



UL 61010-2-201

STANDARD FOR SAFETY

Safety Requirements for Electrical
Equipment for Measurement, Control,
and Laboratory Use – Part 2-201:
Particular Requirements for Control
Equipment

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

UL Standard for Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-201: Particular Requirements for Control Equipment, UL 61010-2-201

Second Edition, Dated May 14, 2018

Summary of Topics

This revision of ANSI/UL 61010-2-201 dated August 8, 2022 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

ANSI/UL 61010-2-201 is an Adoption of IEC 61010-2-201:2017, Second edition issued by the IEC March 2017. Please note that the National Difference document incorporates all of the U.S. national differences for UL 61010-2-201.

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

The requirements are substantially in accordance with Proposal(s) on this subject dated June 10, 2022.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical photocopying, recording, or otherwise without prior permission of UL.

UL provides this Standard "as is" without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

In no event will UL be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

Users of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold UL harmless from and against any loss, expense, liability, damage, claim, or judgment (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing an electronic Standard on the purchaser's computer system.

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

MAY 14, 2018
(Title Page Reprinted: August 8, 2022)



ANSI/UL 61010-2-201-2018 (R2022)

1

UL 61010-2-201

**Standard for Safety Requirements for Electrical Equipment for
Measurement, Control, and Laboratory Use – Part 2-201: Particular
Requirements for Control Equipment**

First Edition – January, 2014

Second Edition

May 14, 2018

This ANSI/UL Standard for Safety consists of the Second Edition including revisions through August 8, 2022.

The most recent designation of ANSI/UL 61010-2-201 as a Reaffirmed American National Standard (ANS) occurred on August 8, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

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

UL's Standards for Safety are copyrighted by UL. Neither a printed nor electronic copy of a Standard should be altered in any way. All of UL's Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of UL.

COPYRIGHT © 2022 UNDERWRITERS LABORATORIES INC.

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

CONTENTS

PREFACE	7
NATIONAL DIFFERENCES	9
FOREWORD	11
INTRODUCTION.....	15
1 Scope and object	17
1.1.1 Equipment included in scope	17
1.1.2 Equipment excluded from scope	18
1.2.1 Aspects included in scope	18
1.2.2 Aspects excluded from scope	19
2 Normative references	19
3 Terms and definitions.....	20
4 Tests	22
4.1 General	22
4.4.2 Application of fault conditions.....	23
5 Marking and documentation	24
5.1.5.2 TERMINALS	24
5.1.8 FIELD WIRING TERMINAL boxes	24
5.3DV Modification of Clause 5.3 of the Part 1 by replacing the text with the following:.....	24
5.4.1 General.....	25
5.4.3 Equipment installation	25
5.4.4 Equipment operation.....	25
6 Protection against electric shock	25
6.1.2 Exceptions	25
6.2.1 General.....	26
6.2.2 Examination	26
6.2.3 Openings above parts that are HAZARDOUS LIVE	26
6.2.4 Openings for pre-set controls.....	26
6.2.101 Accessibility of TERMINALS and ports	27
6.2.102 Control equipment.....	28
6.5.2.1 General.....	29
6.5.2.6 Transformer PROTECTIVE BONDING screen.....	29
6.5.2.101 Classes of equipment or equipment classes	29
6.5.2.102 Protective earth requirements for ENCLOSED EQUIPMENT.....	31
6.5.2.103 Protective earth requirements for OPEN EQUIPMENT	31
6.6.1 General.....	31
6.6.2 TERMINALS for EXTERNAL CIRCUITS.....	32
6.6.3 Circuits with TERMINALS which are HAZARDOUS LIVE.....	32
6.7.1.1 General	32
6.7.1.2 CLEARANCES.....	34
6.7.1.5 Requirements for insulation according to type of circuit	34
6.7.1.101 Non-metallic material supporting HAZARDOUS LIVE parts	35
6.7.2 Insulation for MAINS CIRCUITS of OVERVOLTAGE CATEGORY II with a nominal supply voltage up to 300 V	35
6.7.3.1 General.....	36
6.7.3.2 CLEARANCES.....	37
6.7.3.3 CREEPAGE DISTANCES	38
6.7.101 Insulation for FIELD WIRING TERMINALS of OVERVOLTAGE CATEGORY II with a nominal voltage up to 1 000 V.....	38
6.10 Connection to the MAINS supply source and connections between parts of equipment ...	38

6.11	Disconnection from supply source	38
7	Protection against mechanical HAZARDS	39
7.1.101	OPEN and PANEL MOUNTED EQUIPMENT	39
7.2	Sharp edges	39
7.3.3	RISK assessment for mechanical HAZARDS to body parts	39
7.3.4	Limitation of force and pressure	40
7.3.5	Gap limitations between moving parts	40
7.7	Expelled parts	40
8	Resistance to mechanical stresses	40
8.1	General	40
8.2.2	Impact test	40
8.3	Drop test	41
9	Protection against the spread of fire	41
9.2	Eliminating or reducing the sources of ignition within the equipment	41
9.3.2	Constructional requirements	41
10	Equipment temperature limits and resistance to heat	42
10.1	Surface temperature limits for protection against burns	43
10.3	Other temperature measurements	43
10.4.1	General	43
10.4.2	Temperature measurement of heating equipment	49
10.5.2	Non-metallic ENCLOSURES	49
11	Protection against HAZARDS from fluids	49
11.6	Specially protected equipment	49
12	Protection against radiation, including laser sources, and against sonic and ultrasonic pressure	49
13	Protection against liberated gases and substances, explosion and implosion	49
13.1	Poisonous and injurious gases and substances	50
13.2.1	Components	50
13.2.2	Batteries and battery charging	50
14	Components and subassemblies	50
14.101	Components bridging insulation	50
14.102	Switching devices	51
15	Protection by interlocks	51
16	HAZARDS resulting from application	51
17	RISK assessment	51

Annexes

Annex E (informative) Guideline for reduction of POLLUTION DEGREES

Annex F (normative) ROUTINE TESTS

F.2	Protective earth	55
F.3.1	General	55
F.4	Floating circuits	55
F.101	Supply circuits other than MAINS and floating circuits	55

Annex L (informative) Index of defined terms

Annex AA (informative) General approach to safety for control equipment

AA.1	Personnel	58
------	-----------------	----

AA.1.1	General	58
AA.1.2	OPERATOR	58
AA.1.3	SERVICE PERSONNEL	58
AA.2	Operating access areas.....	59
AA.3	Service access areas	59
AA.4	Equipment types.....	59
AA.4.1	General	59
AA.4.2	OPEN EQUIPMENT	59
AA.4.3	ENCLOSED EQUIPMENT	60

Annex BB (informative) System drawing of isolation boundaries

BB.1	General.....	61
BB.2	Installation environment of OPEN control equipment	61
BB.3	Control equipment electrical safety drawing	63
BB.4	Applying the standard to the control equipment electrical safety drawing.....	66
BB.5	Conclusion	74

Annex CC (informative) Historical techniques for secondary circuits

CC.1	Secondary circuits background.....	75
CC.2	Secondary circuits without RISK of electrical shock	75
CC.2.1	General.....	75
CC.2.2	Secondary circuits which do not pose a RISK of electrical shock	75
CC.3	Secondary circuits without RISK of spread of fire	76
CC.3.1	General.....	76
CC.3.2	Secondary circuits which do not pose a RISK of spread of fire.....	77

Annex DD (normative) Flammability test for magnesium alloy fire ENCLOSURES or flame barriers (see [9.3.2](#))

DD.1	General	79
DD.2	Samples	79
DD.3	Mounting of samples	79
DD.4	Test flame	79
DD.5	Test procedure.....	79

Annex EE (informative) Information/documentation and correlation to its uses

Annex FF (informative) Measurement of CLEARANCES and CREEPAGE DISTANCES

Annex 101.DVA (informative) Description of major changes from the First edition to the Second edition of IEC 61010-2-201

Annex 101.DVA	Addition of Annex 101.DVA as follows:	86
---------------	---	----

Bibliography

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

PREFACE

This UL Standard is based on IEC Publication 61010-2-201: Second edition Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-201: Particular Requirements for Control Equipment. IEC publication 61010-2-201 is copyrighted by the IEC.

This UL Standard 61010-2-201 Standard for Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-201: Particular Requirements for Control Equipment, is to be used in conjunction with the third edition of UL 61010-1. The requirements for control equipment are contained in this Part 2 Standard and UL 61010-1.

Requirements of this Part 2 Standard, where stated, amend the requirements of UL 61010-1.

Where a particular subclause of UL 61010-1 is not mentioned in UL 61010-2-201, the UL 61010-1 subclause applies.

These materials are subject to copyright claims of IEC and UL. No part of this publication may be reproduced in any form, including an electronic retrieval system, without the prior written permission of UL. All requests pertaining to the Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-201: Particular Requirements for Control Equipment Standard should be submitted to UL.

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.

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

NATIONAL DIFFERENCES

National Differences from the text of International Electrotechnical Commission (IEC) Publication 61010-2-201, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 2-201: Particular Requirements for Control Equipment copyright March 2017 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

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY REQUIREMENTS FOR ELECTRICAL EQUIPMENT FOR MEASUREMENT, CONTROL, AND LABORATORY USE – Part 2-201: Particular requirements for control equipment

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
65/652/FDIS	65/657/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 second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

This second edition includes the following significant technical changes with respect to the previous edition;

- a) clarify, change, delete definitions which were causing confusion,
- b) change and clarify the temperature testing methodology,
- c) change documentation methodologies allowed,
- d) change some TERMINAL markings,
- e) add clarity to some of the informative annexes,
- f) add Annex [E](#) with changes,
- g) add Annexes [AA](#) – [FF](#).

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

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) of that standard. 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.

In this standard, the following print types are used:

- requirements and definitions: in roman type;
- NOTES: in smaller roman type;
- *conformity and tests*: in italic type;
- terms used throughout this standard which have been defined in Clause [3](#): SMALL ROMAN CAPITALS.

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 website 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.

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

INTRODUCTION

IEC 61010-2-2xx documents are a series of standards on safety of industrial-process measurement, control and automation equipment.

This part specifies the complete safety related requirements and related tests for control equipment (e.g. programmable controller (PLC), the components of distributed control systems (DCS), 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 of IEC 61010.

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

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 any product performing the function of control equipment and/or their associated peripherals. In addition, these products have as their intended use the command and control of machines, automated manufacturing and industrial processes, e.g. discrete and continuous control. Some equipment examples are: programmable logic controller (PLC);
- programmable automation controller (PAC);
- distributed control systems (DCS);
- remote I/O;
- industrial PC (computers) and panel PC;
- programming and debugging tools (PADTs);
- displays and human-machine interfaces (HMI);
- positioners.

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, III and IV (IEC 60664-1) in low-voltage installations, where the RATED equipment supply voltage does not exceed AC. 1 000 V r.m.s. (50/60 Hz), or DC 1 000 V.

The requirements of ISO/IEC Guide 51 and IEC Guide 104, as they relate to this part of IEC 61010, 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 1 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 17, 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);
- h) arising from REASONABLY FORESEEABLE MISUSE and ergonomic factors are specified in (see Clause 16);
- i) RISK assessment for HAZARDS or environments not fully covered above (see Clause 17).

NOTE 2 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, IEC 61131-6).

2 Normative references

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

Addition:

IEC 60384-14, *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, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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

IEC 60695-11-3, *Fire hazard testing – Part 11-3: Test flames – 500 W flames – Apparatus and confirmational test methods*

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

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

IEC 61643-21, *Low voltage surge protective devices – Part 21: Surge protective devices connected to telecommunications and signalling networks – Performance requirements and testing methods*

IEC 61643-311, *Components for low-voltage surge protective devices – Part 311: Performance requirements and test circuits for gas discharge tubes (GDT)*

IEC 61643-321, *Components for low-voltage surge protective devices – Part 321: Specifications for avalanche breakdown diode (ABD)*

IEC 61643-331, *Components for low-voltage surge protective devices – Part 331: Specification for metal oxide varistors (MOV)*

3 Terms and definitions

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

3.2.3

PROTECTIVE CONDUCTOR TERMINAL

Modification:

In this part “PROTECTIVE CONDUCTOR TERMINAL” is replaced by “PROTECTIVE EARTH TERMINAL”.

Note 1 to entry: PROTECTIVE EARTH TERMINAL is most familiar to industrial users, manufacturers, etc. Therefore since this part is targeted towards industrial use, the most familiar term is utilized.

3.5.11

OPERATOR

Addition:

Note 1 to entry: See definition in Part 1 and Annex [AA](#).

Add the following terms and definitions:

3.101

AMBIENT TEMPERATURE

temperature, determined under prescribed conditions, of the air surrounding the equipment

3.102

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 60050-441:2000, 441-12-02.

3.103

ENCLOSURE

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

Note 1 to entry: An ENCLOSURE, in general, may or may not have any safety capabilities, which depend on its application and construction.

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

[SOURCE: IEC 60050-195:1998, 195-02-35, modified – the notes to entry have been added]

3.104

EXTERNAL CIRCUIT

circuit connected by FIELD WIRING of the control equipment

3.105

FIELD WIRING

wiring of the control equipment, which is not installed in the control equipment manufacturer's facility

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

Note 2 to entry: Control equipment manufacturer's, e.g. pre-assembled or molded cabling is not considered FIELD WIRING.

3.106

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 can:

a) be OPEN EQUIPMENT or ENCLOSED EQUIPMENT;

b) 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) vary in size and functionality depending on the combination and the number of modules;

d) be combined with operational equipment or enhanced in function by the addition of modules by the customer.

3.107

OPEN EQUIPMENT

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

Note 1 to entry: See Annex [AA](#).

3.108

OPERATOR

Addition:

Note 1 to entry: See definition in Part 1 and Annex [AA](#) of this document.

3.109

PANEL MOUNTED EQUIPMENT

equipment where a portion of the equipment may form part of the ENCLOSURE

Note 1 to entry: See [Figure 103](#).

3.110

PORTABLE EQUIPMENT

equipment intended to be carried by hand and not fixed during NORMAL USE

3.111

PROTECTIVE EXTRA-LOW VOLTAGE CIRCUIT PELV CIRCUIT

protective earth referenced electrical circuit in which the voltage cannot exceed the following:

NORMAL CONDITION and SINGLE FAULT CONDITION: The AC voltage levels are 30 V r.m.s., 42,4 V peak and the DC voltage level is 60 V. For equipment intended for use in WET LOCATIONS, the AC voltage levels are 16 V r.m.s., 22,6 V peak and the DC voltage level is 35 V.

[SOURCE: IEC 60050-826-12-32:2004, modified – clarified and more fully described]

3.112

SAFETY EXTRA-LOW VOLTAGE CIRCUIT SELV CIRCUIT

non-protective earth referenced electrical circuit in which the voltage cannot exceed the following:

NORMAL CONDITION and SINGLE FAULT CONDITION: The AC voltage levels are 30 V r.m.s., 42,4 V peak and the DC voltage level is 60 V. For equipment intended for use in WET LOCATIONS, the AC voltage levels are 16 V r.m.s., 22,6 V peak and the DC voltage level is 35 V.

[SOURCE: IEC 60050-826-12-31:2004, modified – clarified and more fully described]

3.113

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. For example there may be a least favourable configuration for temperature test, and a different least favourable test configuration for voltage test. If this is the case then the appropriate least favourable test configuration(s) shall be used 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.

4.4.2 Application of fault conditions

Add the following subclause:

4.4.2.101 Switching devices tests

4.4.2.101.1 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 [4.4.2.101.2](#), if required by [14.102](#).

Table 101
Overload test circuit values

Intended load	Current	Voltage	Power factor
AC general use	1,5 × RATED	RATED	0,75 to 0,80
DC general use	1,5 × RATED	RATED	–
AC resistance	1,5 × RATED	RATED	1,0
DC resistance	1,5 × RATED	RATED	–
AC pilot duty ^a	RATED ^a	1,1 × RATED ^b	<0,35
DC pilot duty ^a	RATED ^a	1,1 × RATED ^b	–
NOTE 1 Source IEC 60947-5-1.			
NOTE 2 Pilot duty = RATING assigned to a relay or switch that controls the coil of another relay or switch.			
^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.			

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

4.4.2.101.2 Endurance test

After completion of the overload test in [4.4.2.101.1](#), 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 load	Current	Voltage	Power factor
AC general use	RATED	RATED	0,75 to 0,80
DC general use	RATED	RATED	–
AC resistance	RATED	RATED	1,0
DC resistance	RATED	RATED	–
AC pilot duty ^a	RATED	RATED	<0,35
DC pilot duty ^a	RATED	RATED	–
NOTE 1 Source IEC 60947-5-1.			
NOTE 2 Pilot duty = RATING assigned to a relay or switch that controls the coil of another relay or switch.			
^a The test circuit is identical to the overload test circuit except that the voltage is the RATED voltage.			

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

5 Marking and documentation


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

5.1.5.2 TERMINALS

Modification:

Replace item a) as follows:

a) FUNCTIONAL EARTH TERMINALS (i.e. used for non-safety purposes such as interference immunity improvement) shall be marked with one of the following symbols:

 IEC 60417-5018 (2002-10) or

 symbol 5 of Part 1, IEC 60417-5017 (2006-08).

Where a TERMINAL serves both as the PROTECTIVE CONDUCTOR TERMINAL and as a FUNCTIONAL EARTH TERMINAL, symbol 6 and other requirements for PROTECTIVE CONDUCTOR TERMINAL shall be applied. Where a TERMINAL serves both as an earth (bonding) TERMINAL and FUNCTIONAL EARTH TERMINAL, symbol 5 and other requirements for earth TERMINALS shall be applied.

5.1.8 FIELD WIRING TERMINAL boxes

Addition after first paragraph:

A FIELD WIRING TERMINAL need not be marked to indicate the temperature RATING if it is intended for the connection of a control circuit conductor only.

A control circuit is any circuit that does not carry MAINS power and is generally limited to 15 A.

5.3DV D2 Modification of Clause 5.3 of the Part 1 by replacing the text with the following:

Open equipment shall be exempt from the Durability of markings test unless cleaning in the area of required markings is recommended by the manufacturer.

5.4.1 General

Addition:

For equipment intended to be installed by SERVICE PERSONNEL or trained installers, all documentation may be provided by electronic media.

Where the documentation is provided by electronic media, this may be accomplished by including the symbol No. 14 of Table 1 (ISO 7000-0434B: 2004-01), on the product, and the location of the documentation, e.g. URL, QRcode, on the product, packaging or printed information with the product.

5.4.3 Equipment installation

Addition:

h) OPEN EQUIPMENT: If the control equipment is classified as OPEN EQUIPMENT, its documentation shall specify the ENCLOSURE that has to be provided by the user, e.g. mechanical rigidity, IP RATING;

NOTE See also [7.1.101](#) and [8.1.101](#).

Modification:

Replace item d)1) as follows:

d) 1) supply and FIELD WIRING requirements, e.g. insulation, temperature RATING;

5.4.4 Equipment operation

Modification:

j) details of methods of reducing the RISKS of burns from surfaces permitted to exceed the temperature limits of [10.1](#), [Table 19](#).

6 Protection against electric shock

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

6.1.2 Exceptions

Replacement:

If it is not feasible for operating reasons to prevent the following parts being both ACCESSIBLE and HAZARDOUS LIVE, they are permitted to be ACCESSIBLE to SERVICE PERSONNEL during NORMAL USE while they are HAZARDOUS LIVE:

For example:

a) parts of lamps and lamp sockets after lamp removal:

b) parts intended to be replaced by SERVICE PERSONNEL (for example, batteries) and which may be HAZARDOUS LIVE during the replacement or other SERVICE PERSONNEL action, but only if they are ACCESSIBLE only by means of a TOOL and have a warning marking (see 5.2):

If any of the parts in examples a) and b) receive a charge from an internal capacitor, they shall not be HAZARDOUS LIVE 10 s after interruption of the supply.

If a charge is received from an internal capacitor, conformity is checked by the measurements of 6.3 to establish that the levels of 6.3.1 c) are not exceeded.

6.2.1 General

This subclause of Part 1 is applicable to ENCLOSED EQUIPMENT.

6.2.2 Examination

This subclause of Part 1 is applicable to ENCLOSED EQUIPMENT.

6.2.3 Openings above parts that are HAZARDOUS LIVE

This subclause of Part 1 is applicable to ENCLOSED EQUIPMENT.

6.2.4 Openings for pre-set controls

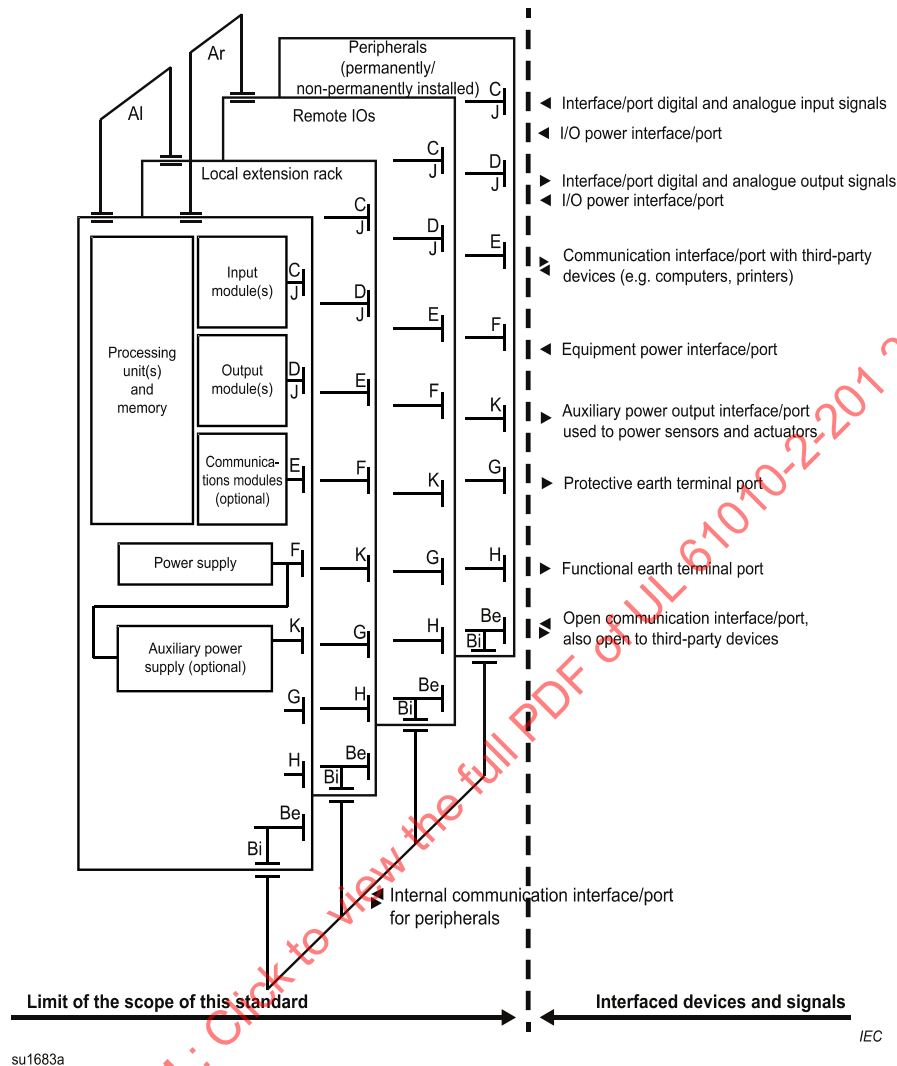
Addition:

First paragraph: This subclause of Part 1 is applicable to ENCLOSED EQUIPMENT. This subclause applies to SERVICE PERSONNEL only.

Add the following subclauses:

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

6.2.101 Accessibility of TERMINALS and ports



Key

- Al Communication interface/port for local extension rack
- Ar Communication interface/port for remote I/O station, control network, fieldbus
- Be Open communication interface/port, also open to third-party devices; e.g. PADT, personal computer used for programming
- Bi Internal communication interface/port for peripherals
- C Interface/port for digital and analogue input signals
- D Interface/port for digital and analogue output signals
- E Serial or parallel communication interfaces/ports for data communication with third-party devices; e.g. computers, printers
- F Equipment power interface/port.
- G PROTECTIVE EARTH TERMINAL/port
- H FUNCTIONAL EARTH TERMINAL/port
- J I/O power interface/port
- K Auxiliary power output interface/port used to power sensors and actuators

Figure 101

Typical interface/port diagram of control equipment

[Table 103](#) defines whether ports of control equipment are OPERATOR ACCESSIBLE, and thus require protection against electric shock. Other than for Ports Ar, Be and E, protection can be achieved by making the HAZARDOUS LIVE parts within the port not ACCESSIBLE.

Table 103
OPERATOR ACCESSIBLE ports for open and ENCLOSED EQUIPMENT

Port	OPERATOR ACCESSIBLE ^c	
	OPEN EQUIPMENT	ENCLOSED EQUIPMENT
Al communication interface/port for local extension rack	No	Yes
Ar communication interface/port for remote IO station, control network, fieldbus ^a	Yes	Yes
Be open communication interface/port, also open to third-party devices; e.g. PADT, personal computer used for programming ^a	Yes	Yes
Bi internal communication interface/port for peripherals	No	Not applicable ^b
C interface/port for digital and analogue input signals	No	Yes
D interface/port for digital and analogue output signals	No	Yes
E serial or parallel communication interfaces/ports for data communication with third-party devices; e.g. computers and printers ^a	Yes	Yes
F equipment power interface/port	No	Yes
G PROTECTIVE EARTH TERMINAL/port	No	Yes
H FUNCTIONAL EARTH TERMINAL/port	No	Yes
J I/O power interface/port	No	Yes
K auxiliary power output interface/port used to power sensors and actuators	No	Yes
^a Ports Ar, Be and E contain circuits which may be connected to other equipment and shall be considered ACCESSIBLE.		
^b Port Bi is an internal communication port and thus never leaves the ENCLOSED EQUIPMENT, by definition.		
^c Under special circumstances, some ports of either OPEN or ENCLOSED EQUIPMENT may or may not be considered OPERATOR ACCESSIBLE.		

OPERATOR ACCESSIBLE parts and the ports, as defined in [Table 103](#) as OPERATOR ACCESSIBLE = Yes shall be prevented from becoming HAZARDOUS LIVE under normal and single-fault conditions.

Conformity is checked by inspection and in case of doubt by measurement and test according to 6.2.

6.2.102 Control equipment

6.2.102.1 ACCESSIBLE parts

ACCESSIBLE parts of control equipment shall not be, or in the case of a single fault, become HAZARDOUS LIVE. Although these requirements are principally directed at ENCLOSED EQUIPMENT, these requirements also apply TO OPEN EQUIPMENT. When applied to OPEN EQUIPMENT, the control equipment shall be considered to be installed, according to the manufacturer's instructions. Also see [5.4.3](#) and Annex [AA](#).

If SERVICE PERSONNEL are required to make adjustments, etc., during e.g. commissioning of OPEN EQUIPMENT, then protection from HAZARDS in the area near the adjustment shall be provided to prevent contact. If the HAZARD is not indicated by a warning label (see 5.2) then other protective means e.g. ENCLOSURE or PROTECTIVE BARRIER is required.

Conformity is checked by inspection and examination according to [6.2.2](#).

6.2.102.2 SELV/PELV circuits

SELV/PELV circuits do not require additional evaluation for RISK against electrical shock, provided that those circuits are in dry locations.

6.5.2.1 General

Addition:

NOTE 101 PROTECTIVE CONDUCTOR TERMINALS and earth contacts are not connected directly to the neutral TERMINAL within the equipment. This does not prevent the connection of appropriately RATED devices (such as capacitors or surge suppression devices) between the PROTECTIVE EARTH TERMINAL and neutral.

6.5.2.6 Transformer PROTECTIVE BONDING screen

Modification:

Add the following second paragraph:

If the control equipment has no overcurrent protection means for the winding then the test current shall be twice the RATING of the control equipment overcurrent protection means (e.g. fuse, circuit breaker). This overcurrent protection means may be integrated into the control equipment either or specified in the manual.

Add the following subclauses:

6.5.2.101 Classes of equipment or equipment classes

6.5.2.101.1 General

Equipment classes are described to designate the means by which electric shock protection is maintained in NORMAL CONDITION and single-fault conditions of the installed equipment.

NOTE Derived from IEC 61140:2001, Clause 7.

6.5.2.101.2 Class I equipment

Equipment in which protection against electric shock is achieved using BASIC INSULATION. And additionally a means of connecting the conductive parts, which are otherwise capable of assuming HAZARDOUS LIVE voltages if the BASIC INSULATION fails, to the protective earth conductor.

NOTE Class I equipment can have parts with DOUBLE INSULATION or REINFORCED INSULATION or parts operating at safety extra-low voltage.

If a flexible cord is utilized, it shall include a provision for a protective earth conductor that shall be part of the cord set.

ACCESSIBLE conductive parts of equipment, which may become HAZARDOUS LIVE in the event of a single fault, shall be connected to the protective circuit of the equipment. Conductive parts, such as screws, rivets and nameplates, which otherwise could become HAZARDOUS LIVE under single-fault conditions, shall be protected by other means such as double/REINFORCED INSULATION so that they do not become HAZARDOUS LIVE.

When a part of the equipment is removed from the ENCLOSURE, for normal maintenance, for example, the protective circuits serving other parts of the equipment shall not be interrupted.

Protective earth requirements are specified in [6.5.2.102](#) or [6.5.2.103](#).

6.5.2.101.3 Class II equipment

Equipment in which protection against electric shock does not rely on BASIC INSULATION only, but also on the provision of additional safety precautions, such as DOUBLE INSULATION or REINFORCED INSULATION. There is no provision for protective earth or reliance upon installation conditions.

A PROTECTIVE IMPEDANCE may be used in lieu of DOUBLE INSULATION.

A means for maintaining the continuity of circuits is acceptable (i.e. grounded internal components or conductive surfaces) provided that these circuits are double insulated from the ACCESSIBLE circuits of the equipment.

Connection to the earth TERMINALS for functional purposes is acceptable (such as radiofrequency interference suppression) provided the DOUBLE INSULATION system is still provided for protective purposes.

Equipment may be of one of the following types:

- a) insulation-encased by a durable and substantially continuous ENCLOSURE of insulating material which envelops all conductive parts. Small parts, such as nameplates, screws and rivets are exempted if they are isolated from HAZARDOUS LIVE parts by insulation at least equivalent to REINFORCED INSULATION;
- b) metal-encased by a substantially continuous metal ENCLOSURE, in which DOUBLE INSULATION is used throughout, except for those parts where REINFORCED INSULATION is used;
- c) combination of a) and b).

NOTE 1 Insulation-encasement can form a part of the whole of the SUPPLEMENTARY INSULATION or of the REINFORCED INSULATION.

NOTE 2 Utilization of DOUBLE INSULATION and/or REINFORCED INSULATION throughout, with a PROTECTIVE EARTH TERMINAL or contact, is deemed to be of class I construction.

NOTE 3 This equipment may have parts operating at safety extra-low voltage.

6.5.2.101.4 Class III equipment

Equipment in which protection against electric shock is provided by circuits supplied by safety extra-low voltage (SELV/PELV). And additionally, the voltages generated by or within the equipment do not exceed the limits for SELV/PELV.

Connection to the earth TERMINALS for functional purposes is acceptable (such as radiofrequency interference suppression).

Wiring for SELV/PELV circuits shall be either segregated from the wiring for circuits other than SELV/PELV, or the insulation of all conductors shall be RATED for the higher voltage. Alternatively, earthed screening or additional insulation shall be arranged around the wiring for SELV/PELV circuits or around the wiring of other circuits, based on IEC 60364-4-41.

6.5.2.102 Protective earth requirements for ENCLOSED EQUIPMENT

The ACCESSIBLE parts of Class I equipment (e.g, chassis, frame and fixed metal parts of metal ENCLOSURES) other than those which cannot become HAZARDOUS LIVE shall be electrically interconnected and connected to a PROTECTIVE EARTH TERMINAL.

This requirement can be met by structural parts providing adequate electrical continuity. This applies whether the equipment is used on its own or incorporated in an assembly.

Cords or cables that supply power to Class I equipment PORTABLE EQUIPMENT peripherals shall be provided with a protective earth conductor.

ACCESSIBLE isolated conductive parts are considered not to constitute a danger if they are so located as to exclude any contact with live parts and withstand the dielectric test voltage of [Table 5](#) for REINFORCED INSULATION, corresponding to the highest RATED operational voltage of the unit.

Class II equipment may have an internal functional earth bonding conductor but shall not be provided with a PROTECTIVE EARTH TERMINAL or a protective earth conductor in the equipment power input cord.

If the equipment is provided with a PROTECTIVE EARTH TERMINAL (Class I equipment), the following requirements also apply in addition to the previous general connection specifications.

- The PROTECTIVE EARTH TERMINAL shall be readily ACCESSIBLE and so placed that the connection of the equipment to the protective earth conductor is maintained when the cover or any removable part is removed.
- Products which are intended for MAINS cord connected use (such as equipment peripherals) shall be provided with a PROTECTIVE EARTH TERMINAL integral to the plug cap or socket (if removable cord set).
- The PROTECTIVE EARTH TERMINAL shall be of screw, stud or pressure type and shall be made of a suitable corrosion resistant material.
- The clamping means of PROTECTIVE EARTH TERMINALS shall be adequately locked against accidental loosening, and it shall not be possible to loosen them without the aid of a TOOL.
- PROTECTIVE EARTH TERMINALS and earth contacts shall not be connected direct to the neutral TERMINAL within the equipment. This does not prevent the connection of appropriately RATED devices (such as capacitors or surge suppression devices) between the PROTECTIVE EARTH TERMINAL and neutral.
- The PROTECTIVE EARTH TERMINAL and subsequent protective equipment internal to the equipment shall comply with the requirements in 6.5.2.4 or 6.5.2.5.
- The PROTECTIVE EARTH TERMINAL shall have no other function.

6.5.2.103 Protective earth requirements for OPEN EQUIPMENT

OPEN EQUIPMENT shall comply with the requirements of 6.5.2.4 or 6.5.2.5 with the exception that the provision for connection to an external protective conductor may be replaced by a means for bonding to the ENCLOSURE ACCESSIBLE to the OPERATOR.

6.6.1 General

Modification:

Replace NOTE 2 as follows:

NOTE 2 For cord connected MAINS supply, see [6.10](#).

6.6.2 TERMINALS for EXTERNAL CIRCUITS

Modification:

Add at beginning of the subclause:

All parts of TERMINALS that maintain contact and carry current shall be of metal of adequate mechanical strength.

The mechanical design of the interfaces shall allow that no individual conductor is subjected to bending of a radius of curvature less than six times its diameter after removal of the covering elements (armour, sheaths, fillers).

Conformity is checked by inspection.

CLEARANCES between TERMINALS and TERMINAL to earthed parts are given in [6.7.101](#).

6.6.3 Circuits with TERMINALS which are HAZARDOUS LIVE

Replacement:

This subclause applies to both TERMINALS and ports (see [Table 103](#)).

For ENCLOSED EQUIPMENT no ACCESSIBLE conductive parts may be HAZARDOUS LIVE. For OPEN EQUIPMENT protection for those TERMINALS and ports defined in [Table 103](#) shall be provided.

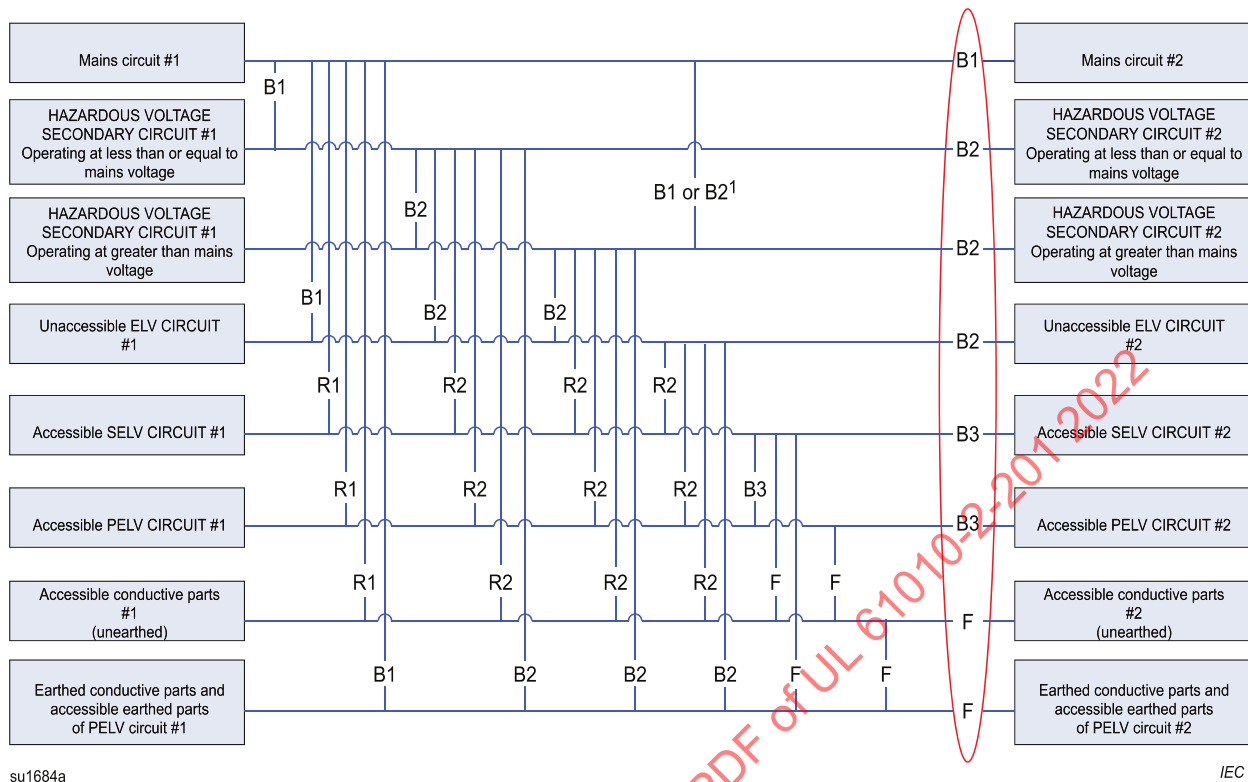
Conformity is checked by inspection.

6.7.1.1 General

Modification:

Add after the first paragraph:

Insulation requirements between separate circuits and between circuits and ACCESSIBLE conductive parts are specified in [Figure 102](#).



B1 Basic level of protection shall meet the requirements of 6.4. Creepage, CLEARANCES, and solid insulation shall meet the requirements of 6.7.2.

B2 Basic level of protection shall meet the requirements of 6.4. Creepage, CLEARANCES, and solid insulation shall meet the requirements of 6.7.3.

B3 Basic level of protection shall meet the requirements of 6.4. Creepage, CLEARANCES, and solid insulation shall meet the requirements of 6.7.3. May be waived if fault testing per 4.4 demonstrates no HAZARD occurs.

R1 Double/reinforced level of protection shall meet the requirements of 6.5. Creepage, CLEARANCES, and solid insulation shall meet the requirements of 6.7.2.

R2 Double/reinforced level of protection shall meet the requirements of 6.5. Creepage, CLEARANCES, and solid insulation shall meet the requirements of 6.7.3.

F Functional insulation. No specific level specified.

Earthed conductive parts – Shall meet the requirements of 6.5.2.4 or 6.5.2.5.

Items circled in red, on right side, may only apply to spread of fire considerations, Clause 9.

¹ The greater of B1 or B2 insulation, depending on the higher of the WORKING VOLTAGES of the MAINS and secondary circuits.

Figure 102

Requirements for insulation between separate circuits and between circuits and ACCESSIBLE conductive parts

Add at the end of the subclause:

Between 1) ACCESSIBLE SELV circuits, 2) ACCESSIBLE PELV circuits or 3) ungrounded conductive ACCESSIBLE parts and HAZARDOUS LIVE parts, there shall be two levels of protection: e.g. a) DOUBLE INSULATION, b) REINFORCED INSULATION, c) BASIC INSULATION + PROTECTIVE BONDING.

6.7.1.2 CLEARANCES

Addition:

Linear interpolation is permitted between the nearest two points in Table 3. The calculated minimum CLEARANCE using this multiplication factor shall be rounded up to the next higher 0,1 mm increment.

Requirements for insulation of measuring circuits are specified in IEC 61010-2-030.

NOTE See IEC 61010-1:2010, K.3 for requirements for switching circuits such as a switching power supply.

6.7.1.5 Requirements for insulation according to type of circuit

Replacement:

Requirements for insulation between separate circuits and between circuits and ACCESSIBLE conductive parts are specified as follows:

a) in [Figure 102](#);

b) in IEC 61010-1:2010, Clause K.3 for circuits that have one or more of the following characteristics:

- 1) the maximum possible TRANSIENT OVERVOLTAGE is limited by the supply source or within the equipment to a known level below the level assumed for the MAINS CIRCUIT;
- 2) the maximum possible TRANSIENT OVERVOLTAGE is above the level assumed for the MAINS CIRCUIT;
- 3) the WORKING VOLTAGE is the sum of voltages from more than one circuit, or is a mixed voltage;
- 4) the WORKING VOLTAGE includes a recurring peak voltage that may include a periodic non-sinusoidal waveform or a non-periodic waveform that occurs with some regularity;
- 5) the WORKING VOLTAGE has a frequency above 30 kHz;

c) in IEC 61010-1:2010, Clause K.1 for MAINS CIRCUITS of OVERVOLTAGE CATEGORY III or IV or for OVERVOLTAGE CATEGORY II over 300 V;

d) in IEC 61010-1:2010, Clause K.2 for secondary circuits separated from the circuits in c) only by means of a transformer.

Requirements for insulation of measuring circuits are specified in IEC 61010-2-030.

NOTE See IEC 61010-1:2010, Clause K.3 for requirements for switching circuits such as a switching power supply.

Add the following subclauses:

6.7.1.101 Non-metallic material supporting HAZARDOUS LIVE parts

Non-metallic material supporting HAZARDOUS LIVE parts shall have a comparative tracking index greater than, or equal to, 175.

6.7.2 Insulation for MAINS CIRCUITS of OVERVOLTAGE CATEGORY II with a nominal supply voltage up to 300 V

Modification:

For MAINS CIRCUITS above 300 V, see Annex K. For Tables K.2, K.3 and K.4, linear interpolation of creepage is allowed, but creepage can never be below CLEARANCE.

6.7.2.1 CLEARANCES and CREEPAGE DISTANCES

Modification:

Replace [Table 4](#) by the following:

Table 4
CLEARANCE and CREEPAGE DISTANCES for MAINS CIRCUITS of OVERVOLTAGE CATEGORY II up to 300 V

Voltage line-to- neutral AC r.m.s. V ^c	Values for CLEARANCE distances ^d			Values for CREEPAGE DISTANCES ^b								
	POLLU- TION DEGREE 1	POLLU- TION DEGREE 2	POLLU- TION DEGREE 3	POLLUTION DEGREE 1		POLLUTION DEGREE 2				POLLUTION DEGREE 3		
				PWB MG I, II, III	MG I, II, III	PWB MG I,II,IIIa	MG I	MG II	MG III	MG I	MG II	MG III
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
≤ 50	0,04	0,2 ^a	0,8	0,04	0,18	0,04	0,6	0,85	1,2	1,5	1,7	1,9
≤ 100	0,1	0,2 ^a	0,8	0,1	0,25	0,16	0,71	1,0	1,4	1,8	2,0	2,2
≤ 150	0,5	0,5	0,8	0,5	0,5	0,5	0,8	1,1	1,6	2,0	2,2	2,5
≤ 300	1,5	1,5	1,5	1,5	1,5	1,5	1,5	2,1	3	3,8	4,2	4,7

^a For printed wiring board, the values for POLLUTION DEGREE 1 apply.

^b Linear interpolation of creepage is allowed. But creepage can never be below CLEARANCE.

^c DC or AC peak values are $\sqrt{2} \times$ AC r.m.s. values shown.

^d Interpolation for CLEARANCES is not permitted.

NOTE 1 Table derived from IEC 60664-1.

NOTE 2 MG I = Material group I, CTI ≥ 600.

NOTE 3 MG II = Material group II, 600 > CTI ≥ 400.

NOTE 4 MG IIIa = Material group IIIa, 400 > CTI ≥ 175.

NOTE 5 MG IIIb = Material group IIIb, 175 > CTI ≥ 100.

NOTE 6 MG III = MG IIIa and MG IIIb.

NOTE 7 PWB = Printed wiring board.

NOTE 8 Creepages in this table have already increased so they are not below the CLEARANCE distance.

NOTE 9 For printed wiring boards, 0,04 mm is the minimum CREEPAGE DISTANCE.

Add after the conformity statement:

Since conformity is checked by inspection and measurement, dielectric test is not required.

Add after the last conformity statement:

NOTE 101 See Annex FF for examples of CLEARANCE and CREEPAGE measurement special cases.

6.7.2.2.1 General

Add the following first line:

If MAINS or secondary voltage is greater than 300 V, use Annex K.

Replace [Table 5](#):

Table 5
Test voltages for solid insulation between MAINS and between MAINS and secondary circuits
OVERVOLTAGE CATEGORY II up to 300 V^d

Voltage line-to- neutral AC r.m.s. V ^a	For BASIC INSULATION and SUPPLEMENTARY INSULATION				For REINFORCED INSULATION			
	Test voltages, V				Test voltages, V			
	AC		DC		AC		DC	
	5 s	1 min	5 s	1 min	5 s	1 min	5 s	1 min
≤ 50 ^b	1 250	300	1 750	420	2 500	600	3 500	850
≤ 100 ^c	1 300	350	1 800	500	2 600	700	3 600	990
≤ 150	1 350	400	1 900	570	2 700	800	3 800	1 100
≤ 300	1 500	550	2 100	780	3 000	1 100	4 200	1 600
NOTE Table derived from IEC 60664-1.								
^a DC or AC peak values are $\sqrt{2} \times$ AC r.m.s. values shown.								
^b For DC products this range ends at 60 V.								
^c For DC products this range begins at 60 V.								
^d No test is needed for SELV/PELV circuits/units.								

Replace the second paragraph on conformity:

Conformity is checked by inspection, and by the AC test of 6.8.3.1, or the DC test of 6.8.3.2, using the applicable voltage from [Table 5](#). Both the 1 min and 5 s test shall be performed or a single test which is the worst case combination of the 1 min and 5 s tests.

NOTE 101 For example, if a 1 min test with 1,1 kV and a 5 s test with 3 kV are required, instead a single test with 3 kV and 1 min is sufficient.

6.7.3.1 General

Modification:

Add at end of paragraph:

For MAINS CIRCUITS above 300 V, see Annex K.

6.7.3.2 CLEARANCES

Replace [Table 6](#):

Table 6
CLEARANCES and test voltages for secondary circuits derived from MAINS CIRCUITS of OVERVOLTAGE CATEGORY II up to 300 V

	MAINS voltage, OVERVOLTAGE CATEGORY II					
	≤100 V AC r.m.s. ^b		≤150 V AC r.m.s. ^b		≤300 V AC r.m.s. ^b	
	RATED impulse voltage		RATED impulse voltage		RATED impulse voltage	
	500 V		800 V		1 500 V	
Secondary WORKING VOLTAGE V AC r.m.s. ^b	CLEARANCE mm ^a	Test voltage V AC r.m.s.	CLEARANCE mm ^a	Test voltage V AC r.m.s.	CLEARANCE mm ^a	Test voltage V AC r.m.s.
10	0,04	440	0,10	500	0,47	770
12,5	0,04	440	0,10	500	0,47	770
16	0,04	440	0,10	500	0,50	840
33	0,05	455	0,11	510	0,52	850
50	0,05	455	0,12	520	0,53	860
100	0,07	476	0,13	540	0,61	900
150	0,10	507	0,16	580	0,69	940
300	0,24	641	0,39	770	0,94	1 040
600	0,79	980	1,01	1 070	1,61	1 450
1 000	1,66	1 500	1,92	1 630	2,52	1 970
1 250	2,23	1 700	2,50	1 960	3,16	2 280
1 600	3,08	2 200	3,39	2 390	4,11	2 730
2 000	4,17	2 750	4,49	2 890	5,30	3 230
2 500	5,64	3 300	6,02	3 520	6,91	3 850
3 200	7,98	4 000	8,37	4 390	9,16	4 660
4 000	10,6	4 900	10,9	5 320	11,6	5 610
5 000	13,7	6 000	14,0	6 590	14,9	6 960
6 300	17,8	8 000	18,2	8 270	19,1	8 620
8 000	23,5	10 000	23,9	10 400	24,7	10 700
10 000	30,3	12 500	30,7	12 900	31,6	13 300
12 500	39,1	15 800	39,6	16 100	40,5	16 400
16 000	52,0	20 000	52,5	20 400	53,5	20 700
20 000	67,4	25 000	67,9	25 300	68,9	25 600
25 000	87,4	31 300	87,9	31 600	89,0	32 000
32 000	117	40 400	117	40 400	118	40 700
40 000	151	50 300	151	50 300	153	50 800
50 000	196	62 800	196	62 800	198	63 400
63 000	258	79 400	258	79 400	260	80 000

^a Linear interpolation allowed.

^b DC or AC peak values are $\sqrt{2} \times$ AC r.m.s. values shown.

6.7.3.3 CREEPAGE DISTANCES

Modification:

Replace the first column heading of Table 7 of Part 1:

Secondary WORKING VOLTAGE AC. r.m.s V.

Add the following subclause:

6.7.101 Insulation for FIELD WIRING TERMINALS of OVERVOLTAGE CATEGORY II with a nominal voltage up to 1 000 V

Minimum CLEARANCES at FIELD-WIRING TERMINALS from TERMINAL to TERMINAL and from TERMINAL to conductive ENCLOSURE shall comply with the requirements of [Table 104](#).

Minimum CREEPAGE DISTANCES for FIELD WIRING TERMINALS shall be in accordance with [Table 104](#).

Table 104
Minimum CREEPAGE and CLEARANCE in air of OVERVOLTAGE CATEGORY II up to 1 000 V at FIELD-WIRING TERMINALS^{d, e}

WORKING VOLTAGE AC V r.m.s. V ^c	Termination CLEARANCE mm			Termination CREEPAGE mm	
	General use	Limited RATINGS ^{a, b}	To walls of metallic ENCLOSURES which may be deflected	General use	Limited RATINGS ^{a, b}
≤ 50	1,6	1,6	12	1,6	1,6
≤ 150	3,2	1,6	12	3,2	1,6
≤ 300	3,2	1,6	12	3,2	1,6
≤ 600	6,4	4,8	12	6,4	4,8
≤ 1 000	14	—	14	21,6	—
NOTE Table derived from UL 508, UL 1059 and IEC 61131-2:2007.					
^a Applicable to control equipment having ratings not more than 15 A at ≤150 V, 10 A at 151 V – 300 V, or 5 A at 301 V – 600 V.					
^b Applicable to control equipment which control more than one load, provided that the total load connected at one time does not exceed 30 A at ≤150 V, 20 A at 151 V – 300 V, or 10 A at 301 V – 600 V.					
^c DC or AC peak values are $\sqrt{2} \times$ AC r.m.s. values shown.					
^d For OVERVOLTAGE CATEGORY III and IV, Annex K shall be applied.					
^e For FIELD WIRING TERMINALS (and connectors) with mixed voltages (e.g. SELV 24 V and 230 V) the larger CLEARANCE and CREEPAGE DISTANCES, for the higher WORKING VOLTAGE between the two, of Table 104 or 6.7.2 shall be utilized.					

Conformity is checked by inspection and measurement.

6.10 Connection to the MAINS supply source and connections between parts of equipment

This subclause of Part 1 is only applicable to cord connected MAINS supply.

6.11 Disconnection from supply source

This subclause of Part 1 is not applicable.

NOTE 101 This subclause of Part 1 is not used for this standard. Local practices and codes govern the aspect of installation and use of control equipment.

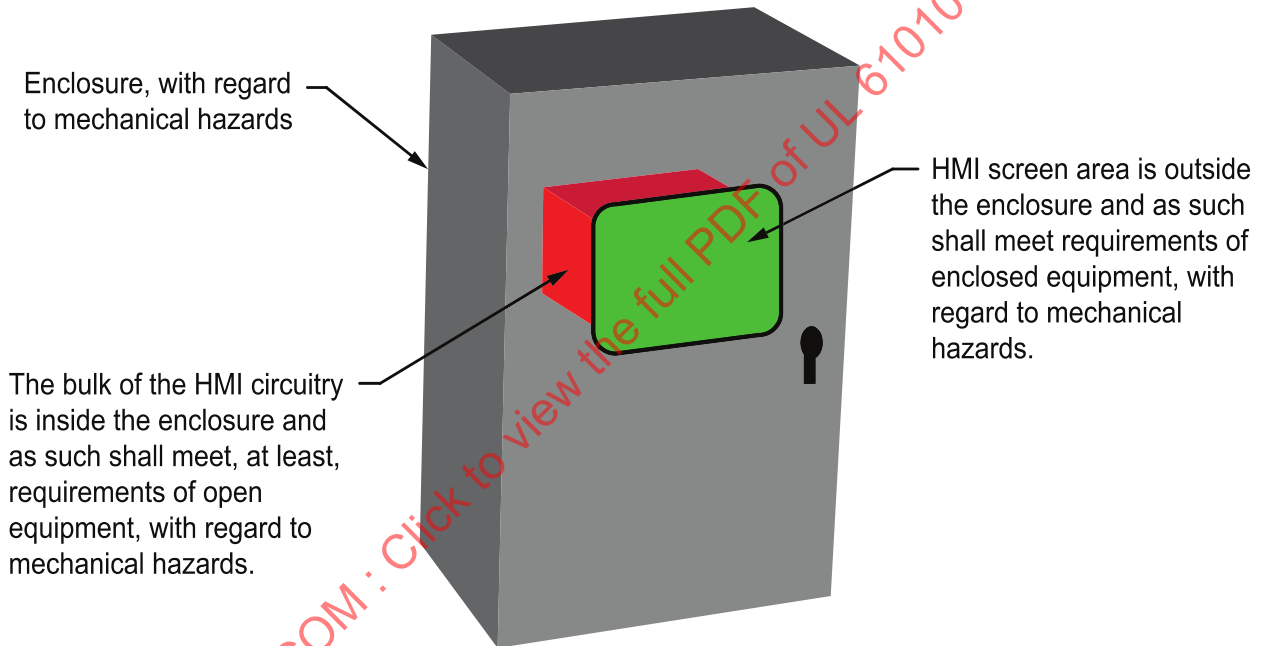
7 Protection against mechanical HAZARDS

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

Add the following subclause:

7.1.101 OPEN and PANEL MOUNTED EQUIPMENT

OPEN EQUIPMENT is intended to be installed within an ENCLOSURE which protects the OPERATOR from HAZARDS, including mechanical HAZARDS. PANEL MOUNTED EQUIPMENT may be considered as OPEN EQUIPMENT for the portion that is inside the ENCLOSURE, however, the portion of the control equipment that is not inside the ENCLOSURE and is otherwise ACCESSIBLE to an OPERATOR shall be considered to form part of an ENCLOSURE providing protection against potential HAZARDS and shall be evaluated to Clause [7](#).



su1685

Figure 103

Mechanical HAZARDS, with regard to PANEL MOUNTED EQUIPMENT

7.2 Sharp edges

Addition:

NOTE 101 Consideration may be given to parts or areas uniquely ACCESSIBLE to SERVICE PERSONNEL.

7.3.3 RISK assessment for mechanical HAZARDS to body parts

Modification:

Add after first paragraph but before conformity statement:

If a control equipment has only cooling fans as moving parts, then only a check for accessibility is needed.

7.3.4 Limitation of force and pressure

This subclause of Part 1 is not applicable.

7.3.5 Gap limitations between moving parts

This subclause of Part 1 is not applicable.

7.7 Expelled parts

This subclause of Part 1 is not applicable.

8 Resistance to mechanical stresses

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

8.1 General

Modification:

Replace the second paragraph and its listed points with the following:

The normal energy protection level is $6,8 \pm 5 \% J$.

Add the following subclauses:

8.1.101 OPEN EQUIPMENT

OPEN EQUIPMENT is intended to be installed within another ENCLOSURE which supplies the safety aspects protecting the OPERATOR from HAZARDS.

8.1.102 PANEL MOUNTED EQUIPMENT

PANEL MOUNTED EQUIPMENT may be considered as OPEN EQUIPMENT for the portion that is inside the ENCLOSURE, however, the portion of the control equipment that is not inside the ENCLOSURE and is otherwise ACCESSIBLE to an OPERATOR shall be considered to form part of an ENCLOSURE providing protection against potential HAZARDS and shall be evaluated to Clause [8](#).

8.2.2 Impact test

Modification:

Replace the fifth paragraph with the following:

Each test point is subjected to one impact by a smooth steel sphere with a diameter of approximately 50 mm.

Replace the ninth paragraph (above Figure 10) with the following:

The dimension X and mass are determined by the following equation: $J = X \times m \times g$

$J = 6,8 \text{ Joules} \pm 5\%$

$g = 10 \text{ m/s}^2$

NOTE 1 Values of the dimension X and mass are approximately 1,3 m and 0,5 kg using this formula.

NOTE 2 Test formula, units, etc. derived from pendulum test method of IEC 60068-2-75.

8.3 Drop test

Addition:

This subclause is applicable for ENCLOSED EQUIPMENT, not for OPEN EQUIPMENT.

9 Protection against the spread of fire

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

9.2 Eliminating or reducing the sources of ignition within the equipment

Modification:

Add to item a) 1):

NOTE Insulation within an energy limited circuit is considered to be functional insulation.

Add to item a) 2), at end of paragraph before conformity statement:

See also [Figure 102](#).

9.3.2 Constructional requirements

Modification:

Add at the beginning of the subclause:

For OPEN EQUIPMENT, items a) and b) apply.

For ENCLOSED EQUIPMENT, a), b) and c) apply.

If the portion of PANEL MOUNTED EQUIPMENT, see [Figure 104](#), that forms a part of the ENCLOSURE in which it is mounted is non-metallic material, it shall have a flame spread RATING of V-1 or better or conformity is tested by the glow wire test described below.

NOTE Example a panel mounted HMI device extending through the wall of a cabinet.

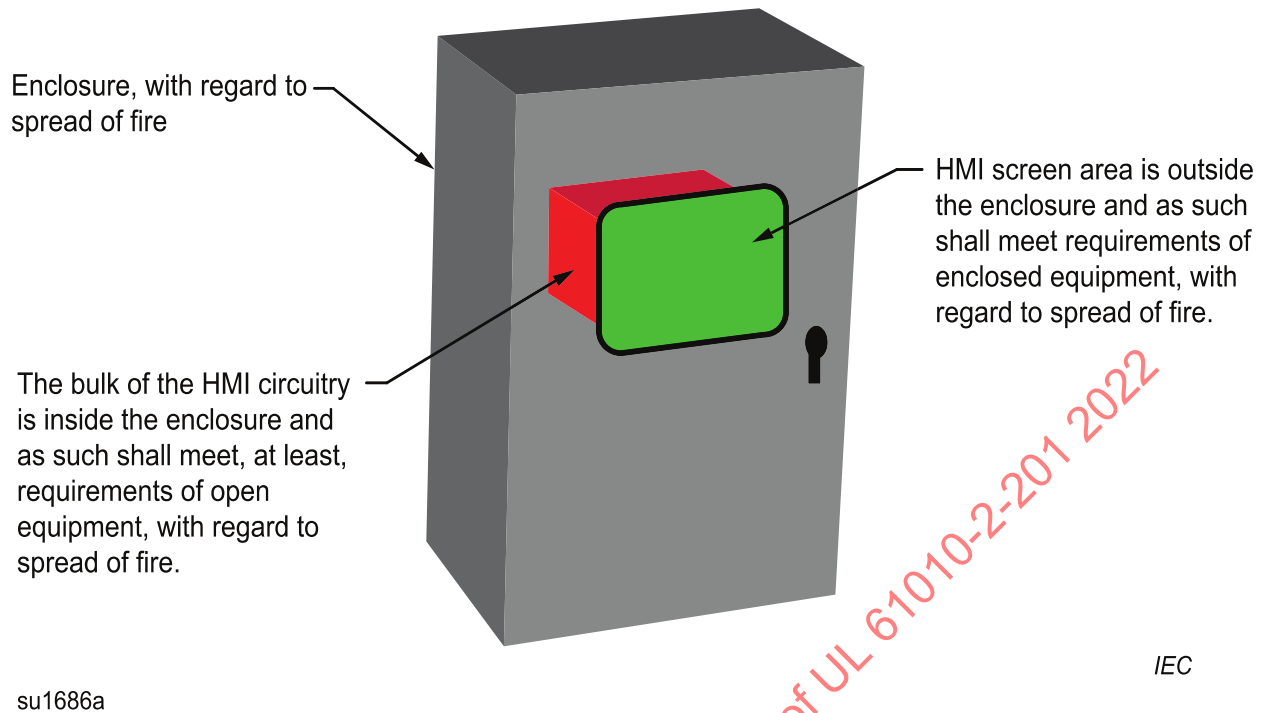


Figure 104

Spread of fire HAZARDS, with regard to PANEL MOUNTED EQUIPMENT

Non-metallic materials that are not baffles (see IEC 61010-1:2010, Figure 12), flame barriers and do not form a part of the ENCLOSURE require no flame spread RATING.

Add under a) at the end of the conformity statement:

or optionally by a glow-wire test at 750 °C with a 30 s application and an extinguishing time less than, or equal to, 30 s according to IEC 60695-2-11.

Replace item c) 2) by the following text:

The ENCLOSURE and any baffle or flame barrier shall be made of metal or of non-metallic materials having a flammability classification of V-1 or better, of IEC 60695-11-10. If magnesium alloy is used for the ENCLOSURE or a flame barrier it shall be verified as specified in Annex [DD](#).

Replace the conformity statement after item 3) with the following:

Conformity is checked by inspection. If the ENCLOSURE or flame barrier is made of magnesium alloy, the flammability test of requirement c) 2) is checked as specified in Annex [DD](#). In other cases of doubt, the flammability classification of requirement c) 2) is checked by performing the vertical burning test of IEC 60695-11-10 on samples of the material used in the relevant parts.

10 Equipment temperature limits and resistance to heat

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

10.1 Surface temperature limits for protection against burns

Modification:

Replace [Table 19](#):

Table 19
Surface temperature limits, under NORMAL CONDITION

Part	ENCLOSED EQUIPMENT °C	OPEN EQUIPMENT °C
1 Outer surface of ENCLOSURE or barrier (unintentional contact)		
a) metal uncoated or anodized	65	70
b) metal coated (paint, non-metallic)	80	85
c) plastics	85	85
d) glass and ceramics	80	85
e) small areas (< 2 cm ²) that are not likely to be touched in NORMAL USE	100	100
2 Knobs and handles (NORMAL USE contact)		
a) metal	55	55
b) plastics	70	70
c) glass and ceramics	65	70
d) non-metallic parts that in NORMAL USE are held only for short periods (1 s-4 s)	70	85
NOTE 1 NORMAL USE contact could be surfaces touched by an OPERATOR in NORMAL USE or by SERVICE PERSONNEL.		
NOTE 2 This table is based on IEC Guide 117:2010.		

For equipment with ambient temperature ratings above 40C, higher temperatures are possible. See clause 10.1 of IEC 61010-1:2010. See 5.4.4 item j).

10.3 Other temperature measurements

Modification:

Add at the end of item a):

This does not apply to control equipment FIELD WIRING, e.g. I/O's or to TERMINAL boxes for control equipment FIELD WIRING which do not contain power consuming parts.

Add item f):

FIELD WIRING TERMINALS' temperature shall be monitored during the temperature test. This data shall be used in conjunction with the device's RATED AMBIENT TEMPERATURE to determine the FIELD WIRING insulation temperature requirements.

10.4.1 General

Replace this subclause of Part 1 as follows:

10.4.1.100 General method

Equipment under test (EUT) shall be tested under reference test conditions. The reference test AMBIENT TEMPERATURE shall be the same as the maximum RATED AMBIENT TEMPERATURE, as defined in IEC 61010-1:2010, 1.4.1 c) or 1.4.2.c).

NOTE 1 RATED AMBIENT TEMPERATURE may be referenced in other terminology, e.g. RATED operating temperature, or designation, such as Ta.

Unless a particular SINGLE FAULT CONDITION specifies otherwise, the manufacturer's instructions concerning ventilation, cooling liquid, limits for intermittent use, etc. are followed. Any cooling liquid shall be at the highest RATED temperature.

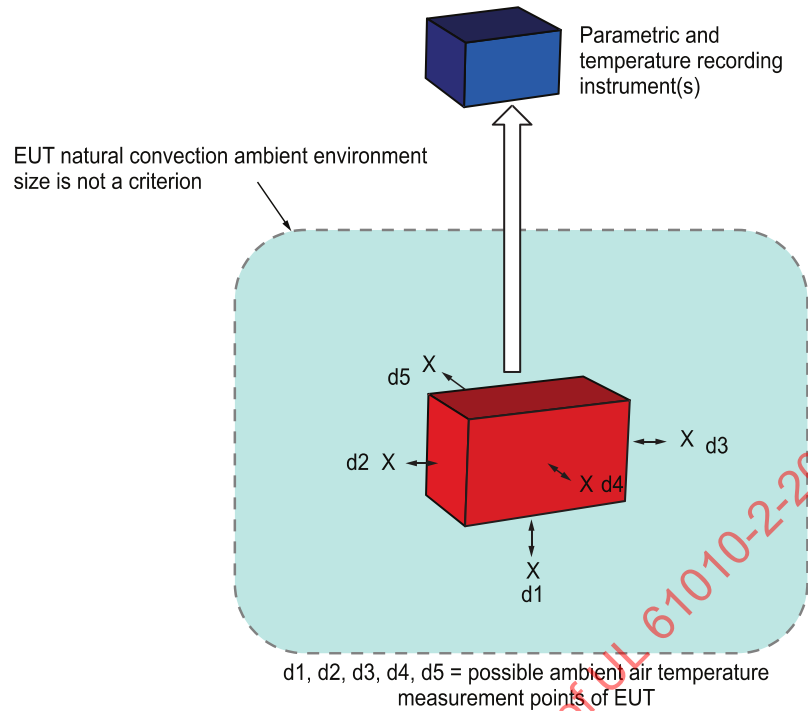
The EUT shall be mounted in its least favourable position/orientation.

The EUT shall be generating its least favourable heat dissipation. This dissipation may be caused by some combination of load current, input voltage, input frequency, I/O duty cycle, etc.

EUT FIELD WIRING shall be the smallest size suitable for the maximum current RATING of the EUT according to manufacturer's instructions.

The test room/chamber/box (size is not a test criteria) environment surrounding the EUT shall not be subject to air movement caused by sources not part of the EUT, i.e. it shall be a natural convection environment. See [Figure 105](#).

NOTE 2 To reduce and block forced air movement in a test room or in a climatic chamber around the EUT, the EUT can be placed in a partially or completely closed test box allowing air movement / natural convection only caused by the EUT. Or barriers made of any suitable material could be used around the EUT, to block air movement.



su3126

IEC

Figure 105
General temperature test environment

Temperatures are measured when steady state has been reached.

If the EUT is meant to function as a standalone unit it shall be tested standalone, e.g. a standalone HMI or communications switch/router.

If the EUT is not meant to function as a standalone unit, e.g. I/O module of a MODULAR EQUIPMENT system, then a representative system shall be utilized for testing. This system shall represent a practical least favourable combination of conditions for the EUT.

NOTE 3 Practical least favourable combination of conditions means a realistic situation the EUT can be utilized for in a real world application, not a theoretical combination which would never be used in practice.

This practical least favourable combination shall be, at a minimum, the items necessary for the EUT to function, e.g. power supply, communication module (TM's in [Figure 106](#)) and EUT. The EUT shall be surrounded, as permitted by manufacturer's documentation, on both sides with real modules or "simulation modules" (thermally representative modules, TM's in [Figure 106](#)) representing the worst case thermal environment for the EUT, i.e. adding more modules around the EUT does not cause further temperature increase of the EUT. A justification of the configuration for the test shall be provided in the test report.

An example configuration for testing an I/O module EUT, of a modular system, might be:

- the EUT (I/O module),
- a power supply,

- communication module,
- three of the same type I/O module operating at full load to the left of the EUT,
- three of the same type I/O module operating at full load to the right of the EUT, and
- adding more I/O modules left or right does not cause the EUT's temperature to change.

For vented equipment, cooled by natural air convection, the AMBIENT TEMPERATURE is the incoming air temperature at a point not more than 50 mm and not less than 25 mm away from the plane of the equipment's air flow entry point. See [Figure 106](#). The points d1, d2 and d3, in [Figure 106](#), are the possible measurement points. The point with the lowest temperature should be utilized as the AMBIENT TEMPERATURE.

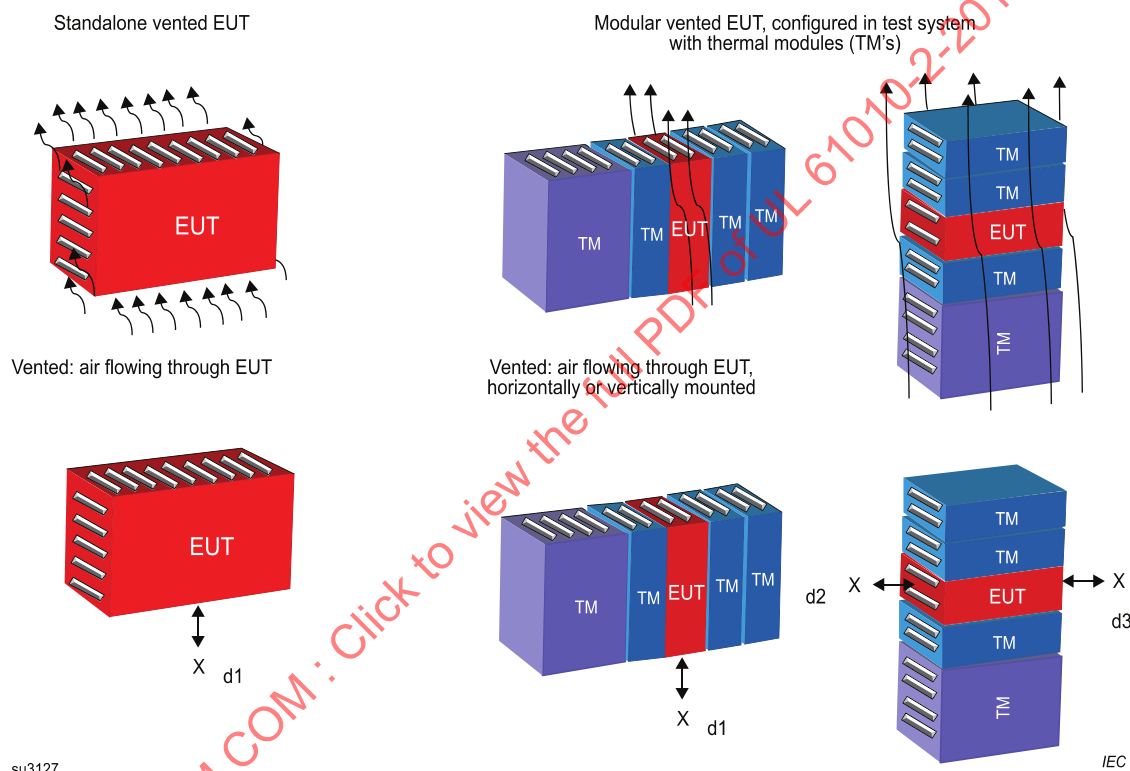


Figure 106

Vented equipment

NOTE 4 Vents are purposeful air openings intended to allow air to pass through the equipment for the purpose of cooling, not incidental vents, e.g. switch shaft or communication jack openings.

For non-vented equipment, cooled by natural air convection, the AMBIENT TEMPERATURE is the air temperature at a point not more than 50 mm and not less than 25 mm away from the equipment, on a horizontal plane located at the vertical mid-point of the equipment. See [Figure 107](#). The points d2-d5 in [Figure 107](#) are the possible measurement points. The point with the lowest temperature should be utilized as the AMBIENT TEMPERATURE.

Due to mounting requirements, some of the measurement points may not be practical to utilize.

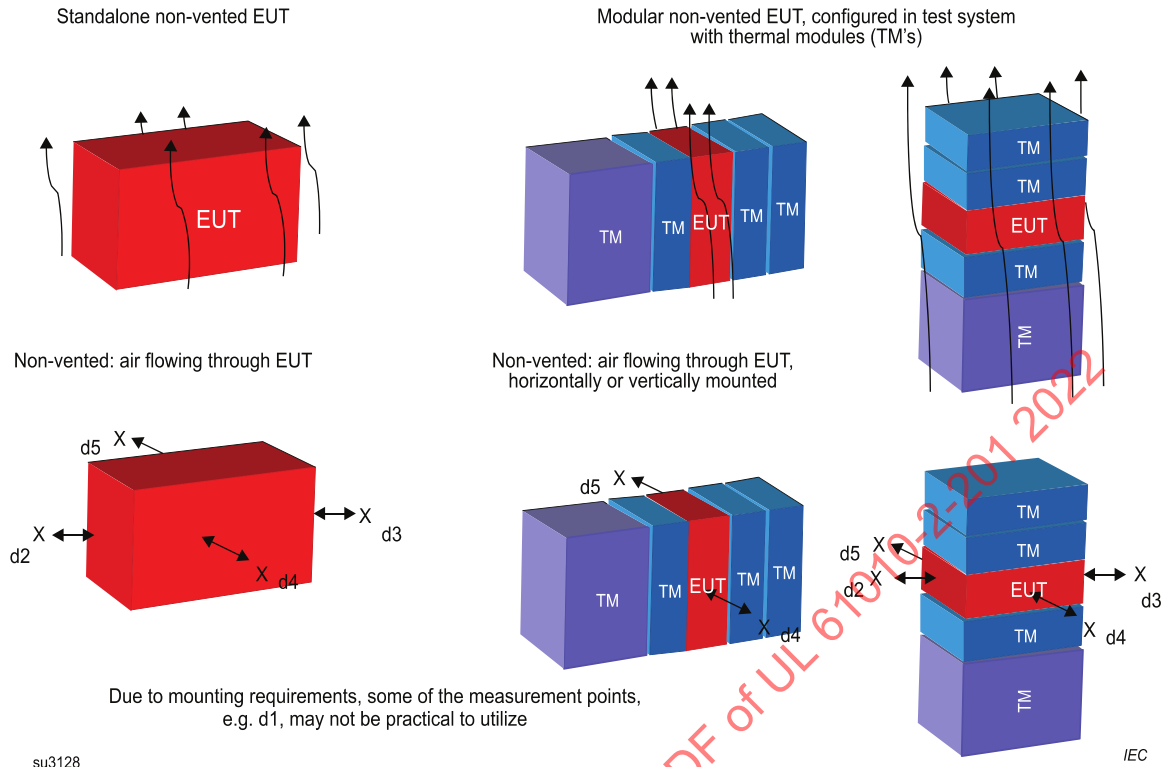


Figure 107

Non-vented equipment

10.4.1.101 Special method, PANEL MOUNTED EQUIPMENT

PANEL MOUNTED EQUIPMENT presents some special considerations, see [Figure 108](#).

In this case part of the equipment (EUT_a) may be in one ambient environment, e.g. ambient environment #1 and the rest of the equipment (EUT_b) may be in another ambient environment, e.g. ambient environment #2. The equipment construction techniques can be quite different, e.g. (referring to [Figure 108](#)) open/vented in ambient environment #1 and enclosed/nonvented in ambient environment #2.

It should be kept in mind, it may be necessary that these two different environments be applied simultaneously, to ensure least favourable conditions.

Each part of the equipment (EUT_a and EUT_b) shall be evaluated separately according to its own environment.

The general method described in [10.4.1.100](#) with regard to test conditions and least favourable EUT configuration, orientation, etc. shall be followed.

Three special methods for testing PANEL MOUNTED EQUIPMENT are provided:

a) The equipment shall be mounted such that the two portions (EUT_a and EUT_b) of the EUT are subjected to their specific environments.

NOTE 1 This provides the most accurate results, but is the most difficult to create for a test.

b) The total EUT ($EUT_a + EUT_b$) shall be mounted in a single environment, which shall be the higher RATED temperature of the two, and the recorded temperatures of the lower RATED temperature EUT portion are corrected by the difference between the EUT's maximum RATED AMBIENT TEMPERATURE and the actual test AMBIENT TEMPERATURE.

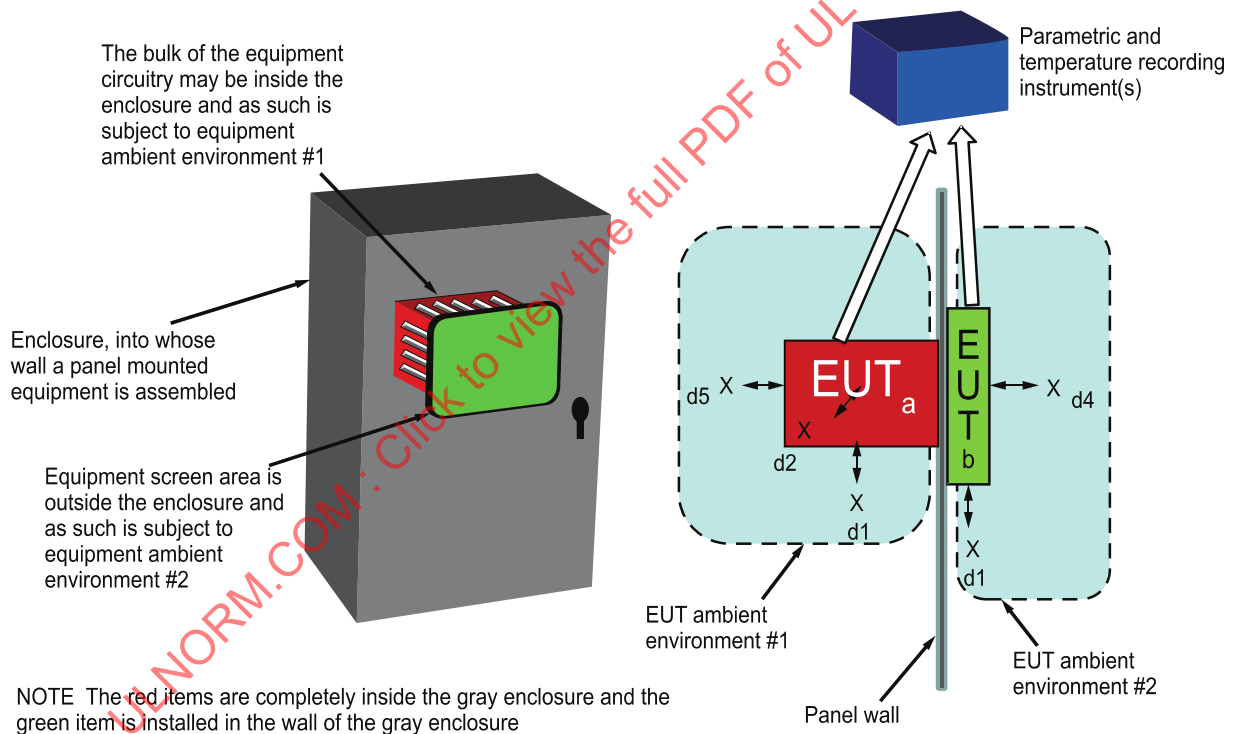
EXAMPLE: If EUT_a 's maximum RATED AMBIENT TEMPERATURE = 60 °C and EUT_b 's maximum RATED AMBIENT TEMPERATURE = 50 °C, the test shall be run with a test AMBIENT TEMPERATURE = 60 °C. Temperatures taken for EUT_b would be corrected by -10 °C (50 °C - 60 °C).

NOTE 2 This method is not as accurate as a) but will yield conservative results compared to c).

c) The total EUT ($EUT_a + EUT_b$) shall be mounted in a single environment, which shall be the lower RATED temperature of the two, and the recorded temperatures of the higher RATED temperature EUT portion are corrected by the difference between the EUT's maximum RATED AMBIENT TEMPERATURE and the actual test AMBIENT TEMPERATURE.

EXAMPLE: If EUT_a 's maximum RATED AMBIENT TEMPERATURE = 60 °C and EUT_b 's maximum RATED AMBIENT TEMPERATURE = 50 °C, the test shall be run with a test AMBIENT TEMPERATURE = 50 °C. Temperatures taken for EUT_a would be corrected by +10 °C (60 °C - 50 °C).

NOTE 3 This method is not as accurate as a) and will not yield conservative results compared to b).



su3129

IEC

Figure 108

Panel mounted device extending through the wall of a cabine

10.4.1.102 Special method, large or heavy equipment

Equipment too large or too heavy can be tested at room AMBIENT TEMPERATURE, if the recorded temperatures are corrected by the difference between the EUT's maximum RATED AMBIENT TEMPERATURE and the actual test room AMBIENT TEMPERATURE.

Where this method is applied, rationale shall be provided in the test report.

10.4.1.103 Other considerations, applying to all cases

Other considerations for temperature testing:

a) The temperature of insulating material of windings is measured as the temperature of winding wire and of core lamination in contact with the insulating material. It can be determined by the resistance method or by using temperature sensors selected and positioned so that they have a negligible effect on the temperature of the winding. The latter method may be used if the windings are non-uniform or if it is difficult to measure resistance.

b) Due to the difficulty of setup and repeat for single fault tests, these tests can be done at room AMBIENT TEMPERATURE. The recorded temperatures shall be corrected by the difference between the EUT's maximum RATED AMBIENT TEMPERATURE and the actual test room AMBIENT TEMPERATURE.

10.4.2 Temperature measurement of heating equipment

This subclause of Part 1 is not applicable.

10.5.2 Non-metallic ENCLOSURES

Modification:

Add at the beginning of the subclause:

This subclause is applicable for ENCLOSED EQUIPMENT.

11 Protection against HAZARDS from fluids

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

11.6 Specially protected equipment

Replacement:

If the equipment is rated and marked by the manufacturer as conforming to a stated degree of protection, e.g. from IEC 60529, it shall resist the entry of fluids and other material to the extent specified.

Conformity is checked 1) by inspection or 2) by subjecting the equipment to the appropriate treatment, e.g. of IEC 60529, after which the CLEARANCES and solid insulation shall pass the voltage tests of 6.8 (without humidity preconditioning) applicable to the type of insulation (see 6.7) and ACCESSIBLE parts shall not exceed the limits of 6.3.1. If there is any doubt, 2) shall be applied.

12 Protection against radiation, including laser sources, and against sonic and ultrasonic pressure

This clause of Part 1 is applicable.

13 Protection against liberated gases and substances, explosion and implosion

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

13.1 Poisonous and injurious gases and substances

This subclause of Part 1 is not applicable.

13.2.1 Components

This subclause of Part 1 is not applicable.

13.2.2 Batteries and battery charging

Addition:

NOTE For batteries and battery packs the following standards can additionally apply: IEC 62133 (battery packs), UL 1642 (lithium batteries), UL 2054 (rechargeable batteries).

14 Components and subassemblies

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

Add the following subclauses:

14.101 Components bridging insulation

14.101.1 Capacitors

A capacitor connected between two line conductors in a MAINS CIRCUIT, or between one line conductor and the neutral conductor shall comply with subclass X1 or X2 of IEC 60384-14.

A capacitor between the MAINS CIRCUIT and protective earth shall comply with subclass Y1, Y2 or Y4 of IEC 60384-14.

A capacitor bridging DOUBLE INSULATION or REINFORCED INSULATION in the control equipment shall comply with subclass Y1 or Y2 of IEC 60384-14.

In all cases a capacitor shall be used in accordance with its RATING.

These requirements do not apply to a capacitor connected between a hazardous voltage secondary circuit and protective earth, where only BASIC INSULATION is required.

Capacitors in conformity with IEC 60384-14 and approved by a recognized testing authority may be removed from the circuit for the high-voltage TYPE TEST.

NOTE Removal from the circuit is allowed, when the value of the required voltage test is higher than the rated value of the capacitor.

Compliance is checked by inspection.

14.101.2 Surge suppressors

It is permitted to use any type of surge suppressor, including a voltage dependent resistor (VDR, also known as MOV), in a secondary circuit.

NOTE 1 It is not a requirement of this standard to comply with any particular component standard for surge suppressors used in secondary circuits. However, attention is drawn to the IEC 61643 series of standards, in particular:

- IEC 61643-21 (surge suppressors in telecommunications application),
- IEC 61643-311 (gas discharge tubes),
- IEC 61643-321 (avalanche breakdown diodes),
- IEC 61643-331 (metal oxide varistors).

If a surge suppressor is used in a MAINS CIRCUIT, it shall be a VDR and it shall comply with IEC 61051-2.

NOTE 2 A VDR is sometimes referred to as a varistor or a metal oxide varistor (MOV). Devices such as gas discharge tubes, carbon blocks and semiconductor devices with non-linear voltage/current characteristics are not considered as VDRs in this standard.

Conformity is checked by inspection.

14.102 Switching devices

This subclause is only applicable to switching devices with a RISK of fire or shock.

Switching devices controlling outputs shall be used within their RATINGS, according to IEC 60947-5-1, or equipment utilizing them shall be subjected to the overload and endurance tests specified in [4.4.2.101.1](#) and [4.4.2.101.2](#), respectively. The same sample shall be subjected first to the overload test and then the endurance test. The test specified in [6.7.2.2.1](#) shall immediately follow the endurance test or the overload test when conducted alone.

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

15 Protection by interlocks

This clause of Part 1 is not applicable.

16 HAZARDS resulting from application

This clause of Part 1 is applicable.

17 RISK assessment

This clause of Part 1 is applicable.

Annexes

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

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

Annex E (informative)

Guideline for reduction of POLLUTION DEGREES

Replacement:

The micro-environment inside the equipment is determined by the environmental conditions to which the equipment is exposed during operation, installation, maintenance, and any POLLUTION generated by the equipment itself as well as by the effectiveness of applied sealing measures.

Equipment can be divided into environmental situations as depicted in [Table E.1](#).

Table E.1
Environmental situations

Environmental situation	Equipment operated in ...	Installation or maintenance of equipment in ...
A	controlled environment ^a	controlled environment
B	uncontrolled environment	controlled environment or equipment is not opened during installation or maintenance
C	uncontrolled environment	uncontrolled environment

^a A controlled environment is an environment having the conditions of IEC 61010-1:2010, 1.4.1 c) and d).

NOTE The environmental situation of [Table E.1](#) provides a systematic classification of the environments to which the equipment is exposed and whether the equipment may be opened for installation and maintenance purposes.

Reduction of the POLLUTION DEGREE of the micro-environment may be achieved by the methods of Table E.2. The POLLUTION DEGREE may not be reduced when the equipment is subject to condensation or it produces pollutants itself.

	Original POLLUTION DEGREE						
	2			3		4	
	Environmental situation (Table E.1)						
	A	B	C	B	C	B	C
Additional Protection	Protection Degree with additional protection						
ENCLOSURE IPx4							
ENCLOSURE IPx5, IPx6	1	--	--	--	--	--	--
ENCLOSURE IPx7, IPx8	1	1	--	2 ^{a,b}	--	2 ^{a,b}	--
Constant heating within the equipment with an ENCLOSURE of IPx4 or higher	1	--	--	--	--	--	--
Hermetically sealed ENCLOSURE	1	1	1	1	1	1	1
NOTE 1 Reduction maximum to PD 1.							
NOTE 2 PD 3 and PD 4 not considered as controlled environment.							
NOTE 3 Reduction measures are meant as alternatives.							
NOTE 4 IP classification based on IEC 60529.							
^a Conformal coating, further 1 POLLUTION DEGREE reduction							
^b Potting or encapsulation, further 1 POLLUTION DEGREE reduction							
– = no reduction							

NOTE Examples how to use the tables:

- ¹⁾ Equipment in an external environment of PD = 2 and environmental situation = B protected by an ENCLOSURE IPx7 or IPx8 gets a reduction to PD = 1.
- ²⁾ Equipment in an external environment of PD = 3 and environmental situation = B protected by an ENCLOSURE IPx7 or IPx8 gets a reduction to PD = 2, and with additional protection by conformal coating gets a reduction to PD = 1.

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

Annex F (normative)

ROUTINE TESTS

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

F.2 Protective earth

Modification:

Add between the paragraph and the NOTE:

The resistance shall not exceed 0,1 Ω .

F.3.1 General

Addition:

No test is required for supply voltages equal to or below those specified in IEC 61010-1:2010, 6.3.1, a).

F.4 Floating circuits

Addition:

No test is required for supply voltages equal to or below those specified in IEC 61010-1:2010, 6.3.1, a).

Add the following clause:

F.101 Supply circuits other than MAINS and floating circuits

These are supply circuits other than those defined in Clause F.3 and [F.4](#).

A test voltage is applied between

- a) the supply circuit, and
- b) all input and output TERMINALS of all other circuits which have to be isolated from the supply circuit in a), connected together.

During this test, the control equipment shall be electrically isolated from any external earth.

This test is not applied to small metal parts e.g. name plates, screws or rivets, since they are not normally connected to any circuit.

The test voltage may be AC or DC or impulse, and is selected from IEC 61010-1:2010, Table F.1 for the appropriate OVERVOLTAGE CATEGORY. For the AC and DC tests, the test voltage is raised to its specified value within 5 s, and maintained for at least 2 s. Impulse tests are the 1,2/50 μ s test specified in IEC 61180, conducted for a minimum of three pulses of each polarity at 1 s minimum intervals.

No flashover of CLEARANCES or breakdown of solid insulation shall occur during the test, nor shall the test device indicate failure.

No test is needed for SELV/PELV circuits/units.

No test is required for supply voltages equal to or below those specified in IEC 61010-1:2010, 6.3.1, a).

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

Annex L
(informative)

Index of defined terms

This annex of Part 1 is not applicable.

See Clause 3 of Part 1 and Clause [3](#) of this standard for a complete set of defined terms.

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

Annex AA (informative)

General approach to safety for control equipment

AA.1 Personnel

AA.1.1 General

There are two types of persons whose safety needs to be considered, OPERATORS and SERVICE PERSONNEL. [Figure AA.1](#) depicts the general situation.

NOTE SERVICE PERSONNEL is described in [3.113](#).

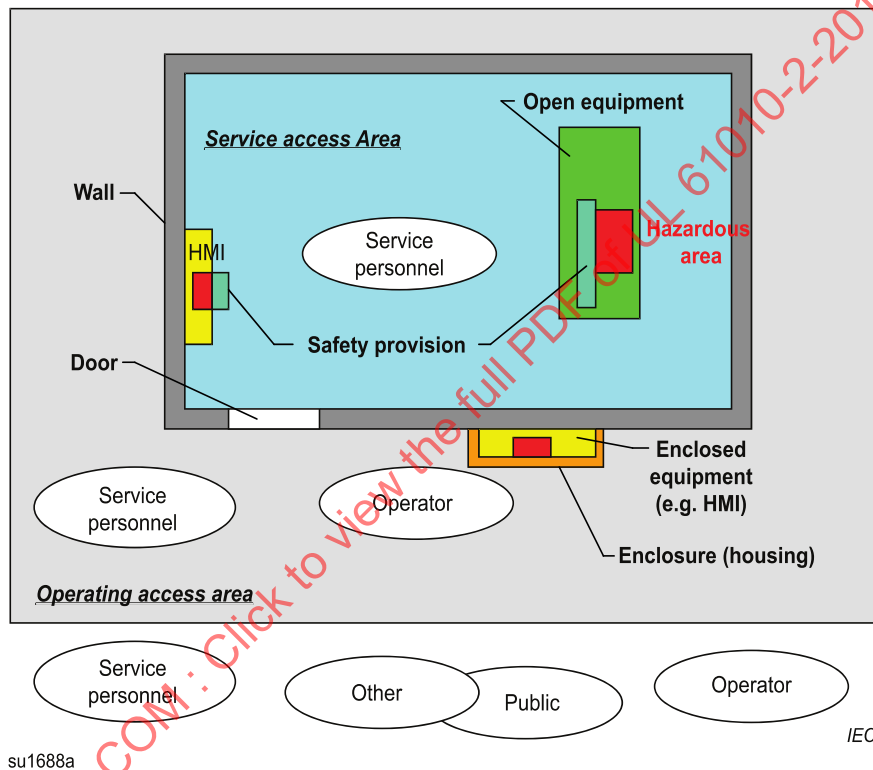


Figure AA.1

Control equipment access and safety concerns

AA.1.2 OPERATOR

OPERATOR is the term applied to all persons other than SERVICE PERSONNEL. Requirements for protection should assume that OPERATORS are not trained to identify HAZARDS, but will not intentionally create a hazardous situation. Consequently, the requirements will provide protection for cleaners and casual visitors as well as the assigned OPERATORS. In general, OPERATORS should not have access to hazardous parts, and to this end, such parts should only be in service access areas or in ENCLOSED EQUIPMENT located in operating access areas.

AA.1.3 SERVICE PERSONNEL

SERVICE PERSONNEL are expected to use their training and skill to avoid possible injury to themselves and others due to obvious HAZARDS that exist in service access areas of the control equipment or on ENCLOSED

EQUIPMENT located in operating access areas. However, SERVICE PERSONNEL should be protected against unexpected HAZARDS.

This can be done by, for example:

- locating parts that need to be ACCESSIBLE for servicing away from areas with electrical and mechanical HAZARDS;
- providing shields to avoid accidental contact with hazardous parts;
- providing interlocks as protection against HAZARDS;
- providing labels or instructions to warn personnel about any residual RISK.

Information about potential HAZARDS can be marked on the control equipment or provided with the control equipment, depending on the likelihood and severity of injury, or made available for SERVICE PERSONNEL. In general, OPERATORS shall not be exposed to HAZARDS likely to cause injury, and information provided for OPERATORS should primarily aim at avoiding misuse and situations likely to create HAZARDS, such as connection to the wrong power source and replacement of fuses by incorrect types.

Local requirements may specify that SERVICE PERSONNEL need to be licensed or certified for the equipment they service.

AA.2 Operating access areas

This is meant as the control equipment location. SERVICE PERSONNEL have access to these areas and OPERATORS may be allowed depending on the level of training or instruction necessary for access. This could be a room or a cabinet, as examples.

AA.3 Service access areas

These are areas of the control equipment where service tasks are expected to be performed, i.e. changing fuses, batteries, cleaning filters, performing isolation tests. Only SERVICE PERSONNEL have access. This could be a room or a cabinet, as examples. These areas are normally secured.

AA.4 Equipment types

AA.4.1 General

Two types of control equipment are available. These have different constructional requirements. These are meant for use by different personnel and/or installation in different areas. These two control equipment types are OPEN and ENCLOSED EQUIPMENT.

AA.4.2 OPEN EQUIPMENT

OPEN EQUIPMENT is meant for access only by SERVICE PERSONNEL. It provides protection for SERVICE PERSONNEL against unintentional contact with:

- a) unexpected HAZARDOUS LIVE parts;
- b) unexpected hot surfaces, as opposed to expected hot surfaces such as heat sinks and semiconductors;
- c) unexpected mechanical HAZARDS, such as sharp edges, protruding wires and screws, as opposed to expected mechanical hazards such as fans.

AA.4.3 ENCLOSED EQUIPMENT

ENCLOSED EQUIPMENT is meant for access by an OPERATOR. It provides protection for the OPERATOR in NORMAL CONDITION and SINGLE FAULT CONDITION against:

- a) contact with HAZARDOUS LIVE parts;
- b) hot surfaces;
- c) mechanical HAZARDS.

NOTE The ENCLOSURE can be used to prevent spread of fire, from the ENCLOSED EQUIPMENT, if the ENCLOSURE is designed for that purpose.

ULNORM.COM : Click to view the full PDF of UL 61010-2-201 2022

Annex BB (informative)

System drawing of isolation boundaries

BB.1 General

The intent of Annex [BB](#) is to foster a consistent use of this standard by designers and certifiers.

One concept discussed is a kind of system drawing, which can be used to understand and communicate the electrical safety and isolation in a system as it is developed. This drawing can then help inform future designers and certification parties, working on the system, of the concepts originally set down.

This annex will focus on OPEN EQUIPMENT. The figures shown in this Annex [BB](#) are examples and serve for illustration of the text.

BB.2 Installation environment of OPEN control equipment

[Figure BB.1](#) depicts an example of a typical ENCLOSURE. The ENCLOSURE contains multiple items which comprise parts of the overall automation system.

The incoming circuit breakers/disconnects are shown near the top of the ENCLOSURE. This may be the factory three phase distribution AC power, e.g. 480 V AC. Next to this is a control transformer. This is used to step down the factory power to local control power, e.g. 480 V AC three phase to single phase 120 V AC.

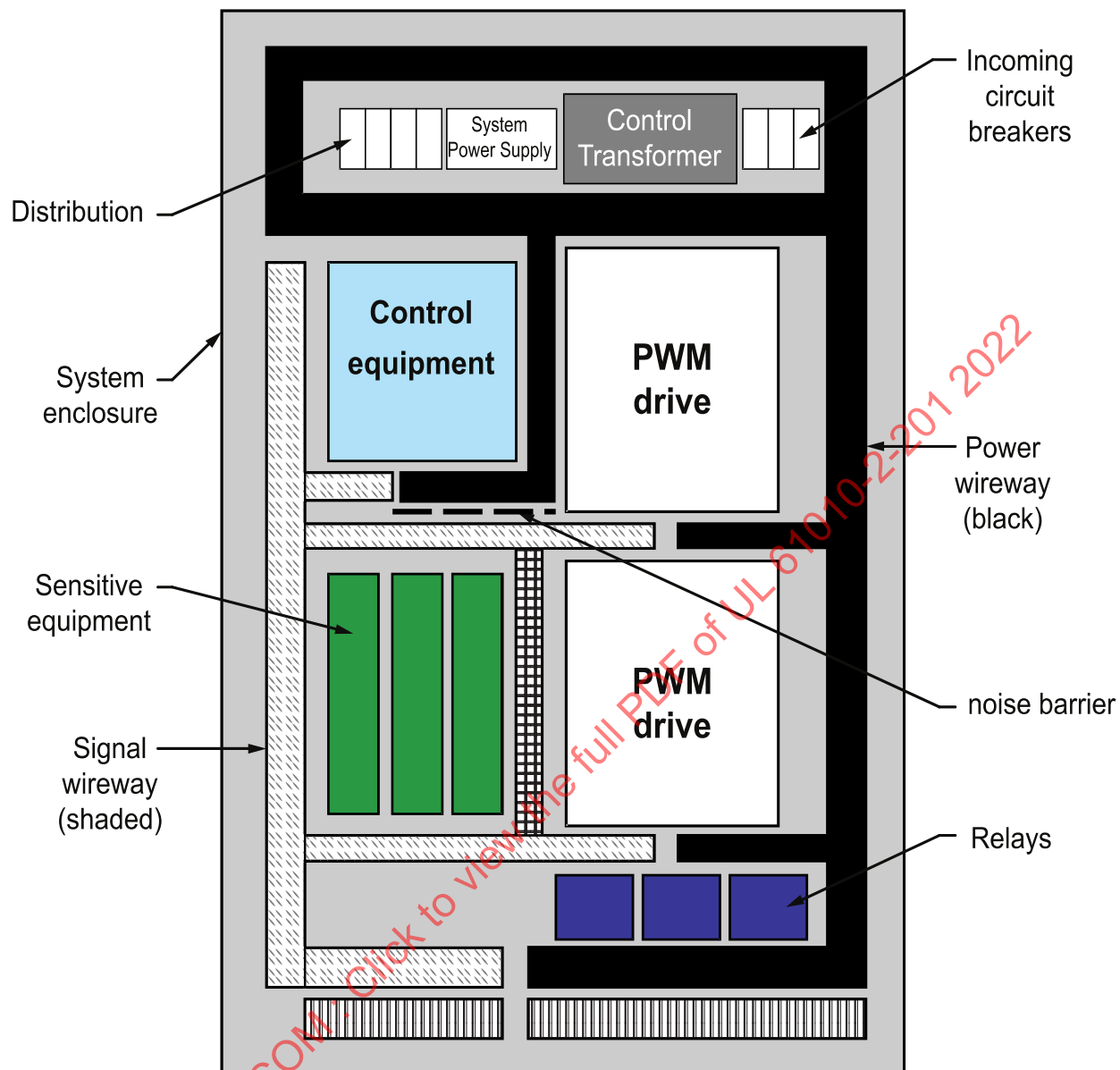
The system power supply, which utilizes the local control power to provide control equipment power, e.g. 24 V DC is located to the left of the control transformer. Located close by these items, would be power distribution circuit breakers and TERMINALS so as to distribute the local control and control equipment power within the ENCLOSURE. Note these items are normally located near the top of the ENCLOSURE to keep their heat production from affecting more heat sensitive equipment below.

Located on the right side of the ENCLOSURE are a set of PWM drives, which are not the subject of this standard, see IEC 61800 series. However it is typical to see such an automation system configuration.

More sensitive equipment (sensitive from a temperature and/or of EMC noise perspective) is normally located near the bottom of the ENCLOSURE.

The subject of this standard, control equipment, is located at the left centre. It is more temperature and noise tolerant, but not as insensitive as those items near the top of the ENCLOSURE.

Note the wireway organization. It is laid out to segregate wiring by type; e.g. high power, higher voltage, noise prone wiring in the black wireway and low power, low voltage, low noise wiring in the shaded wireway. Note also the noise barrier where it is necessary for high power/noise and low power/noise wiring to be in close proximity.



su1689a

IEC

Figure BB.1
Typical system ENCLOSURE layout

BB.3 Control equipment electrical safety drawing

Utilizing the general layout just discussed, and focusing on the control equipment, it is possible to create a generalized schematic of the environment in which the control equipment resides. [Figure BB.2](#) represents an example schematic for what might be called a control equipment electrical safety drawing.

This diagram can provide a key item in the design of any control system the environment and the method by which that system will achieve its electrical safety.

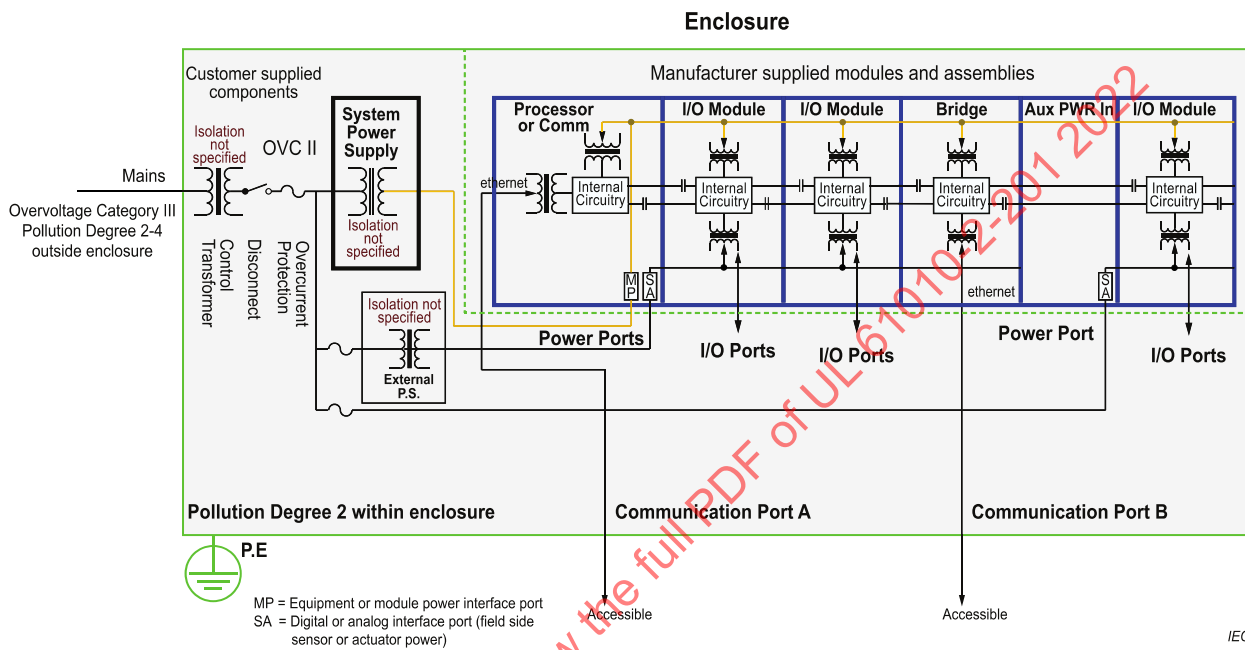


Figure BB.2

Simplified system schematic

The control equipment, which is being designed, is within the dashed green box and referred to as “manufacturer supplied modules and assemblies”. This is the equipment being designed with the help of this standard. As this example is a modular system, a number of example modules, e.g. processor or communication module, I/O module, bridge (another type of communication module) and a power input module are shown. Many other types of modules are possible. See [Figure 101](#).

Since this example is OPEN EQUIPMENT, it is shown housed inside the ENCLOSURE. This is generally a larger ENCLOSURE into which many different equipment items are housed. See [Figure BB.1](#).

The two lines exiting the ENCLOSURE, in [Figure BB.2](#) to [Figure BB.11](#), are communications lines normally ACCESSIBLE by personnel, e.g. OPERATORS, or interfaced to other equipment, e.g. PWM drives. As these items could be ACCESSIBLE by OPERATORS, protection is provided. See communication ports e.g. Ar, Be or E on [Figure 101](#) and [Table 103](#).

Each of the modules e.g. processor or communication module, I/O module, bridge and auxiliary power input module may have other ports where connection is made to the module. I/O ports are shown in the schematic, e.g. C or D [Figure 101](#) and [Table 103](#). And power ports are also shown, e.g. F or J on [Figure 101](#) and [Table 103](#).

At the top of each module a transformer is shown. This is used to schematically indicate isolation between power entering at the top and the “internal circuitry” fed from the transformer. Similarly at the bottom of side of each module is another transformer symbol. Again this indicates the isolation between the “internal circuitry” and the power and circuitry which may be on the opposite side.

“Internal circuitry” is that circuitry, e.g. microprocessor or memory, which is internal to the module and sits inside a sort of isolation island formed by the indicated transformers. Hence it could be said the internal circuitry is isolated from the outside world.

[Figure BB.3](#) depicts two example situations for the safety aspects provided in the example above.

Following the blue lightning bolts, representing a hazardous voltage, the voltage is shown entering a power port. If there are failures of the processor module isolation devices or they do not exist, then the person working on the communication port A will be exposed to the hazardous voltage.

Similarly, again referring to [Figure BB.3](#), following the red lightning bolts, also representing a hazardous voltage, the voltage shown entering a different power port. If there are failures of the I/O module and bridge isolation devices or they do not exist, then the person working on the Communication Port B will be exposed to the hazardous voltage.

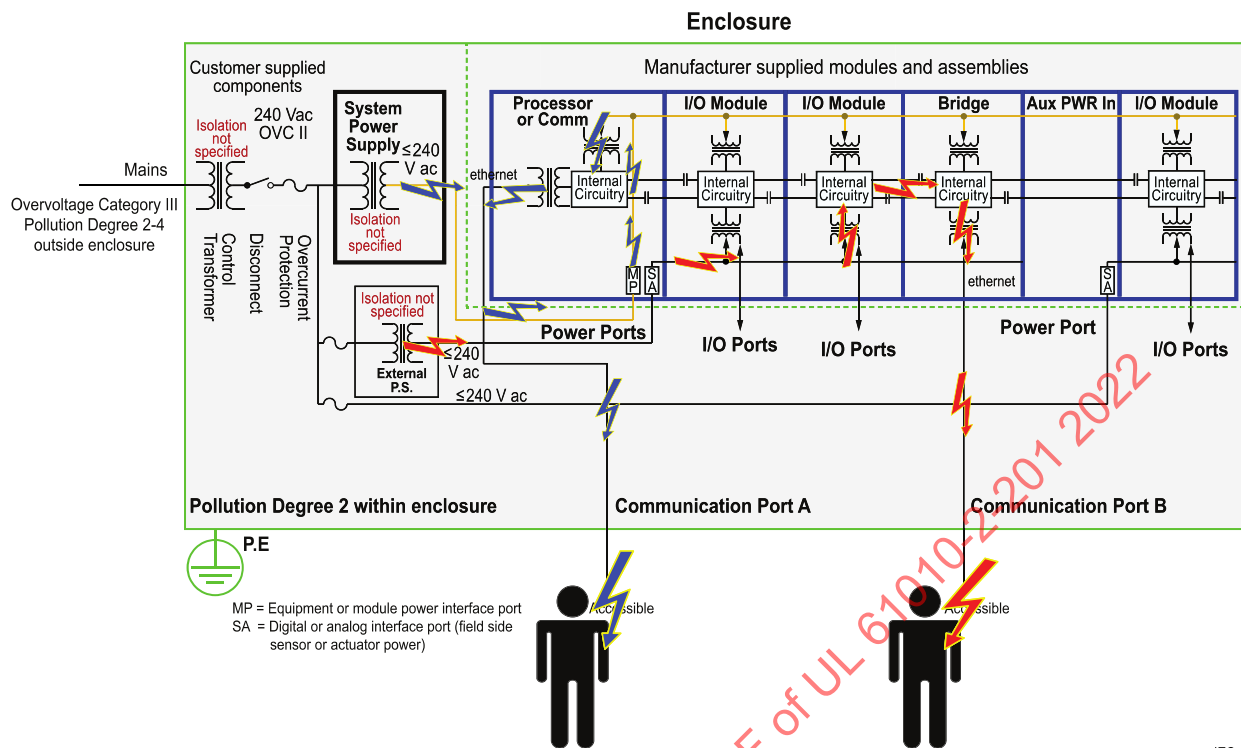


Figure BB.3

HAZARD situation of the control equipment

BB.4 Applying the standard to the control equipment electrical safety drawing

Figure BB.4, Figure BB.5 and Figure BB.6 provide a reference for which clauses of this standard apply to which areas of the control equipment electrical safety drawing.

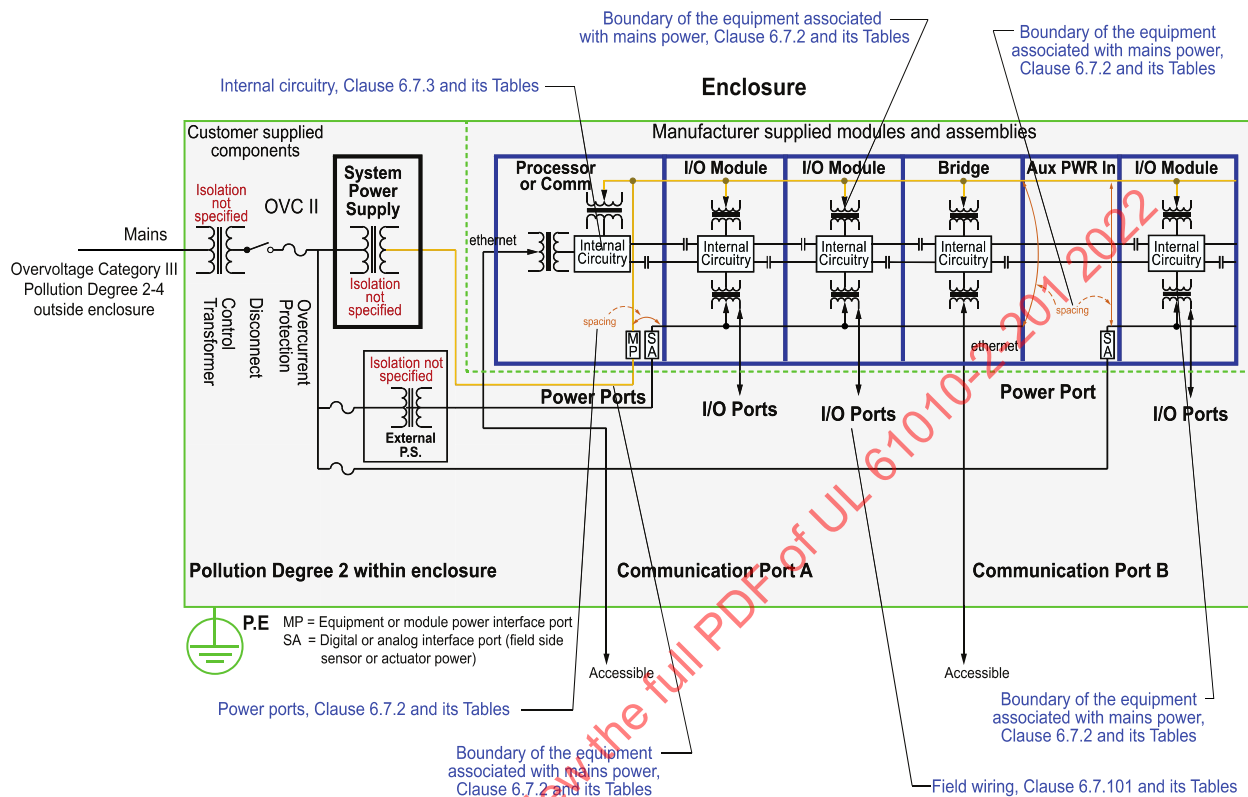
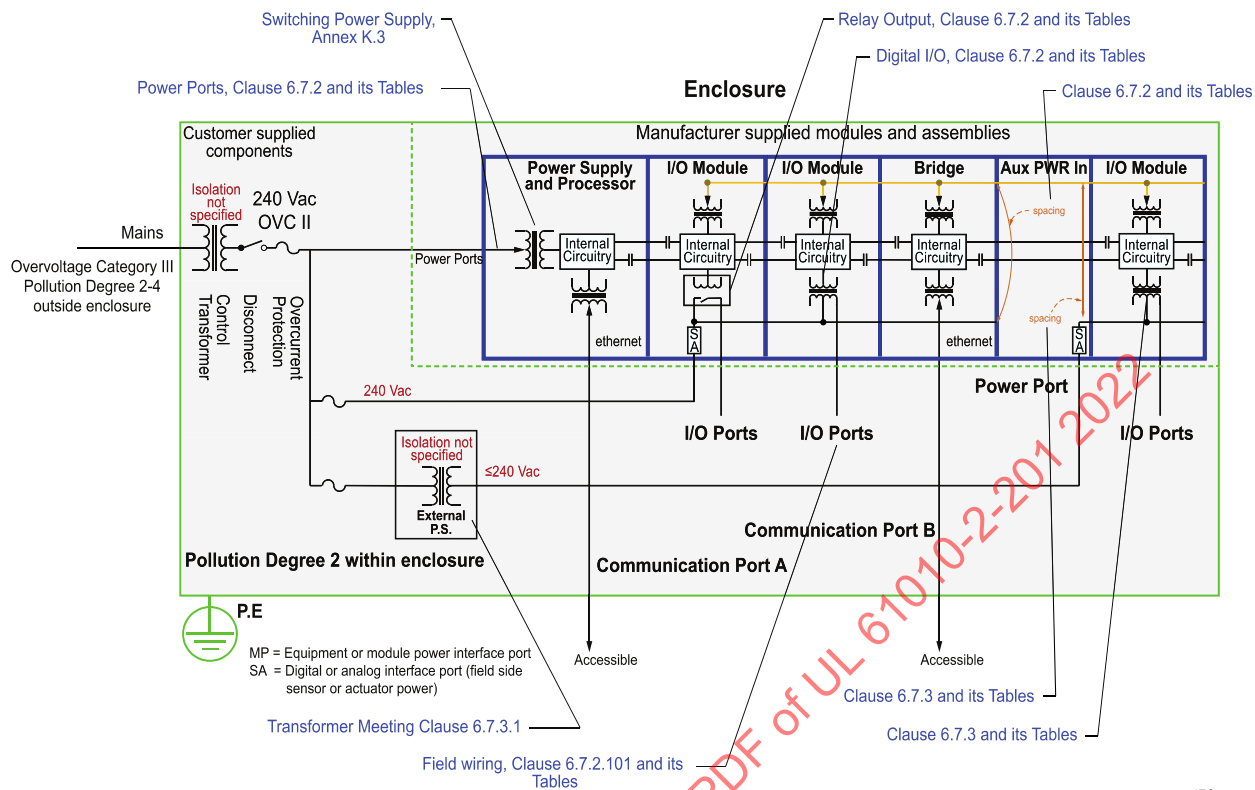


Figure BB.4

Application of the standard to the control equipment safety drawing



Application of 6.7.1.5 items a) and b) to the control equipment safety drawing

For this standard, the equipment shall be safe under normal and SINGLE FAULT CONDITION. Some examples of different methodologies to make the schematic in [Figure BB.3](#) safe methods are now presented.

Referring to [Figure BB.7](#), REINFORCED INSULATION provides the method to handle single faults and maintain safety.

REINFORCED INSULATION at I/O and module power makes the ACCESSIBLE communication ports SELV/PELV.

Communication connections can utilize functional insulation, as they are not required to provide any protection.

As such a single fault at any connection cannot propagate to cause communication connections to become hazardous.

Implementation of the associated safety methods in this example makes the use of SELV/PELV as a protection method unnecessary, but still permissible.

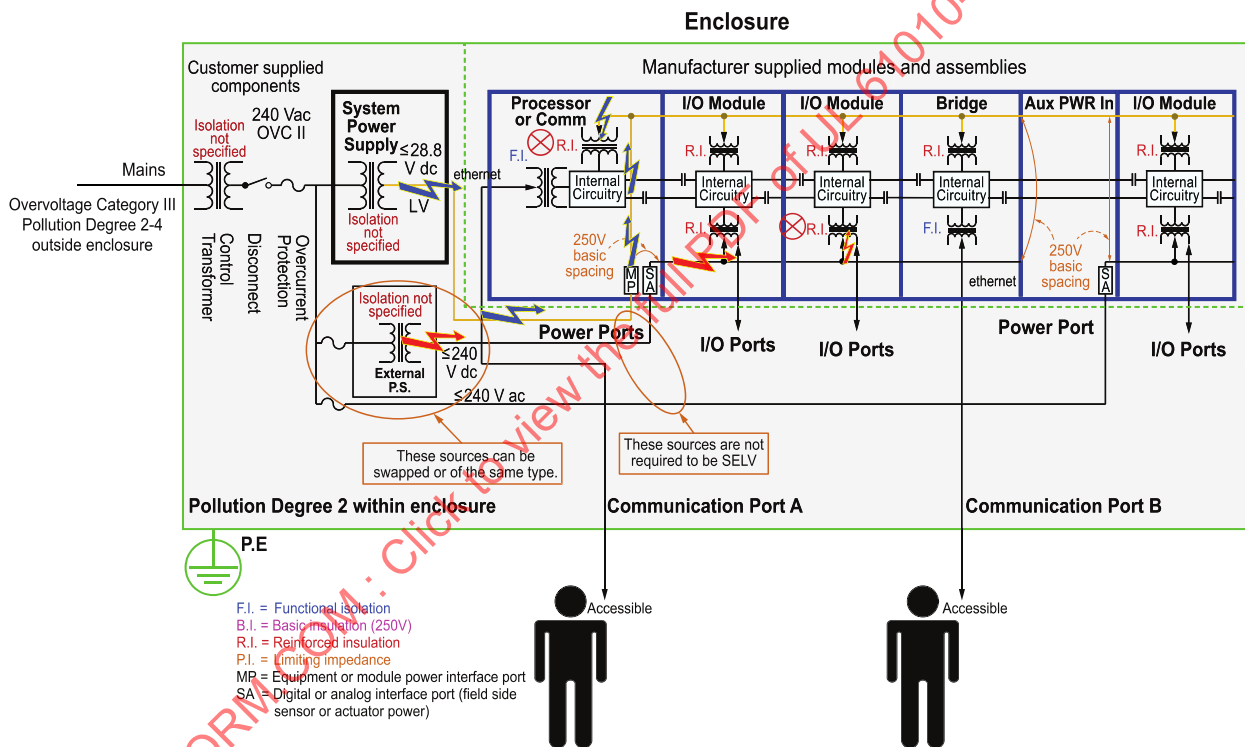


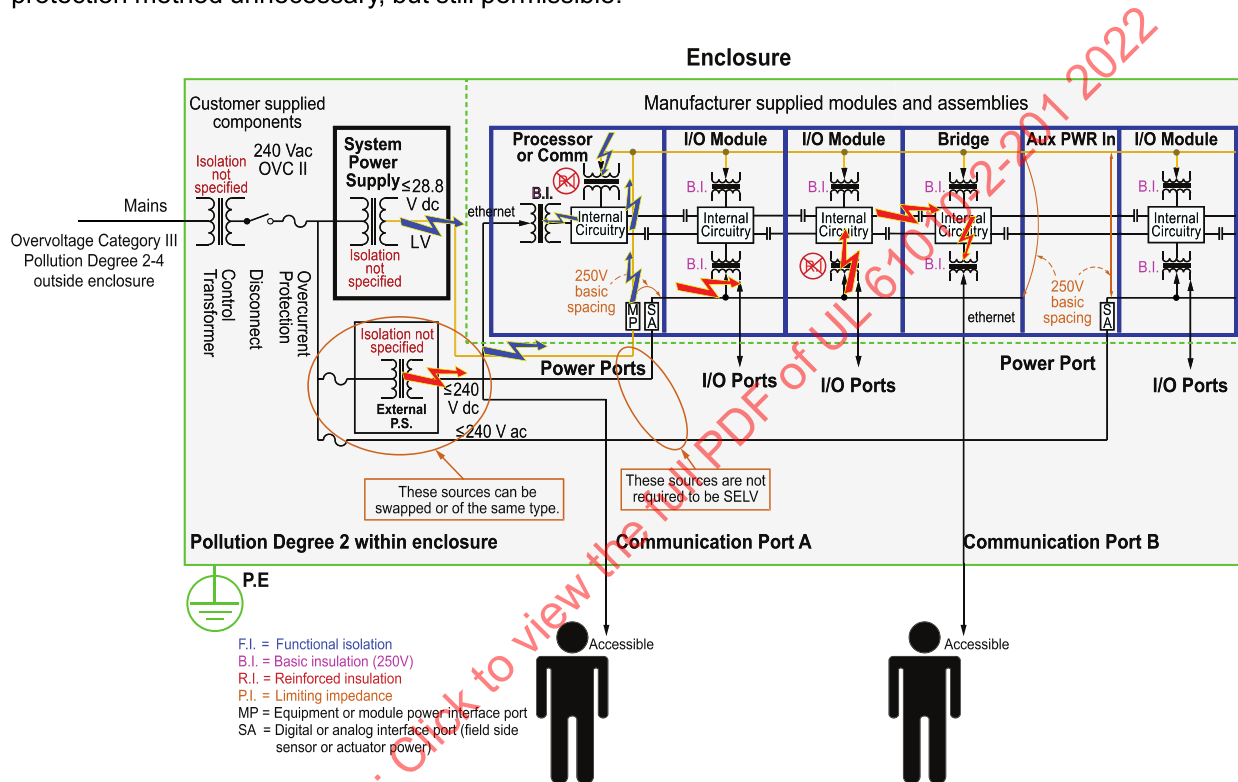
Figure BB.7
REINFORCED INSULATION

Referring to [Figure BB.8](#), BASIC INSULATION provides the method to handle single faults and maintain safety.

BASIC INSULATION is provided at all connections. One failure of a BASIC INSULATION is allowed, but a second level of BASIC INSULATION is always present.

As such a single fault at any connection cannot propagate to cause communication connections to become hazardous.

Implementation of the associated safety methods in this example makes the use of SELV/PELV as a protection method unnecessary, but still permissible.



su1694a

IEC