fuel supply.

2.101.14DV D2 *Addition of 2.101.14DV with the following text:*

IGNITION ACTIVATION PERIOD

The period of time between energizing the main gas valve and deactivation of the ignition means during a trial for ignition period.

2.101.15DV D2 *Addition of 2.101.15DV with the following text:*

AUTOMATIC RESTART TIME

The period of time between a soft lockout and the automatic action to initiate another ignition sequence.

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

4.1.1 *Replacement*

Unless otherwise specified, the system and each system component are tested as delivered, having been mounted as declared in table 7.2, requirement 31, in the most unfavourable position when there is more than one position.

When a separate system component is submitted, the manufacturer shall provide those other system components which may be necessary to perform the relevant tests.

4.1.7 Not applicable.

4.2 Samples required

4.2.1 *Replacement*

Unless otherwise specified, one sample shall be used for the tests of clauses 5 to 14 inclusive. A different sample(s) shall be used for the tests of clauses 15 to 17. At the option of the manufacturer, the tests of clauses 18 to 26 inclusive may be conducted on a new sample or on the sample(s) used for the tests of clauses 5 to 14 inclusive. The tests of clause 27 shall be conducted on a new sample.

4.3 Instructions for test

4.3.2.1 *Modification*

Delete "and those for a.c./d.c. at the more unfavourable supply."

4.3.2.1DV D2 *Modification of 4.3.2.1 by adding the following text to the clause:*

Controls declared for ac only are tested with ac rated frequency. Controls declared for dc only are tested with dc. Controls declared for ac/dc are tested at both ac and dc voltages.

4.3.2.4 Not applicable.

4.3.2.6 *Replacement*

For systems marked or declared for more than one rated voltage or rated current, the tests of clause 17 are made at the rated voltage and associated current (or vice versa) which produces the most unfavourable combination.

5 Rating

This clause of part 1 is applicable.

6 Classification

This clause of part 1 is applicable except as follows:

6.1 According to nature of supply

6.1.1 Systems for a.c. only

Replace explanatory matter as follows:

Systems intended for use on a.c. supply may only be used on a.c. supplies

6.1.3 Not applicable

6.1.3DV D1 *Modification of 6.1.3 by adding the following text:*

This clause is applicable.

6.3 According to their purpose

Additional subclauses:

6.3.101 – burner control system;

6.3.102 – flame detector;

6.3.103 – programming unit;

6.3.104 – ignition device;

6.3.105 – electronic high-voltage ignition source;

6.3.106 – flame sensor.

6.4 According to features of automatic action

6.4.1 Not applicable.

6.4.3 *Addition*

Burner control systems are classified as having Type 2 action

6.4.3.12 Not applicable

Additional subclauses

6.4.3.101 – non-volatile lock-out (Type 2.V);

6.4.3.102 – volatile lock-out (Type 2.W);

6.4.3.103 – non-permanent operation (Type 2.AC);

6.4.3.104 – permanent operation (Type 2.AD);

6.4.3.105 – spark supervision (Type 2.AE);

6.4.3.106 – air/pressure flow supervision (Type 2.AF);

6.4.3.107 – position-checked external devices (Type 2.AG);

6.4.3.108 – visible light flame simulation check (Type 2.AH);

6.4.3.109 – proved hot surface igniter (Type 2.AI).

6.7 According to ambient temperature limits of the switch head

6.7.1 *Modification*

*Replace "*Control with a switch head*" by "*System and system components*".*

6.7.2 *Modification*

*Replace "*Control with a switch head*" by "*System and system components*".*

6.10 According to number of cycles of actuation (M) of each manual action

6.10.5 to 6.10.7 Not applicable.

6.11 According to number of automatic cycles (A) of each automatic action

Addition:

In the countries members of CENELEC, the minimum value is 250 000 automatic cycles. In Canada, China, in Japan and the USA, the minimum value is 100 000 cycles.

6.11.4 to 6.11.2 Not applicable.

6.15 According to construction

6.15.3 Not applicable

6.15.3DV D2 *Modification of 6.15.3 by adding the following note:*

Note: Throughout this document, in-line cords are not permitted.

6.16 Not applicable

Additional subclauses:

6.101 According to type of burner

Classification should be according to burner operation (for example, forced draught) and type of fuel (for example, gas). See 2.101.1 to 2.101.11.

6.102 According to type of pilot

6.103 According to type of ignition

6.104 According to starting fuel rate

7 Information

This clause of part 1 is applicable except as follows:

7.2.6 *Replacement*

Except as indicated in 7.4, for integrated systems all information is provided by means of declaration (X). For incorporated systems not declared under requirement 50, the marking required is as indicated in table 7.2. For incorporated systems declared under requirement 50, the only marking required is the manufacturer's name or trade mark and the unique type reference if other required marking is provided by documentation (D).

See the explanation of documentation (D) contained in 7.2.1.

7.2.9 *Modification:*

Replace "T_{max} other than 55 °C*" by "*T_{max} other than 60 °C*" in the line for symbol for "*Ambient temperature limits of switch head*".*

Table 7.2

	Information	Clause or subclause	Method
	Modification:		
	Replace the following requirements by:		
4	Nature of supply (a.c. or d.c.)	4.3.2, 6.1	C
6	Purpose of system or system component	4.3.5, 6.3	D
7	The type of load controlled by each circuit[7)]	14, 17.3.1, 6.2, 27.1.2	D
15	Degree of protection provided by enclosure[8)]	6.5.1, 6.5.2, 11.5	D
17	Which of the terminals are suitable for the connection of external conductors, and if they are suitable for line or neutral conductors, or both	6.6, 7.4.2, 7.4.3	D
22	Temperature limits of the system and system components if T_{min} is lower than 0 °C, or T_{max} other than 60 °C	6.7, 14.5, 14.7, 17.3	D
23	Temperature limits of mounting surfaces (T_s)	6.12.2, 14.1, 17.3	D
26	Number of cycles of actuation (M) for each manual action[101)]	6.10	X
28	Not applicable		
31	Method of mounting the system and each system component[5)]	4.1.1, 11.6	D
34	Details of any limitation of operating time	6.4.3.103, 6.4.3.104, 14, 17	D
37	Not applicable		
38	Not applicable		
40	Additional features of Type 2 actions	6.4.3	D
41	Not applicable		
42	Not applicable		
44	Not applicable		
46	Operating sequence	2.3.13, 11.3.108, 15	D
48	Not applicable		
50	System or system components intended to be delivered exclusively to the equipment manufacturer	7.2.1, 7.2.6	X
	Add the following additional requirements:		
101	Maximum flame detector response time (if applicable)	2.3.103, 15	D
102	Minimum flame detector self-checking rate (if applicable)	2.3.106, 15	D
103	Maximum flame failure lock-out time (if applicable)	2.3.107, 15	D
104	Maximum flame-failure re-ignition time (if applicable)	2.3.108, 15	D
105	Maximum ignition time (if applicable)	2.3.111, 15	D
106	Maximum main flame establishing period (if applicable)	2.3.113, 15	D
107	Maximum pilot-flame establishing period (if applicable)	2.3.114, 15	D
108	Maximum post-ignition time (if applicable)	2.3.115, 15	D
109	Maximum pre-ignition time (if applicable)	2.3.116, 15	D
110	Void		
111	Minimum post-purge time (if applicable)	2.3.118.1, 15	D
112	Minimum pre-purge time (if applicable)	2.3.118.2, 15	D
113	Minimum recycle time (if applicable)	2.3.120, 15	D
114	Maximum start-up lock-out time (if applicable)	2.3.125, 15	D
115	Minimum waiting time (if applicable)	2.3.126, 15	D
116	Type of burner	6.101	D
117	Type of pilot	6.102, 2.101.2, 2.101.4, 2.101.7, 2.101.9, 2.101.11	D
118	Type of ignition	2.101.1, 2.101.3, 2.101.6, 2.101.8, 6.103	D
119	See Annex H		
120	Means for protecting setting of timings	11.3.4	X

Table 7.2 Continued on Next Page

Table 7.2 Continued

	Information	Clause or subclause	Method
121	See Annex H		
122	Resistance to vibration	17.1.3, 17.16.103	D
123	S_1 (signal for presence of flame)	2.3.104.1, 15.5, 15.6, 15.7	D
124	S_2 (signal for absence of flame)	2.3.104.2, 15.5, 15.6, 15.7	D
125	S_{max} (maximum flame signal, if applicable)[103)]	2.3.104.3, 15.5, 15.6, 15.7	D
126	Electronic high-voltage ignition spark gap [102)]	11.3.107, 13.2.101	D
127	Other system components for use with the submitted components to provide a complete system	2.2.101, 2.2.102, 2.2.104, 2.2.106	D
128	For each valve opening period, the maximum time (if applicable)	2.3.127, 11.3.113, 11.3.114, 15.5 p)	D
129	Maximum valve sequence period (if applicable)	2.3.128, 11.3.112, 15.5 q)	D
130	S_3 (signal for presence of flame during visible light simulation test)	2.3.104.4, 11.3.110	X
131	For proved igniters, the characteristics (energy, current, voltage, resistance, temperature, etc.) which establish that the proved igniter has the energy to ignite the fuel	2.3.117	D
132	Proved igniter operating value (Minimum and/or maximum, as applicable)	2.3.117.1, 15.7, 17.16.108, H.27.1.3	D
133	Maximum igniter proving time (If applicable)	2.3.117.2, 15.5	D
134	Maximum igniter failure response time (If applicable)	2.3.117.3, 15.5	D
135	Type of lock-out	2.3.112, 11.3.108, H.27.1.3.101	D
136	See Annex H		

NOTES

Additional notes

[101)] For 17.16.105 the number of manual actions for lock-out re-set is a minimum of 6 000.

[102)] If a range is declared, the maximum value is used for the test of 13.2.102 and 13.2.103.

[103)] S_{max} shall be declared for those systems in which the maximum flame signal affects timings or sequence.

Table 7.2DV D2 *Modification of Table 7.2 as follows:*

	Information	Clause or subclause	Method
103.1DV	**Maximum flame failure response time (if applicable)**	**2.101.13DV**	**D**
106.1DV	**Maximum trial for ignition period (if applicable)**	**2.3.113.1DV**	**D**
115.1DV	**Operating Timings (if applicable)**	**15.5DV**	**D**

Add Clause reference to item 117 ″2.101.12DV″.

8 Protection against electric shock

This clause of part 1 is applicable except as follows:

8.1 General requirements

Additional subclause:

8.1.101 High-voltage ignition sources

Provision shall be made for protection against contact with high-voltage ignition sources having any of the following characteristics:

a) for continuous spark ignition (pulses within the mains frequency range):

– the maximum voltage is higher than 10 kV (peak), and/or

– the maximum current is higher than 0,7 mA (peak);

b) for pulse spark ignition (see figure 101:

– the charge of an individual ignition pulse exceeds 100 µC, and

– the duration, *(d)*, is greater than 0,1 s, and

– the interval *(i)* between individual ignition pulses is less than 0,25 s

Either the system manufacturer shall provide a warning that is visible when the high-voltage ignition source is mounted as in normal use, or the equipment manufacturer shall be advised of the need to provide such protection or a warning.

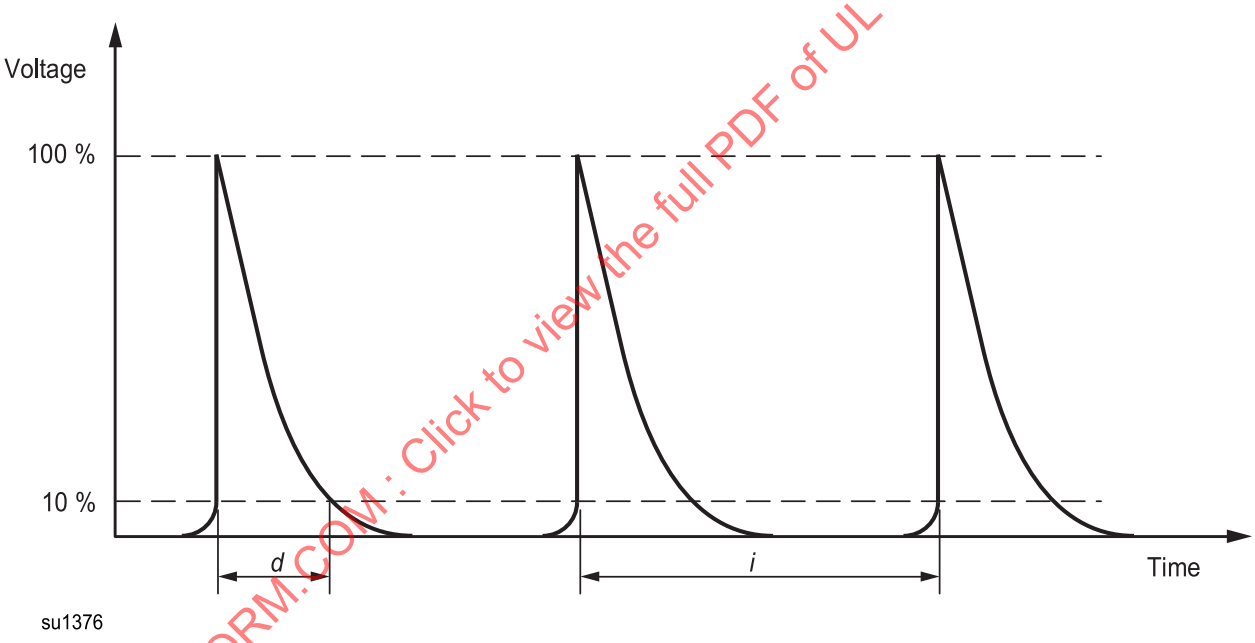

Figure 101 – Pulse spark generation

8.3 Capacitors

Not 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:

10.2.4 Flat push-on connectors

Additional subclause:

10.2.4.101 Direct plug-in connections

Systems designed for direct plug-in connection to a sub-base shall be so constructed that they withstand the forces of normal insertion and withdrawal in such a manner that compliance with this part 2-5 is not impaired.

Compliance is checked by performing 10 insertions and withdrawals according to the manufacturer's instructions.

After this test, no significant displacement or damage shall occur.

The terminals used for direct plug-in connections between the system and/or system components and their sub-bases are not considered flat push-on connectors.

11 Constructional requirements

This clause of part 1 is applicable except as follows:

11.1 Materials

11.1.2 Not applicable

11.3 Actuation and operation

11.3.4 Setting by the manufacturer

Replacement

Adjustment means used for the setting of timings shall be secured by means providing protection against access by unInstructed persons or shall be declared as requiring such protection in the application.

For example, such adjustment means may

1) be sealed with a material suitable for the temperature range of the system and/or system components such that tampering is apparent, or

2) consist of special parts only available from the manufacturer, or

3) be accessible only with the use of special-purpose tools or access codes.

Compliance is checked by inspection. Where sealing is used, inspection is done before and after the tests of clause 17.

11.3.5 Contacts – General

Additional subclauses:

11.3.5.101 The system shall include at least two switching elements to directly de-energize the safety relevant valve terminals.

NOTE A single relay operating two independent contacts is considered to be only one switching element.

11.3.5.101.1 Measures to prevent common mode errors

Requirements and test methods are under consideration.

11.3.9 Pull-cord actuated control

Not applicable.

Additional subclauses:

11.3.101 Burner control circuits

Circuits employing burner control systems used in earthed supply systems shall be two-wire, one-side nominally earthed. Devices intended to open such a circuit shall be connected to the unearthed side of the supply circuit.

11.3.102 Circuits employing burner control systems used in unearthed supply systems shall be two-wire. All devices intended to open such circuits shall be connected to the same side of the supply circuit.

11.3.103 Circuits employing burner control systems used in earthed three-phase supply systems shall be four-wire. Devices intended to open such circuits shall be connected to all three phases.

11.3.104 Circuits employing burner control systems used in unearthed three-phase supply systems shall be three-wire. Devices intended to open such circuits shall be connected to two or three phases.

11.3.105 If the system initiates a signal to energize the fuel flow means at less than 85 % rated voltage for a.c. and less than 80 % rated voltage for d.c., the system shall comply with the following:

a) in the running position, the system shall proceed to safety shutdown or operate with the timings measured at declared ambient temperatures as declared in table 7.2, requirements 101 to 104, inclusive;

b) in any other position, the operating sequence shall comply with the declarations of table 7.2, requirement 46. The start-up lock-out time shall not exceed twice the value declared in table 7.2, requirement 114.

Compliance is checked by H.26.5.4.

11.3.106 The system shall provide a safe start check that will cause a), b) or c) to occur if the failure results in a flame before the fuel flow means are energized.

a) The system shall fail to start the operating sequence;

b) the system shall lock out within the time declared in table 7.2, requirement 103;

c) the system shall remain in pre-purge.

The system may remain in conditions a) or c) until the fault clears.

For systems which incorporate electronic devices, compliance is determined by the tests of H.27.

For systems not subject to the tests of H.27, a flame signal shall be simulated and introduced at the start of the flame establishing period until a), b) or c) occurs.

11.3.107 Systems declared as Type 2.AD shall perform a self-check at least once every hour, when the system is in the running position.

Systems declared in table 7.2, requirement 102, have the self-checking rate evaluated as part of the declared sequence and timings. This requirement shall be evaluated in clauses 15, 17 and H.27.1.3.102 to H.27.1.3.103.2 inclusive.

11.3.108 Systems shall perform the declared operating sequence.

11.3.108.1 The electric circuit of the actuating means of the lock-out device shall be checked during each start-up sequence.

11.3.108.2 The fuel flow means shall not be energized before the ignition device.

11.3.108.3 Re-ignition is only permitted when the system is in the running position.

11.3.108.4 Automatic recycle is only permitted when the system is in the running position.

11.3.108.5 If no flame is detected at the end of the first or second start-up lock-out time the system shall perform lock-out. However, if the declared operating sequence includes recycle or re-ignition, the system may recycle or allow re-ignition.

Compliance with 11.3.108 is checked by inspection and by test.

11.3.108.6 If no flame is detected at the end of the flame failure lock-out time the system shall perform lock-out. However, if the declared operating sequence includes recycle or re-ignition, the system may recycle or allow re-ignition.

11.3.108.7 After a safety shutdown or after a volatile lock-out reset, the operating sequence may proceed only with a system restart.

11.3.109 If the wiring diagram provided by the manufacturer indicates an input to the system from an external limiter or cut-out, then operation of this external device shall lead to at least safety shutdown.

Compliance is checked by examination of the circuit design.

11.3.110 Visible light flame simulation test

Flame detectors classified as Type 2.AH shall have a check to discriminate between flame simulation and flame signals originating from real flame. Examples of suitable checks are:

a) prior to the signal to energize the fuel flow means during each start-up sequence, the system shall check for the presence of a flame signal that is greater than or equal to S_3. If such a signal is detected, the system shall proceed to lock-out or shall interrupt the start-up sequence;

for the above test, S_3 shall be less than S_2;

or

b) after performing a controlled shutdown, the system shall check for the presence of a flame signal which is less than or equal to S_2. If such a signal is detected, the system shall proceed to lock-out or shall prevent the next start-up sequence.

11.3.111 For multitry systems, the system shall go to lock-out at the end of the valve sequence period.

11.3.112 For multitry systems, further valve open periods may be initiated either as a result of loss of supervised flame during the running position or failure to prove supervised flame during the declared valve sequence period.

Reignition (see 11.3.108.5) is also allowed if declared.

11.3.113 For multitry systems, the valve open periods may have different values during the valve sequence period.

11.4 Actions

11.4.3 Type 2 action

Replacement:

Any Type 2 action shall be so designed that the manufacturing deviation and drift of its operating value, operating time or operating sequence is within the limits declared in table 7.2, requirements 46, 101 to 115 inclusive, and 123 to 125 inclusive.

11.4.15 Not applicable

Additional subclauses:

11.4.101 Type 2.V action

A Type 2.V action shall be so designed that a restart can only be accomplished by a manual reset of the system.

Systems classified as Type 2.V shall have a reset mechanism classified as Type 2.J.

Compliance is checked by inspection and by test.

11.4.102 Type 2.W action

A Type 2.W action shall be so designed that a restart can only be accomplished by either a manual reset or an interruption of the power supply and its subsequent restoration.

Compliance is checked by inspection and by test.

11.4.103 For systems with remotely mounted reset buttons, a short circuit between the connecting cables or between the connecting cables and earth shall not result in a reset.

11.4.104 Systems classified as Type 2.AE shall perform spark supervision prior to energization of the fuel flow means.

11.4.105 Systems classified as Type 2.AF shall check for correct function of external air pressure/flow control.

The system shall perform safety shut-down or lock-out or shall fail to start if a positive external air pressure/flow control signal is detected prior to start-up.

The system shall perform safety shut-down or lock-out if insufficient external air pressure/flow is detected during the purge time or when the system is in the running position.

11.4.106 Systems classified as Type 2.AG which perform position checks during or prior to the start-up sequence shall continue with the operating sequence only after these position checks have been successfully performed.

Compliance with 11.4.103 to 11.4.106 inclusive is checked by inspection and by test.

11.4.107 Systems classified as Type 2.AI shall perform hot surface igniter supervision prior to energization of the fuel flow means.

11.4.108DV D2 *Addition of 11.4.108DV with the following text:*

A manually reset mechanism is subjected to the lock-out and reset test of 17.16.105.

11.10 Equipment inlets and socket-outlets

11.10.2 Not applicable.

11.11 Requirements during mounting, maintenance and servicing

11.11.6 Not applicable.

11.13 Not applicable

Additional subclauses:

11.101 Flame detector constructional requirements

11.101.1 Flame detector devices using infrared sensors shall only react to the flicker property of the flame.

11.101.2 Flame detector devices using ionization sensors (flame rods) shall only make use of the rectification property of the flame.

11.101.3 Flame detector devices using UV-tubes shall have sufficient checks for ageing of the UV-tubes.

– automatic periodic supervision of the sensor function;

– a check of the UV-tube during the purge time with a voltage 15 % higher than that applied to the UV-tube during the remainder of the operating sequence;

– a check that the flame relay has dropped out after each controlled shutdown with the amplifier continually energized.

11.101.4 An open circuit of the flame sensor or its connecting cables shall cause loss of the flame signal.

11.101.5 Flame detectors using UV sensors other than UV tubes shall not react to infrared light. Such flame detectors shall not indicate a signal for the presence of flame when the sensor is illuminated with 10 lux or less at a colour temperature of 2 856 K with the spectrum being cut off below the wavelength of 400 nm by means of a filter.

11.101.6 Sensors for visible light are not allowed if the illumination intensity is lower than 0,5 lx during operation. Systems using sensors for visible light shall not give a detect-of-flame signal during operation below an illumination intensity of 0,5 lx.

Compliance with 11.101.1 to 11.101.6 inclusive is checked by inspection, test and/or measurement.

12 Moisture and dust resistance

This clause of part 1 is applicable

12.2.2DV D2 *Modification of 12.2.2 with the following text:*

Compliance is checked by the test sequence described in 12.2.8DV and 12.2.8.1DV after the humidity treatment of 12.2.7DV.

12.2.3DV D2 *Modification of 12.2.3 with the following text:*

Not applicable

12.2.7DV D2 *Modification of 12.2.7 with the following text:*

Before being placed in the humidity cabinet, one of the samples tested in clause 15.5 shall be conditioned for 4 hours at a temperature of 15.5 ± 2.7°C (60 ± 5°F). The sample is then immediately placed in the humidity cabinet. Immediately following humidity treatment, the electric strength test of 13.2 shall be conducted.

12.2.8DV D2 *Modification of 12.2.8 with the following text:*

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity of 95 ± 4 percent condensing. The temperature of the air, at all places where the samples can be located, is maintained at 40 ±2°C (104 ±4°F) for 48 hours without the sample(s) being operated. During the test, the sample(s) shall be protected from any dripping condensate. The sample(s), while in the cabinet, shall then be operated at rated voltage and cause either ″a,″ ″b″ or ″c″ to occur. If ″a″ or ″b″ occur, the test in 12.2.8.1DV shall be conducted.

a) The control shall act to interrupt flow of fuel under its control.

b) The control shall complete that cycle of operation and will fail to start or lock out on the subsequent cycle.

c) The control shall continue to operate without exceeding the manufacturer's specified maximum timing for flame establishing period, flame failure response time, flame failure reignition time, lockout time, ignition activation period, trial for ignition period and valve sequence period, nor be less than the manufacturer's specified minimum timing for recycle time, automatic restart time and purge time.

For proved igniter systems, the igniter proving characteristics shall not exceed or be less than, as applicable, the value(s) specified by the manufacturer.

12.2.8.1DV D2 *Addition of 12.2.8.1DV with the following text:*

When required by 12.2.8DV, the sample(s) shall be conditioned for 24 hours at a temperature of 40 ± 2°C (104 ± 4°F) at a relative humidity of 50 ± 4 percent. The sample(s) shall then be conditioned for 48 hours, at 88 ± 4 percent relative humidity noncondensing and 40 ± 2°C (104 ± 4°F) without the sample(s) being operated. While maintained at these conditions, the sample(s), shall then be operated at rated voltage and timings shall be retested as specified in clause 15, Manufacturer Deviation and Drift, and shall comply.

12.2.9DV D2 *Modification of 12.2.9 with the following text:*

Not applicable.

13 Electric strength and insulation resistance

This clause of part 1 is applicable except as follows:

13.1 Insulation resistance

Not applicable.

13.2 Electric strength

Additional subclauses.

13.2.101 The electric strength of the high-voltage side of an electronic high-voltage ignition source is not checked by the test of 13.2 to 13.2.4 inclusive, but by the tests of 13.2.102 to 13.2.103, which are conducted immediately after the humidity treatment of 12.2.7 and 12.2.8.

For electronic high-voltage ignition sources which are built into the printed circuit board, additional details of the test methods are to be agreed between the manufacturer and the test authority.

13.2.102 The input supply terminals of the electronic high-voltage ignition source are to be connected to a variable voltage supply at rated input mains frequency. The output voltage is measured at 1,0 V_R and 1,1 V_R with the spark gap as declared in requirement 126 of table 7.2. Then the electronic high-voltage ignition source is subjected to the following tests:

a) all connections to the output terminals are removed. Initially, a voltage not exceeding the rated voltage is applied. Then the input voltage is gradually increased until 150 % of output voltage measured in 13.2.102 (at 1,0 V_R) is achieved. The output voltage is maintained at that value for 1 min; or

b) with the input voltage at 1,1 V_R, the electrode gap is increased from that declared in requirement 126 of table 7.2 until either 150 % of the output voltage measured in 13.2.102 (at 1,0 V_R) is achieved or until the output voltage no longer increases, whichever occurs first. This output voltage is maintained for 1 min; or

c) if test methods a) and b) cannot be applied, a test method shall be agreed between manufacturer and test authority in order to achieve 150 % of the output voltage measured in 13.2.102 at 1,0 V_R or the highest possible output voltage for the device. This output voltage is maintained for 1 min.

13.2.103 Compliance is determined by measuring the output voltage with 1,1 V_R applied to the input terminal and with the spark gap restored to that declared in requirement 126 of table 7.2, if applicable. The measured output voltage shall be within ±10 % of the value measured in 13.2.102 at 1,1 V_R.

For 13.2.102 a), b) and c), flashovers which occur at an air gap provided to protect the circuitry are ignored. Glow discharges at the output terminal are neglected.

14 Heating

This clause of part 1 is applicable except as follows:

14.3 Not applicable

14.4.2 Not applicable

14.4.3.1 to 14.4.3.3 Not applicable

14.4.3.4 *Modification:*

Replace "other automatic controls," by "systems".

14.4.4 Not applicable

14.5.1 *Modification:*

Replace "switch head" by "system".

14.6 *Modification:*

Replace "switch head" by "system".

14.6.2 Not applicable

14.7 *Modification:*

Replace "switch head" by "system".

Modification to table 14.1:

The section entitled "Accessible surfaces of handles, knobs, grips and the like used for carrying and transporting the control" is not applicable.

15 Manufacturing deviation and drift

This clause of part 1 is applicable except as follows:

15.1 Systems shall have adequate consistency of manufacture with regard to their declared operating times, operating sequences, flame detector operating characteristics, and proved igniter operating value.

15.2 Compliance is checked by the tests of this clause.

15.3 The appropriate operating time, operating sequence, flame detector operating characteristics and proved igniter operating value shall be recorded for the sample.

15.4 Three tests shall be conducted for each operating time, each operating sequence, flame detector operating characteristics and each proved igniter operating value declared.

15.5 Operating times

Each of the following operating times which are declared applicable in table 7.2 shall be measured at a voltage of 0,85 V_R a.c. or 0,80 V_R for d.c. and at a temperature of T_{min}.

Measurements shall also be taken at a voltage of 1,1 V_R and a temperature of T_{max}.

None of the times recorded shall exceed the manufacturer's declared maximum times nor be less than the manufacturer's declared minimum times, whichever is applicable

a) flame detector response time;

b) flame detector self-checking rate;

c) flame failure lock-out time;

d) flame failure re-ignition time (relight time);

e) ignition time;

f) main flame establishing period;

g) pilot flame establishing period;

h) post-ignition time;

i) pre-ignition time;

j) Void;

k) post-purge time;

l) pre-purge time;

m) recycle time;

n) start-up lock-out time;

o) waiting time;

p) valve opening period;

q) valve sequence period;

r) igniter proving time;

s) igniter failure response time.

For test purposes, the flame detector operating characteristics (S_1 and/or S_2 and/or S_{max}) may be artificially simulated.

15.5DV D2 *Modification of 15.5 by adding the following text:*

t) trial for ignition period;

u) inter-purge time;

v) lock-out time;

w) flame failure response time;

x) ignition activation period;

y) automatic restart time.

15.5.4 Not applicable

15.6 Operating sequence

The operating sequence shall be tested at a voltage of 0,85 V_R a.c. or 0,80 V_R for d.c. and at a temperature of T_{min}. A test shall also be conducted at a voltage of 1,1 V_R and a temperature of T_{max}.

The operating sequence shall be as declared.

For test purposes, the flame detector operating characteristics (S1 and/or S_2 and/or S_{max}) may be artificially simulated.

15.7 Flame detector operating characteristics and proved igniter operating value

The operating characteristics of flame detectors and proved igniter operating value shall be measured under the following conditions:

a) at V_R and (20 ± 5) °C;

b) at 0,85 V_R and 0 °C or T_{min}, whichever is lower, and

c) at 1,1 V_R and 60 °C or T_{max}, whichever is higher.

The measured values shall be as declared in table 7.2 requirements 123, 124, 125, and 132, as applicable

The details of the measuring equipment shall be arranged between the manufacturer and the test house.

If a lamp is used for response to the visible range of light, it shall have a colour temperature of 2 856 K.

The preceding paragraph is not applicable in the USA and Canada.

16 Environmental stress

This clause of part 1 is applicable except as follows:

Replacement:

16.2.4 *In addition, the appropriate tests of Clause 15 shall be repeated, only at room temperature, after each of the above tests. The values in these tests shall not differ from the values declared in Table 7.2.*

17 Endurance

This clause of part 1 is applicable except as follows:

17.1 General requirements

Replacement:

17.1.1 Systems including those submitted in or with an appliance shall withstand, without excessive wear or other harmful effect, the mechanical, electrical and thermal stresses that occur in normal use.

17.1.2 Compliance is checked by the tests indicated in 17.1.3.

17.1.3 Test sequence and conditions

In general, the sequence of tests is:

– *for electronic systems, the thermal cycling test specified in 17.16.101;*

– *endurance test of automatic and manual action at normal operating rate specified in 17.16.102;*

– *vibration test of 17.16.103, if declared;*

– *endurance test of automatic action at accelerated rate specified in 17.16.104.*

For test conditions, see 17.2 and the relevant tests of 17.16.

The number of operations performed during 17.16.101, 17.16.102 and 17.16.104 is recorded. When the actual number of automatic cycles completed is equal to the number declared in table 7.2 requirement 27, this test sequence is concluded and the following sequence is performed:

– *lock-out reset test of 17.16.105;*

– *endurance test of 17.16.106.1, if applicable;*

– *electrical strength requirements specified in 17.16.107;*

– *evaluation of compliance specified in 17.16.108.*

Whenever possible the tests of 17.16.101 to 17.16.105 may be combined.

17.3 (except 17.3.1) **to 17.15** Not applicable.

17.16 Tests for particular purpose systems

Additional subclauses:

17.16.101 Thermal cycling test for electronic systems

The purpose of the test is to cycle components of an electronic circuit between the extremes of temperature likely to occur during normal use and which may result from ambient temperature variation, mounting surface temperature variation, supply voltage variation or the change from an operating condition to a non-operating condition and vice versa.

The following conditions shall form the basis of the test.

a) Duration of test: 14 days

b) Electrical conditions

The system is loaded according to the ratings declared by the manufacturer, the voltage then being increased to 1,1 V_R except that for 30 min during each 24 h period of the test the voltage is reduced to 0,9 V_R. The change of voltage shall not be synchronized with the change of temperature. Each 24 h period shall also include at least one period in the order of 30 s during which the supply voltage is switched off.

c) Thermal conditions

The ambient temperature and/or the mounting surface temperature are varied between T_{max} and T_{min} to cause the temperature of the components of the electronic circuit to be cycled between their resulting extremes. The rate of ambient and/or mounting surface temperature change shall be in the order of 1°C/min and the extremes of temperature maintained for approximately 1 h.

Care shall be taken to avoid the occurrence of condensation during this test.

d) Rate of operation

During the test, the system shall be cycled through its operational modes at the fastest rate possible up to a maximum of six cycles/min subject to the need to cycle components of the electronic circuit between their temperature extremes.

17.16.102 Endurance test of automatic and manual action at normal operating rate

17.16.102.1 Test sequence and conditions

The test is carried out with the terminals loaded with the maximum current and the minimum power factor declared by the manufacturer.

The system and its flame detector are tested under the following conditions:

a) 45 000 operations at V_R and (20 ± 5) °C;

In the USA and Canada, if the system is electro-mechanical, this test is performed at T_{max}.

b) 2 500 operations at T_{max} and 1,1 V_R or 1,1 times the upper limit of the rated voltage range;

c) 2 500 operations at T_{min} and 0,85 V_R or 0,85 times the lower limit of the rated voltage range for a.c. and 0,80 V_R or 0,80 times the lower limit of the rated voltage range for d.c.

17.16.103 Vibration test

Systems declared in table 7.2, requirement 122 are subjected to the vibration test of IEC 60068-2-6 as follows:

Cycling rate:	as declared
Loaded at:	1,1 V_R
Frequency range:	10 - 150 Hz
Acceleration amplitude:	1 g or higher if declared by the manufacturer
Sweep rate:	1 octave/min
No. of sweep cycles:	10
No. of axes:	3, mutually perpendicular

17.16.104 Endurance test of automatic action at accelerated rate

This test shall be conducted at V_R, I_R and T_{max}.

The following means may be used to accelerate the test time of the systems:

– substitution of the components of the electronic circuit previously found acceptable under the abnormal operation test of clause H.27;

– modification of control circuits to eliminate the portions of control programming that do not affect the operating time of the system or system component being tested;

– applying additional heating or external cooling to the thermal timers in the manner that does not alter the normal operating characteristics of the timer other than its timing.

The electromechanical components may be tested separately under the operating conditions to which they are subjected when incorporated into the system circuit, including the electrical loading of the contacts.

An additional sample may be required for this test.

17.16.105 Lock-out reset test

The system is also tested under the following lock-out conditions, mounted as declared in table 7.2, requirement 31:

– the first half of the declared cycles (see requirement 26 and note 101 to table 7.2), without flame presence;

– the second half of the declared cycles, the flame disappearing during operation.

During the tests described above, the system is operated in such a way that the normal start-up sequence is performed.

The repetitions of the sequence shall be compatible with the method of operation of the system and shall be dependent on the cycling rate, if any, declared by the manufacturer

17.16.106 Components of systems which are declared for operation in an ambient temperature above 125 °C

17.16.106.1 Endurance test

For system components which are declared in table 7.2, requirement 22, for operation in an ambient temperature above 125 °C, but not subjected to this temperature during the tests of 17.16.101 to 17.16.104, the system components are mounted as declared in table 7.2, requirement 31. The system components are placed in a test chamber and cycled for the declared number of cycles.

During the "ON" cycle, the temperature of the system components is raised to within +5 % of the maximum operating temperature declared by the manufacturer.

During the "OFF" cycle, the test chamber heat source is interrupted and the system components cooled naturally or by passing room temperature air over the components as specified by the manufacturer, until the temperature is reduced to 125 °C or less as necessary to permit the system to complete the current cycle.

17.16.107 Electric strength requirements

After all the tests of this clause, the requirements of 13.2 shall apply, with the exception that the samples are not subjected to the humidity treatment before the application of the test voltage.

17.16.108 Evaluation of compliance

After completion of all applicable tests of 17.16.101 to 17.16.107 inclusive, the sample shall be retested according to clause 15. The operating times, operating sequence, flame detector operating characteristics, and proved igniter operating value shall be as declared in table 7.2.

For systems providing electronic disconnection (Type 1.Y or 2.Y), the requirements of H.11.4.16 are still met.

18 Mechanical strength

This clause of part 1 is applicable except as follows:

18.2 Impact resistance

18.2.4.1 Not applicable.

18.5 to 18.8 Not applicable.

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 except as follows:

Addition:

For the high-voltage side of electronic high-voltage ignition sources, the requirements of clause 20 are not 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.

23DV DR *Modification of 23 by adding ISC note as follows:*

This clause is not applicable in North America. In the USA, EMC requirements – emissions are regulated by FCC Part 15. In Canada, EMC requirements – emissions are regulated by ICES 003.

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

See Annex H.

27 Abnormal operation

This clause of part 1 is applicable except as follows:

27.3 Over-voltage and under-voltage test

Not applicable

28 Guidance on the use of electronic disconnection

This clause of part 1 is applicable.

Figures

The figures of part 1 are applicable.

Annexes

The annexes of Part 1 are applicable, except as follows:

Annex CDV D2 *Modification of Annex C by adding the following text:*

Not applicable.

Annex DDV D2 *Modification of Annex D by adding the following text:*

Note – In the USA, heat, fire, and tracking requirements are in UL 746C. In Canada, heat, fire, and tracking requirements are in CSA C22.2 No. 0.17-00 (R2004).

Annex FDV D2 *Modification of Annex F by adding the following text:*

Note – In the USA, heat and fire resistance requirements are in UL 746C. In Canada, heat and fire resistance requirements are in CSA C22.2 No. 0.17-00 (R2004).

Annex GDV D2 *Modification of Annex G by adding the following text:*

Note – In the USA, heat, fire, and tracking requirements are in UL 746C. In Canada, heat, fire, and tracking requirements are in CSA C22.2 No. 0.17-00 (R2004).

Annex H
(normative)
Requirements for electronic controls

H.7 Information

This clause of part 1 annex H is applicable except as follows:

Modification:

Table 7.2 –

Information	Clause or subclause	Method
52 Not applicable		
58a Not applicable		
58b Not applicable		
60 Not applicable		
Modify the existing requirement:		
71 Not applicable		
Add the following additional requirement:		
119 Defined state "out of operation"	H.26.8.2	X
Add the following additional requirement:		
121 The effect on solid-state outputs for motors, transformers, valves, etc. as a result of the tests of clause H.26	H.26.2	X
Add the following additional requirement:		
136 Software fault/error detection time(s) for controls of software class C [12), 104), 105) 106)]	H.27.1.3.102, H.27.1.3.103	X
NOTES:		
Additional notes:		
[104)] The fault/error detection time is the period between the execution (after the fault has occurred), of the relevant software segment, either for function or for checking purposes and the completion of the declared control response.		
[105)] For systems designed for non-permanent operations, the fault/error detection time for the: • first fault shall be according to H.27.1.3.102.1 and H.27.1.3.104.1 • second fault shall be according to H.27.1.3.102.1 and H.27.1.3.104.2		
[106)] For systems designed for permanent operations, the fault/error detection time for the: • first fault shall be according to H.27.1.3.103.1 and H.27.1.3.104.1 • second fault shall be according to H.27.1.3.103.2 and H.27.1.3.104.2		

H.11 Constructional requirements

H.11.12 Controls using software

H.11.12.1 Addition:

If the software fault analysis of requirement 68 of table 7.2 and the hardware analysis of H.27 identifies a control function, the failure of which could impair compliance with H.27.1.3.101, then this control function shall be classified as software class C.

H.11.12.2 Addition:

Systems using software shall have software class C structures. Tested monitoring shall be used where monitoring of software class C functions is performed.

H.11.12.6 Replacement:

For systems using software, the manufacturer shall have used one of the combinations (i-p) of analytical measures given in the columns of table H.11.12.6 during hardware development.

H.11.12.8.1 Replacement:

Detection of an error in a software class C function shall result in one of the responses permitted in H.27.1.3.101. Independent means capable of performing this response shall be provided.

H.11.12.12 Addition:

See 11.3.4.

Additional subclause:

H.11.12.101 If time slot monitoring is used, it shall be sensitive to both an upper and a lower limit of the time interval. Faults resulting in the shift of the upper and/or lower limit shall be taken into account.

H.17 Endurance

This clause of part 1 is not applicable.

See 17.16.101.

H.26 Electromagnetic compatibility (EMC) requirements – immunity

This clause of part 1 is applicable except as follows:

H.26.1 Modification:

The third paragraph is not applicable.

H.26.2 Replacement:

Compliance is checked according to the criteria described in each of the subclauses H.26.5 to H.26.12 inclusive.

H.26.2.DV DE *Modification of H.26.2 with the following text:*

Compliance is checked according to the criteria described in each of the subclauses H.26.5 to H.26.14 inclusive.

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

H.26.5.2 Test values

Replacement:

The system shall tolerate voltage dips, short interruptions and voltage variations in the electricity supply so that, when tested in accordance with H.26.5.3.

a) for the values of Table H.101 criteria a): it shall continue to function in accordance with the requirements of this standard. It shall neither proceed to safety shutdown or lock-out, nor shall it reset from lock-out;

b) for the values of Table H.101 criteria b): either it shall perform as in a) or it may proceed to safety shutdown followed by a system restart, or if in volatile lock-out it may proceed to a system restart.

NOTE: Non-volatile lock-out excludes the use of system restart.

When the power supply is restored, the system restart shall comply with the requirements for a start-up sequence.

Requirement b) can be ignored provided that the power failure is less than 60 s and occurs within 60 s after call for heat. On restoration of the power, the programme may be continued from the point at which it was interrupted.

A shortened start-up sequence, for example a start-up sequence without pre-purge or waiting time, is allowed provided that the power failure occurs within 60 s after the end of start-up sequence and is shorter than 60 s.

Table H.101 – Voltage dips, short interruptions and voltage variations

Assessment criteria	Duration	ΔU		
		30%	60%	100%
a)	Half-cycle of supply waveform			X
	One cycle of supply waveform			X
b)	2,5 cycles	X	X	X
	25 cycles 50 cycles	X	X	X
		X	X	X

The test shall be performed in accordance with H.26.5.3.

Table H.101.DV DE *Modification as follows:*

Table H.101 – Voltage dips, short interruptions and voltage variations

Assessment criteria	Duration (50/60 Hz)	ΔU		
		30%	60%	100%
a)	Half-cycle of supply waveform			X
	One cycle of supply waveform			X
b)	2,5 /3.0[A] cycles	X	X	X
	25/30[B] cycles	X	X	X
	50/60[C] cycles	X	X	X
[A] "2.5 / 3.0 cycles" represents "2.5 cycles for 50Hz supply" and "3.0 cycles for 60Hz supply"				
[B] "25 / 30 cycles" represents "25 cycles for 50Hz supply" and "30 cycles for 60Hz supply"				
[C] "50 / 60 cycles" represents "50 cycles for 50Hz supply" and "60 cycles for 60Hz supply"				

H.26.5.3 Test procedure

Replacement:

The system tested in accordance with IEC 61000-4-11.

The supply voltage to the system shall be reduced according to the values shown in Table H.101. The voltage dips, short interruptions and voltage variations shall be performed at random phase with respect to mains frequency three times in each of the following operating conditions:

a) during pre-purge or waiting time;

b) during start-up lock-out time(s);

c) in the running position;

d) in the lock-out position.

Between the voltage dips, short interruptions and voltage variations, a waiting time of at least 10 s shall be observed.

H.26.5.4 Voltage variation test

Replacement:

The control shall tolerate short-term supply voltage variations.

Compliance is checked by the test of H.26.5.4.

H.26.5.4.1 Purpose of the test

Replacement:

The purpose of the test is to verify the immunity of the control against voltage change taking place over a short period which may occur due to a change of load or stored energy in local power networks. The control shall operate according to the functional specification (see 11.3.105) at least within the voltage tolerance band of the rated voltage +10/-15 %, and below -15 % of the rated voltage the control shall stay safe.

H.26.5.4.2 The duration and procedure

Replacement:

The duration of the voltage changes and the time for which the reduced voltages are to be maintained are given in Table H.26.5.4.2 and illustrated in Figure H.26.5.4.2. The rate of change of voltage shall be constant; however, the voltage is allowed to be stepped. The steps shall be positioned at 0 crossing and shall be not larger than 10 % of V_R. Steps under 1 % of V_R are evaluated as constant rate of change of voltage.

The control, in the running position, is supplied at rated voltage, or at the lowest rated voltage of a rated voltage range. After approximately 1 min, the power supply voltage is reduced to a level such that the control ceases to respond to safety related inputs and/or drive safety related outputs (e.g. flame signal, fuel valve).

This value of the supply voltage is recorded.

Table H.26.5.4.2 – Timing of short-term supply voltage variations

Voltage test level	Time for decreasing voltage	Time at reduced voltage	Time for increasing voltage
Recorded value – 10 %	60 s ± 20 %	10 s ± 20 %	60 s ± 20 %
0 V	60 s ± 20 %	10 s ± 20 %	60 s ± 20 %

In the voltage range of operation, from rated voltage to 1,05 times of the recorded value, the control shall conform to 11.3.105 a). In the voltage range of operation, between 85 % of the rated voltage and 1,05 times of the recorded value, the control shall conform to 11.3.105 b).

For test purposes, precautions shall be taken to ensure that signals e.g. from sensors or switches that can initiate a safety action and the presence of which normally may be independent of the supply voltage, are present at any level of the supply voltage. The signal may be simulated to prevent the control de-energizing the safety relevant output(s) as a result of disappearance of such input signals.

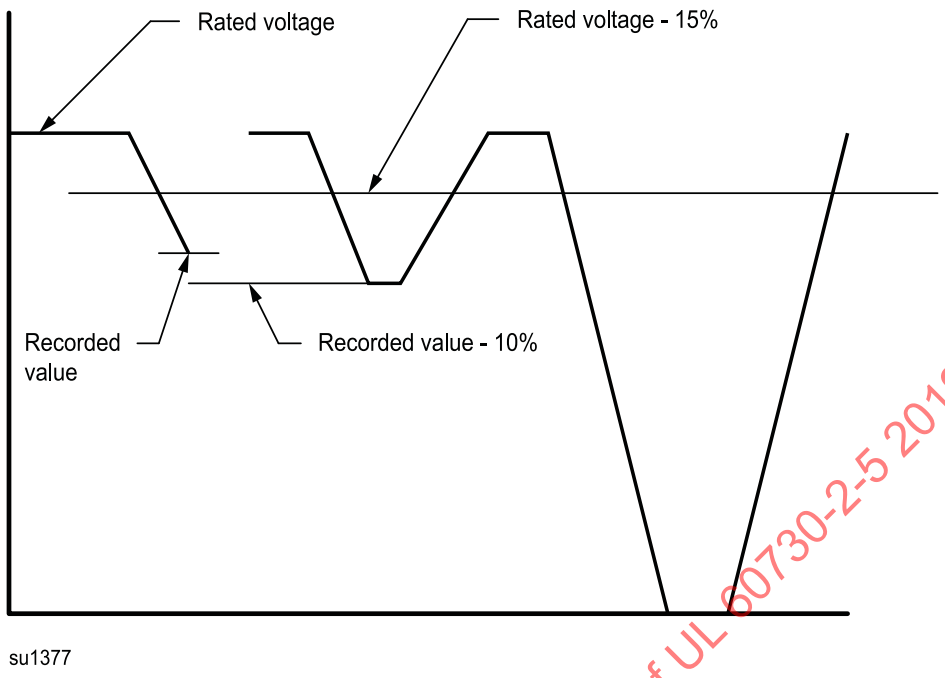

Figure H.26.5.4.2 – Voltage variation test

H.26.5.4.3

Addition:

After the tests, the system:

a) shall continue to function in accordance with the requirements of this standard. It shall neither proceed to safety shutdown or lock-out, nor shall it reset from lock-out, or

b) shall either perform as in a) or it may proceed to safety shutdown followed by a system restart, or if in volatile lock-out it may proceed to a system restart.

NOTE Non-volatile lock-out excludes the use of system restart.

H.26.6 Test of influence of voltage unbalance

Not applicable

H.26.8 Surge immunity test

H.26.8.2 Test values

Addition:

The system shall tolerate voltage surges on the mains supply and relevant signal terminals, so that, when tested in accordance with H.26.8.3,

a) for the values of Table H.26.8.2 installation class 2, it shall continue to function in accordance with the requirements of this standard. It shall neither proceed to safety shutdown or lock-out nor shall it reset from lock-out;

b) for the values of Table H.26.8.2 installation class 3 for all listed tests, either it shall perform as in a) or it may proceed to safety shutdown, which may be followed by a system restart, or if in volatile lock-out it may proceed to a system restart.

NOTE Non-volatile lock-out excludes the use of system restart.

c) for the values of Table H.26.8.2 installation class 4 with line to earth on power supply only, either it shall perform as in a) or b) or it shall go into the defined state “out of operation” as declared by the manufacturer in accordance with Table 7.2 Item 119.

For compliance criteria a) and b), after the tests of this clause, the surge protective components shall not be destroyed.

H.26.8.3 Test procedure

Replacement of the second paragraph:

The test shall be carried out by subjecting the system to five pulses and with the voltage and current values listed in Table H.26.8.2 at intervals of not less than 60 s.

The five pulses of each polarity (+, –) and each phase angle as described in IEC 61000-4-5 are delivered in the following order:

a) 2 pulses with the system in the lock-out position;

b) 1 pulse with the system in the running position;

c) 2 pulses randomly applied during the start-up sequence.

The tests on interface cables are not carried out if the manufacturer explicitly specifies that the length of that cable shall not exceed 10 m.

If “VDR” are used as surge protective devices, they shall comply with IEC 61643-1. Additionally, they shall be selected to withstand the impulses corresponding to the installation class level.

For controls having surge protective device arresters incorporating spark gaps, the test is repeated at a level that is 95 % of the flashover voltage.

H.26.8.3DV DC *Modification to H.26.8.3 by adding the following text:*

If "VDR" are used as surge protective devices, compliance with UL 1449 or ECN-516 is acceptable.

H.26.9 Electrical fast transient/burst test

Replacement of the following subclauses of Part 1:

H.26.9.2 Test levels

Table H.26.9.2 – Test level for electrical fast transient burst

		L1, L2, PE		I/O	
Operating conditions	Severity level in accordance with IEC 61000-4-4	Voltage peak kV	Repetition rate kHz	Voltage peak kV	Repetition rate kHz
a)	2	1	5	0,5	5
b)	3	2	5	1	5
c)	4	4	5	–	–

The table in H.26.9 of IEC 60730-1 (1999) is applicable.

H.26.9.3 Test procedure

The system shall tolerate electrical fast/transient bursts on the mains supply and signal lines, so that, when tested in accordance with H.26.9.2,

a) for the value of operating conditions a): it shall continue to function in accordance with the requirements of this standard. It shall neither go to safety shutdown or lock-out, not shall it reset from lock-out;

b) for the values of operating conditions b): either it shall perform as in a) or it may proceed to safety shutdown which may be followed by a system restart, or if in volatile lock-out it may proceed to a system restart;

NOTE Non-volatile lock-out excludes the use of system restart.

c) for the values of Table H.26.9.2 severity level 4, either it shall perform as in a) or b) or it shall be set out of operation into a defined state as declared by the manufacturer in accordance with Table 7.2 Item 119.

The test shall be performed for 20 cycles with the system having reached the running position, remaining in the running position for a minimum of 30 s within each cycle. The test shall also be performed for a minimum of 2 min with the system in the lock-out position and with the system in the stand-by position.

H.26.10 Ring wave test

This test is applicable in Canada and the USA.

H.26.10.5 Test procedure

Addition:

Systems other than those operating at SELV are tested according to Category II and Category III.

SELV systems are tested according to Category I and Category II.

After the Category II test (the Category I test for SELV systems), the system shall comply with the requirement H.26.2.101.

After the Category III test (the Category II test for SELV systems), the system shall comply with the requirements of 17.5 of part 1 and with any one of the criteria in H.26.2.101 to H.26.2.106, inclusive.

H.26.11 Electrostatic discharge test

Replacement:

Additional subclauses:

H.26.11.101 Test and operating conditions

This test is carried out in accordance with IEC 61000-4-2.

H.26.11.102 Test conditions

Assessment criteria	Severity level	Contact discharge	Air discharge
a)	2	4kV	4 kV
b)	4	8 kV	15 kV

The system has to be tested in each of the following conditions:

– start position;

– running position;

– lock-out position.

H.26.11.103 Operating conditions/compliance

The system shall tolerate electrostatic discharges so that, when tested in accordance with H.26.11,

a) for severity level 2: it shall continue to function in accordance with the requirements of this standard. It shall neither go to safety shutdown or lock-out, nor shall it reset from lock-out;

b) for the values of operating conditions b): either it shall perform as in a) or it may proceed to safety shutdown which may be followed by a system restart, or if in volatile lock-out it may proceed to a system restart.

NOTE Non-volatile lock-out excludes the use of system restart.

In Canada and the USA, accessible parts may include parts which can be contacted during installation and service.

H.26.12 Radio-frequency electromagnetic field immunity

H.26.12.2.1 Test levels for conducted disturbances

Replacement:

Table H.26.12.2.1 – Test levels for conducted disturbances on mains and I/O lines

		Frequency range 150 kHz – 80 MHz	
Assessment criteria	Severity level	Voltage level (e.m.f) U_o V	
		150 kHz – 80 MHz	ISM and CB bands
a)	2	3	6
b)	2	10	20
The levels in the ISM, CB bands are chosen to be 6 dB higher. ISM: Industrial, scientific and medical radio frequency equipment 13,56 ± 0,007 MHz, 40,68 ± 0,02 MHz. CB: Citizen band: 27,125 ± 1,5 MHz.			

The tests on interface cables are not carried out if the manufacturer explicitly specifies that the length of that cable shall not exceed 1 m.

H.26.12.2.2 Test procedure

Addition:

The system shall be swept through the complete frequency range at least once with the system in each of the following positions:

– *start position;*

– *running position;*

– *lock-out position.*

The system is subjected to two sweeps of the frequency range from minimum to maximum at the indicated severity level. One sweep is performed with the system in the lock-out condition. The other sweep is performed during the remainder of the operating sequence.

Additional subclause:

H.26.12.2.101 Compliance

The system shall tolerate conducted electromagnetic fields so that, when tested in accordance with H.26.12.2.1,

a) for the values of Table H.26.12.2.1, criteria a): it shall continue to function in accordance with the requirements of this standard. It shall neither go to safety shutdown or lock-out, nor shall it reset from lock-out;

b) for the values of operating conditions b): either it shall perform as in a) or it may proceed to safety shutdown which may be followed by a system restart, or if in volatile lock-out it may proceed to a system restart.

NOTE Non-volatile lock-out excludes the use of system restart.

H.26.12.3 Radiated electromagnetic fields immunity evaluation

H.26.12.3.1 Test level for radiated electromagnetic fields

Replacement:

Table H.26.12.3.1 – Immunity to radiated electromagnetic fields

		Frequency range 80 MHz – 1 000 MHz	
Assessment criteria	**Severity level**	**Test field strength V/m**	
		80 MHz – 1 000 MHz	**ISM and GSM bands**
a)	2	3	6
b)	3	10	20
The levels in the ISM and GSM bands are chosen to be 6 dB higher. ISM: Industrial, scientific and medical radio-frequency equipment 433,92 ± 0,87 MHz. GSM: Group special mobile: 900 MHz ± 5,0 MHz, modulated by 200 Hz ±1 % pulses of equal mark/space ratio (2,5 ms on and 2,5 ms off).			

H.26.12.3.2 Test procedure

Addition:

The system has to be swept through the complete frequency range at least once with the system in each of the following positions:

– *start position;*

– *running position;*

– *lock-out position*

Additional subclause:

H.26.12.3.101 Compliance

The system shall tolerate radiated electromagnetic fields so that, when tested in accordance with H.26.12.3.2,

a) for the values of Table H.26.12.3.1, criteria a): it shall continue to function in accordance with the requirements of this standard. It shall neither go to safety shutdown or lock-out, nor shall it reset from lock-out;

b) for the values of operating conditions b): either it shall perform as in a) or it may proceed to safety shutdown which may be followed by a system restart, or if in volatile lock-out it may proceed to a system restart.

NOTE Non-volatile lock-out excludes the use of system restart

H.26.13 Test of influence of supply frequency variations

This subclause of Part 1 is applicable except as follows:

H.26.13.2 Test levels

Addition, after Table H.26.12.3.2:

The system shall tolerate supply frequency variations such that, when tested in accordance with H.26.12.3.3,

a) for the values of Table H.26.12.3.2, test level 2: it shall continue to function in accordance with the requirements of this standard. It shall neither go to safety shutdown or lock-out, nor shall it reset from lock-out. Variation in programme timings shall not exceed the percentage of applied frequency variations;

b) for the values of Table H.26.12.3.2, test level 3: either it shall perform as in a) or it may proceed to safety shutdown which may be followed by a system restart, or if in volatile lock-out it may proceed to a system restart.

NOTE Non-volatile lock-out excludes the use of system restart.

H.26.13.3 Test procedure

Addition:

The test shall be performed at least once with the system in each of the following positions:

– start position;

– running position;

– lock-out position.

H.26.14 Power frequency magnetic field immunity test

This subclause of Part 1 is applicable except as follows:

H.26.14.2 Test levels

Addition, after Table H.26.14.2:

The system shall tolerate power frequency magnetic fields so that, when tested in accordance with H.26.14.3

a) for the values of Table H.26.14.2, severity level 2: it shall continue to function in accordance with the requirements of this standard. It shall neither go to safety shutdown or lock-out, nor shall it reset from lock-out.

b) for the values of Table H.26.14.2, severity level 3: either it shall perform as in a) or it may proceed to safety shutdown which may be followed by a system restart, or if in volatile lock-out it may proceed to a system restart

NOTE Non-volatile lock-out excludes the use of system restart.

H.26.14.3 Test procedure

Addition

The test shall be done at least once with the system in each of the following positions:

– start position;

– running position;

– lock-out position.

H.26.15 Evaluation of compliance

This clause of Part 1 is not applicable.

H.27 Abnormal operation

This clause of part 1 is applicable except as follows:

H.27.1.2 *Replacement:*

The system shall be operated under the following conditions:

a) at 1,1 times the rated supply voltage;

b) loaded with the load used in the test of 17.3.1;

c) in an ambient temperature of (20 ± 5) °C;

d) the system is connected to an electrical supply having a fuse rating such that the result of the test is not influenced by the operation of the fuse;

e) with any actuating member set to the most unfavourable position.

H.27.1.3 *Replacement:*

With each fault described in annex AA, simulated or applied to one circuit component at a time, the system shall comply with

– items a) to g) inclusive;

– the applicable subclauses of H.27.1.3.102 to H.27.1.3.105 inclusive; and

– the requirements of software class C (if applicable).

a) The system shall not emit flames, hot metal or hot plastics, and no explosion shall result. For systems with enclosures, compliance is determined by the following test.

The enclosure is wrapped in tissue wrapping paper. The system is operated to steady state or for one hour, whichever occurs first. There shall be no burning of the wrapped tissue paper. Inside the enclosure some parts may temporarily glow, and there may be a temporary emission of smoke or flame.

In the USA, cheesecloth is used instead of tissue wrapping paper.

b) The temperature for supplementary insulation and reinforced insulation shall not exceed 1,5 times the relevant values specified in clause 14, except in the case of thermoplastic material.

There is no specific temperature limit for supplementary insulation and reinforced insulation of thermoplastic material, the temperature of which shall, however, be recorded for the purpose of clause 21.

c) Void.

d) The system shall comply with the requirements of clause 8 and subclause 13.2 for basic insulation

e) There shall be no deterioration of the various parts of the system that would result in non-compliance with the requirements of clause 20.

f) A fuse in the supply, external to the system under test and as described in H.27.1.2 d), shall not rupture unless an internal protective device, that is accessible only after the use of a tool, also operates.

An internal protective device is deemed not to be required if the sample still complies with the following requirements after replacement of the fuse of the supply:

– items a), b) and d) of H.27.1.3

– the requirements of clause 20 for the clearances and creepage distances from active parts to the surfaces of the system that are accessible when the system is mounted as for its intended use.

g) The output waveform shall be as declared in table 7.2, requirement 56.

h) For proved igniter systems, the igniter operating value shall not exceed or be less than, as applicable, the values declared by the manufacturer (table 7.2, requirement 132).

H.27.1.3DV D2 ***Modification of the footnote to clause in H.27.1.3 item a) by adding the following text:***

In the USA and Canada, cheesecloth is used instead of tissue wrapping paper.

Additional subclauses:

H.27.1.3.101 Compliance

Automatic systems shall comply with subclauses H.27.1.3.102 to H.27.1.3.105 inclusive and with the requirements of software class C (if applicable).

H.27.1.3.102 Systems for non-permanent operation / systems without self-checking feature

H.27.1.3.102.1 First fault

Any first fault (see Table H.27.1) in any one electronic component or any one fault together with any other fault arising from the first fault shall result in either:

a) the system proceeding to safety shut-down within the fault/error detection time as declared by the manufacturer in accordance with Table 7.2, Item 136 (terminals for fuel flow means are de-energized) and it remains in this condition as long as the fault appears; or

b) the system proceeding to lock-out within the fault/error detection time as declared by the manufacturer in accordance with Table 7.2, Item 136 provided that the subsequent reset from lock-out under the same fault condition results in lock-out; or

c) the system continuing to operate, the fault being identified during the next start-up sequence, the result being a) or b); or

d) the system remaining operational in accordance with Clause 15.

H.27.1.3.102.2 Second fault

If when appraised according to the test conditions and criteria of H.27.1.3, the first fault results in the system remaining operational in accordance with Clause 15, any further independent fault considered together with the first fault shall result in either H.27.1.3.102.1 a), b), c) or d). During assessment, the second fault shall only be evaluated when a start-up sequence has been performed between the first and second fault.

A third independent fault is not considered.

H.27.1.3.102.3 During the start-up phase and shut-down phase (if applicable), the first and second fault analysis methodology of H.27.1.3.102.1 and H.27.1.3.102.2 shall be used.

H.27.1.3.103 System for permanent operation / system with self-checking feature

H.27.1.3.103.1 First fault

Any first fault (see Table H.27.1) in any one electronic component or any one fault together with any other fault arising from the first fault shall result in either:

a) the system proceeding to safety shut-down within the fault/error detection time as declared by the manufacturer in accordance with Table7.2, item 136, (terminals for fuel flow means are de-energized) and it remains in this condition as long as the fault appears; or

b) the system proceeding to lock-out within the fault/error detection time as declared by the manufacturer in accordance with Table 7.2, item 136, provided that the subsequent reset from lock-out under the same fault condition results in returning to lock-out; or

c) the system remaining operational in accordance with Clause 15.

H.27.1.3.103.2 Second fault

If when appraised according to the test conditions and criteria of H.27.1.3, the fault results in the system remaining operational in accordance with Clause 15, any further independent fault considered together with the first fault shall result in either H.27.1.3.103.1 a), b) or c). During assessment, the second fault shall not be considered to occur within 1 h of the first fault.

A third independent fault is not considered.

Concerning the specific factual analysis, systematic assessment of the safety concept structure may be taken into account.

H.27.1.3.104 Systems for permanent and non-permanent operation: faults during lock-out or safety shut-down

If lock-out or safety shut-down occurs, an additional fault assessment shall be performed in that stage.

Whenever lock-out or safety shut down is reached without an internal fault, an assessment according to H.27.1.3.104.1 and H.27.1.3.104.2 shall be performed.

Whenever lock-out or safety shut down is reached with an internal fault, an additional single fault assessment according to H.27.1.3.104.2 shall be performed.

H.27.1.3.104.1 First fault introduced during lock-out or safety shut-down

Any first fault (together with any other fault arising from that fault) in any one component (see Table H.27.1) induced while the system is staying in the lock-out or safety shut-down position, shall result in either:

a) the system remaining in lock-out or safety shut-down, valve terminals remaining de-energized; or

b) the system becoming inoperative with all valve terminals remaining de-energized; or

c) in case of a subsequent restart: the system during one single restart resulting in a) or b) as mentioned in this subclause under the condition that the valve terminals are energized not longer than the safety time. If the cause of the original lock-out or safety shut-down condition no longer remains, the system may perform a full restart in accordance with the functional requirement of this standard and the second fault assessment shall be carried out in accordance with H.27.1.3.102.2 or H.27.1.3.103.2.

H.27.1.3.104.2 Second fault during lock-out or safety shut-down

Any second fault (together with any other fault arising from that fault) in any one component (see Table H.27.1), induced while the system is staying in the lock-out or safety shut-down position, shall result in either H.27.1.3.104.1 a), b) or c).

During assessment, the second fault shall not be considered to occur within 24 hours after the first fault.

NOTE While conducting this test, the second fault can be applied at any time during the lock out or safety shutdown condition. It is not necessary to wait 24 h before applying the second fault. If the second fault was applied before 24 h and unacceptable results were obtained, the initial fault should be applied and then wait 24 h before applying the second fault.

H.27.1.3.105 Checking circuits

Subclauses H.27.1.3.102 to H.27.1.3.103.2, inclusive are not applicable to that part of a circuit associated with the checking requirements of clause 11.101.3 or to external devices connected to the system.

H.27.1.3.106 The effect of internal faults shall be assessed by simulation and/or examination of the circuit design. The fault shall be considered to have occurred at any stage of the programme sequence.

H.27.1.4 Electronic circuit fault conditions

Replacement:

For the purpose of clause H.27, the applicable failure modes are given in Table H.27.1.

Table H.27.1
Electrical/electronic component fault modes

Component type	Short circuit	Open[1)]	Remarks
Fixed resistors:			
Thin film (wound filament)		X	Includes SMD type
Thick film (flat)		X	Includes SMD type
Wire-wound (single layer)		X	
All other types	X	X	
Variable resistors:			
(for example, potentiometer/trimmer)			
Wire-wound (single layer)		X	
All other types	X[2)]	X	
Capacitors:			
X1 and Y Types according to IEC 60384-14		X	
Metallized film according to IEC 60384-16		X	
All other types	X	X	
Diodes:			
All types	X	X	
Transistors:			
All types (for example, bipolar; LF; RF; microwave; FET; thyristor; diac; triac; uni junction)	X[2)]	X	3)
Hybrid circuit	4)	4)	
Integrated circuits			
All types not covered by clause H.11.12	X[5)]	X	For IC outputs note[3)] applies

Table H.27.1 Continued on Next Page

Table H.27.1 Continued

Component type	Short circuit	Open[1)]	Remarks
Opto-couplers			
According to IEC 60335-1	X[6)]	X	
Relays:			
Coils		X	
Contacts	X[7) 8)]	X	
Reed- relays:	X[7) 8)]	X	Contacts only
Wire-wound inductors			
Single layer		X	
All other inductors	X	X	
Transformers:			
According to IEC 60742		X	
All other types	X[2)]	X	
Crystals	X	X	9)
Switches:	X	X	10)
Connections (jumper wire)		X	11)
Cable and wiring		X	
Printed circuit board conductors	X[13)]	X[12]	

1) Opening of only one pin at a time

2) Short-circuit each pin in turn with every other pin; only two pins at a time.

3) The effect of any full wave type of component, such as a triac going into a halfwave condition, either controlled or uncontrolled (thyristor or diode, respectively) shall be considered.

4) Failure modes for individual components of the hybrid circuit are applicable as described for the individual components in this table.

5) The short circuit of any two adjacent terminals and the short-circuiting of

a) each terminal to the IC-supply, when applicable at the IC;

b) each terminal to the IC-ground, when applicable at the IC.

The failure mode ″short circuit″ is excluded between isolated sections for such ICs that have isolated sections. The isolation between the sections shall comply with the requirements of 13.2 for operational insulation.

6) When opto-couplers comply with 29.2.2 of IEC 60335-1, the shorting between the input and output pins is not considered.

7) The failure modes “short circuit” and the “mechanical breakdown” of the relay need not be considered in the control or control system when the following measures are used:

a) measures to avoid welding:

1) contacts closing on short-circuit:

rating of the fuse according to IEC 60127-1 with $I_n < I_x/2{,}75$

where:

- I_n according to Subclause 3.16 of IEC 60127-1:2006
- $I_x = I_{the}$ of the relay (enclosed) according to Subclause 4.3.2.1 or 4.3.2.2 of IEC 60947-1:2007
- $I_x = I_{th}$ of the relay (free air) according to Subclause 4.3.2.1 or 4.3.2.2 of IEC 60947-1:2007

2) lifetime/load cycle rating:

proof that the contact does not weld after 1 000 000 cycles with the maximum rated contact load declared by the controls manufacturer (4 fold safety)

and

b) measures to avoid micro welding:

1) proof that the permissible (maximum) capacitance loads have been part of the lifetime-test according to a) 2) and

2) proof that no mains-synchronous switching occurs, or the mains synchronous switching has not resulted in non-compliance with the lifetime testing according to a) 2)

and

Table H.27.1 Continued on Next Page

Table H.27.1 Continued

Component type	Short circuit	Open[1)]	Remarks
c) if the relay is tested for 3 million cycles no load conditions in compliance with IEC 60947-5-1 and declared by the manufacturer			
Compliance with the requirements in Note 7 does not supersede the need for compliance with 11.3.5.101 and 11.3.5.102.			
In Canada, Japan and the USA, the short-circuit mode is excluded for relays successfully tested to Clause 17. The successful test can be substituted by the use of a relay certified for the application.			
8) In the USA and Canada, the short-circuit failure mode is excluded for relays successfully tested to clause 17. The successful test can be substituted by the use of a relay certified for the application. Footnote[7)] is not applicable.			
9) For crystal-based clocks, harmonic and subharmonic frequency variations affecting the timings should be considered.			
10) If switches are applied for the selection of safety times, purge times, programmes and/or other safetyrelated settings, these devices should function so that in the event of their opening, the safest possible condition arises (for example, the shortest safety time or the longest purge time). The short-circuit failure mode is excluded for switches successfully tested to clause 17. The successful test can be substituted by the use of a switch certified for the application.			
11) The requirements are the same as footnote[10)], except they are applied to jumper wires intended for clipping when selecting a setting.			
12) For the assessment according H.27.1.3.101 the short-circuit failure mode is excluded if the requirements of Clause 20 for overvoltage category III are met.			
13) The short-circuit failure mode is excluded if the requirements of clause 20 for overvoltage category III are met. The requirements for overvoltage category III are only applicable to the requirements of H.27.1.3 e).			

Table H.27.1DV D2 *Modification to footnote 8 as follows*

In Canada and in the USA, the short-circuit mode is excluded for relays where the contact function is not included in the cyclic operation of the appliance provided that it is successfully tested to Clause 17. The successful test can be substituted by the use of a relay certified for the application. Adequate additional measures shall be taken to avoid contact welding or additional measures to react safely to contact welding. Footnote 7) is not applicable.

Annex J
(normative)
Requirements for controls using thermistors

J.1 Scope

This clause of annex J is applicable except as follows:

J.1.1.1 *Addition:*

A hot surface igniter is not considered to be a thermistor.

J.20 Creepage distances, clearances and distances through insulation

This clause of Part 1 is replaced as follows: ″Under consideration.″