

INTERNATIONAL STANDARD

NORME INTERNATIONALE



BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

Safety requirements for electrical equipment for measurement, control, and laboratory use –

Part 2-201: Particular requirements for control equipment

Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire –

Partie 2-201: Exigences particulières pour les équipements de commande



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2013 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

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

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

About the IEC

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

About IEC publications

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

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,...).

It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

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

Electropedia - www.electropedia.org

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

Customer Service Centre - webstore.iec.ch/csc

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

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Liens utiles:

Recherche de publications CEI - www.iec.ch/searchpub

La recherche avancée vous permet de trouver des publications CEI en utilisant différents critères (numéro de référence, texte, comité d'études,...).

Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

Just Published CEI - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications de la CEI. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.



IEC 61010-2-201

Edition 1.0 2013-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE



BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

**Safety requirements for electrical equipment for measurement, control, and laboratory use –
Part 2-201: Particular requirements for control equipment**

**Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire –
Partie 2-201: Exigences particulières pour les équipements de commande**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE **XA**
CODE PRIX

ICS 13.110; 17.020; 19.020; 25.040.40

ISBN 978-2-83220-588-4

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope and object.....	8
1.1.1 Equipment included in scope	8
1.1.2 Equipment excluded from scope	9
1.2.1 Aspects included in scope	9
1.2.2 Aspects excluded from scope	9
2 Normative references	10
3 Terms and definitions	10
4 Tests	12
4.1 General.....	12
4.3.2 State of equipment	12
4.4 Testing in single fault condition	12
5 Marking and documentation.....	14
5.4.3 Equipment installation	14
6 Protection against electric shock	14
6.1.2 Exceptions.....	14
6.2.1 General	14
6.2.2 Examination	14
6.2.3 Openings above parts that are hazardous live	14
6.2.4 Openings for pre-set controls	15
6.2.101 Accessibility of interfaces/ports/terminals	15
6.2.102 Control equipment	17
6.6.1 General	20
6.6.2 Terminals for external circuits.....	20
6.6.3 Circuits with terminals which are hazardous live	20
6.6.4 Terminals for stranded conductors.....	20
6.7.2 Insulation for mains circuits of overvoltage category II with a nominal supply voltage up to 300 V	22
6.7.3 Insulation for secondary circuits derived from mains circuits of overvoltage category II up to 300 V	24
6.7.101 Insulation for field wiring terminals of overvoltage category II with a nominal voltage up to 1 000 V	26
6.8.3 Test procedures	26
6.10 Connection to the mains supply source and connections between parts of equipment	26
6.11 Disconnection from supply source	27
7 Protection against mechanical hazards.....	27
7.1.101 Open and panel mounted equipment	27
7.2 Sharp edges.....	27
7.3.3 Risk assessment for mechanical hazards to body parts	27
7.3.4 Limitation of force and pressure.....	28
7.3.5 Gap limitations between moving parts	28
7.7 Expelled parts	28
8 Resistance to mechanical stresses	28
8.1.101 Open equipment	28

8.1.102	Panel mounted equipment	28
8.2.2	Impact test	28
8.3	Drop test	28
8.3.1	Equipment other than hand-held equipment and direct plug-in equipment	29
8.3.2	Hand-held equipment and direct plug-in equipment	29
9	Protection against the spread of fire	29
9.2	Eliminating or reducing the sources of ignition within the equipment.....	29
9.3.2	Constructional requirements	29
10	Equipment temperature limits and resistance to heat.....	30
10.1	Surface temperature limits for protection against burns	30
10.3	Other temperature measurements	31
10.4.1	General	31
10.4.2	Temperature measurement of heating equipment.....	32
10.4.3	Equipment intended for installation in a cabinet or a wall.....	32
10.5.2	Non-metallic enclosures	33
11	Protection against hazards from fluids.....	33
11.6	Specially protected equipment.....	33
12	Protection against radiation, including laser sources, and against sonic and ultrasonic pressure	33
13	Protection against liberated gases and substances, explosion and implosion	34
13.1	Poisonous and injurious gases and substances	34
13.2.1	Components	34
13.2.2	Batteries and battery charging	34
14	Components and subassemblies	34
14.101	Components bridging insulation	34
14.101.1	Capacitors	34
14.101.2	Surge suppressors	34
14.102	Switching devices	35
15	Protection by interlocks	35
16	Hazards resulting from application.....	35
17	Risk assessment	35
Annexes	35
Annex F (normative)	Routine tests	36
Annex L (informative)	Index of defined terms	38
Annex AA (informative)	General approach to safety for control equipment	39
Annex BB (informative)	System drawing of isolation boundaries	41
Annex CC (informative)	Historical techniques for secondary circuits	49
Annex DD (informative)	Cross references between IEC 61010-2-201 and IEC 61010- 1:2010 or IEC 61131-2:2007	53
Bibliography	54
Figure 101	– Typical interface/port diagram of control equipment.....	16
Figure 102	– Requirements for insulation between separate circuits and between circuits and accessible conductive parts	21
Figure 103	– Mechanical hazards requirements for panel mounted equipment	27
Figure 104	– Safety enclosure with HMI installed through a wall	30

Figure 105 – Panel mounted HMI device extending through the wall of a cabinet.....	33
Figure AA.1 – Control equipment access and safety concerns	39
Figure BB.1 – Typical system enclosure layout	42
Figure BB.2 – Simplified system schematic.....	43
Figure BB.3 – Hazard situation of the control equipment.....	44
Figure BB.4 – Application of the standard to the control equipment safety drawing	45
Figure BB.5 – Reinforced insulation	46
Figure BB.6 – Basic insulation	47
Figure BB.7 – Reinforced insulation, basic insulation and limiting impedance	48
Table 101 – Overload test circuit values	13
Table 102 – Endurance test circuit values.....	13
Table 103 – Operator accessibility for open and enclosed equipment	16
Table 4 – Clearance and creepage distances for mains circuits of overvoltage category II up to 300 V.....	23
Table 5 – Test voltages for solid insulation between mains and between mains and secondary circuits overvoltage category II up to 300 V ^d	24
Table 6 – Clearances and test voltages for secondary circuits derived from mains circuits of overvoltage category II up to 300 V.....	25
Table 104 – Minimum creepages and clearances in air of overvoltage category II up to 1 000 V at field-wiring terminals.....	26
Table 105 – Drop tests.....	29
Table 19 – Surface temperature limits, under normal conditions	31
Table CC.1 – Limits of output current and output power for inherently limited power sources.....	51
Table CC.2 – Limits of output current, output power and ratings for over-current protective devices for non-inherently limited power sources.....	52
Table DD.1 – Cross-references between IEC 61010-2-201 and IEC 61010-1 or IEC 61131-2	53

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE –

Part 2-201: Particular requirements for control equipment

FOREWORD

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

International Standard IEC 61010-2-201 has been prepared by IEC technical committee 65: Industrial-process measurement, control and automation.

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

FDIS	Report on voting
65/515/FDIS	65/521/RVD

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

This Part 2-201 is intended to be used in conjunction with IEC 61010-1. It was established on the basis of the third edition (2010). Consideration may be given to future editions of, or amendments to, IEC 61010-1.

This Part 2-201 supplements or modifies the corresponding clauses in IEC 61010-1 so as to convert that publication into the IEC standard: *Particular requirements for control equipment*.

Where a particular subclause of Part 1 is not mentioned in this part 2, that subclause applies as far as is reasonable. Where this part states “addition”, “modification”, “replacement”, or “deletion”, the relevant requirement, test specification or note in Part 1 should be adapted accordingly.

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

It has the status of a basic safety publication in accordance with IEC Guide 104.

A list of all parts in the IEC 61010 series, published under the general title *Safety requirements for electrical equipment for measurement, control and laboratory use*, can be found on the IEC website.

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

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

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

INTRODUCTION

This IEC 61010-2-201 document constitutes Part 2-201 of a planned series of standards on industrial-process measurement, control and automation equipment.

This part specifies the complete safety requirements for control equipment (e.g. programmable controller (PLC)), the components of Distributed Control Systems, I/O devices, Human Machine Interface (HMI)).

Safety terms of general use are defined in IEC 61010-1. More specific terms are defined in each part.

This part incorporates the safety related requirements of Programmable Controllers.

Annex DD provides a cross reference between clauses of this standard and those of IEC 61010-1 or IEC 61131-2:2007.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

IEC 61010-2-201:2013

<https://standards.iteh.ai/catalog/standards/sist/72e9158-cebd-42f1-86d6-01a79c1c0c3e/iec-61010-2-201-2013>

SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE –

Part 2-201: Particular requirements for control equipment

1 Scope and object

This clause of Part 1 is applicable, except as follows.

1.1.1 Equipment included in scope

Replacement:

This part of IEC 61010 specifies safety requirements and related verification tests for control equipment of the following types:

- Programmable controllers (PLC and PAC);
- the components of Distributed Control Systems (DCS);
- the components of remote I/O – systems;
- industrial PC (computers) and Programming and Debugging Tools (PADTs);
- Human-Machine Interfaces (HMI);
- any product performing the function of control equipment and/or their associated peripherals,

which have as their intended use the control and command of machines, automated manufacturing and industrial processes, e.g. discrete and continuous control.

Components of the above named equipment and in the scope of this standard are:

- (auxiliary) stand-alone power supplies;
- peripherals such as digital and analogue I/O, remote-I/O;
- industrial network equipment.

Control equipment and their associated peripherals are intended to be used in an industrial environment and may be provided as open or enclosed equipment.

NOTE 1 Control equipment intended also for use in other environments or for other purposes (example; for use in building installations to control light or other electrical installations, or for use on cars, trains or ships) can have additional conformity requirements defined by the safety standard(s) for these applications. These requirements can involve as example: insulation, spacings and power restrictions.

NOTE 2 Computing devices and similar equipment within the scope of IEC 60950 (planned to be replaced by IEC 62368) and conforming to its requirements are considered to be suitable for use with control equipment within the scope of this standard. However, some of the requirements of IEC 60950 for resistance to moisture and liquids are less stringent than those in IEC 61010-1:2010, 5.4.4 second paragraph.

Control equipment covered in this standard is intended for use in overvoltage category II (IEC 60664-1) in low-voltage installations, where the rated equipment supply voltage does not exceed a.c. 1 000 V r.m.s. (50/60 Hz), or d.c. 1 500 V.

NOTE 3 If equipment in the scope of this part is applied to overvoltage category III and IV installations, then the requirements of Annex K of Part 1 apply.

The requirements of ISO/IEC Guide 51 and IEC Guide 104, as they relate to this Part, are incorporated herein.

1.1.2 Equipment excluded from scope

Replacement:

This standard does not deal with aspects of the overall automated system, e.g. a complete assembly line. Control equipment (e.g. DCS and PLC), their application program and their associated peripherals are considered as components (components in this context are items which perform no useful function by themselves) of an overall automated system.

Since control equipment (e.g. DCS and PLC) are component devices, safety considerations for the overall automated system including installation and application are beyond the scope of this standard. Refer to IEC 60364 series of standards or applicable national/local regulations for electrical installation and guidelines.

1.2.1 Aspects included in scope

Replacement:

The purpose of the requirements of this standard is to ensure that all hazards to the operator, service personnel and the surrounding area are reduced to a tolerable level.

NOTE By using the terms "operator" and "service personnel" this standard considers the perception of hazards depending on training and skills. Annex AA gives a general approach in this regard.

Requirements for protection against particular types of hazard are given in Clauses 6 to 13, as follows:

- a) electric shock or burn (see Clause 6);
- b) mechanical hazards (see Clauses 7 and 8);
- c) spread of fire from the control equipment (see Clause 9);
- d) excessive temperature (see Clause 10);
- e) effects of fluids and fluid pressure (see Clause 11);
- f) effects of radiation, including lasers sources, and sonic and ultrasonic pressure (see Clause 12);
- g) liberated gases, explosion and implosion (see Clause 13);

Requirements for protection against hazards arising from reasonably foreseeable misuse and ergonomic factors are specified in Clause 16.

Risk assessment for hazards or environments not fully covered above is specified in Clause 17.

NOTE Attention is drawn to the existence of additional requirements regarding the health and safety of labour forces.

1.2.2 Aspects excluded from scope

Replacement:

This standard does not cover:

- a) reliability, functionality, performance, or other properties of the control equipment not related to safety;
- b) mechanical or climatic requirements for operation, transport or storage;
- c) EMC requirements (See e.g. IEC 61326 or IEC 61131-2);
- d) protective measures for explosive atmospheres (See e.g. IEC 60079 series);
- e) functional safety (See e.g. IEC 61508 or IEC 61131-6).

2 Normative references

This clause of Part 1 is applicable, except as follows:

Addition of the following references to the list:

IEC 60068-2-31:2008, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60384-14:2005, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

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

IEC 60947-7-1:2009, *Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors*

IEC 61010-1:2010, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61010-2-030, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for testing and measuring circuits*

IEC 61051-2:1991, *Varistors for use in electronic equipment – Part 2: Sectional specification for surge suppression varistors*

3 Terms and definitions

This clause of Part 1 is applicable, except as follows:

Additional terms and definitions:

3.101

enclosed equipment

equipment which includes an enclosure, having safety capability, or combination of an enclosure, having safety capability, and installation provisions enclosing on all sides, with the possible exception of its mounting surface, to prevent personnel from accidentally touching hazardous live, hot or moving parts contained therein and meeting requirements of mechanical strength, flammability, and stability (where applicable)

Note 1 to entry: Examples are portable and hand-held equipment.

Note 2 to entry: This definition is related to IEC 60050-441:1990, 441-12-02.

3.102

enclosure

housing affording the type and degree of protection suitable for the intended application

[SOURCE: IEC 60050-195:1998, 195-02-35]

Note 1 to entry: An enclosure, in general, may or may not have any safety capabilities. That depends on its application purpose and construction.

Note 2 to entry: In this standard an enclosure is assumed to have safety capability, unless specifically stated otherwise.

3.103 field wiring

wiring of the control equipment, which is installed by the user

Note 1 to entry: Examples of field wiring are power supply, digital and analogue input and output wiring.

3.104 hand-held equipment

equipment which is intended to be held in one hand while being operated with the other hand

3.105 modular equipment

equipment consisting of different modules such as a Rack, CPU, different I/O-modules, network modules etc.

Note 1 to entry: Modular equipment

- a) can be open equipment or enclosed equipment,
- b) can consist of modules that cannot operate alone or of a basic module that is operational alone and can be enhanced in functions by additional modules,
- c) can vary in size and functionality depending on the combination and the number of modules and
- d) can be combined with operational equipment or enhanced in function by the addition of modules by the customer.

3.106 open equipment

equipment which does not protect personnel from accidentally touching live or moving parts contained therein nor meet requirements of mechanical strength, flammability and stability (where applicable)

Note 1 to entry: See Annex AA.

3.107 operator

person, with appropriate training and awareness of the general hazards in an industrial environment, commanding and monitoring, but not changing, a machine or process

Note 1 to entry: The operator does not change e.g. the control equipment hardware configuration or install software updates provided by the manufacturer.

Note 2 to entry: The operator commands and monitors a machine or process e.g. through an HMI connected to the equipment.

3.108 portable equipment

equipment intended to be carried by hand and not fixed during normal use

3.109 protective extra-low voltage circuit PELV circuit

electrical circuit in which the voltage cannot exceed a.c. 30 V r.m.s., 42,4 V peak or d.c. 60 V in normal and single-fault condition, except earth faults in other circuits

Note 1 to entry: A PELV circuit incorporates a connection to protective earth. Without the protective earth connection or if there is a fault in the protective earth connection the circuit voltages are not controlled.

Note 2 to entry: Derived from IEC 60050-826:2004, 826-12-32, PELV system

3.110 **safety extra-low voltage circuit** **SELV circuit**

electrical circuit in which the voltage cannot exceed a.c. 30 V r.m.s., 42,4 V peak or d.c. 60 V in normal and single-fault condition, including earth faults in other circuits

Note 1 to entry: Derived from IEC 60050-826:2004, 826-12-31, SELV system.

3.111 **service personnel**

person, with the appropriate technical training, experience and awareness of hazards and of measures to minimize danger to themselves, other persons or to the control equipment, in an industrial environment, changing or repairing the control equipment

Note 1 to entry: Service personnel are persons having the appropriate technical training and experiences necessary to be aware of hazards – e.g. electrical hazards, temperature hazards, fire hazards – to which they are exposed in performing a task and of measures to minimize danger to themselves or to other persons or to the control equipment, in an industrial environment

Note 2 to entry: Service personnel change or repair the control equipment e.g. hardware configuration or installing software updates provided by the manufacturer.

4 Tests

This clause of Part 1 is applicable, except as follows.

4.1 General

Addition:

The product is verified to this standard in a test configuration, defined by the manufacturer, which represents the least favourable configuration. See 4.3.

It is likely or possible that there are different test configurations which yield least favourable test conditions, e.g. a least favourable configuration for temperature tests, a least favourable test configuration for electrical safety test. If this is the case then these different least favourable test configuration(s) shall be used in the test for which they are appropriate, with regard to 4.3.2 and 4.4.

These least favourable test configurations and test conditions shall be practical and useful for the intended applications.

Conformity verification: The selected test configuration(s) and test conditions shall be documented with the rationale in the test report

4.3.2 State of equipment

Addition:

The state of the control equipment shall take into account the least favourable rated environmental conditions. This may be taken into account by the actual test environment of the control equipment or by suitable analysis and correction of the results in a set of reference test conditions.

4.4 Testing in single fault condition

Addition of first line after 4.4:

For test and verification conditions, see 4.1.

Additional subclause:

4.4.1.101 Switching devices tests

4.4.1.101.1 Overload test

Switching devices shall close and open a test circuit having the current, voltage, and power factor values given in Table 101. Fifty cycles, each consisting of 1 closing and 1 opening, shall be completed using a timing of 1 s on, 9 s off. After completion of the 50 cycles, the equipment shall be subjected to the endurance test in 4.4.1.101.2, if required by 14.102.

Table 101 – Overload test circuit values

Intended use	Current	Voltage	Power factor
AC general use	1,5 × rated	Rated	0,75 to 0,80
DC general use	1,5 × rated	Rated	1,0
AC resistance	1,5 × rated	Rated	1,0
DC resistance	1,5 × rated	Rated	1,0
AC pilot duty ^a	Rated ^a	1,1 × rated ^b	<0,35
DC pilot duty ^a	Rated ^a	1,1 × rated ^b	1,0

^a Unless otherwise specified, the inrush current shall be 10 times the steady-state current.

^b Set up the EUT at its rated voltage and current and then increase the voltage by 10 % without further adjustment of the load.

NOTE Source IEC 61131-2:2007

Conformity, pass/fail, is determined by test completion without electrical/dielectric/mechanical breakdown of the equipment.

4.4.1.101.2 Endurance test

After completion of the overload test in 4.4.1.101.1, the switching device is to close and open a test circuit having the current, voltage, and power factor values given in Table 102. A total of 6 000 cycles, consisting of 1 closing and 1 opening, shall be completed. The cycle timing shall be 1 s on and 9 s off, except for the first 1 000 cycles of the pilot duty test. The first 1 000 cycles of the pilot duty test shall be at a rate of 1 cycle per second except that the first 10 to 12 cycles are to be as fast as possible.

The endurance test need not be conducted on solid-state output devices for general or resistive use.

Table 102 – Endurance test circuit values

Intended use	Current	Voltage	Power factor
AC general use	Rated	Rated	0,75 to 0,80
DC general use	Rated	Rated	1,0
AC resistance	Rated	Rated	1,0
DC resistance	Rated	Rated	1,0
AC pilot duty ^a	Rated	Rated	<0,35
DC pilot duty ^a	Rated	Rated	1,0

^a The test circuit is identical to the overload test circuit except that the voltage is the rated voltage.

NOTE Source IEC 61131-2:2007