

# INTERNATIONAL STANDARD



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

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

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ELECTROTECHNICAL  
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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

#### **Part 2-201: Particular requirements for control equipment**

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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,
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## INTRODUCTION

IEC 61010-2-2xx documents are a ~~planned~~ 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**.

~~This part incorporates the safety related requirements of Programmable Controllers.~~

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

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# 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** ~~of the following types which 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 (PLC and PAC);**
- ~~the components of~~ distributed control systems (DCS);
- ~~the components of~~ remote I/O ~~systems;~~
- industrial PC (computers) **and panel PC;**
- programming and debugging tools (PADTs);
- **displays and** human-machine interfaces (HMI);
- ~~any product performing the function of control equipment and/or their associated peripherals;~~
- **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 ~~1 500~~ **1 000** V.

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

The requirements of ISO/IEC Guide 51 and IEC Guide 104, as they relate to this part 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);

~~Requirements for protection against hazards~~

- 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 ~~is specified in~~ (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 60068-2-31:2008, Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens~~

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

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

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

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

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

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

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

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

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

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 60050-441:1990 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 purpose 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 ~~by the user~~ 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.

### 3.104

#### **hand-held equipment**

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

### 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**

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

*Addition:*

Note 1 to entry: ~~The operator does not change e.g. the control equipment hardware configuration or install software updates provided by the manufacturer. See definition in Part 1 and Annex AA of this document.~~

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

### 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 ~~a.c. 30 V r.m.s., 42,4 V peak or d.c. 60 V in normal and single fault condition, except earth faults in other circuits~~ 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.

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

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

[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 ~~a.c. 30 V r.m.s., 42,4 V peak or d.c. 60 V in normal and single fault condition, including earth faults in other circuits~~ 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.

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

[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 tests, ~~a least favourable test configuration for electrical safety,~~ and a different least favourable test configuration for voltage test. If this is the case then ~~these different least favourable test configuration(s) shall be used in the test for which they are appropriate,~~ 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.*

### 4.3.2 State of equipment

*Addition:*

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

### 4.4 Testing in single fault condition

*Addition of first line after 4.4:*

~~For test and verification conditions, see 4.1.~~

#### 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 <del>use</del> load	Current	Voltage	Power factor
AC general use	1,5 × RATED	RATED	0,75 to 0,80
DC general use	1,5 × RATED	RATED	<del>1,0</del> –
AC resistance	1,5 × RATED	RATED	1,0
DC resistance	1,5 × RATED	RATED	<del>1,0</del> –
AC pilot duty <sup>a</sup>	RATED <sup>a</sup>	1,1 × RATED <sup>b</sup>	<0,35
DC pilot duty <sup>a</sup>	RATED <sup>a</sup>	1,1 × RATED <sup>b</sup>	<del>1,0</del> –
NOTE 1 Source IEC <del>61131-2:2007</del> 60947-5-1.			
NOTE 2 Pilot duty = RATING assigned to a relay or switch that controls the coil of another relay or switch.			
<sup>a</sup> Unless otherwise specified, the inrush current shall be 10 times the steady-state current.			
<sup>b</sup> 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/~~dielectric~~/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 <del>use</del> load	Current	Voltage	Power factor
AC general use	RATED	RATED	0,75 to 0,80
DC general use	RATED	RATED	1,0 –
AC resistance	RATED	RATED	1,0
DC resistance	RATED	RATED	1,0 –
AC pilot duty <sup>a</sup>	RATED	RATED	<0,35
DC pilot duty <sup>a</sup>	RATED	RATED	1,0 –
NOTE 1 Source IEC <del>61131-2:2007</del> 60947-5-1.			
NOTE 2 Pilot duty = RATING assigned to a relay or switch that controls the coil of another relay or switch.			
<sup>a</sup> 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/dielectric/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.

### 5.4.1 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 ~~final safety ENCLOSURE characteristics~~ that has to be provided by the user, e.g. ~~safety enclosure~~ 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**

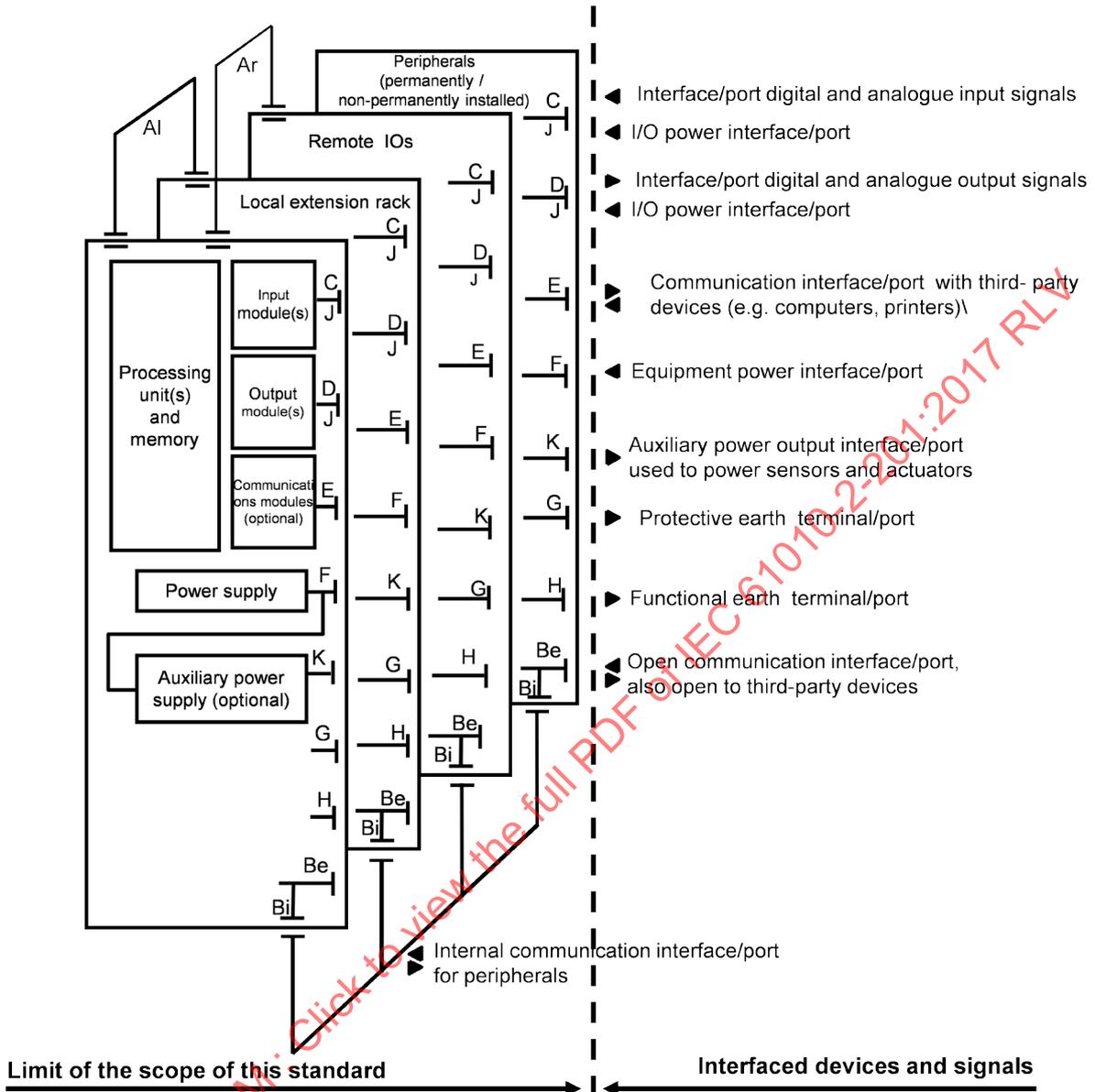
*Addition:*

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

*Add the following subclauses:*

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**6.2.101 Accessibility of interfaces/TERMINALS and ports**



IEC

**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. ~~Devices with F ports have requirements on keeping downstream devices intelligent during power up, power down and power interruptions.~~
- G PROTECTIVE EARTHING TERMINAL/port
- H FUNCTIONAL EARTHING 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 ~~inaccessible as determined by 6.2~~ not ACCESSIBLE.

**Table 103 – OPERATOR ~~accessibility~~ ACCESSIBLE ports for open and ENCLOSED EQUIPMENT**

Port	OPERATOR ACCESSIBLE <sup>c</sup>	
	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 <sup>a</sup>	Yes	Yes
Be open communication interface/port, also open to third-party devices; e.g. PADT, personal computer used for programming <sup>a</sup>	Yes	Yes
Bi internal communication interface/port for peripherals	No	Not applicable <sup>b</sup>
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 <sup>a</sup>	Yes	Yes
F equipment power interface/port	No	Yes
G PROTECTIVE EARTHING TERMINAL/port	No	Yes
H FUNCTIONAL EARTHING 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
<sup>a</sup> Ports Ar, Be and E contain circuits which may be connected to other equipment and shall be considered ACCESSIBLE. <sup>b</sup> Port Bi is an internal communication port and thus never leaves the ENCLOSED EQUIPMENT, by definition. <sup>c</sup> Under special circumstances, some ports of either OPEN or ENCLOSED EQUIPMENT may or may not be considered OPERATOR ACCESSIBLE.		

~~Under special circumstances, some ports of either open or enclosed equipment may or may not be considered operator accessible. This shall be agreed upon between the manufacturer and the user by instructions in the user manual.~~

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 ~~by~~ e.g. ~~safety~~ 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.

### ~~6.5.2.3 Protective conductor terminal~~

#### 6.5.2.1 General

*Addition:*

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

### ~~6.5.2.5 Impedance of protective bonding of permanently connected equipment~~

*Addition at the end of the subclause:*

~~If no overcurrent protection means is specified in the control equipment installation manual then, conformity is checked by applying a test current for 1 min and then calculating impedance. The test current is the greater of:~~

- ~~a) 25 A d.c. or a.c. r.m.s. at rated mains frequency;~~
- ~~b) a current equal to twice the rated current of the control equipment.~~

### 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 ~~also providing~~ 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 ~~can~~ 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 earthing 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 earthing 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 earthing TERMINALS for functional purposes is acceptable (such as radiofrequency interference suppression) provided the DOUBLE INSULATION system is still provided for protective purposes.

Such 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, ~~with the exception of~~. Small parts, such as nameplates, screws and rivets, ~~which~~ 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 EARTHING 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, ~~where~~ the voltages generated by or within the equipment do not exceed the limits for SELV/PELV.

Connection to the earthing 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 earthing 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 ~~for connection to an external protective conductor.~~

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 earthing conductor. ~~See 6.5.2.2.~~

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 EARTHING TERMINAL or a protective earthing conductor in the equipment power input cord.

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

- The PROTECTIVE EARTHING TERMINAL shall be readily ACCESSIBLE and so placed that the connection of the equipment to the protective earthing 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 EARTHING TERMINAL integral to the plug cap or socket (if removable cord set).
- The PROTECTIVE EARTHING TERMINAL shall be of screw, stud or pressure type and shall be made of a suitable corrosion resistant material.
- The clamping means of PROTECTIVE EARTHING TERMINALS shall be adequately locked against accidental loosening, and it shall not be possible to loosen them without the aid of a TOOL.
- PROTECTIVE EARTHING TERMINALS and earthing 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 EARTHING TERMINAL and neutral.
- The PROTECTIVE EARTHING 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 EARTHING TERMINAL shall have no other function.

### 6.5.2.103 Protective earthing 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.

~~Conformity shall be checked in accordance with IEC 60947-7-1 or relevant IEC standard.~~

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 ~~common~~ 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.*

#### ~~6.6.4 Terminals for stranded conductors~~

~~*Replacement:*~~

~~Any stranded conductor carrying hazardous live voltage shall be prevented from contacting other conductive parts, by appropriate clearance and creepage distances.~~

~~*Conformity is checked by measurement with a stranded conductor of 8 mm length or by inspection.*~~

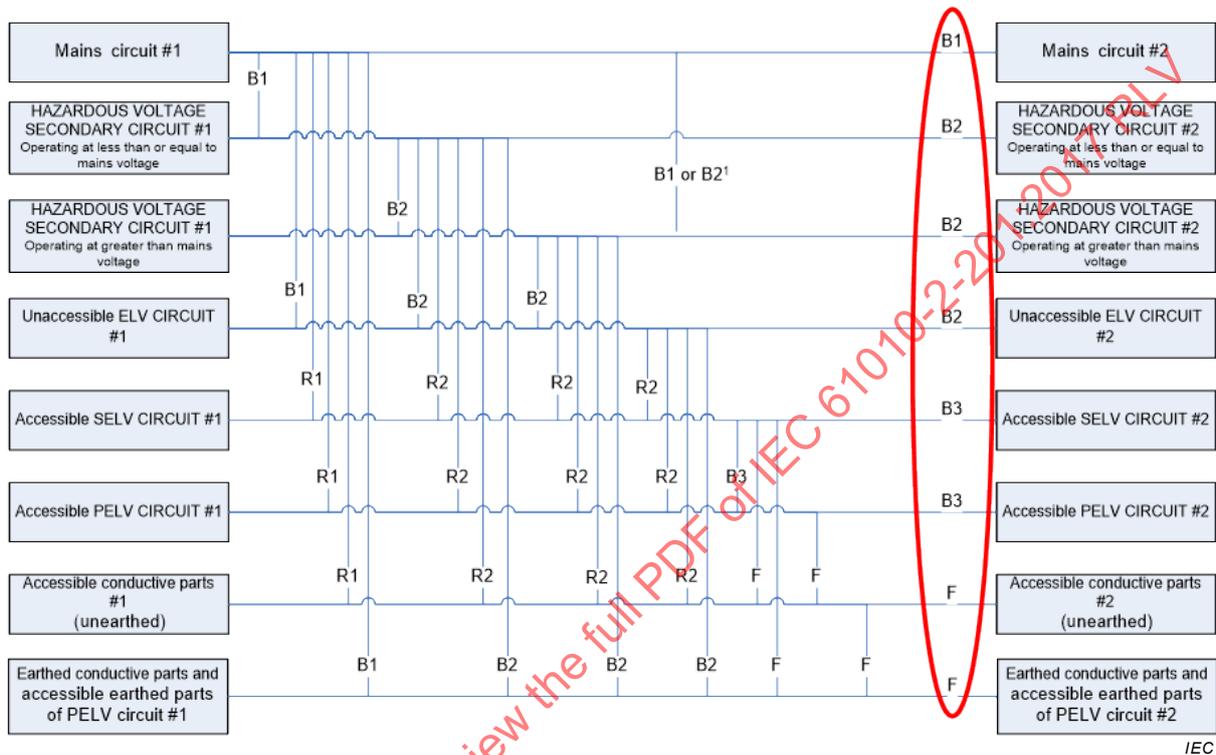
~~NOTE The use of wire-end sleeves (ferrules) with plastic collars avoids stranded conductors.~~

### 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 ~~Supplementary~~ 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 ~~Supplementary~~ 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.

~~Creepage and clearance requirements are based upon the maximum voltage involved.~~

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

<sup>1</sup> 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:

~~SELV/PELV circuits and ungrounded conductive accessible parts shall meet the insulation requirements for double, reinforced insulation or basic insulation and ground between these and hazardous live parts.~~

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.

### 6.7.1.5 Requirements for insulation according to type of circuits

*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.

#### ~~6.7.1.102 Non-metallic barriers and related applications~~

~~Non-metallic material used to increase clearance and/or creepage distances (e.g. barriers) but not relied upon to maintain the position of live parts (even if contacting live parts) shall have a comparative tracking index greater than or equal to 100.~~

## 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 <sup>c</sup>	Values for CLEARANCE distances <sup>d</sup>			Values for CREEPAGE DISTANCES <sup>a, b</sup>								
	POLLUTION DEGREE 1	POLLUTION DEGREE 2	POLLUTION DEGREE 3	POLLUTION DEGREE 1		POLLUTION DEGREE 2			POLLUTION DEGREE 3			
	mm	mm	mm	PWB MG I, II, III mm	MG I, II, III mm	PWB MG I, II, IIIa mm	MG I mm	MG II mm	MG III mm	MG I mm	MG II mm	MG III mm
≤ 50	0,04	0,2 <sup>a</sup>	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 <sup>a</sup>	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

<sup>a</sup> For printed wiring board, the values for POLLUTION DEGREE 1 apply.

<sup>b</sup> Linear interpolation of creepage is allowed. But creepage can never be below CLEARANCE.

<sup>c</sup> DC or AC peak values are  $\sqrt{2} \times$  AC r.m.s. values shown.

<sup>d</sup> Interpolation for CLEARANCES is not permitted.

NOTE 1 Table derived from IEC 60664-1, IEC 60664-5.

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<sup>d</sup>**

Voltage line-to-neutral a.c. r.m.s. V <sup>a</sup>	For basic and supplementary insulation			For reinforced insulation		
	Rated impulse voltage 1,2/50µs V	Test voltages for up to 2 000 m V		Rated impulse voltage 1,2/50µs V	Test voltages for up to 2 000 m V	
		a.c. 1 min	d.c. 1 min		a.c. 1 min	d.c. 1 min
≤ 50 <sup>b</sup>	500	1 250	1 750	800	2 500	3 500
≤ 100 <sup>c</sup>	800	1 300	1 800	1 500	2 600	3 600
≤ 150	1 500	1 350	1 900	2 500	2 700	3 800
≤ 300	2 500	1 500	2 100	4 000	3 000	4 200

<sup>a</sup> d.c. or a.c. peak values are  $\sqrt{2} \times$  a.c.r.m.s. values shown.  
<sup>b</sup> For d.c. products this range ends at 60 V.  
<sup>c</sup> For d.c. products this range begins at 60 V.  
<sup>d</sup> No test is needed for SELV/PELV circuits/units.

NOTE Table derived from IEC 60664-1 and IEC 60364.

Voltage line-to-neutral AC r.m.s. V <sup>a</sup>	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 <sup>b</sup>	1 250	300	1 750	420	2 500	600	3 500	850
≤ 100 <sup>c</sup>	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.

<sup>a</sup> DC or AC peak values are  $\sqrt{2} \times$  AC r.m.s. values shown.  
<sup>b</sup> For DC products this range ends at 60 V.  
<sup>c</sup> For DC products this range begins at 60 V.  
<sup>d</sup> 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 ~~for circuits stressed only by d.c.~~, 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 Insulation for secondary circuits derived from mains circuits of overvoltage category II up to 300 V~~

**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**

*Modification:*

*Replace Table 6:*

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**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. <sup>b</sup>		≤150 V AC r.m.s. <sup>b</sup>		≤300 V AC r.m.s. <sup>b</sup>	
	RATED impulse voltage 500 V		RATED impulse voltage 800 V		RATED impulse voltage 1 500 V	
Secondary WORKING VOLTAGE V AC r.m.s. <sup>b</sup>	CLEARANCE mm <sup>a</sup>	Test voltage V AC r.m.s.	CLEARANCE mm <sup>a</sup>	Test voltage V AC r.m.s.	CLEARANCE mm <sup>a</sup>	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

<sup>a</sup> Linear interpolation allowed.

<sup>b</sup> DC or AC peak values are  $\sqrt{2} \times$  AC r.m.s. values shown.

**Modification:**

~~Item 3) does not apply.~~

**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<sup>e</sup>.

~~Addition of new footnote to Table 7 of Part 1:~~

~~<sup>e</sup> d.c. or a.c. peak values are  $\sqrt{2} \times V$  a.c.r.m.s. values shown.~~

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~~s~~ and CLEARANCE~~s~~ in air of OVERVOLTAGE CATEGORY II up to 1 000 V at FIELD-WIRING TERMINALS<sup>d,e</sup>**

WORKING VOLTAGE AC V r.m.s. V <sup>c</sup>	Termination CLEARANCE <del>s</del> mm			Termination CREEPAGE <del>s</del> mm	
	General use	Limited RATINGS <sup>a, b</sup>	To walls of metallic ENCLOSURES which may be deflected	General use	Limited RATINGS <sup>a, b</sup>
≤ 50	<del>3,2</del> 1,6	1,6	12	<del>3,2</del> 1,6	<del>3,2</del> 1,6
≤ 150	3,2	1,6	12	<del>6,4</del> 3,2	<del>3,2</del> 1,6
≤ 300	<del>6,4</del> 3,2	1,6	12	<del>9,5</del> 3,2	<del>3,2</del> 1,6
≤ 600	<del>9,5</del> 6,4	4,8	12	<del>12,7</del> 6,4	<del>9,5</del> 4,8
≤ 1 000	14	–	14	21,6	–

NOTE Table derived from UL 508, UL 1059 and IEC 61131-2:2007.

<sup>a</sup> 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.

<sup>b</sup> 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.

<sup>c</sup> DC or AC peak values are  $\sqrt{2} \times$  AC r.m.s. values shown.

<sup>d</sup> For OVERVOLTAGE CATEGORY III and IV, Annex K shall be applied.

<sup>e</sup> 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.

~~If the equipment is rated at an altitude greater than 2 000 m, the clearance shall be multiplied by the applicable factor of IEC 61010-1:2010, Table 3.~~

Conformity is checked by inspection and measurement.

### ~~6.8.3~~ Test procedures

*Addition:*

~~The a.c. voltage test equipment shall be able to supply a current of at least 100 mA a.c. r.m.s. for voltages below 5 kV and a power of 500 VA at and above 5 kV or the test generator as specified in IEC 60664-1:2007, 6.1.3.6 can be utilized.~~

### 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.

*Addition:*

~~Other mains supply connections types and interconnection between equipment and parts of equipment is addressed in 6.6.~~

### 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.

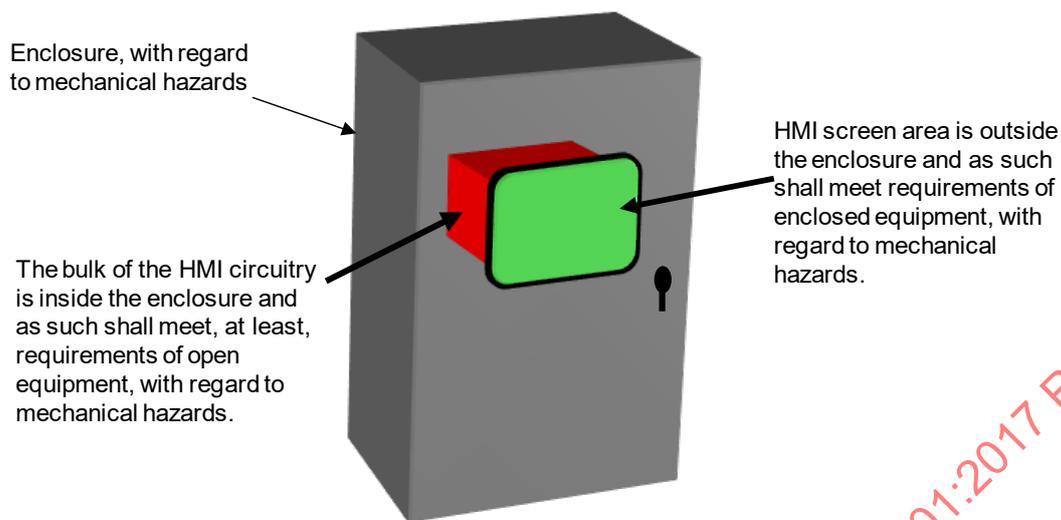
## 7 Protection against mechanical HAZARDS

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 ~~other~~ ENCLOSURE which ~~supplies the safety aspects protecting~~ 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 ~~providing safety~~ and is otherwise ACCESSIBLE to an OPERATOR shall be considered to form part of an ENCLOSURE providing ~~safety protection against potential HAZARDS~~ and shall be evaluated to Clause 7.



**Figure 103 – Mechanical HAZARDS ~~requirements for, with regard~~ to PANEL MOUNTED EQUIPMENT**

## 7.2 Sharp edges

*Addition :*

~~NOTE While this seems to be a reasonable requirement there is a large question of conformity checking, e.g. what is smooth and rounded. The question of easily touched is applied differently between enclosed and open equipment. The question of what is a "normal use" situation is also to be considered. Example: DIN rail (see IEC 60715) grounding clamps, which are purposely serrated to properly ground the device, would be a worry for service personnel, but not in normal use, where the clamp is hidden, this is not a problem.~~

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 ~~mechanical~~ 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 ~~providing safety~~ and is otherwise ACCESSIBLE to an OPERATOR shall be considered to form part of an ENCLOSURE providing ~~safety~~ protection against potential HAZARDS and shall be evaluated to Clause 8.

### 8.2.2 Impact test

*Modification:*

~~The X test distance is 1,3 m.~~

*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.

**Table 105 — Drop tests**

	<b>Portable equipment (any weight)</b>	<b>Hand-held equipment and direct plug-in equipment (any weight) c</b>	<b>Test procedure reference standard</b> IEC 60068-2-31:2008, Test Ec	<b>Comments</b>
Free fall, Procedure a		1 000 mm; 2 trials <1 kg 1 00 mm; 2 trials <10 kg	5.2	b
Dropping onto a face	30° or 100 mm (whichever is less severe); 2 trials	30° or 100 mm (whichever is less severe); 2 trials	5.1.3.1	a, b
Dropping onto an edge or corner	30° or 100 mm (whichever is less severe); 2 trials	30° or 100 mm (whichever is less severe); 2 trials	5.1.3.2	a, b

a — If the number of bottom edges exceeds four, the number of drops shall be limited to four edges.

b — The control equipment is dropped so that it lands in the position expected to present the most severe condition.

c — Direct plug-in is not meant to include control equipment such as I/O cards and their wiring plugs. These are not considered plugs as in this context.

~~Control equipment with non-metallic enclosures with a minimum rated ambient temperature below 2 °C are cooled to the minimum rated ambient temperature, and tested within 10 min.~~

~~NOTE — If the control equipment consists of two or more units, the value for the mass refers to the mass of each individual unit. However, if one or more units are intended to be attached to, or supported by, another unit, these units are treated as a single unit.~~

### ~~8.3.1 — Equipment other than hand-held equipment and direct plug-in equipment~~

~~This subclause of Part 1 is not applicable. See 8.3.~~

### ~~8.3.2 — Hand-held equipment and direct plug-in equipment~~

~~This subclause of Part 1 is not applicable. See 8.3.~~

## **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:*

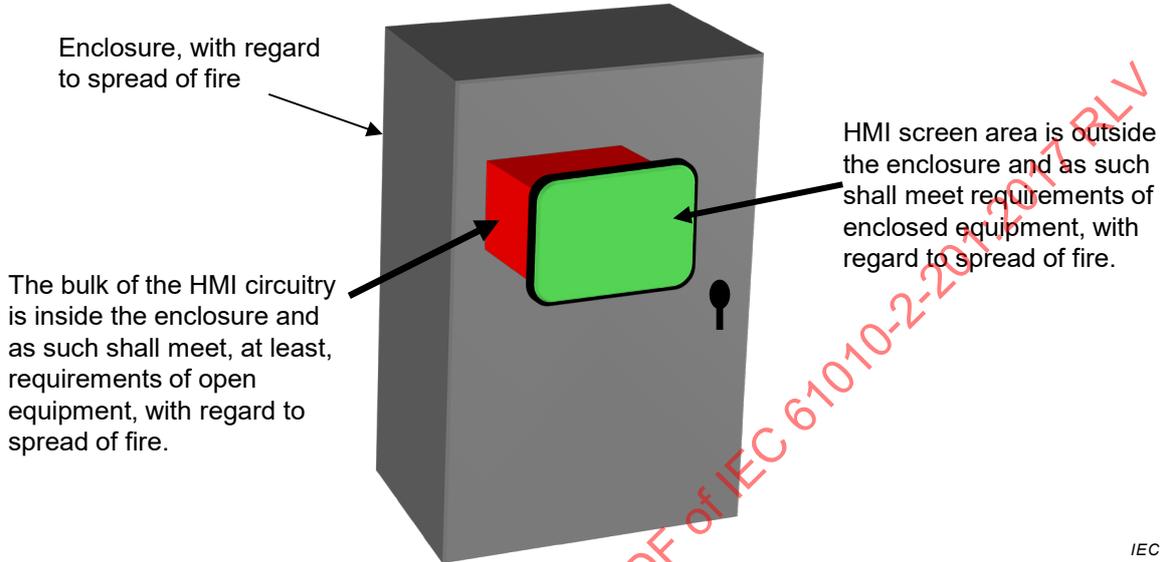
*Add at the beginning of the subclause:*

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

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

~~If open EQUIPMENT, with non-metallic enclosure material, forms part of the enclosed equipment,~~ 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 ~~utilize~~ 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** – ~~Safety enclosure with HMI installed through a wall~~ 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 CONDITIONS**

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 <sup>2</sup> ) 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

*Addition 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)~~

~~For control equipment to be used at altitudes above 2 000 m the least favourable combination of cooling conditions have to be considered. For details see IEC 60721-2-3.~~

~~Add item-g f)~~

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

#### 10.4.1 General

~~Addition at the end of the subclause:~~

~~Temperatures shall be measured while the equipment is generating its least favourable dissipation. This dissipation may be caused by some combination of load current, input voltage, input frequency, I/O duty cycle, etc.~~

~~The equipment shall be mounted in its least favourable position in a test ambient temperature equal to its maximum rated operating air temperature. However, the equipment may be at lower test ambient if the measured temperatures are increased by the difference between the equipment's maximum rated operating temperature and the actual test ambient.~~

~~The test ambient temperature shall be monitored either at a point not more than 50 mm from the plane of the equipment's air flow entry point, for ventilated equipment, or at a point not more than 50 mm away from the equipment on a horizontal plane located at the vertical mid-point of the equipment, for non-ventilated equipment.~~

~~The environment surrounding the equipment under test shall not be subject to air movement caused by sources not part of the equipment under test.~~

~~Wiring should be the smallest size suitable for the maximum current rating of the equipment and manufacturer's instructions.~~

~~If it is not practical to run the temperature test on the device alone, such as in a modular equipment system, then a representative system may be utilized, so long as it represents a practical least favourable combination of conditions for the unit under test.~~

~~NOTE Practical least favourable combination of conditions means a realistic situation as the device would be used in a real-world application, not a theoretical combination which would never be used in practice.~~

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.*

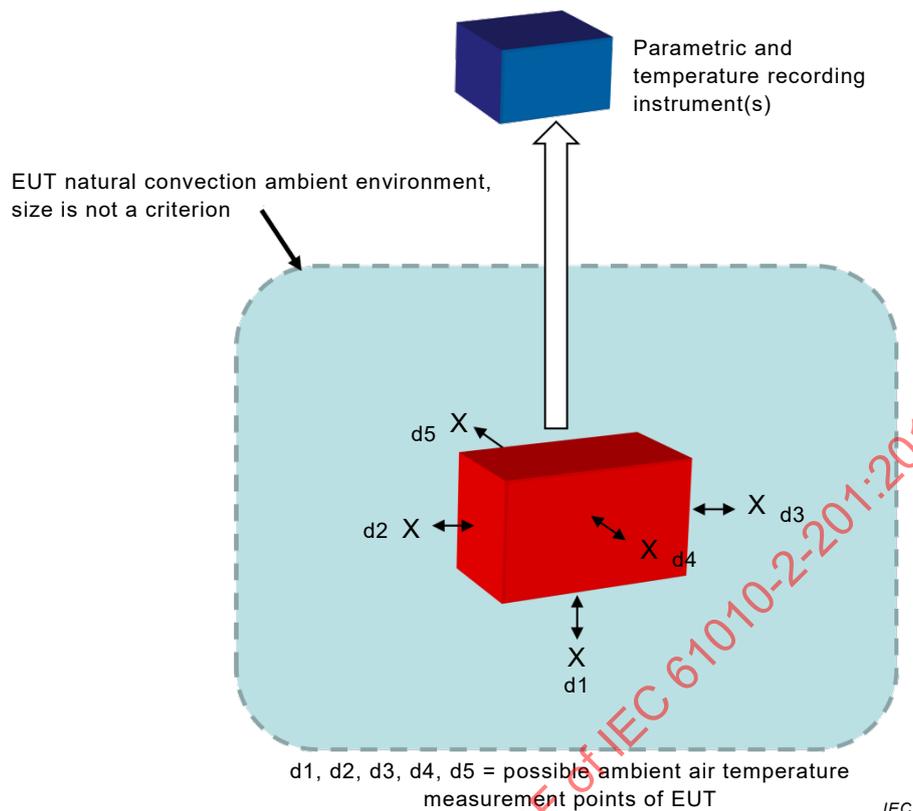
*The EUT shall be mounted in its least favourable position/orientation.*

*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.



**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.*

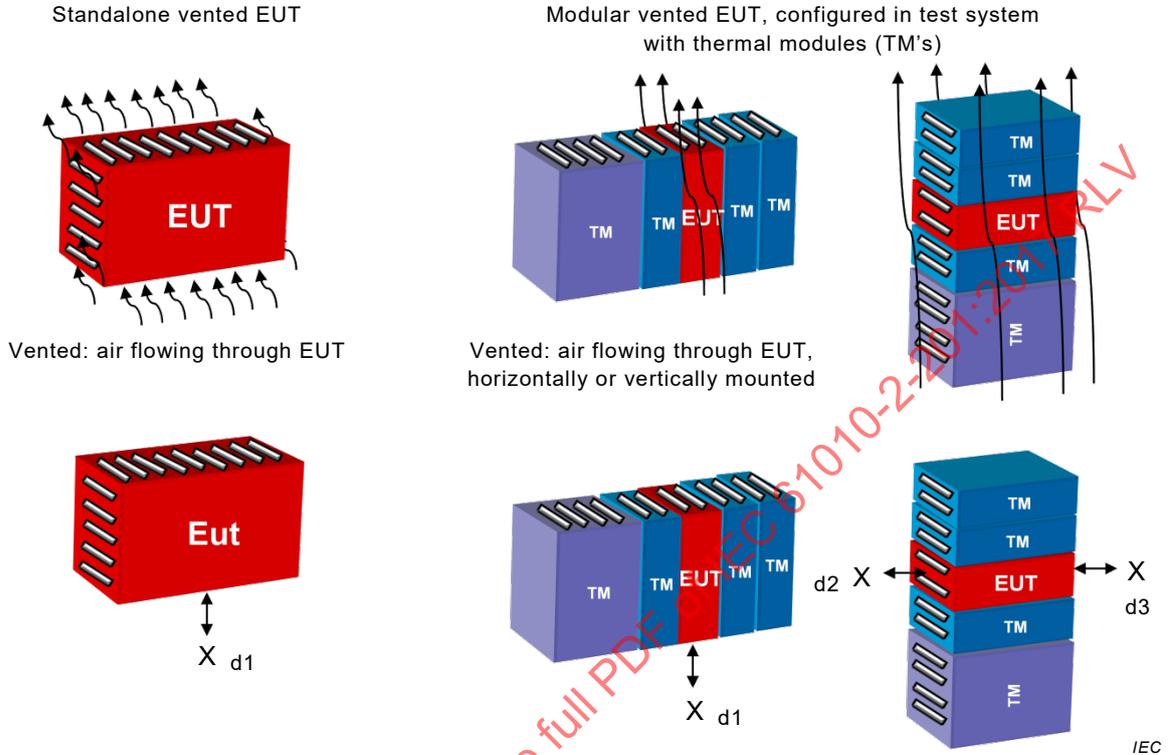
NOTE 3 Practical least favourable combination of conditions means a realistic situation the EUT can be utilized for in a real world application, not a theoretical combination which would never be used in practice.

*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.

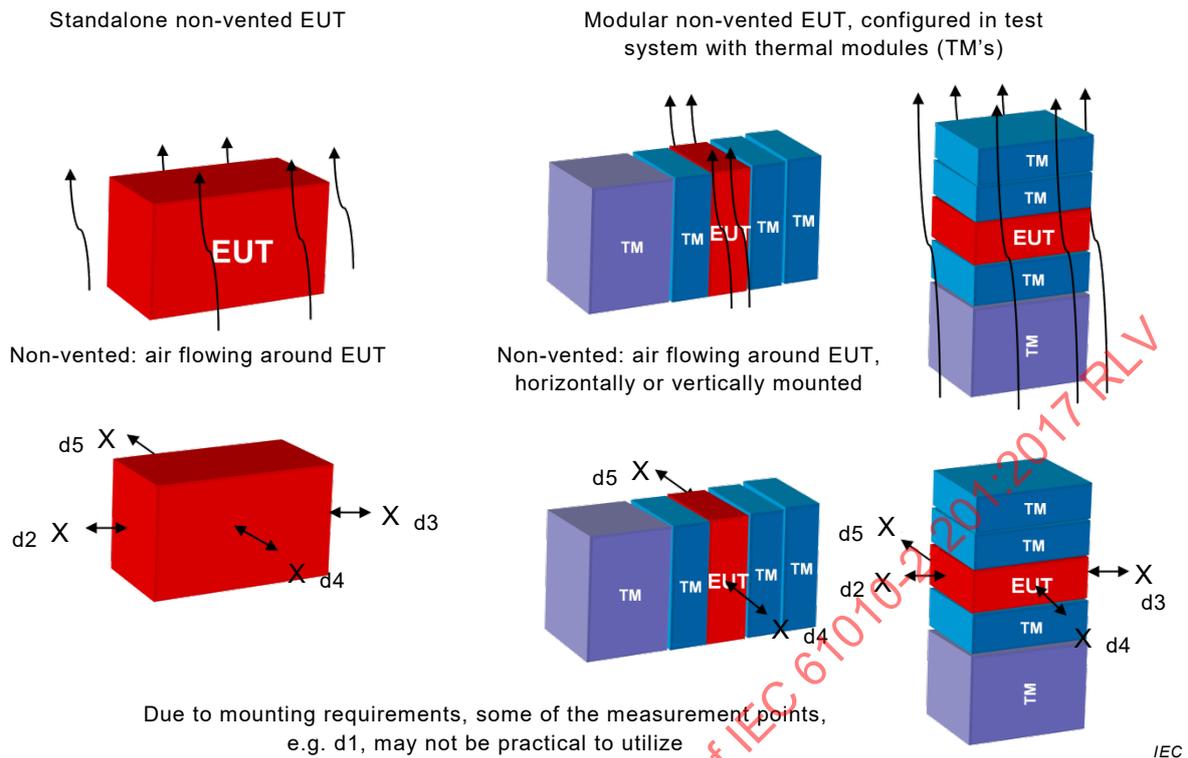


**Figure 106 – Vented equipment**

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/non-vented 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.*

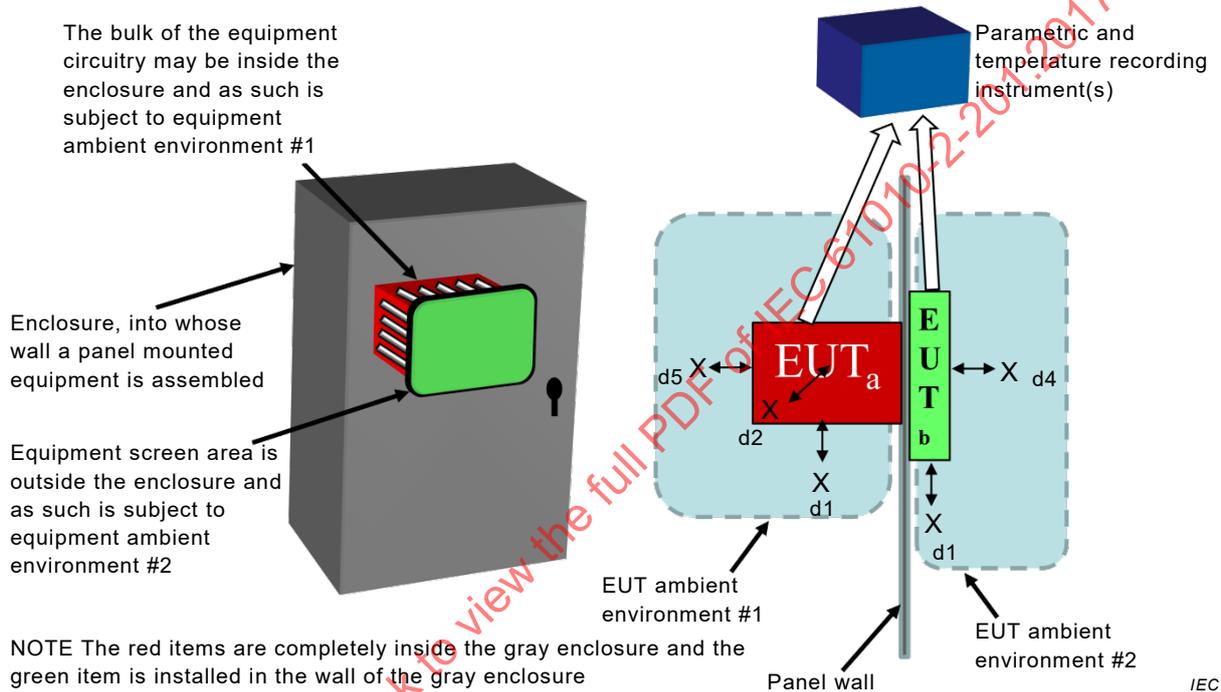
EXAMPLE: If EUT<sub>a</sub>'s maximum RATED AMBIENT TEMPERATURE = 60 °C and EUT<sub>b</sub>'s maximum RATED AMBIENT TEMPERATURE = 50 °C, the test shall be run with a test AMBIENT TEMPERATURE = 60 °C. Temperatures taken for EUT<sub>b</sub> would be corrected by –10 °C (50 °C – 60 °C).

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

- c) *The total EUT (EUT<sub>a</sub> + EUT<sub>b</sub>) 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<sub>a</sub>'s maximum RATED AMBIENT TEMPERATURE = 60 °C and EUT<sub>b</sub>'s maximum RATED AMBIENT TEMPERATURE = 50 °C, the test shall be run with a test AMBIENT TEMPERATURE = 50 °C. Temperatures taken for EUT<sub>a</sub> 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).



**Figure 108 – Panel mounted device extending through the wall of a cabinet**

#### 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:

- 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.
- 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.

#### ~~10.4.3 Equipment intended for installation in a cabinet or a wall~~

~~Addition at the beginning of the subclause:~~

~~This subclause applies to open equipment.~~

~~Open equipment shall be mounted in an enclosure considered representative of the least favorable intended use. The maximum enclosure dimensions shall to be determined by one of the following methods:~~

- ~~a) 150 % of the dimensions of the device, length, width, and height,~~
- ~~b) the dimensions of the device, length, width, and height, plus any keep out zone around the device if marked on the device or defined by the manufacturer in the installation sheet,~~
- ~~c) the minimum enclosure size if marked on the device or defined by the manufacturer in the installation sheet,~~
- ~~d) the intended enclosure, such as a standard outlet box if marked on the device or defined by the manufacturer in the installation sheet.~~

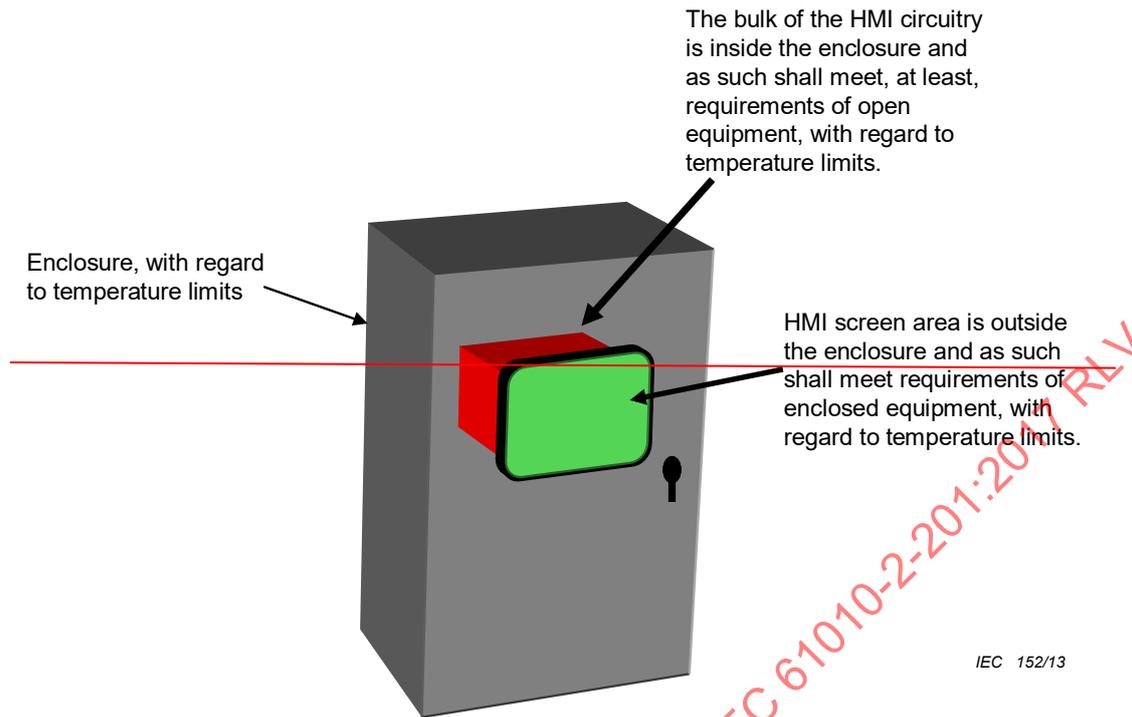
~~When utilizing a) or b), any device face which has wire(s) exiting it may add twenty (20) times the largest accommodated wire diameter, as bend radius, to the appropriate dimension(s), length, width, and/or height. This is to allow proper wire bending space.~~

~~NOTE 1 Example: Utilizing method a); wire bend radius can add 50 mm to the height dimension, then that new dimension is multiplied by 150 %.~~

~~The test ambient air temperature is measured as described in 10.4.1.~~

~~NOTE 2 Example a panel mounted HMI device extending through the wall of a cabinet.~~

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**Figure 105 – Panel mounted HMI device extending through the wall of a cabinet**

## 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 ~~and~~ or 2) by subjecting the equipment to the appropriate ~~tests of the quoted standard~~ 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. ~~After tests against ingress of water the voltage test, 6.8, without humidity preconditioning has to be made. 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 ~~and shall be used in accordance with its rating.~~

~~This requirement also applies to a capacitor bridging double insulation or reinforced insulation elsewhere in the control equipment, where that insulation is providing protection from electric shock or fire.~~

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.

~~This does~~ 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 ~~dismounted~~ removed from the circuit for the high-voltage TYPE TEST.

NOTE ~~Dismounting could be feasible~~ 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 ~~shall~~ 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, ~~except as follows.~~

~~Addition:~~

~~The foreseeable misuse shall be checked from the viewpoint of the operator and from the viewpoint of the service personnel, where for service personnel, only a minimum of protection is required. See 3.107 and 3.111.~~

## 17 RISK assessment

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

~~Addition at the beginning of the clause:~~

~~These aspects shall take into account the aspects of operator versus service personnel. See 3.107 and 3.111.~~

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## **Annexes**

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

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## 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 <sup>a</sup>	controlled environment
B	uncontrolled environment	controlled environment or equipment is not opened during installation or maintenance
C	uncontrolled environment	uncontrolled environment
<sup>a</sup> A controlled environment is an environment having the conditions of IEC61010-1:2010, 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.

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**Table E.2 – Reduction of POLLUTION DEGREES (PD)**

	Original POLLUTION DEGREE						
	2			3		4	
	Environmental situation (Table E.1)						
	A	B	C	B	C	B	C
<b>Additional Protection</b>	<b>Protection Degree with additional protection</b>						
<b>ENCLOSURE IPx4</b>	--	--	--	--	--	--	--
<b>ENCLOSURE IPx5, IPx6</b>	1	--	--	--	--	--	--
<b>ENCLOSURE IPx7, IPx8</b>	1	1	--	2 <sup>a,b</sup>	--	2 <sup>a,b</sup>	--
<b>Constant heating within the equipment with an ENCLOSURE of IPx4 or higher</b>	1	--	--	--	--	--	--
<b>Hermetically sealed ENCLOSURE</b>	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.							
<sup>a</sup> Conformal coating, further 1 POLLUTION DEGREE reduction							
<sup>b</sup> 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.

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## 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  $\Omega$ .

#### 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 earthing.

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  $\mu$ 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).

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**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.

~~Additional annexes:~~

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## 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.

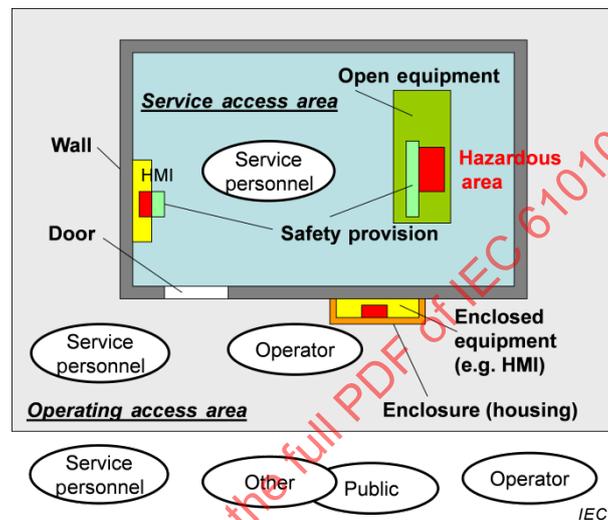


Figure AA.1 – Control equipment access and safety concerns

##### 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 (~~i.e. safety enclosure~~) 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 ~~will~~ provides protection for SERVICE PERSONNEL ~~in the following areas~~ 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;
  - ~~— Examples of expected hot surfaces: heat sinks, semiconductors~~
- c) unexpected mechanical HAZARDS, such as sharp edges, protruding wires and screws, as opposed to expected mechanical hazards such as fans.
  - ~~— Examples of expected mechanical hazards: fans~~
  - ~~— Examples of unexpected mechanical hazards: sharp edges, protruding wires, screws~~

~~Spread of fire is addressed for open equipment.~~

### AA.4.3 ENCLOSED EQUIPMENT

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

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

~~Spread of fire is addressed for enclosed equipment.~~

NOTE The ~~safety enclose~~ ENCLOSURE can be used ~~as the method, in this case,~~ to prevent spread of fire, from the ENCLOSED EQUIPMENT, if the ENCLOSURE is designed for that purpose.

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## 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.

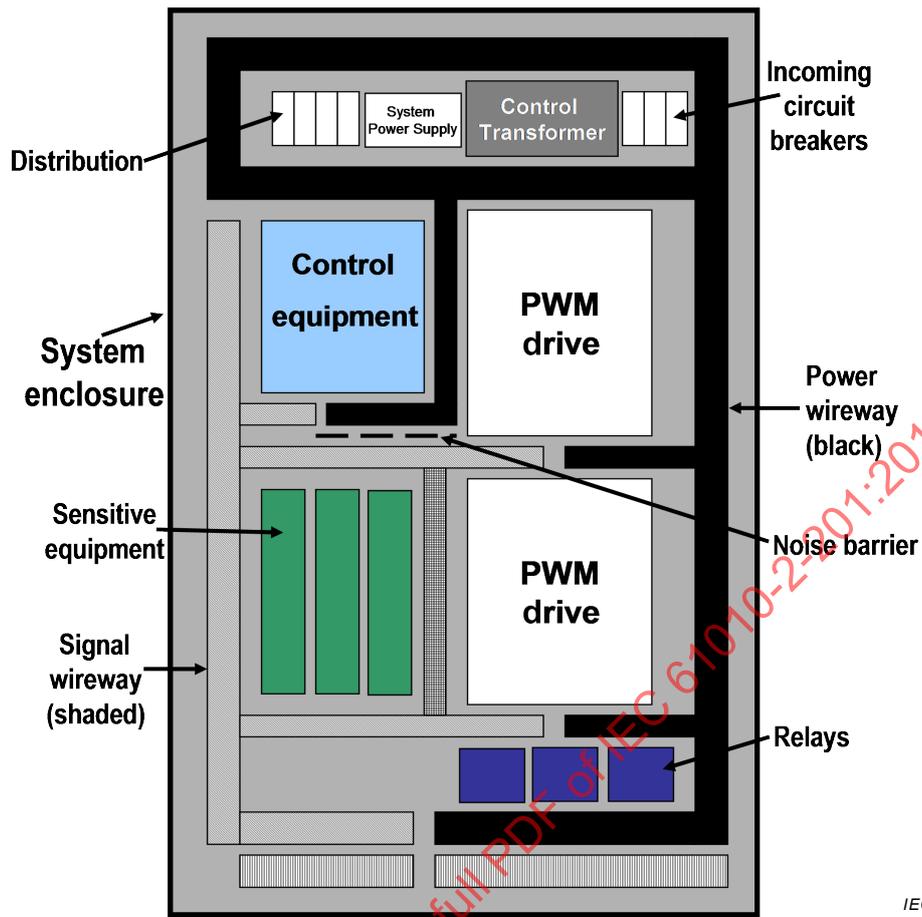
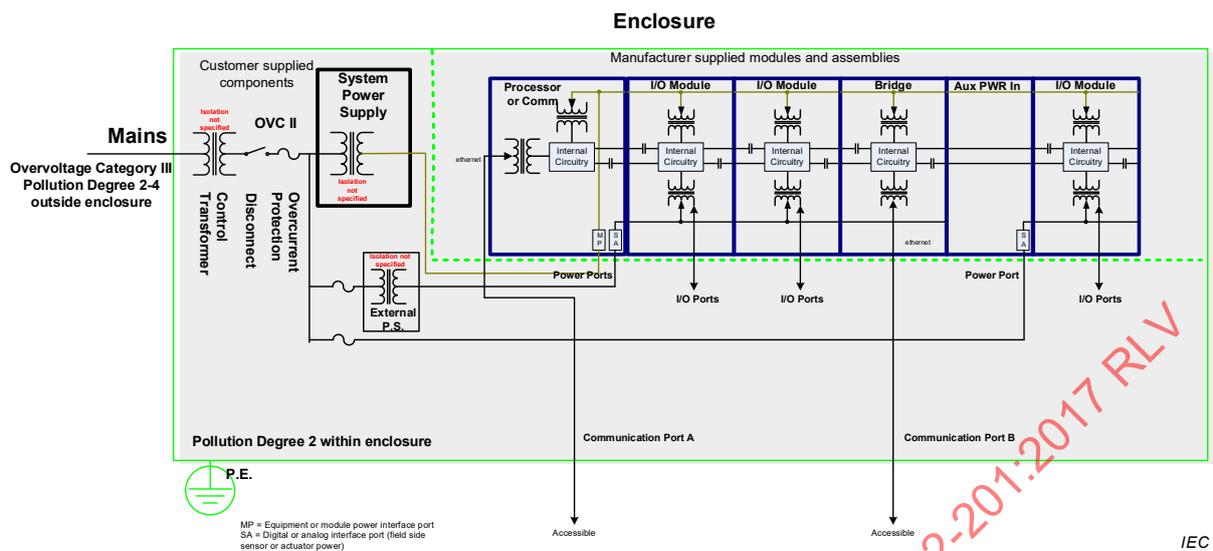


Figure BB.1 - Typical system ENCLOSURE layout

### 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 ~~system~~ ENCLOSURE. This is generally a larger ENCLOSURE into which many different equipment items are housed. See Figure BB.1.

**Note** The two ~~blue~~ lines exiting the ENCLOSURE, in Figures BB.2 to BB.11, ~~these~~ are communications lines normally ~~accessed~~ 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.

**What aspect of safety will be provided in this example?**

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 communication module bridge isolation devices or they do not exist, then the person working on the communication port B will be exposed to the hazardous voltage.

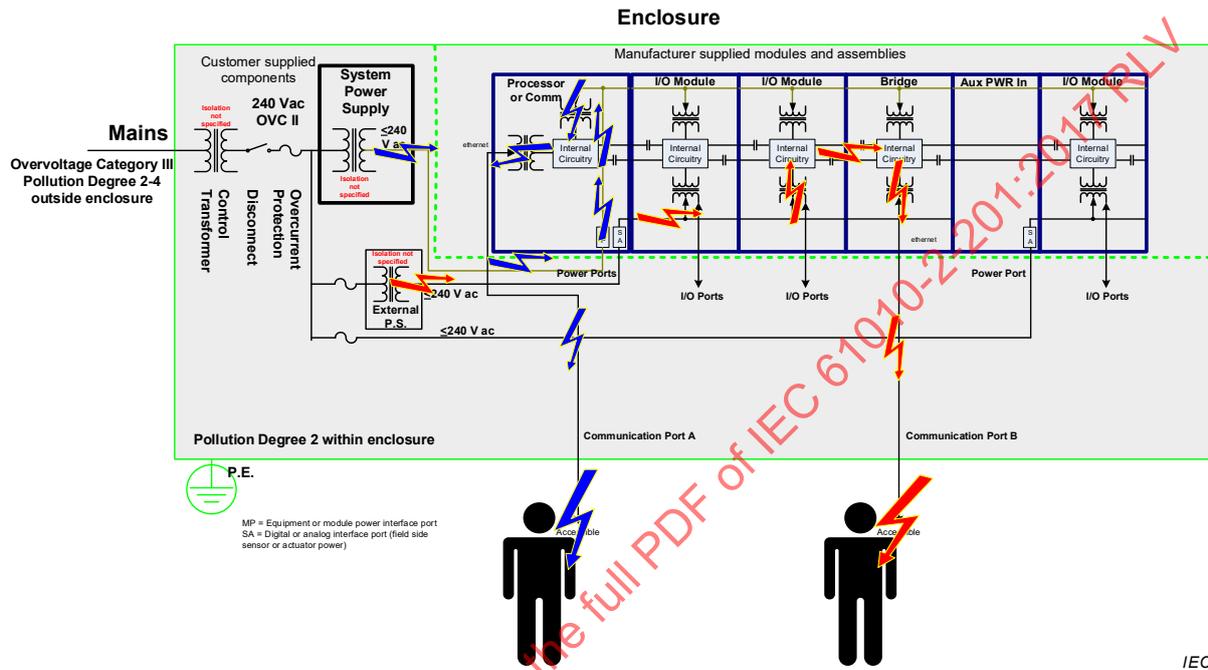
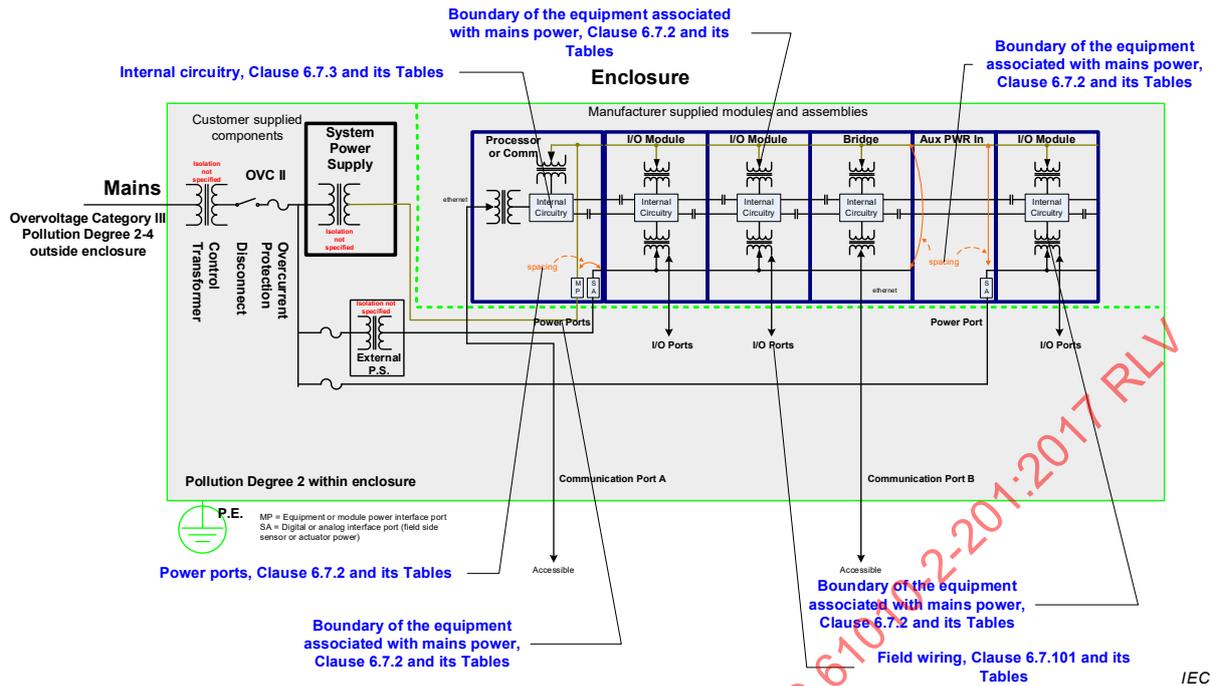


Figure BB.3 – HAZARD situation of the control equipment

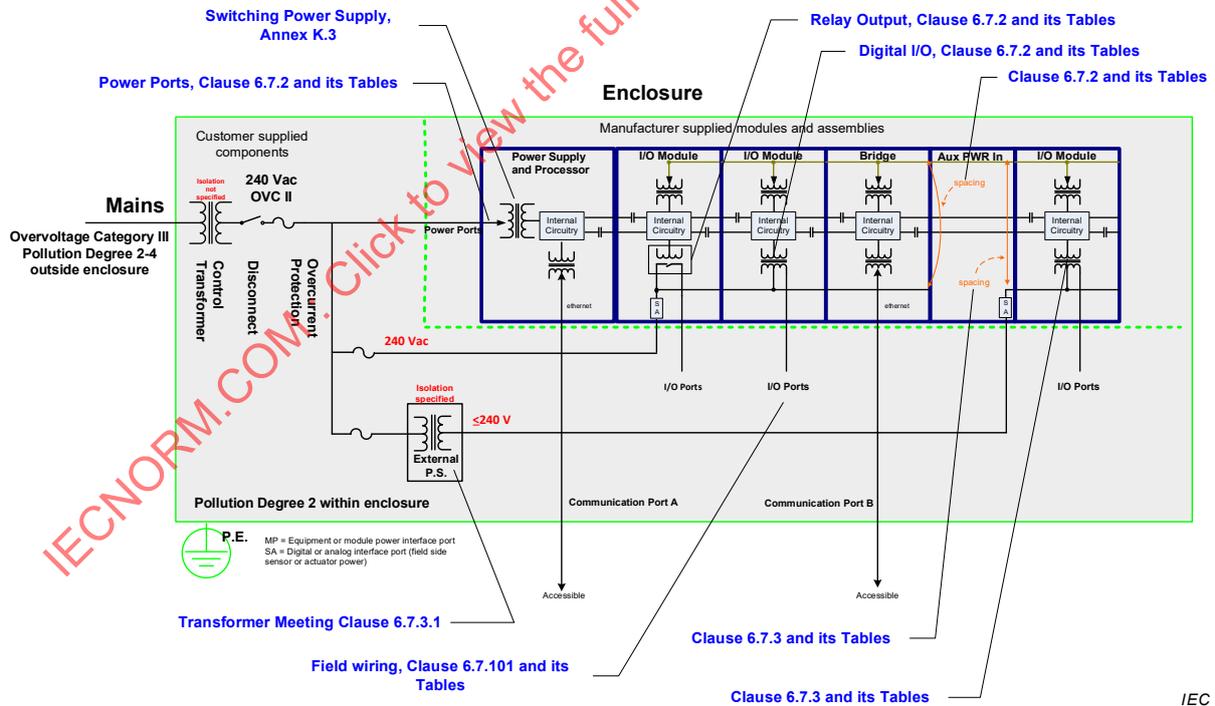
#### BB.4 Applying the standard to the control equipment electrical safety drawing

With regard to this standard and Figure BB.2 how would the clauses and tables of this standard be applied? Figure BB.4, Figure BB.5 and Figure BB.6 provides a reference for which clauses of this standard apply to which areas of the control equipment electrical safety drawing.



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**Figure BB.4 – Application of the standard to the control equipment safety drawing**



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**Figure BB.5 – Application of 6.7.1.5 items a) and b) to the control equipment safety drawing**

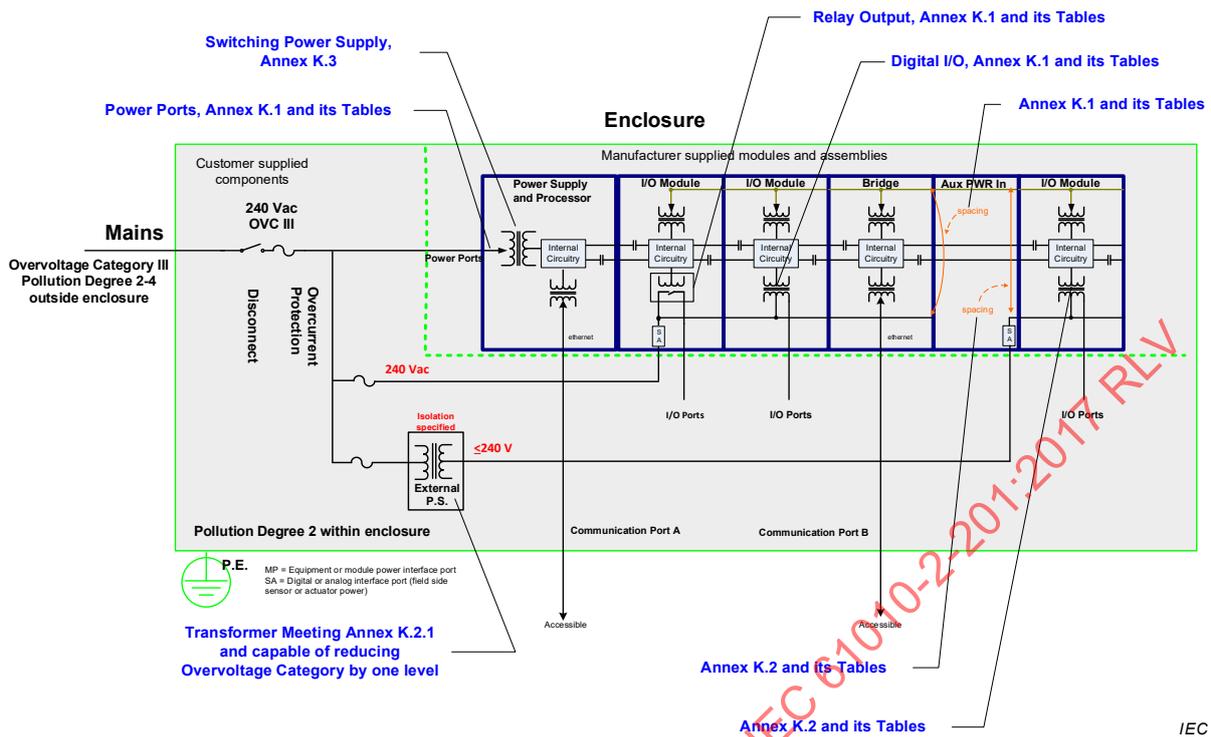


Figure BB.6 – Application of 6.7.1.5 items a), b), c) and d) to the control equipment safety drawing

**BB.5 Example methodologies for electrical safety and documentation**

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 ~~data path~~ 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.

~~SELV incoming power is not required.~~

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

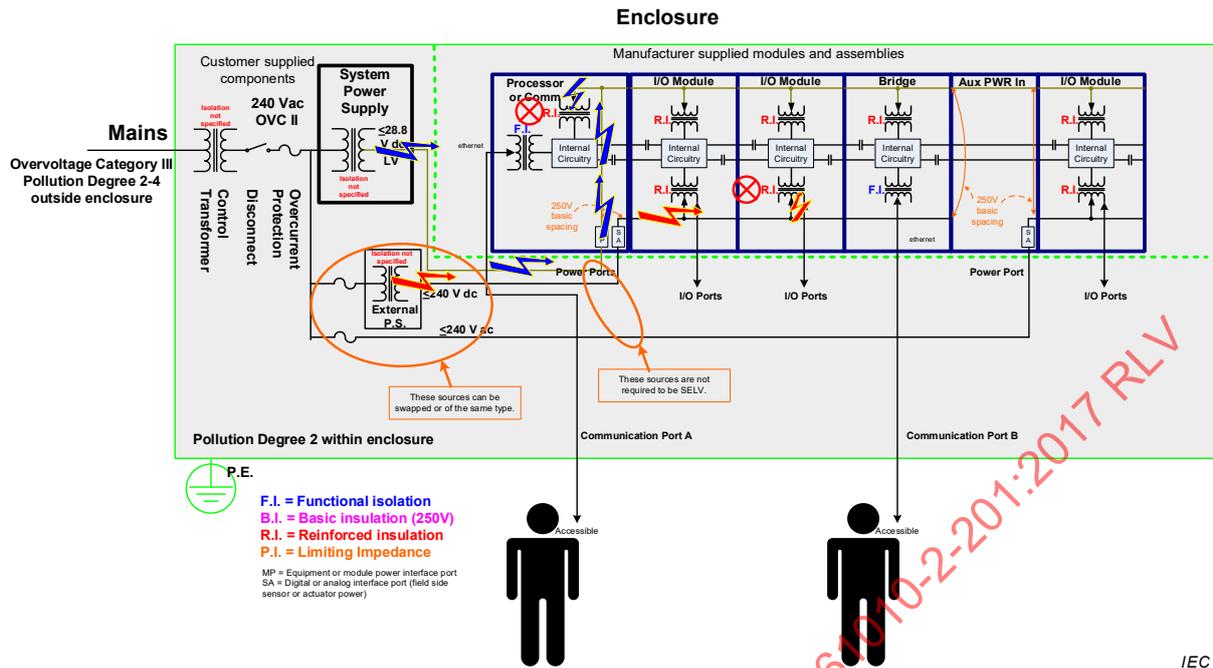


Figure BB.7 – REINFORCED INSULATION

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.

~~SELV incoming power not required.~~

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

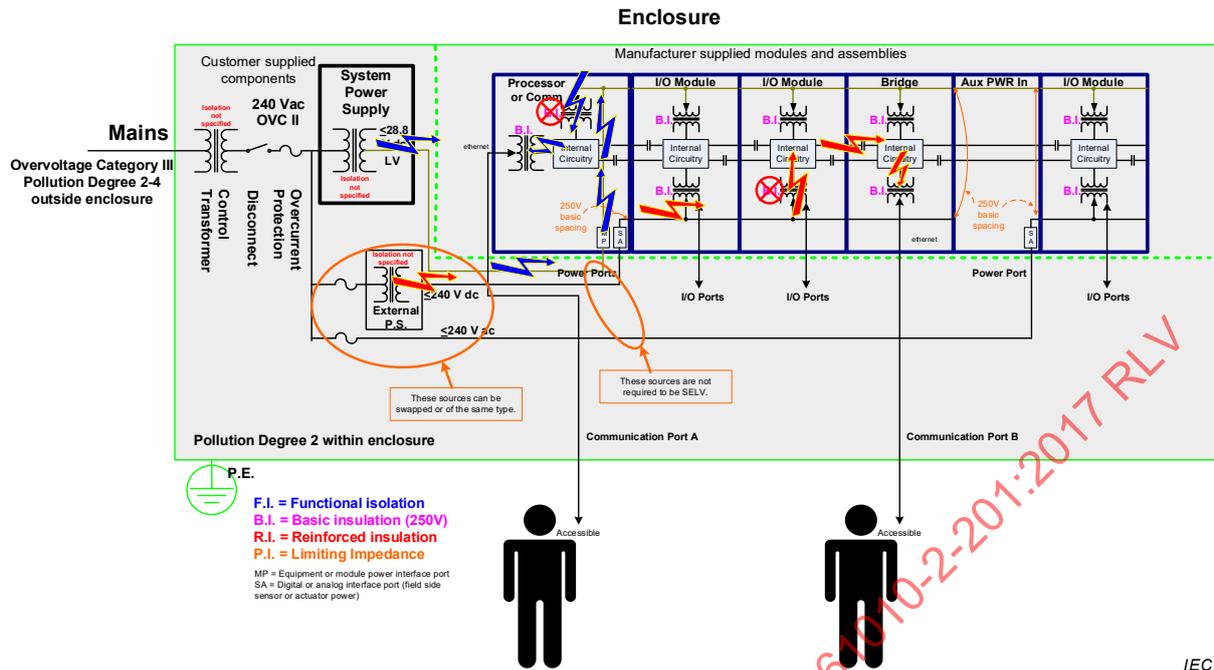


Figure BB.8 – BASIC INSULATION

Referring to Figure BB.9, REINFORCED INSULATION, BASIC INSULATION and ~~limiting~~ PROTECTIVE IMPEDANCE provide the method to handle single faults and maintain safety.

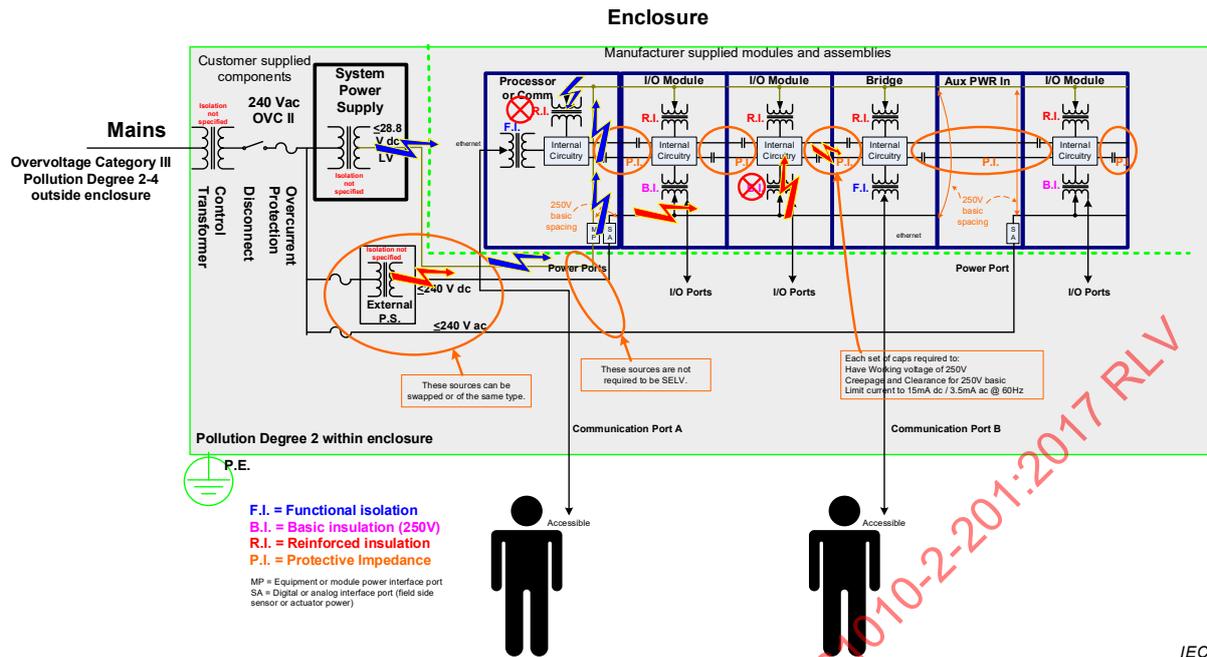
REINFORCED INSULATION is provided at module power. ~~Limiting~~ PROTECTIVE IMPEDANCE, by inter-module capacitors, and basic (supplementary) insulation is provided at the I/O.

Communication connections can be 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.

~~SELV incoming power not required.~~

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.9 – REINFORCED INSULATION, BASIC INSULATION and limiting PROTECTIVE IMPEDANCE**

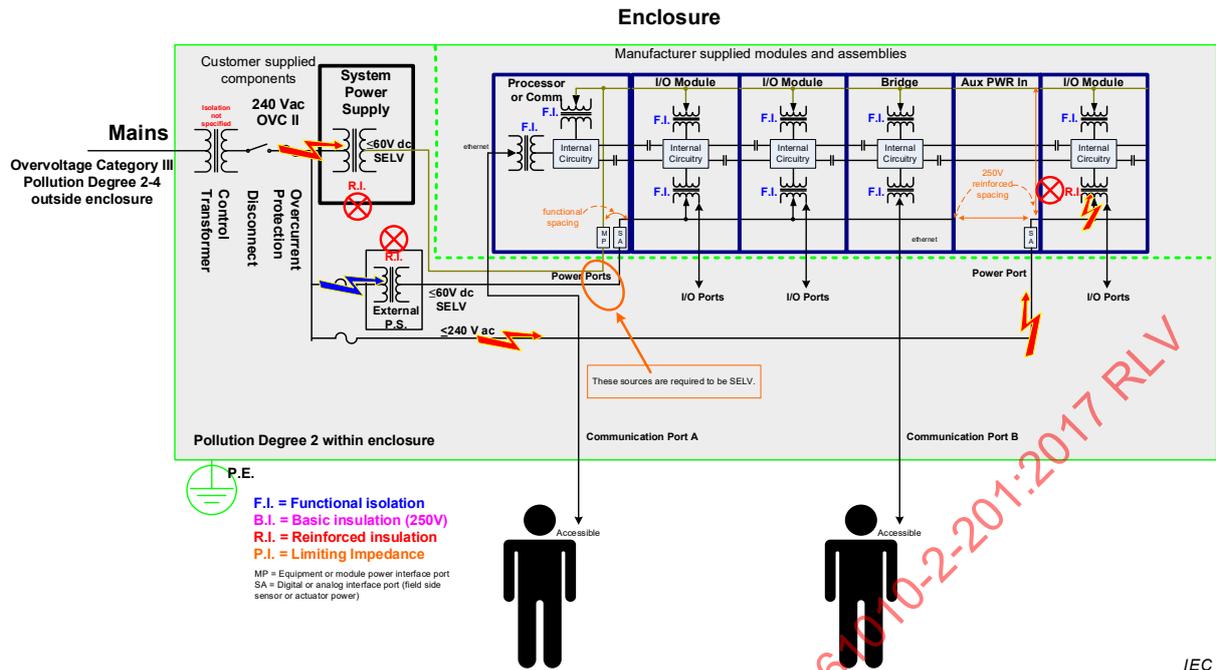
Referring to Figure BB.10, external power supplies provide REINFORCED INSULATION with SELV/PELV output levels and hence provide the method to handle single faults and maintain safety.

I/O, communication connections can be functional insulation, as they are not required to provide any protection.

REINFORCED INSULATION is necessary wherever any non-SELV/PELV power is applied, e.g. AC I/O.

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

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**Figure BB.10 – REINFORCED INSULATION from external power supplies**

Referring to Figure BB.11, external power supplies provide BASIC INSULATION and hence provide a method to handle single faults and maintain safety.

BASIC INSULATION is also provided at all connections I/O. One failure of a BASIC INSULATION at the power supplies is allowed, but a second level of BASIC INSULATION is always present, at the I/O.

PROTECTIVE IMPEDANCE, by inter-module capacitors, and BASIC INSULATION can also be provided at the I/O. In this way a first failure is protected against.

Communication connections can be 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.

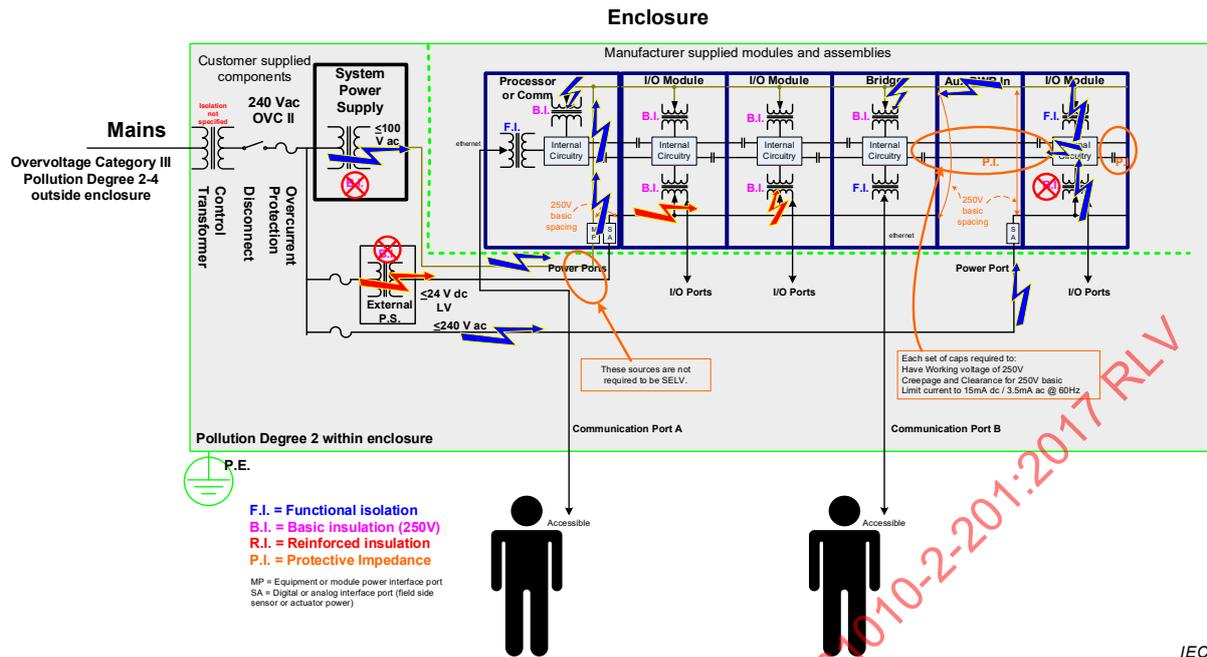


Figure BB.11 – BASIC INSULATION from external power supplies

These ~~three~~ five scenarios are just a few of many which can be the basis of a control system electrical safety.

Whatever the method chosen, it is recommended it be documented in a drawing, such as shown here.

### BB.5 Conclusion

The development of a control equipment electrical safety drawing is invaluable in understanding and communicating the electrical safety and isolation in a system as it is developed. This can keep all parties involved in the original certification, as well as future participants making additions to an expandable system, on a consistent path.

## **Annex CC** (informative)

### **Historical techniques for secondary circuits**

#### **CC.1 Secondary circuits background**

Annex CC is meant to describe a set of circuits utilized historically in control equipment. These techniques are not recommended for new designs. Newer techniques have been devised and accepted into common practice eliminating the need for these circuits.

This annex is an overview and is not meant to be a complete description of these circuits, the techniques nor the requirements and conditions to utilize them. For a complete set of information on these circuits, see UL 508.

The circuits listed offered two areas of effect: controlling the provisions against electric shock and against spread of fire.

#### **CC.2 Secondary circuits without RISK of electrical shock**

##### **CC.2.1 General**

The following secondary circuits also do not pose a RISK of electrical shock and do not require additional evaluation for RISK against electrical shock:

- a) class 2 circuit;
- b) limited voltage/current circuit;
- c) limited voltage circuit;
- d) limited energy circuit that involves open circuit potential less than or equal to 30 V AC or 42,4 V peak;
- e) limiting impedance circuit.

These circuits are described in CC.2.2.1, CC.2.2.2, CC.2.2.3, CC.2.2.4 and CC.2.2.5.

##### **CC.2.2 Secondary circuits which do not pose a RISK of electrical shock**

###### **CC.2.2.1 Class 2 circuit**

A Class 2 circuit shall be supplied by an isolating source, providing DOUBLE INSULATION or REINFORCED INSULATION, which has a maximum output voltage of 42,4 V peak (sinusoidal or non-sinusoidal AC) or 60 V for continuous DC or 24,8 V peak for DC interrupted at a rate of 200 Hz or less with approximately 50 % duty cycle.

The maximum output current of a Class 2 source depends on whether it is inherently limited or not inherently limited. For inherently limited sources, Table CC.1 applies. For not inherently limited sources, Table CC.2 applies.

###### **CC.2.2.2 Limited voltage/current circuit**

A limited voltage/current circuit shall be supplied by an isolating source, providing DOUBLE or REINFORCED INSULATION, in such a way that the maximum open-circuit voltage available to the circuit is not more than AC 30 V r.m.s. and 42,4 V peak and the current available is limited to a value not exceeding 8 A measured after 1 min of operation.

The secondary winding of an isolating type transformer may be used to comply with this requirement.

A secondary fuse or other such secondary circuit protective device used to limit the available current shall be RATED at no more than 5,0 A for a circuit RATED less than, or equal to, 20 V peak, or 100 VA for a circuit RATED from 20 V to 30 V peak.

If the current-limiting device is provided in the MAINS CIRCUIT, there are no restrictions on its current RATING as long as it limits the available secondary current to 8 A.

#### **CC.2.2.3 Limited voltage circuit**

A limited voltage circuit shall be supplied by an isolating source, providing DOUBLE or REINFORCED INSULATION, with a maximum open-circuit voltage of not more than AC 30 V r.m.s. and 42,4 V peak without any limitation on the available current or volt-ampere capacity.

Overcurrent protection shall be provided to protect against burnout and damage to the secondary circuit cables/wiring insulation resulting from any overload or short-circuit condition. This protection may alternately be provided in the MAINS CIRCUIT by overcurrent protective devices provided with the control equipment or by branch circuit devices.

#### **CC.2.2.4 Limited energy circuit which involves open-circuit potential less than, or equal to, AC 30 V r.m.s. and 42,4 V peak**

A limited energy circuit shall be supplied by an isolating source, providing DOUBLE or REINFORCED INSULATION, in such a way that the maximum volt-ampere capacity available to the circuit is 200 VA or less at a maximum open-circuit voltage of less than or equal to AC 30 V r.m.s. and 42,2 V peak. The secondary winding of an isolating type transformer may be used to comply with this requirement. A primary or secondary fuse or other circuit protective device may be used to limit the maximum volt-ampere capacity.

#### **CC.2.2.5 Limiting impedance circuit**

A limiting impedance circuit shall be supplied by an impedance that complies with the following two requirements:

- a) the calculated power dissipation of the impedance, as the result of a direct short applied across the circuit downstream of the impedance, does not exceed the power RATING of the impedance, and
- b) the power dissipated in the impedance shall be less than 15 W.

If the above calculated power dissipation exceeds the RATING of the impedance, the impedance may still be used if the power is less than 15 W and if the impedance does not open or short when subjected to a direct short applied across the circuit downstream of the impedance.

The limiting impedance shall be able to function under SINGLE FAULT CONDITION unless the circuit limited by the impedance is enclosed.

A single resistor, or a single across-the-line capacitor approved per 14.101.1, is considered to comply with this limiting impedance requirement.

### **CC.3 Secondary circuits without RISK of spread of fire**

#### **CC.3.1 General**

The following secondary circuits also do not pose a RISK of spread of fire and do not require additional evaluation for RISK of spread of fire:

- a) class 2 circuit;
- b) limited voltage/current circuit;

- c) limiting impedance circuit;
- d) limited power circuit.

**CC.3.2 Secondary circuits which do not pose a RISK of spread of fire**

**CC.3.2.1 Class 2 circuit**

See CC.2.2.1.

**CC.3.2.2 Limited voltage/current circuit**

See CC.2.2.2.

**CC.3.2.3 Limiting impedance circuit**

See CC.2.2.5.

**CC.3.2.4 Limited power circuit**

A limited power circuit is a circuit supplied by sources such as a battery or a transformer winding where the open-circuit potential is not more than AC 30 V r.m.s. and 42,4 V peak or DC 60 V, and the energy available to the circuit is limited according to one of the following means:

- a) the maximum output current and power are inherently limited to not more than the values of Table CC.1;
- b) the maximum output current under all conditions and power are limited by impedance to be not more than the values of Table CC.1;
- c) an over-current protective device limits the maximum output current and power to not more than the values of Table CC.2;
- d) a regulating network limits the maximum output current and power to not more than the values of Table CC.1 in NORMAL USE or as a result of one fault in the regulating network; or
- e) a regulating network limits the maximum output current and power to not more than the values of Table CC.1 in NORMAL USE, and an over-current protective device limits the output current and power to not more than the values of Table CC.2 as the result of any one fault in the regulating network.

Where an over-current protective device is used, it shall be a fuse or a non-adjustable non-self-resetting device.

**Table CC.1 – Limits of output current and output power for inherently limited power sources**

Open-circuit output voltage $U$		Maximum output current A	Maximum output power $V \times A$
AC V r.m.s.	DC V		
$\leq 20$	$\leq 20$	8,0	$5 \times U$
$20 < U \leq 30$	$20 < U \leq 30$	8,0	100
	$30 < U \leq 60$	$150/U$	100

For non-sinusoidal AC and for DC with ripple exceeding 10 %, the peak voltage shall not exceed 42,4 V peak.

**Table CC.2 – Limits of output current, output power and RATINGS  
for over-current protective devices for non-inherently limited power sources**

Open-circuit output voltage $U$		Maximum output current	Maximum output power	RATED current value of over-current protective device
AC V r.m.s.	DC V	A	V × A	A
≤ 20	≤ 20	1 000/ $U$	250	≤ 5
20 < $U$ ≤ 30	20 < $U$ ≤ 60	1 000/ $U$	250	≤ 100/ $U$

RATED current values for over-current protective devices are for fuses and circuit-breakers which break the current within 120 s at a current value of 210 % of the value in the last column of Table CC.2.

Conformity is checked by measuring the output voltage, the maximum output current and the maximum available output power under the following conditions:

- 1) output voltage is measured in no-load condition;
- 2) output current and available power are measured after 60 s of operation, with any over-current protective devices short-circuited, with a resistive load (including short-circuit) which produces the highest value of current and power respectively.

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**Annex DD**  
(informative)

**Cross references between IEC 61010-2-201  
and IEC 61010-1:2010 or IEC 61131-2:2007**

**Table DD.1 – Cross references between IEC 61010-2-201  
and IEC 61010-1 or IEC 61131-2**

<del>These clauses and subclauses of IEC 61010-1 are addressed in IEC 61010-2-201</del>	<del>These clauses and subclauses of IEC 61131-2 are merged into IEC 61010-2-201</del>	<del>These clauses and subclauses of IEC 61131-2 are not merged into IEC 61010-2-201.</del>
<del>1.1 Scope</del>	<del>1.1 Scope and object</del>	
<del>1.3 Verification</del>	<del>1.2 Compliance with this part</del>	
<del>1.4 Environmental conditions</del>	<del>1.3 Normative references</del>	
<del>2 Normative references</del>	<del>2 Type tests</del>	
<del>3 Terms and definitions</del>	<del>3 Terms and definitions</del>	
<del>4 Tests</del>	<del>4 Normal service conditions and requirements</del>	
<del>5 Marking and documentation</del>		<del>5 Functional requirements</del>
<del>6 Protection against electric shock</del>	<del>11 Safety requirements</del>	<del>6 Normal service and functional type tests and verifications</del>
<del>7 Protection against mechanical hazards</del>	<del>12 Safety type tests and verifications</del>	<del>7 General information to be provided by the manufacturer</del>
<del>8 Resistance to mechanical stresses</del>	<del>13 Safety routine tests</del>	<del>8 Electromagnetic compatibility (EMC) requirements</del>
<del>9 Protection against the spread of fire</del>	<del>14 Safety information to be provided by the manufacturer</del>	<del>9 Electromagnetic compatibility (EMC) type tests and verifications</del>
<del>10 Equipment temperature limits and resistance to heat</del>		<del>10 Electromagnetic compatibility (EMC) information to be provided by the manufacturer</del>
<del>11 Protection against hazards from fluids</del>		
<del>12 Protection against radiation, including laser sources, and against sonic and ultrasonic pressure</del>		
<del>13 Protection against liberated gases and substances, explosion and implosion</del>		
<del>14 Components and subassemblies</del>		
<del>15 Protection by interlocks</del>		
<del>16 Hazards resulting from application</del>		
<del>17 Risk assessment</del>		
<del>Annexes</del>	<del>Annexes</del>	

## **Annex DD** (normative)

### **Flammability test for magnesium alloy fire ENCLOSURES or flame barriers (see 9.3.2)**

#### **DD.1 General**

When magnesium alloy is used as a fire ENCLOSURE or a flame barrier, the flammability properties shall be determined to support the requirements of 9.3.2. The method described in Annex DD will demonstrate whether the material will ignite under typical conditions, and whether the flame, if it does ignite, will propagate long enough to cause a HAZARD of the spread of fire.

This method is similar to the method used for determining the flammability characteristics of plastics.

NOTE The test methods and conformance criteria of the 500 W Vertical Burning Test for plastic materials of ANSI/UL 94 are equivalent.

Conformity is checked as specified in Clause DD.2 to Clause DD.5. During the test and until 1 min after the last application of the test flame, the sample shall not ignite.

#### **DD.2 Samples**

One sample is tested, consisting of a complete fire ENCLOSURE or flame barrier.

#### **DD.3 Mounting of samples**

The sample is mounted and oriented as it would be in actual use.

#### **DD.4 Test flame**

The 500 W nominal test flame of IEC 60695-11-3 is used.

#### **DD.5 Test procedure**

The test flame is applied to an inside surface of the sample at a minimum of three points and a maximum of five points, including the section of the sample where the material is the thinnest, sections of the sample where ventilation or other openings are located, and sections of the sample that are located near a source of ignition. If it is not possible to apply the flame to the inside surface, it may be applied to the outside surface.

If a vertical part is involved, the flame is applied at an angle of approximately 20° from the vertical. If ventilation or other openings are involved, the flame is applied to an edge of an opening, otherwise to a solid surface. In all cases, the tip of the inner blue cone of the flame is to be in contact with the sample.

The flame is applied to each point for 5 s, removed for 5 s, then reapplied again to the same point until a total of five applications have been made to this point. After that, the flame is removed for 60 s, and then applied in the same manner to the next test point on the sample.

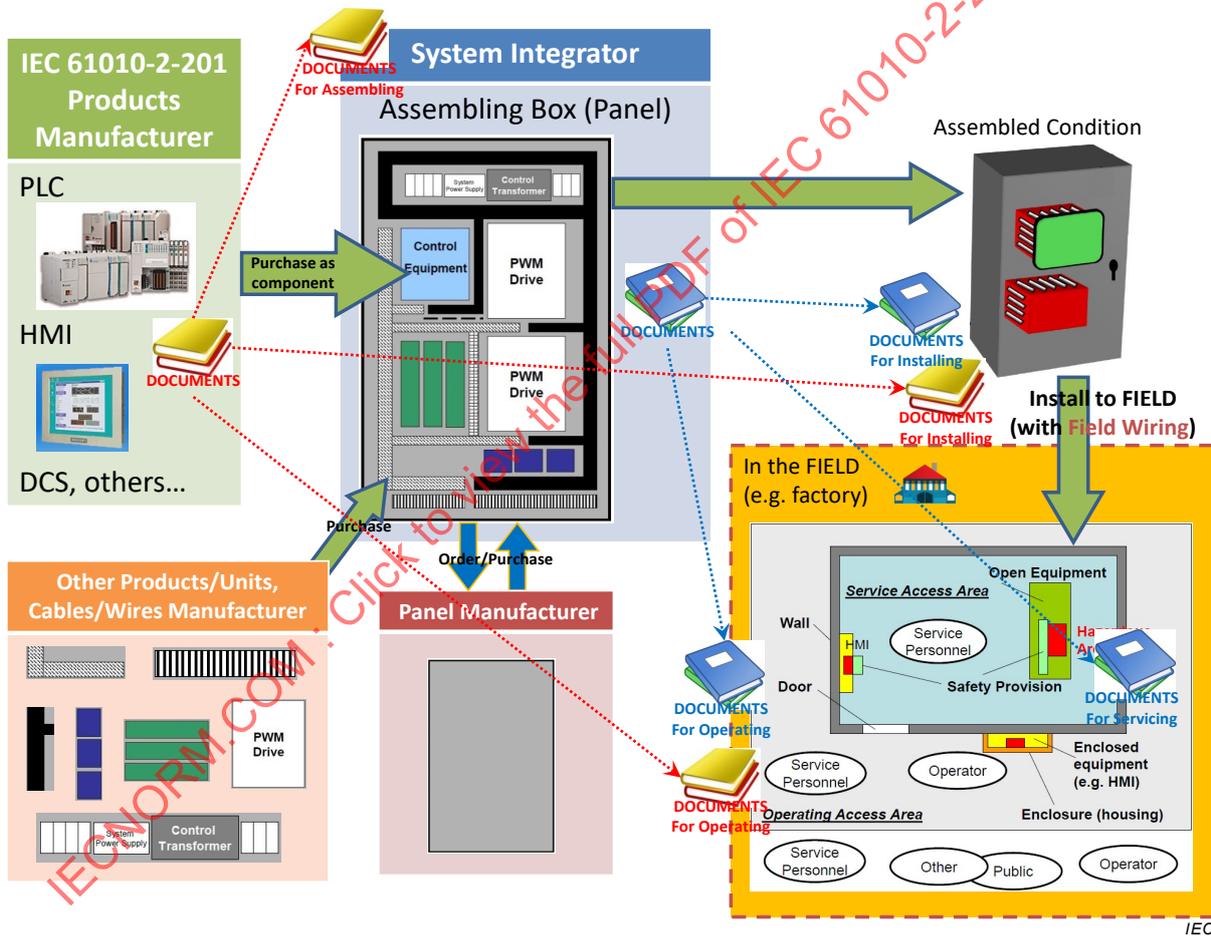
## Annex EE (informative)

### Information/documentation and correlation to its uses

Annex EE is not a certification requirement. It is included only to depict one of many many examples of how industrial components are combined together to form a useful application. Other industries have a similar or the same work flow.

This example focuses on how information/documentation, regarding safety aspects, might flow through the development process of that useful application.

As shown in Figure EE.1, component products generally shall be combined together with other products to execute some useful application. As such, the information/documentation has more of an installer, service, system designer focus rather than an end use focus and need.



**Figure EE.1 – Information/documentation for component products**

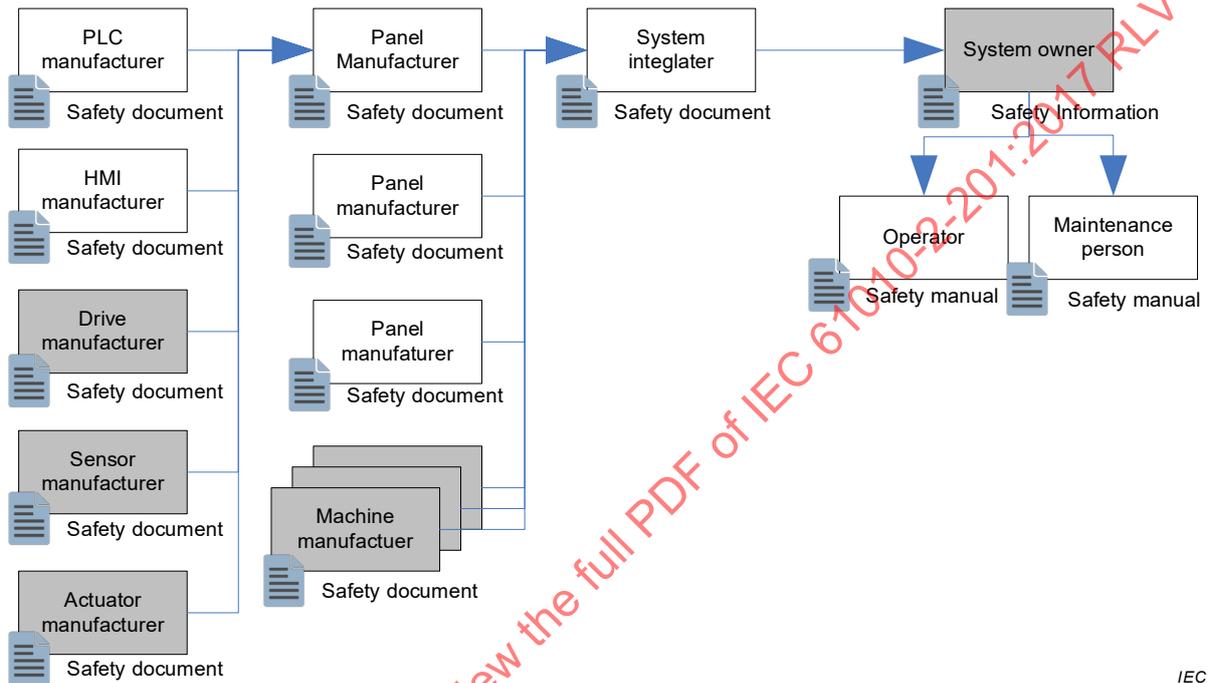
Figure EE.2 shows an example of safety information as it is collected, selected and differentially compiled for different end uses, with regard to some certain installation.

On the left are the documentation sets provided by the component manufacturers. These may include safety information (the focus in the example), programming information, specification information, end-of-life recycling information, warranty information, etc.

Moving to the right, next those components may be utilized by panel manufacturers to build their part of the overall installation. They might select parts of the information from each to the component manufacturers to include in their safety information to reformat, include and pass on with their own panel safety information.

At the next stage, a system integrator selects, reformats, and passes on his safety information which the system owner requested or the integrator feels the owner will need.

Lastly then the system owner may again partition the information targeted at his OPERATORS and maintenance people.



IEC

**Figure EE.2 – Information/documentation accumulation and segregation tree for an example installation**

This is one on many ways information/documentation of various types, threads its way from the manufacturer to the OPERATORS, maintenance personnel, etc.

## Annex FF (informative)

### Measurement of CLEARANCES and CREEPAGE DISTANCES

The following examples complement those examples given in IEC 61010-1:2010, Annex C.

These examples are presented to enhance explanation of situations commonly found in control equipment. Very often they occur in the cases where surface mount devices (SMD) are utilized on printed wiring boards (PWBs). SMD devices present situations where there can be minimal or no distance between a component and the PWB. This brings into focus the question of which CLEARANCE and CREEPAGE rules apply with regard to the component of some material group (MG) and the PWB when the distance between component and PWB shrinks to minimal values.

The methods of measuring CLEARANCES and CREEPAGE DISTANCES are indicated in the following Figure FF.1 and Figure FF.2. These cases do not differentiate between gaps and grooves or between types of insulation.

The following assumptions are made:

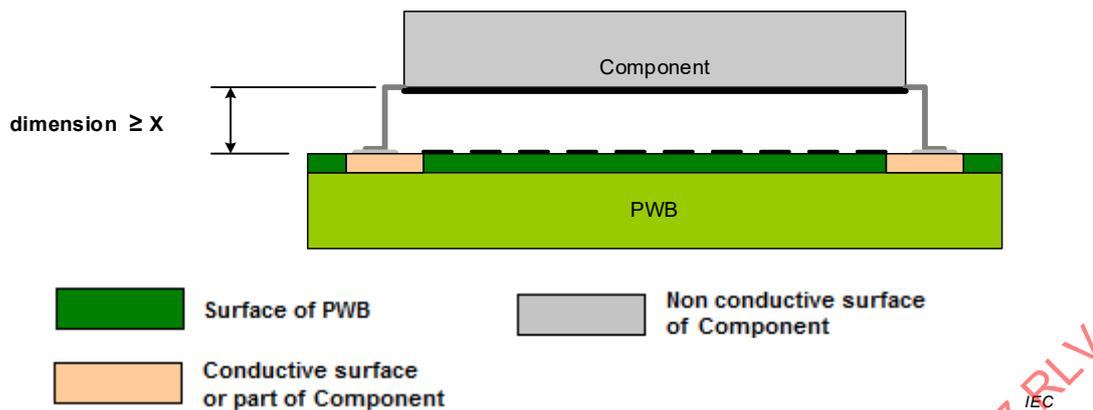
- a) where the distance across a groove is equal to or larger than  $X$  (see Table FF.1), the CREEPAGE DISTANCE is measured along the contours of the groove (see Figure FF.1);
- b) any recess is assumed to be bridged with an insulating link having a length equal to  $X$  and being placed in the least favourable position (see Figure FF.2);
- c) CLEARANCES and CREEPAGE DISTANCES measured between parts which can assume different positions in relation to each other are measured when these parts are in their least favourable position.

In the following examples dimension  $X$  has the value given in Table FF.1 depending on the POLLUTION DEGREE.

**Table FF.1 – Dimensions of  $X$**

POLLUTION DEGREE	Dimension $X$ mm
1	0,25
2	1,0
3	1,5

If the associated CLEARANCE is less than 3 mm, the dimension  $X$  in Table FF.1 may be reduced to one-third of this CLEARANCE.



**Figure FF.1 – The path a component mounted to a PWB (side view)**

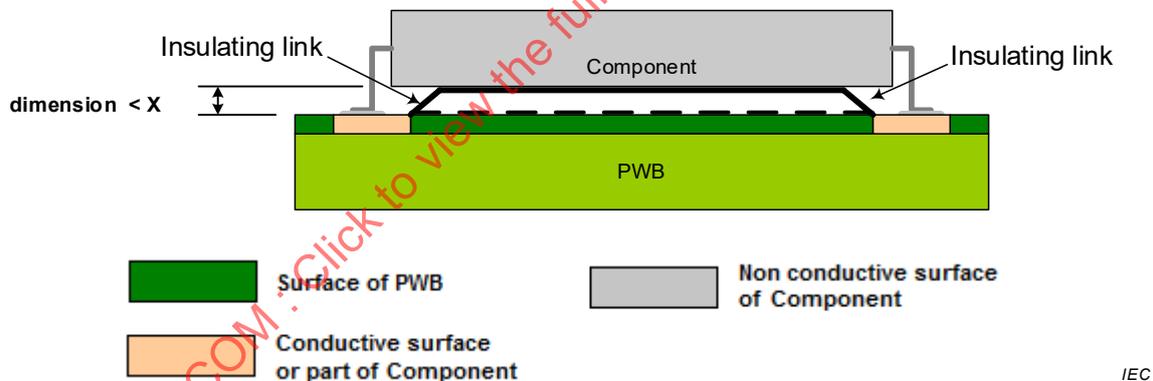
EXAMPLE Figure FF.1: The path a component mounted to a PWB (side view).

The CLEARANCE is the shortest direct air path across the top of the PWB.

The CREEPAGE DISTANCE follows the contour of the component, along the shortest path measured on any side of the component.

NOTE 1 When components have a lower MG value than the surface on which they are mounted, the critical distance can be along the surface of the component. If the surface of the component and the surface on which it is mounted have the same MG, the critical CREEPAGE DISTANCE can be the direct path along the surface of the PWB.

NOTE 2 The conductive contacts on a component might be positioned such that the shortest path might be above or beside the component, and not necessarily below the component as shown.



**Figure FF.2 – The path a component mounted to a PWB (side view)**

EXAMPLE Figure FF.2: The path a component mounted to a PWB (side view).

The CLEARANCE is the shortest direct air path across the top of the PWB.

The CREEPAGE DISTANCE follows the insulating links to the contour of the bottom of the component.

The MG of the various surfaces shall be taken into consideration.

NOTE 3 The measurement across the surface of the component starts where the link distance, value from Table FF.1, starting from the conductive contacts meets the surface of the component and continues to where the link distance from the opposite conductive contact meets the surface of the component.

NOTE 4 The conductive contacts on a component might be positioned such that the shortest path might be between these two contacts, or between one conductive contact and the conductive surface on the PWB, and not always between the two conductive surfaces on the PWB surface.

## Bibliography

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

### Addition:

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60664-5:~~2007~~, *Insulation coordination for equipment within low-voltage systems – Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm<sup>1</sup>*

IEC 60715:~~1984~~, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of electrical devices in switchgear and controlgear installations*

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IEC 61326 (all parts), *Electrical equipment for measurement, control and laboratory use – EMC requirements*

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~~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: Specification for gas discharge tubes (GDT)*~~

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

<sup>1</sup> Withdrawn.

<sup>2</sup> ~~To be published.~~

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

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IEC Guide 117:~~2010~~, *Electrotechnical equipment – Temperatures of touchable hot surfaces*

*ANSI/UL 94, Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 508:~~1999~~, *Standard for Industrial Control Equipment*

UL 1059:~~2004~~, *Standard for Terminal Blocks*

UL 1642:~~2009~~, *Standard for Lithium Batteries*

UL 2054:~~2011~~, *Standard for Household and Commercial Batteries*

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# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



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

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

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

### Part 2-201: Particular requirements for control equipment

#### FOREWORD

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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.**

## 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.

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# 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 <sup>a</sup>	RATED <sup>a</sup>	1,1 × RATED <sup>b</sup>	<0,35
DC pilot duty <sup>a</sup>	RATED <sup>a</sup>	1,1 × RATED <sup>b</sup>	–

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.

<sup>a</sup> Unless otherwise specified, the inrush current shall be 10 times the steady-state current.

<sup>b</sup> 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 <sup>a</sup>	RATED	RATED	<0,35
DC pilot duty <sup>a</sup>	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.			
<sup>a</sup> 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.

### 5.4.1 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**

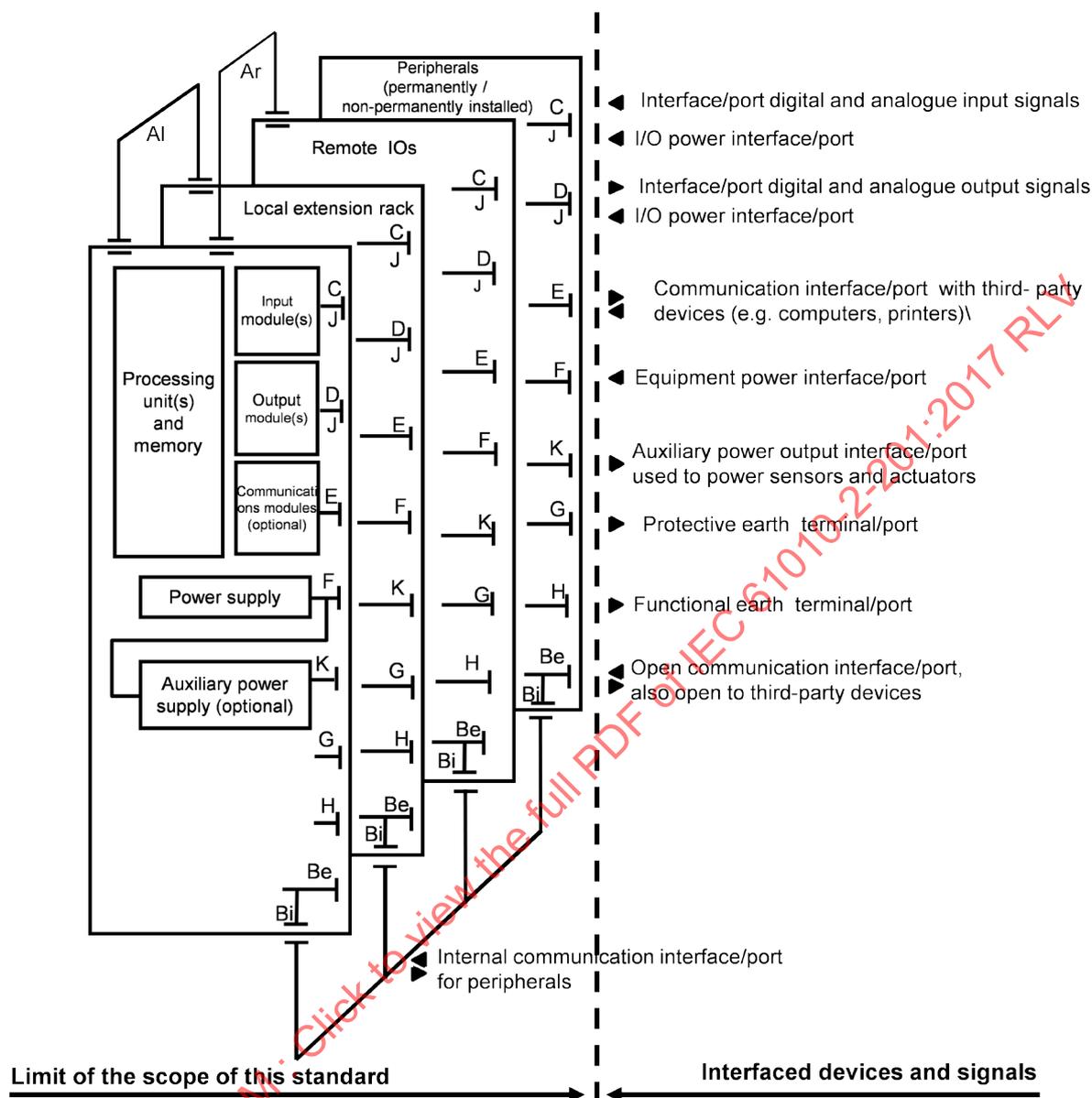
*Addition:*

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

*Add the following subclauses:*

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**6.2.101 Accessibility of TERMINALS and ports**



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**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 <sup>c</sup>	
	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 <sup>a</sup>	Yes	Yes
Be open communication interface/port, also open to third-party devices; e.g. PADT, personal computer used for programming <sup>a</sup>	Yes	Yes
Bi internal communication interface/port for peripherals	No	Not applicable <sup>b</sup>
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 <sup>a</sup>	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
<sup>a</sup> Ports Ar, Be and E contain circuits which may be connected to other equipment and shall be considered ACCESSIBLE. <sup>b</sup> Port Bi is an internal communication port and thus never leaves the ENCLOSED EQUIPMENT, by definition. <sup>c</sup> 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.*

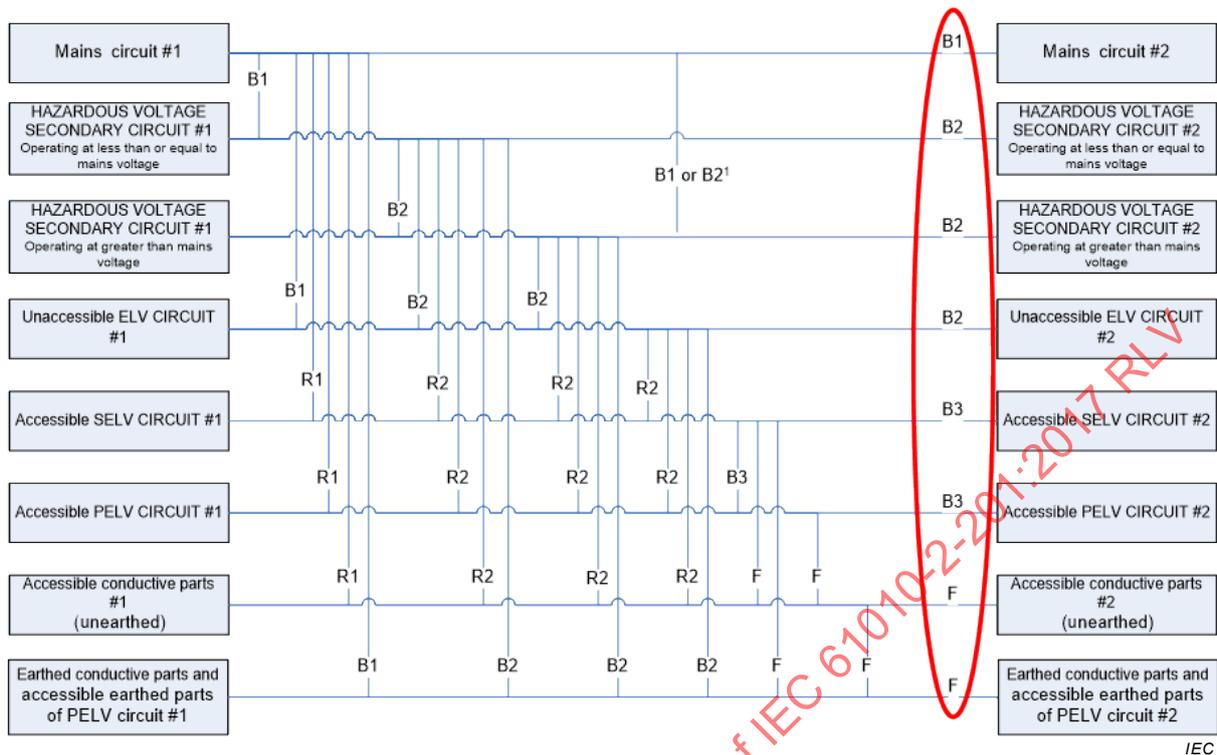
#### **6.7.1.1 General**

*Modification:*

*Add after the first paragraph:*

Insulation requirements between separate circuits and between circuits and ACCESSIBLE conductive parts are specified in Figure 102.

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- 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.

<sup>1</sup> 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.

### 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 <sup>c</sup>	Values for CLEARANCE distances <sup>d</sup>			Values for CREEPAGE DISTANCES <sup>b</sup>								
	POLLUTION DEGREE 1	POLLUTION DEGREE 2	POLLUTION DEGREE 3	POLLUTION DEGREE 1			POLLUTION DEGREE 2			POLLUTION DEGREE 3		
	mm	mm	mm	PWB MG I, II, III mm	MG I, II, III mm	PWB MG I, II, IIIa mm	MG I mm	MG II mm	MG III mm	MG I mm	MG II mm	MG III mm
≤ 50	0,04	0,2 <sup>a</sup>	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 <sup>a</sup>	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

<sup>a</sup> For printed wiring board, the values for POLLUTION DEGREE 1 apply.

<sup>b</sup> Linear interpolation of creepage is allowed. But creepage can never be below CLEARANCE.

<sup>c</sup> DC or AC peak values are  $\sqrt{2} \times$  AC r.m.s. values shown.

<sup>d</sup> 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<sup>d</sup>**

Voltage line-to-neutral AC r.m.s. V <sup>a</sup>	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 <sup>b</sup>	1 250	300	1 750	420	2 500	600	3 500	850
≤ 100 <sup>c</sup>	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.

<sup>a</sup> DC or AC peak values are  $\sqrt{2} \times$  AC r.m.s. values shown.  
<sup>b</sup> For DC products this range ends at 60 V.  
<sup>c</sup> For DC products this range begins at 60 V.  
<sup>d</sup> 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

Modification:

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. <sup>b</sup>		≤150 V AC r.m.s. <sup>b</sup>		≤300 V AC r.m.s. <sup>b</sup>	
	RATED impulse voltage 500 V		RATED impulse voltage 800 V		RATED impulse voltage 1 500 V	
Secondary WORKING VOLTAGE V AC r.m.s. <sup>b</sup>	CLEARANCE mm <sup>a</sup>	Test voltage V AC r.m.s.	CLEARANCE mm <sup>a</sup>	Test voltage V AC r.m.s.	CLEARANCE mm <sup>a</sup>	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

<sup>a</sup> Linear interpolation allowed.

<sup>b</sup> 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<sup>d, e</sup>**

WORKING VOLTAGE AC V r.m.s. V <sup>c</sup>	Termination CLEARANCE mm			Termination CREEPAGE mm	
	General use	Limited RATINGS <sup>a, b</sup>	To walls of metallic ENCLOSURES which may be deflected	General use	Limited RATINGS <sup>a, b</sup>
≤ 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.

<sup>a</sup> 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.

<sup>b</sup> 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.

<sup>c</sup> DC or AC peak values are  $\sqrt{2} \times$  AC r.m.s. values shown.

<sup>d</sup> For OVERVOLTAGE CATEGORY III and IV, Annex K shall be applied.

<sup>e</sup> 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.

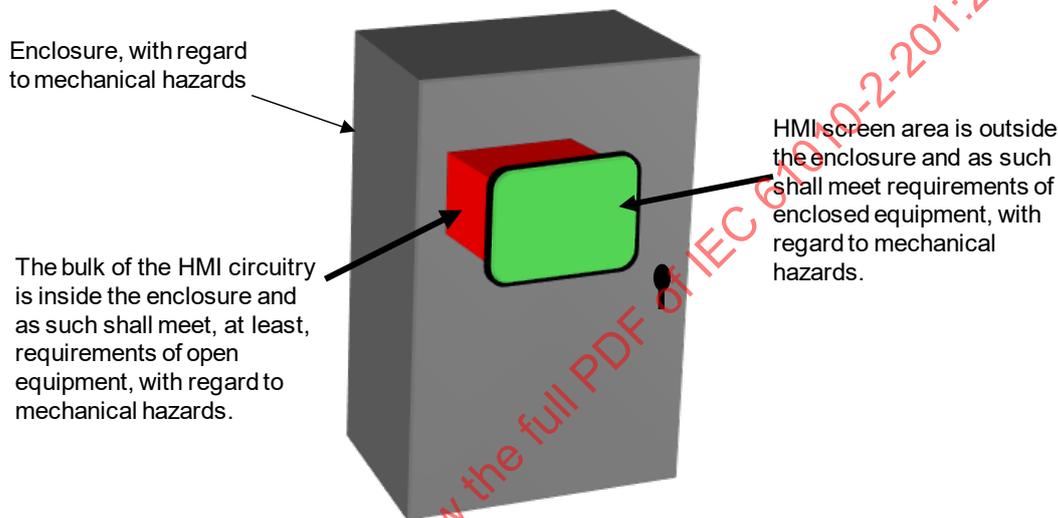
## 7 Protection against mechanical HAZARDS

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.



**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 ±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:*

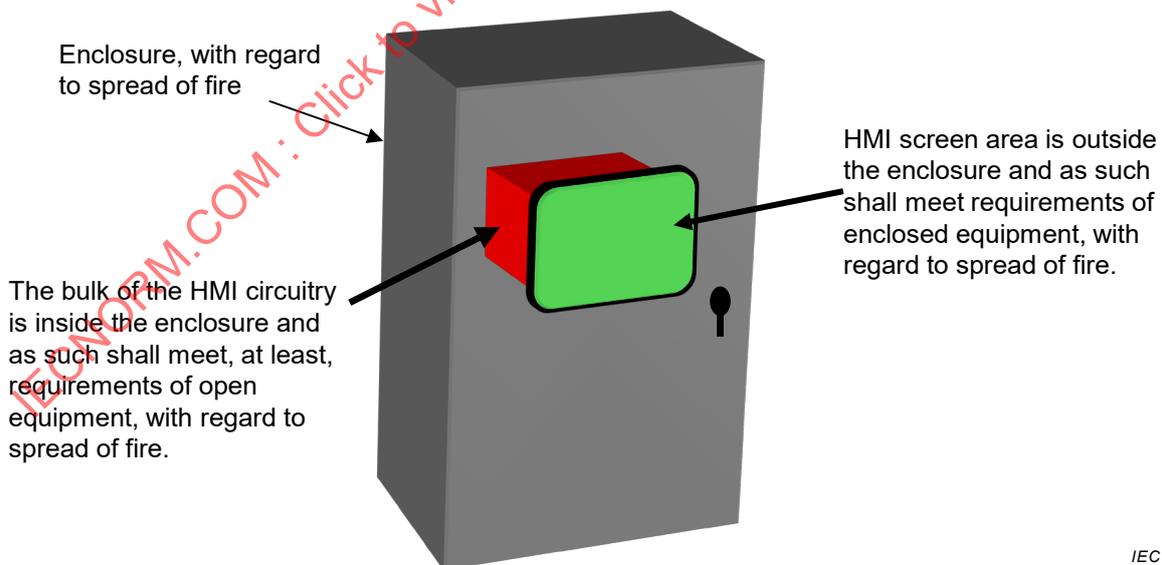
*Add at the beginning of the subclause:*

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 <sup>2</sup> ) 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.*

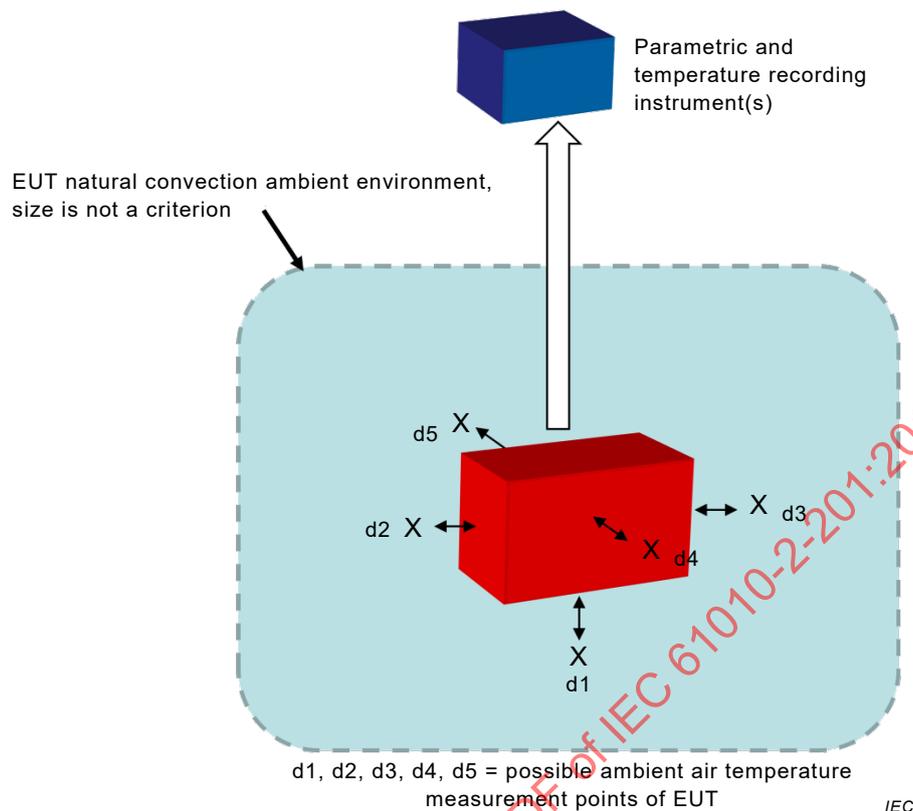
*The EUT shall be mounted in its least favourable position/orientation.*

*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.



**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.*

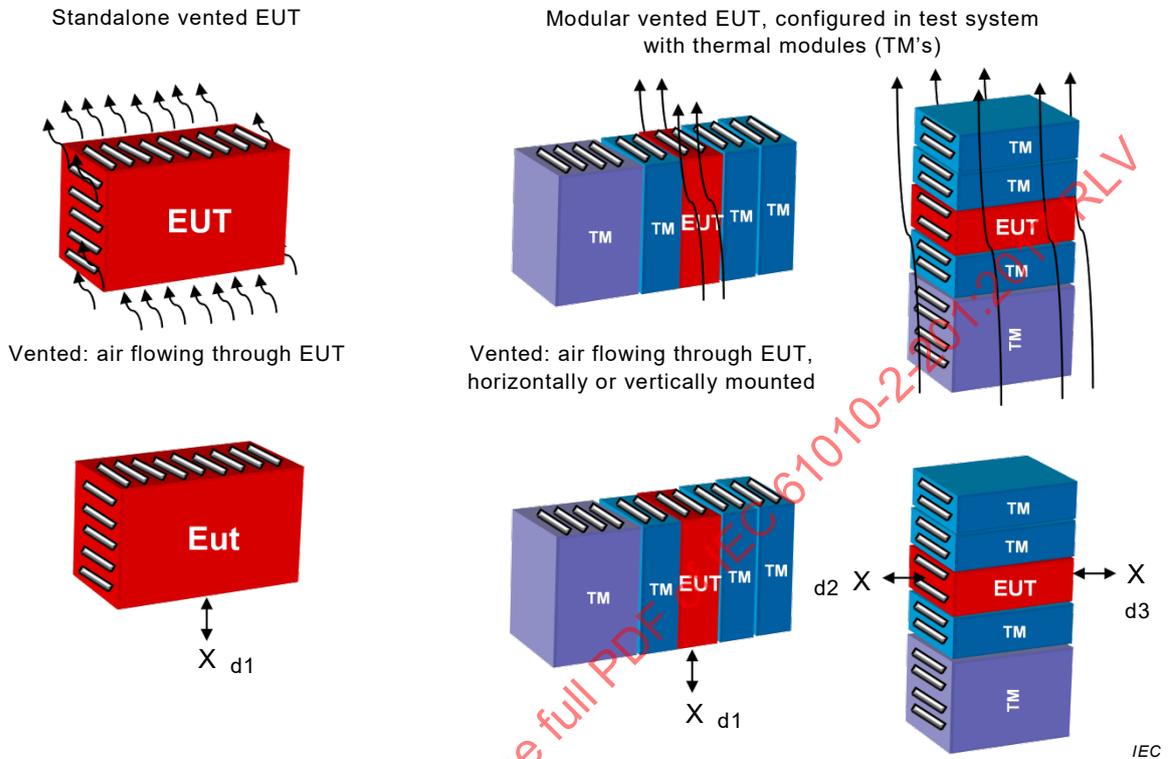
NOTE 3 Practical least favourable combination of conditions means a realistic situation the EUT can be utilized for in a real world application, not a theoretical combination which would never be used in practice.

*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.

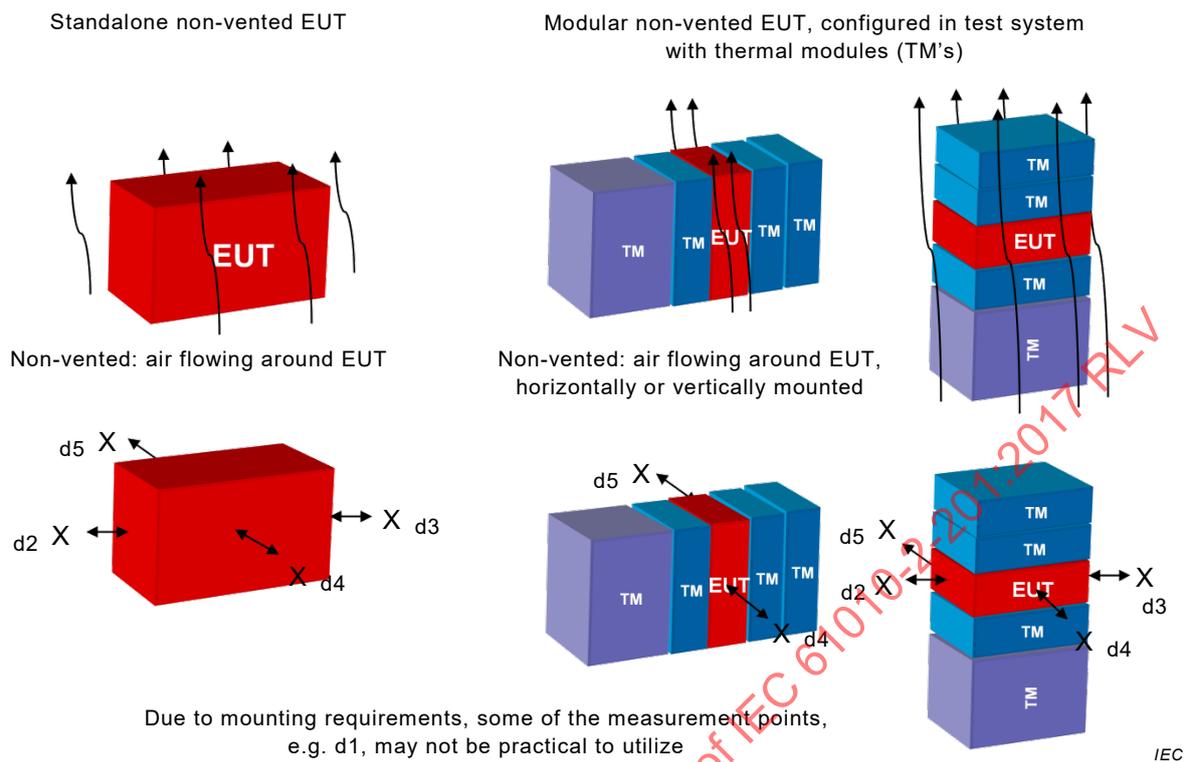


**Figure 106 – Vented equipment**

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/non-vented 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.*

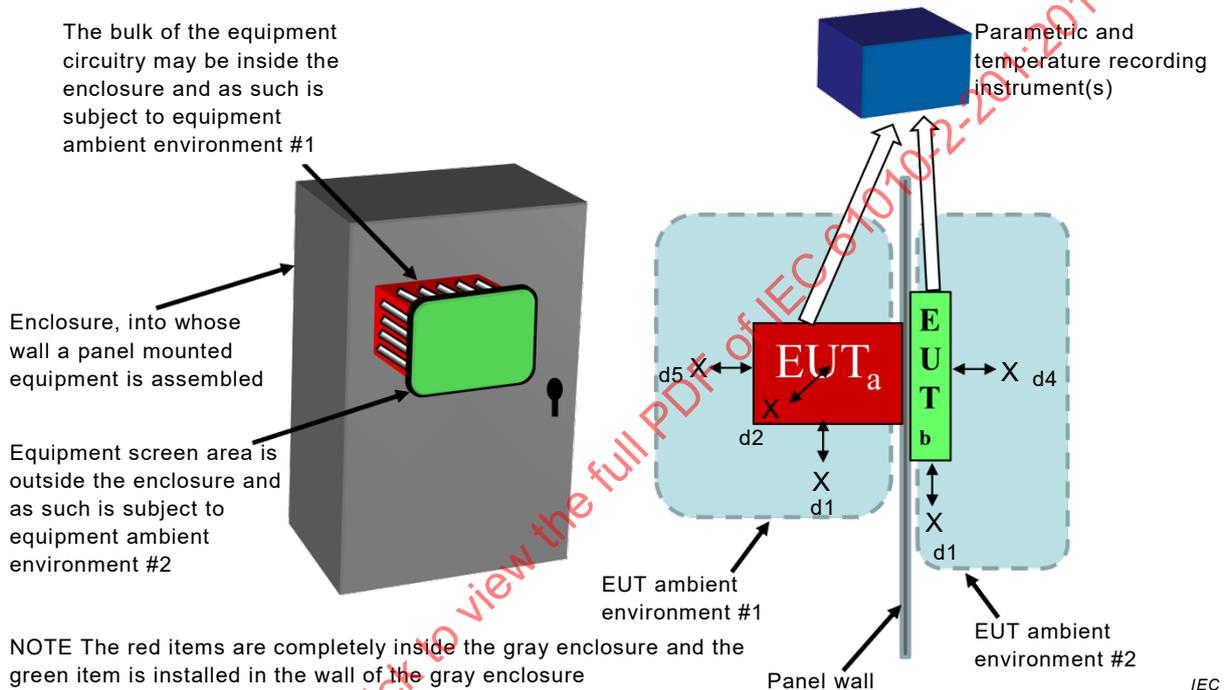
EXAMPLE: If EUT<sub>a</sub>'s maximum RATED AMBIENT TEMPERATURE = 60 °C and EUT<sub>b</sub>'s maximum RATED AMBIENT TEMPERATURE = 50 °C, the test shall be run with a test AMBIENT TEMPERATURE = 60 °C. Temperatures taken for EUT<sub>b</sub> would be corrected by -10 °C (50 °C - 60 °C).

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

- c) *The total EUT (EUT<sub>a</sub> + EUT<sub>b</sub>) 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<sub>a</sub>'s maximum RATED AMBIENT TEMPERATURE = 60 °C and EUT<sub>b</sub>'s maximum RATED AMBIENT TEMPERATURE = 50 °C, the test shall be run with a test AMBIENT TEMPERATURE = 50 °C. Temperatures taken for EUT<sub>a</sub> 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).



**Figure 108 – Panel mounted device extending through the wall of a cabinet**

**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.

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## **Annexes**

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

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## 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 <sup>a</sup>	controlled environment
B	uncontrolled environment	controlled environment or equipment is not opened during installation or maintenance
C	uncontrolled environment	uncontrolled environment
<sup>a</sup> A controlled environment is an environment having the conditions of IEC61010-1:2010, 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.

**Table E.2 – Reduction of POLLUTION DEGREES (PD)**

	Original POLLUTION DEGREE						
	2			3		4	
	Environmental situation (Table E.1)						
	A	B	C	B	C	B	C
<b>Additional Protection</b>	<b>Protection Degree with additional protection</b>						
ENCLOSURE IPx4	--	--	--	--	--	--	--
ENCLOSURE IPx5, IPx6	1	--	--	--	--	--	--
ENCLOSURE IPx7, IPx8	1	1	--	2 <sup>a,b</sup>	--	2 <sup>a,b</sup>	--
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.							
<sup>a</sup> Conformal coating, further 1 POLLUTION DEGREE reduction							
<sup>b</sup> 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.

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## **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  $\Omega$ .

#### **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  $\mu$ 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).

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**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.

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## 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.

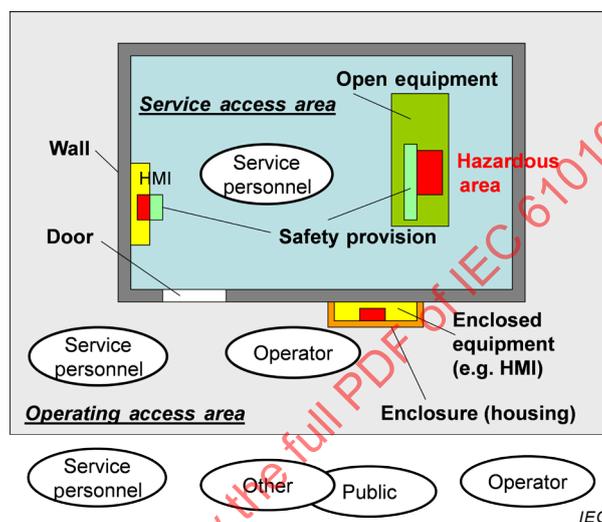


Figure AA.1 – Control equipment access and safety concerns

##### 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.

## 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.

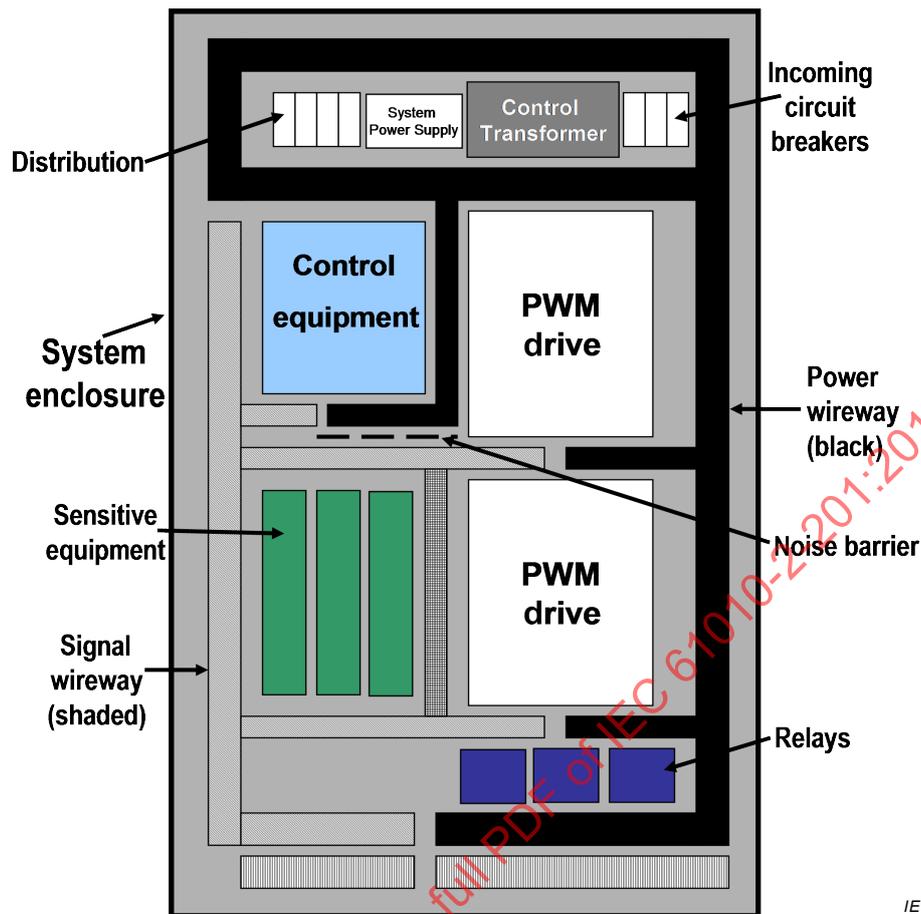
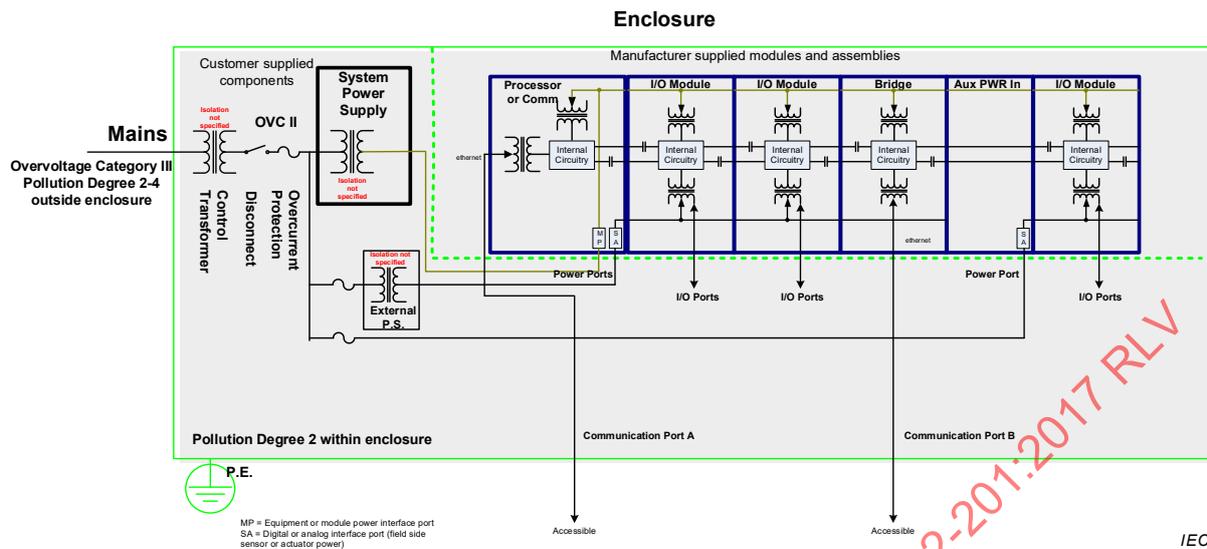


Figure BB.1 – Typical system ENCLOSURE layout

### 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 Figures BB.2 to 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.

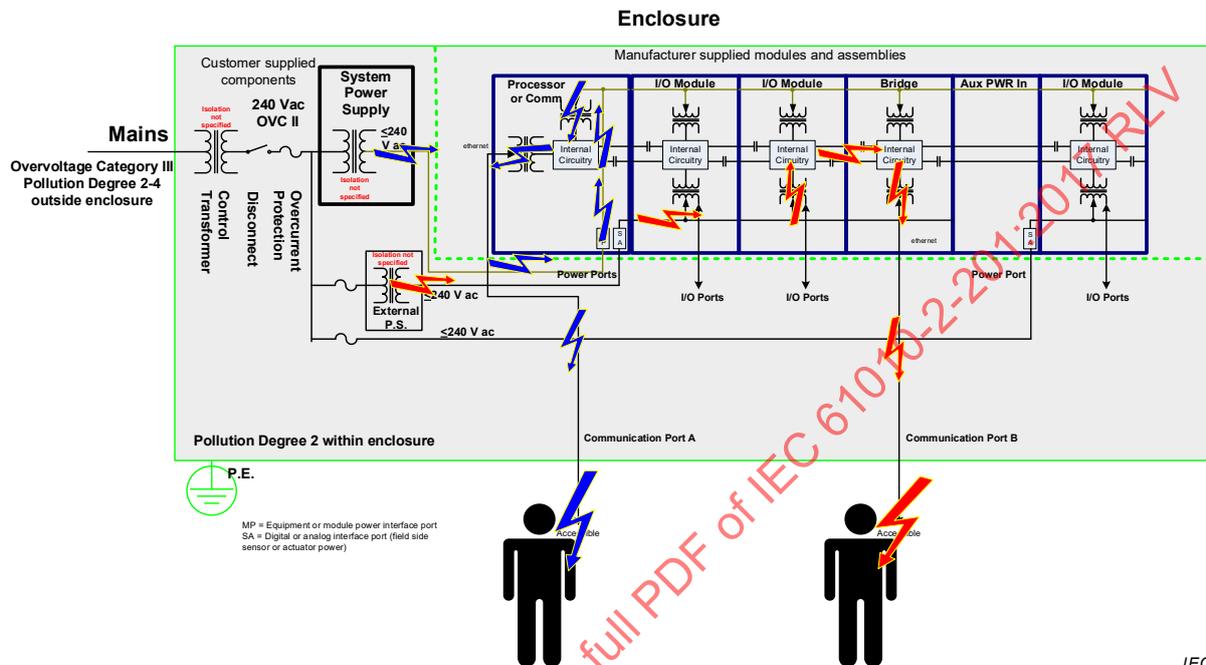


Figure BB.3 – HAZARD situation of the control equipment

#### 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.

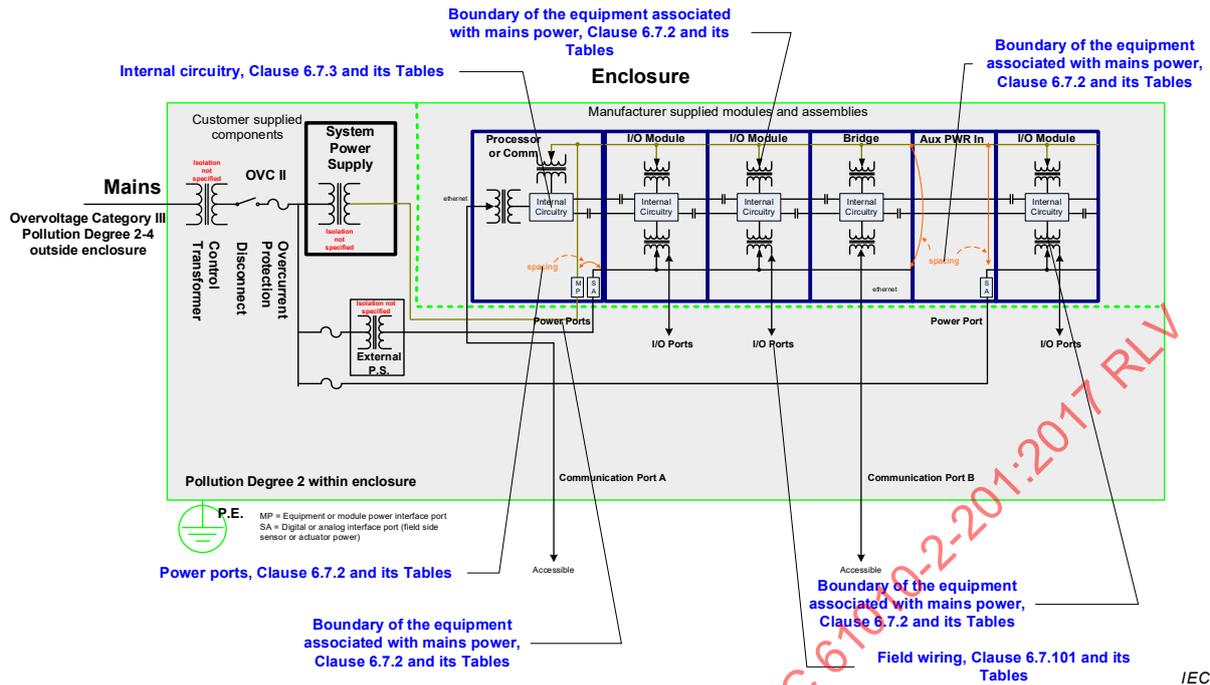


Figure BB.4 – Application of the standard to the control equipment safety drawing

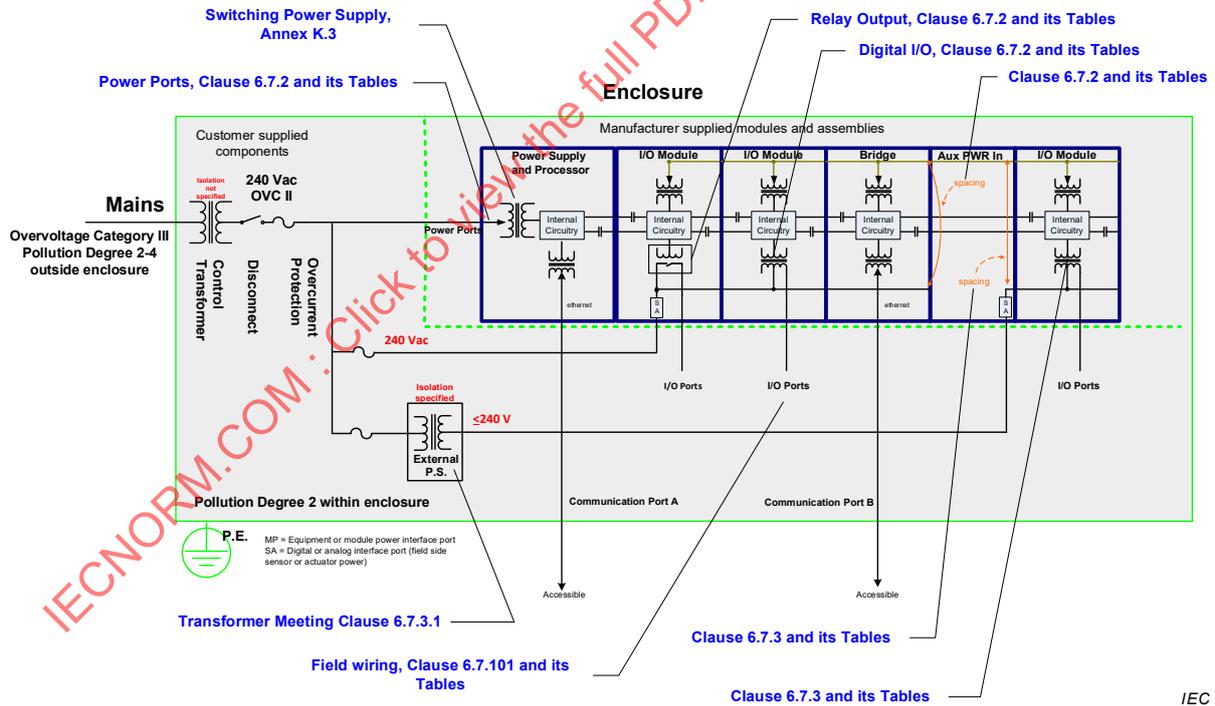
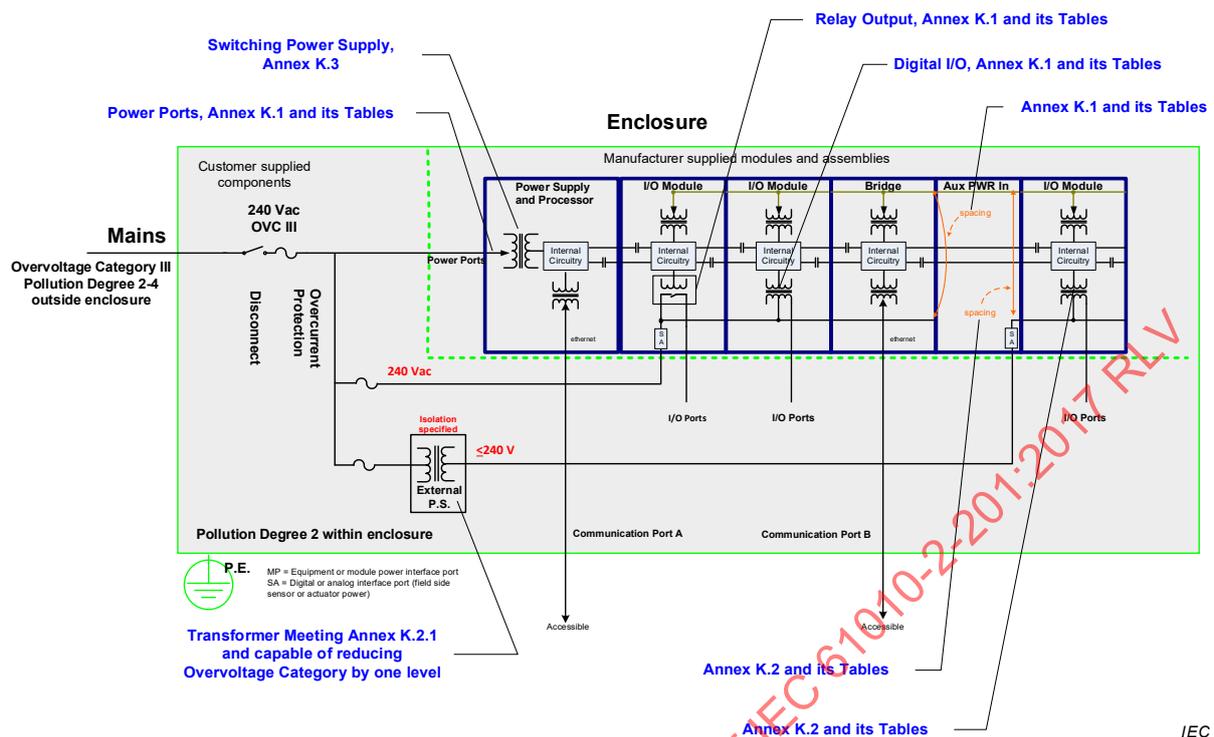


Figure BB.5 – Application of 6.7.1.5 items a) and b) to the control equipment safety drawing



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.

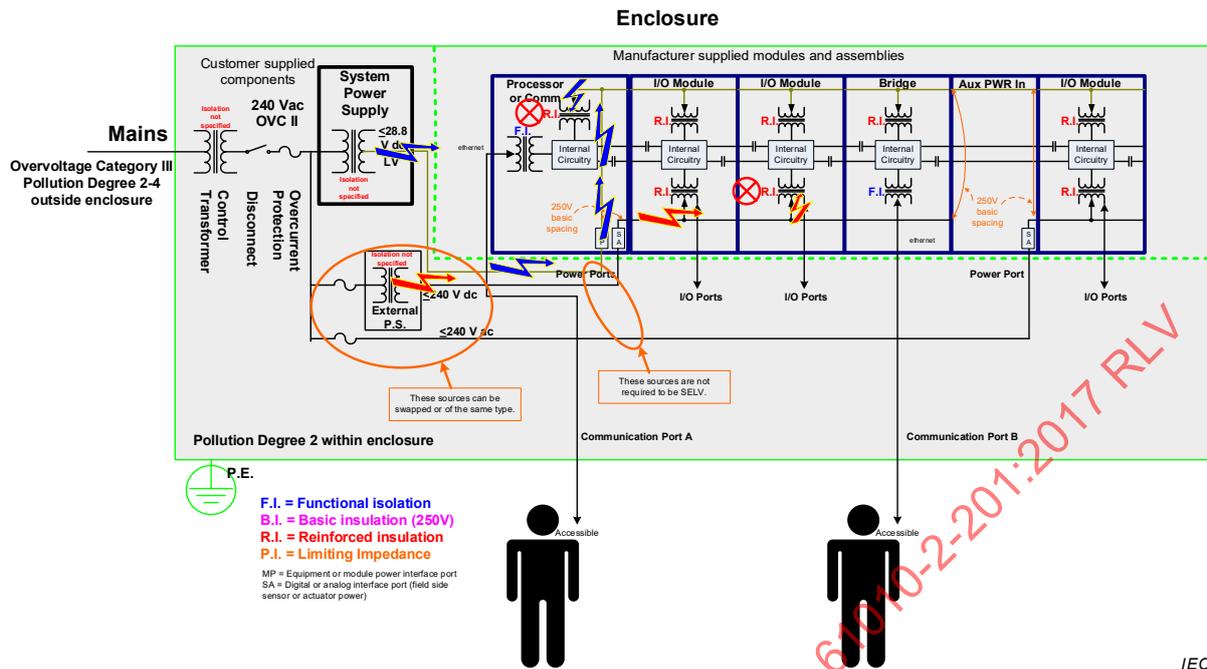


Figure BB.7 – REINFORCED INSULATION

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.

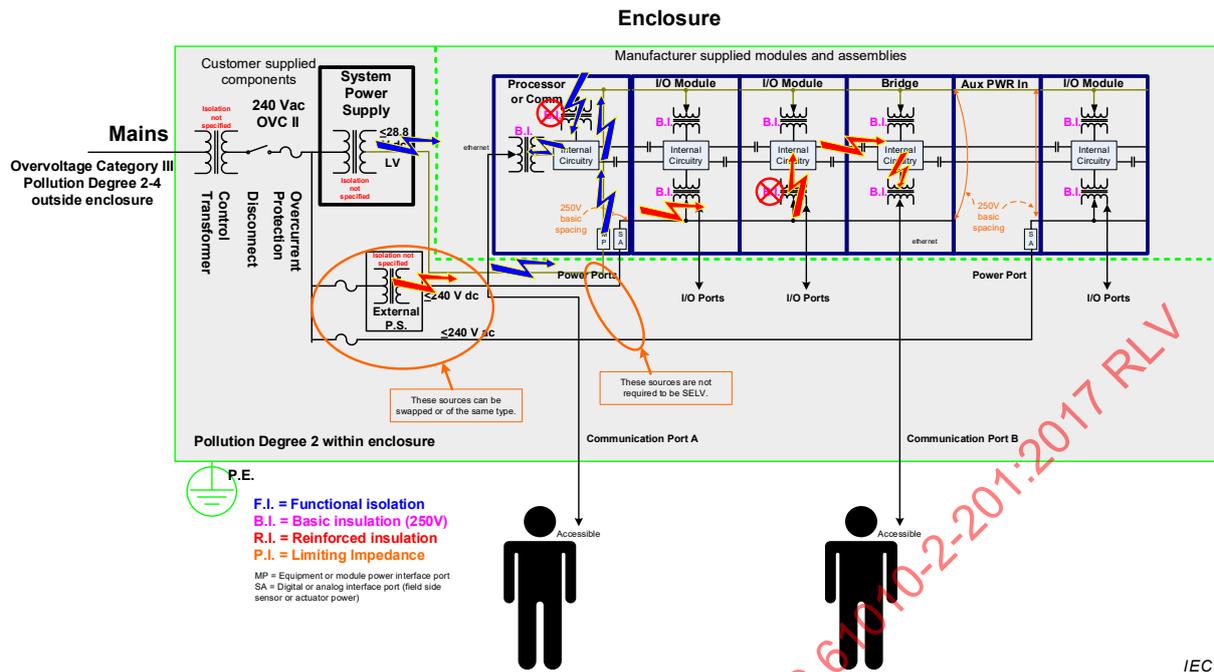


Figure BB.8 – BASIC INSULATION

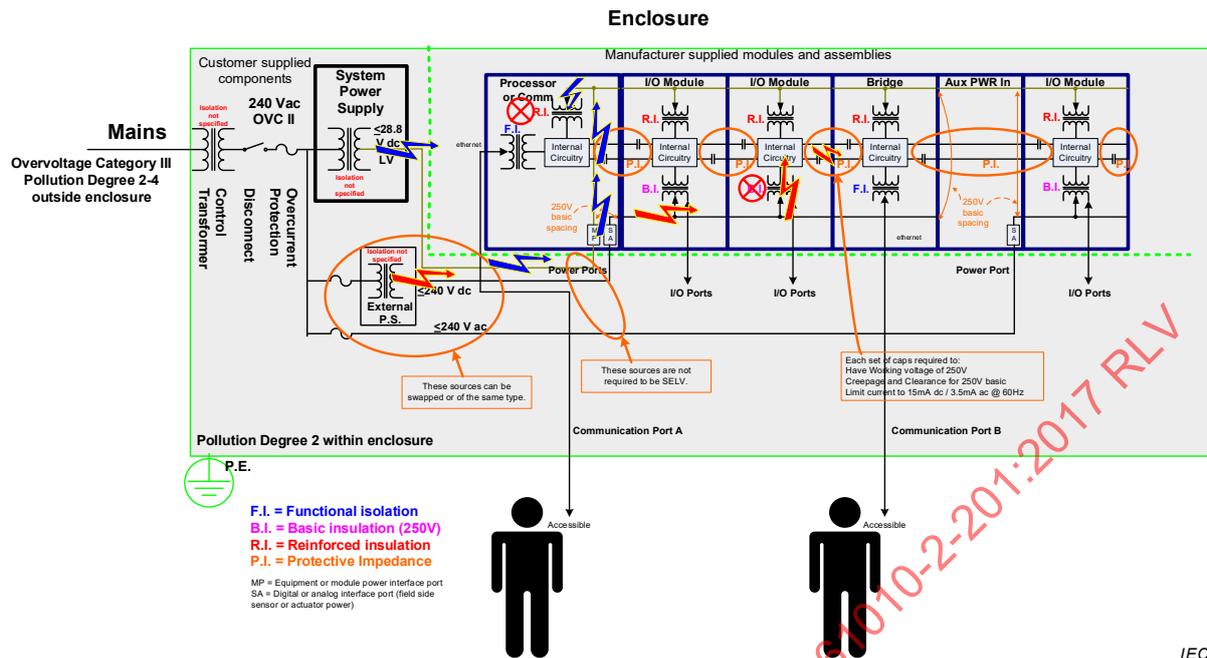
Referring to Figure BB.9, REINFORCED INSULATION, BASIC INSULATION and PROTECTIVE IMPEDANCE provide the method to handle single faults and maintain safety.

REINFORCED INSULATION is provided at module power. PROTECTIVE IMPEDANCE, by inter-module capacitors, and basic (supplementary) insulation is provided at the I/O.

Communication connections can be 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.



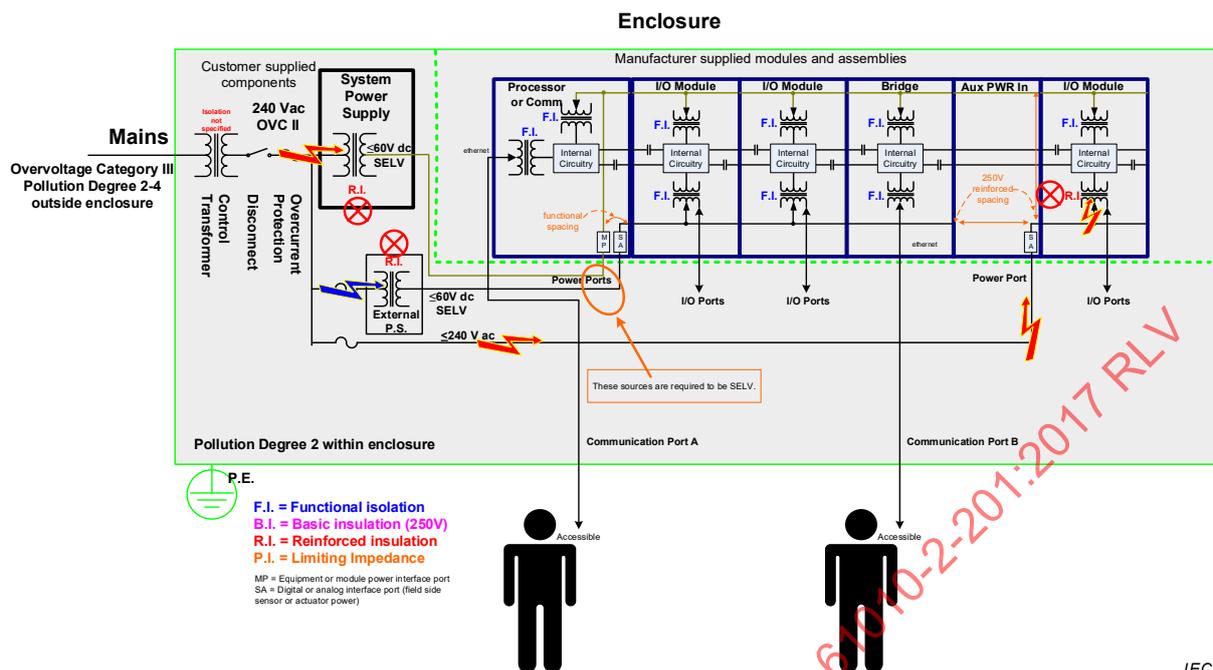
**Figure BB.9 – REINFORCED INSULATION, BASIC INSULATION and PROTECTIVE IMPEDANCE**

Referring to Figure BB.10, external power supplies provide REINFORCED INSULATION with SELV/PELV output levels and hence provide the method to handle single faults and maintain safety.

I/O, communication connections can be functional insulation, as they are not required to provide any protection.

REINFORCED INSULATION is necessary wherever any non-SELV/PELV power is applied, e.g. AC I/O.

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



**Figure BB.10 – REINFORCED INSULATION from external power supplies**

Referring to Figure BB.11, external power supplies provide BASIC INSULATION and hence provide a method to handle single faults and maintain safety.

BASIC INSULATION is also provided at all connections I/O. One failure of a BASIC INSULATION at the power supplies is allowed, but a second level of BASIC INSULATION is always present, at the I/O.

PROTECTIVE IMPEDANCE, by inter-module capacitors, and BASIC INSULATION can also be provided at the I/O. In this way a first failure is protected against.

Communication connections can be 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.

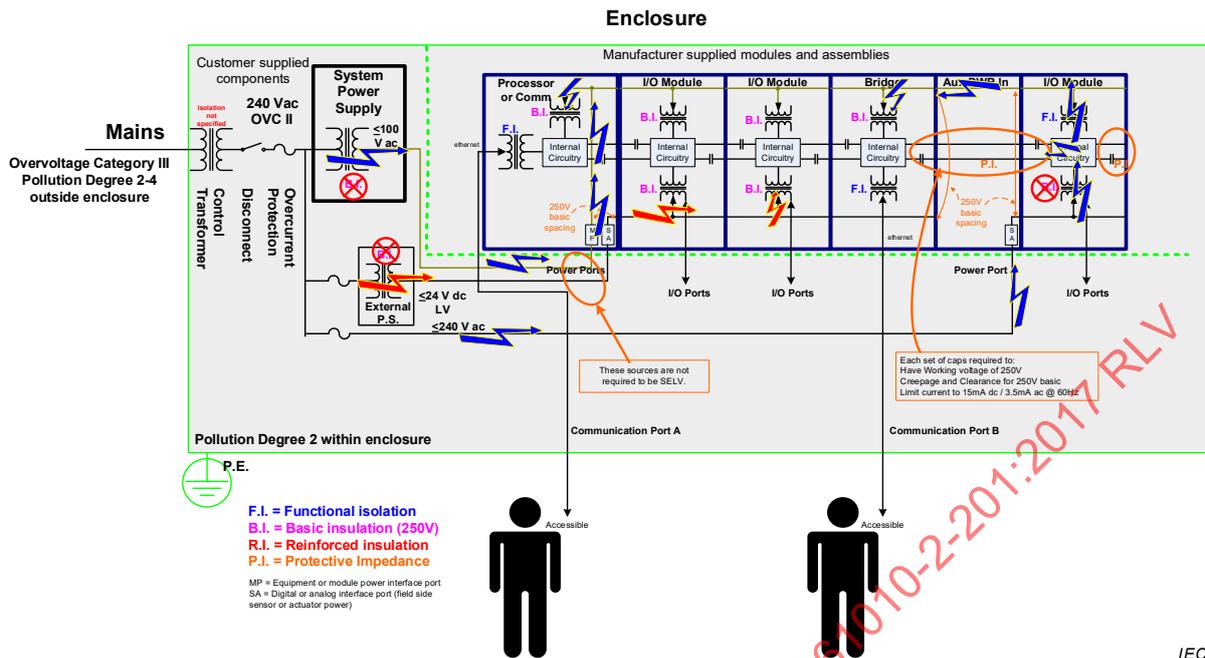


Figure BB.11 – BASIC INSULATION from external power supplies

These five scenarios are just a few of many which can be the basis of a control system electrical safety.

Whatever the method chosen, it is recommended it be documented in a drawing, such as shown here.

### BB.5 Conclusion

The development of a control equipment electrical safety drawing is invaluable in understanding and communicating the electrical safety and isolation in a system as it is developed. This can keep all parties involved in the original certification, as well as future participants making additions to an expandable system, on a consistent path.

## **Annex CC** (informative)

### **Historical techniques for secondary circuits**

#### **CC.1 Secondary circuits background**

Annex CC is meant to describe a set of circuits utilized historically in control equipment. These techniques are not recommended for new designs. Newer techniques have been devised and accepted into common practice eliminating the need for these circuits.

This annex is an overview and is not meant to be a complete description of these circuits, the techniques nor the requirements and conditions to utilize them. For a complete set of information on these circuits, see UL 508.

The circuits listed offered two areas of effect: controlling the provisions against electric shock and against spread of fire.

#### **CC.2 Secondary circuits without RISK of electrical shock**

##### **CC.2.1 General**

The following secondary circuits also do not pose a RISK of electrical shock and do not require additional evaluation for RISK against electrical shock:

- a) class 2 circuit;
- b) limited voltage/current circuit;
- c) limited voltage circuit;
- d) limited energy circuit that involves open circuit potential less than or equal to 30 V AC or 42,4 V peak;
- e) limiting impedance circuit.

These circuits are described in CC.2.2.1, CC.2.2.2, CC.2.2.3, CC.2.2.4 and CC.2.2.5.

##### **CC.2.2 Secondary circuits which do not pose a RISK of electrical shock**

###### **CC.2.2.1 Class 2 circuit**

A Class 2 circuit shall be supplied by an isolating source, providing DOUBLE INSULATION or REINFORCED INSULATION, which has a maximum output voltage of 42,4 V peak (sinusoidal or non-sinusoidal AC) or 60 V for continuous DC or 24,8 V peak for DC interrupted at a rate of 200 Hz or less with approximately 50 % duty cycle.

The maximum output current of a Class 2 source depends on whether it is inherently limited or not inherently limited. For inherently limited sources, Table CC.1 applies. For not inherently limited sources, Table CC.2 applies.

###### **CC.2.2.2 Limited voltage/current circuit**

A limited voltage/current circuit shall be supplied by an isolating source, providing DOUBLE or REINFORCED INSULATION, in such a way that the maximum open-circuit voltage available to the circuit is not more than AC 30 V r.m.s. and 42,4 V peak and the current available is limited to a value not exceeding 8 A measured after 1 min of operation.

The secondary winding of an isolating type transformer may be used to comply with this requirement.

A secondary fuse or other such secondary circuit protective device used to limit the available current shall be RATED at no more than 5,0 A for a circuit RATED less than, or equal to, 20 V peak, or 100 VA for a circuit RATED from 20 V to 30 V peak.

If the current-limiting device is provided in the MAINS CIRCUIT, there are no restrictions on its current RATING as long as it limits the available secondary current to 8 A.

#### **CC.2.2.3 Limited voltage circuit**

A limited voltage circuit shall be supplied by an isolating source, providing DOUBLE or REINFORCED INSULATION, with a maximum open-circuit voltage of not more than AC 30 V r.m.s. and 42,4 V peak without any limitation on the available current or volt-ampere capacity.

Overcurrent protection shall be provided to protect against burnout and damage to the secondary circuit cables/wiring insulation resulting from any overload or short-circuit condition. This protection may alternately be provided in the MAINS CIRCUIT by overcurrent protective devices provided with the control equipment or by branch circuit devices.

#### **CC.2.2.4 Limited energy circuit which involves open-circuit potential less than, or equal to, AC 30 V r.m.s. and 42,4 V peak**

A limited energy circuit shall be supplied by an isolating source, providing DOUBLE or REINFORCED INSULATION, in such a way that the maximum volt-ampere capacity available to the circuit is 200 VA or less at a maximum open-circuit voltage of less than or equal to AC 30 V r.m.s. and 42,2 V peak. The secondary winding of an isolating type transformer may be used to comply with this requirement. A primary or secondary fuse or other circuit protective device may be used to limit the maximum volt-ampere capacity.

#### **CC.2.2.5 Limiting impedance circuit**

A limiting impedance circuit shall be supplied by an impedance that complies with the following two requirements:

- a) the calculated power dissipation of the impedance, as the result of a direct short applied across the circuit downstream of the impedance, does not exceed the power RATING of the impedance, and
- b) the power dissipated in the impedance shall be less than 15 W.

If the above calculated power dissipation exceeds the RATING of the impedance, the impedance may still be used if the power is less than 15 W and if the impedance does not open or short when subjected to a direct short applied across the circuit downstream of the impedance.

The limiting impedance shall be able to function under SINGLE FAULT CONDITION unless the circuit limited by the impedance is enclosed.

A single resistor, or a single across-the-line capacitor approved per 14.101.1, is considered to comply with this limiting impedance requirement.

### **CC.3 Secondary circuits without RISK of spread of fire**

#### **CC.3.1 General**

The following secondary circuits also do not pose a RISK of spread of fire and do not require additional evaluation for RISK of spread of fire:

- a) class 2 circuit;
- b) limited voltage/current circuit;

- c) limiting impedance circuit;
- d) limited power circuit.

### CC.3.2 Secondary circuits which do not pose a RISK of spread of fire

#### CC.3.2.1 Class 2 circuit

See CC.2.2.1.

#### CC.3.2.2 Limited voltage/current circuit

See CC.2.2.2.

#### CC.3.2.3 Limiting impedance circuit

See CC.2.2.5.

#### CC.3.2.4 Limited power circuit

A limited power circuit is a circuit supplied by sources such as a battery or a transformer winding where the open-circuit potential is not more than AC 30 V r.m.s. and 42,4 V peak or DC 60 V, and the energy available to the circuit is limited according to one of the following means:

- a) the maximum output current and power are inherently limited to not more than the values of Table CC.1;
- b) the maximum output current under all conditions and power are limited by impedance to be not more than the values of Table CC.1;
- c) an over-current protective device limits the maximum output current and power to not more than the values of Table CC.2;
- d) a regulating network limits the maximum output current and power to not more than the values of Table CC.1 in NORMAL USE or as a result of one fault in the regulating network; or
- e) a regulating network limits the maximum output current and power to not more than the values of Table CC.1 in NORMAL USE, and an over-current protective device limits the output current and power to not more than the values of Table CC.2 as the result of any one fault in the regulating network.

Where an over-current protective device is used, it shall be a fuse or a non-adjustable non-self-resetting device.

**Table CC.1 – Limits of output current and output power for inherently limited power sources**

Open-circuit output voltage $U$		Maximum output current	Maximum output power
AC V r.m.s.	DC V		
$\leq 20$	$\leq 20$	8,0	$5 \times U$
$20 < U \leq 30$	$20 < U \leq 30$	8,0	100
	$30 < U \leq 60$	$150/U$	100

For non-sinusoidal AC and for DC with ripple exceeding 10 %, the peak voltage shall not exceed 42,4 V peak.

**Table CC.2 – Limits of output current, output power and RATINGS  
for over-current protective devices for non-inherently limited power sources**

Open-circuit output voltage $U$		Maximum output current A	Maximum output power $V \times A$	RATED current value of over-current protective device A
AC V r.m.s.	DC V			
$\leq 20$	$\leq 20$	$1\ 000/U$	250	$\leq 5$
$20 < U \leq 30$	$20 < U \leq 60$	$1\ 000/U$	250	$\leq 100/U$

RATED current values for over-current protective devices are for fuses and circuit-breakers which break the current within 120 s at a current value of 210 % of the value in the last column of Table CC.2.

Conformity is checked by measuring the output voltage, the maximum output current and the maximum available output power under the following conditions:

- 1) output voltage is measured in no-load condition;
- 2) output current and available power are measured after 60 s of operation, with any over-current protective devices short-circuited, with a resistive load (including short-circuit) which produces the highest value of current and power respectively.

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## **Annex DD** (normative)

### **Flammability test for magnesium alloy fire ENCLOSURES or flame barriers (see 9.3.2)**

#### **DD.1 General**

When magnesium alloy is used as a fire ENCLOSURE or a flame barrier, the flammability properties shall be determined to support the requirements of 9.3.2. The method described in Annex DD will demonstrate whether the material will ignite under typical conditions, and whether the flame, if it does ignite, will propagate long enough to cause a HAZARD of the spread of fire.

This method is similar to the method used for determining the flammability characteristics of plastics.

NOTE The test methods and conformance criteria of the 500 W Vertical Burning Test for plastic materials of ANSI/UL 94 are equivalent.

Conformity is checked as specified in Clause DD.2 to Clause DD.5. During the test and until 1 min after the last application of the test flame, the sample shall not ignite.

#### **DD.2 Samples**

One sample is tested, consisting of a complete fire ENCLOSURE or flame barrier.

#### **DD.3 Mounting of samples**

The sample is mounted and oriented as it would be in actual use.

#### **DD.4 Test flame**

The 500 W nominal test flame of IEC 60695-11-3 is used.

#### **DD.5 Test procedure**

The test flame is applied to an inside surface of the sample at a minimum of three points and a maximum of five points, including the section of the sample where the material is the thinnest, sections of the sample where ventilation or other openings are located, and sections of the sample that are located near a source of ignition. If it is not possible to apply the flame to the inside surface, it may be applied to the outside surface.

If a vertical part is involved, the flame is applied at an angle of approximately 20° from the vertical. If ventilation or other openings are involved, the flame is applied to an edge of an opening, otherwise to a solid surface. In all cases, the tip of the inner blue cone of the flame is to be in contact with the sample.

The flame is applied to each point for 5 s, removed for 5 s, then reapplied again to the same point until a total of five applications have been made to this point. After that, the flame is removed for 60 s, and then applied in the same manner to the next test point on the sample.

## Annex EE (informative)

### Information/documentation and correlation to its uses

Annex EE is not a certification requirement. It is included only to depict one of many many examples of how industrial components are combined together to form a useful application. Other industries have a similar or the same work flow.

This example focuses on how information/documentation, regarding safety aspects, might flow through the development process of that useful application.

As shown in Figure EE.1, component products generally shall be combined together with other products to execute some useful application. As such, the information/documentation has more of an installer, service, system designer focus rather than an end use focus and need.

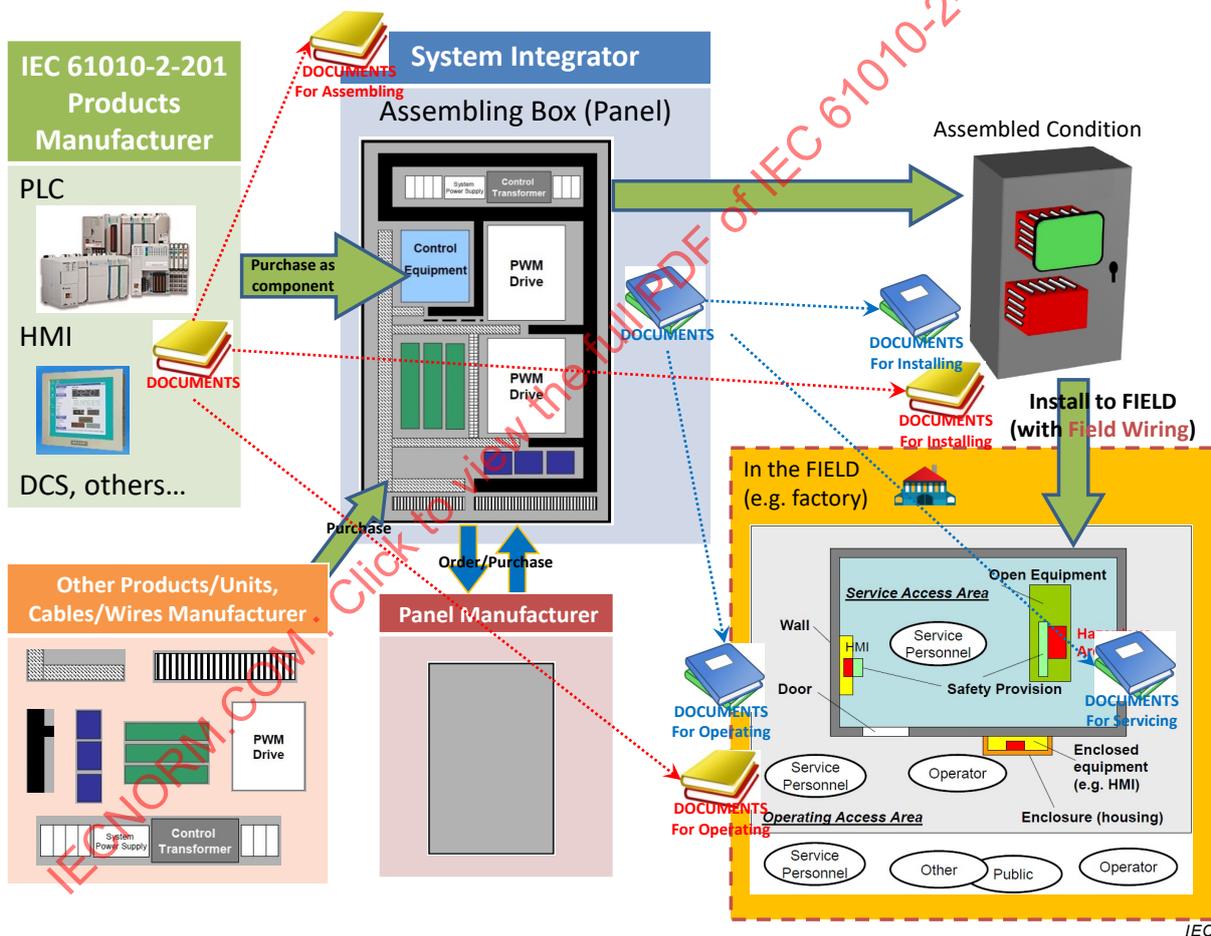


Figure EE.1 – Information/documentation for component products

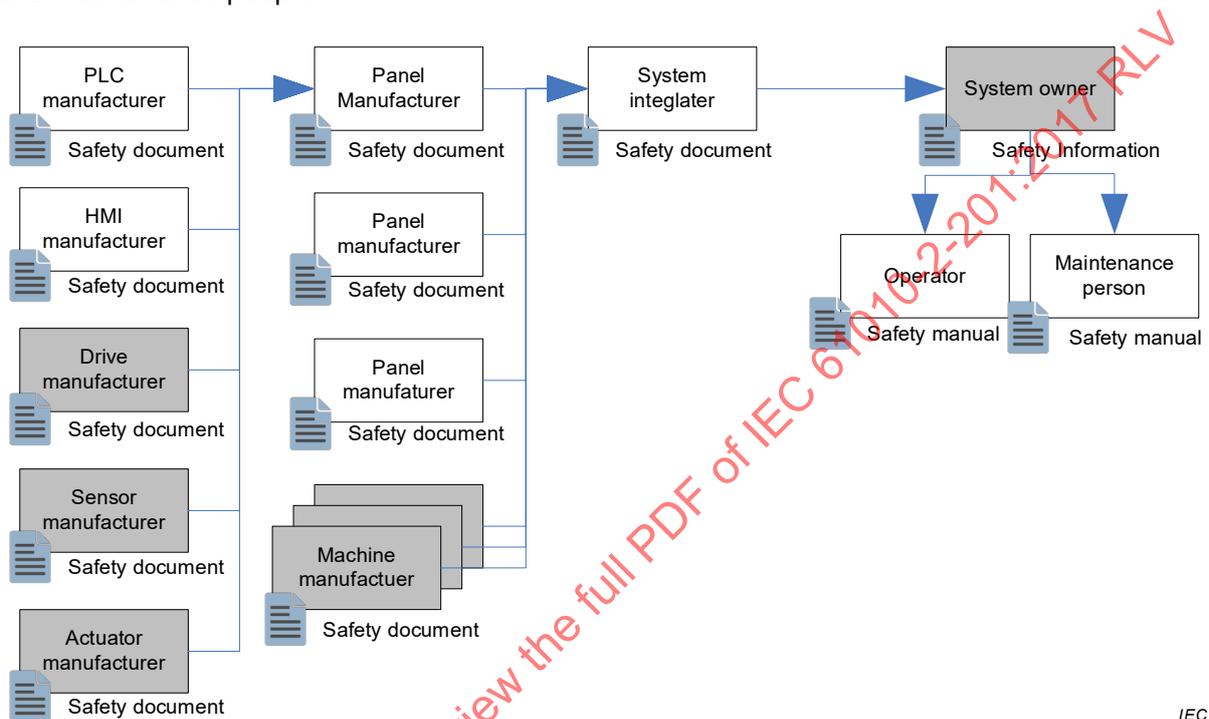
Figure EE.2 shows an example of safety information as it is collected, selected and differentially compiled for different end uses, with regard to some certain installation.

On the left are the documentation sets provided by the component manufacturers. These may include safety information (the focus in the example), programming information, specification information, end-of-life recycling information, warranty information, etc.

Moving to the right, next those components may be utilized by panel manufacturers to build their part of the overall installation. They might select parts of the information from each to the component manufacturers to include in their safety information to reformat, include and pass on with their own panel safety information.

At the next stage, a system integrator selects, reformats, and passes on his safety information which the system owner requested or the integrator feels the owner will need.

Lastly then the system owner may again partition the information targeted at his OPERATORS and maintenance people.



IEC

**Figure EE.2 – Information/documentation accumulation and segregation tree for an example installation**

This is one on many ways information/documentation of various types, threads its way from the manufacturer to the OPERATORS, maintenance personnel, etc.

**Annex FF**  
(informative)

**Measurement of CLEARANCES and CREEPAGE DISTANCES**

The following examples complement those examples given in IEC 61010-1:2010, Annex C.

These examples are presented to enhance explanation of situations commonly found in control equipment. Very often they occur in the cases where surface mount devices (SMD) are utilized on printed wiring boards (PWBs). SMD devices present situations where there can be minimal or no distance between a component and the PWB. This brings into focus the question of which CLEARANCE and CREEPAGE rules apply with regard to the component of some material group (MG) and the PWB when the distance between component and PWB shrinks to minimal values.

The methods of measuring CLEARANCES and CREEPAGE DISTANCES are indicated in the following Figure FF.1 and Figure FF.2. These cases do not differentiate between gaps and grooves or between types of insulation.

The following assumptions are made:

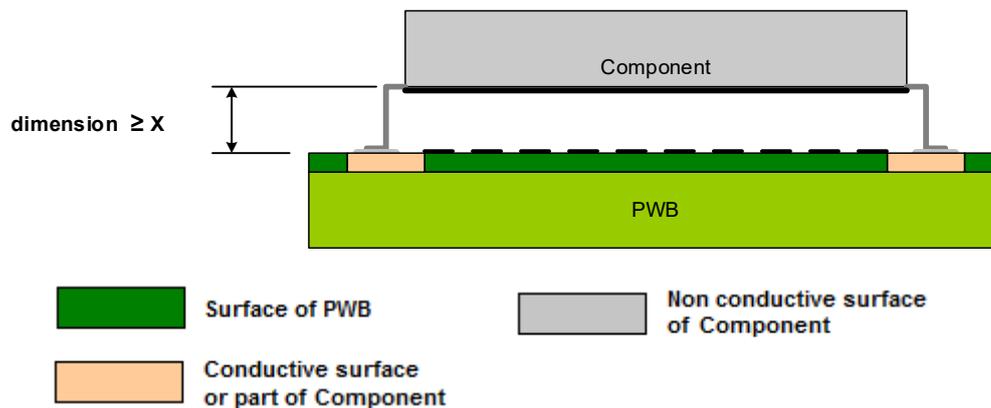
- a) where the distance across a groove is equal to or larger than  $X$  (see Table FF.1), the CREEPAGE DISTANCE is measured along the contours of the groove (see Figure FF.1);
- b) any recess is assumed to be bridged with an insulating link having a length equal to  $X$  and being placed in the least favourable position (see Figure FF.2);
- c) CLEARANCES and CREEPAGE DISTANCES measured between parts which can assume different positions in relation to each other are measured when these parts are in their least favourable position.

In the following examples dimension  $X$  has the value given in Table FF.1 depending on the POLLUTION DEGREE.

**Table FF.1 – Dimensions of  $X$**

POLLUTION DEGREE	Dimension $X$ mm
1	0,25
2	1,0
3	1,5

If the associated CLEARANCE is less than 3 mm, the dimension  $X$  in Table FF.1 may be reduced to one-third of this CLEARANCE.



**Figure FF.1 – The path a component mounted to a PWB (side view)**

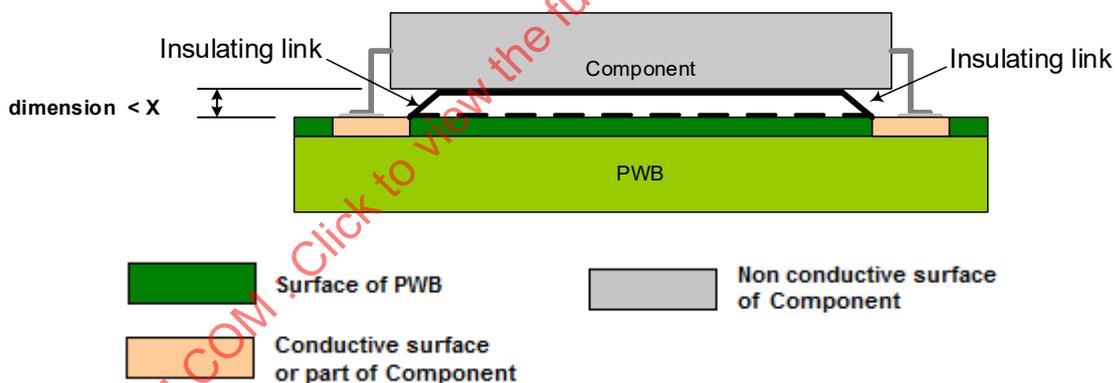
EXAMPLE Figure FF.1: The path a component mounted to a PWB (side view).

The CLEARANCE is the shortest direct air path across the top of the PWB.

The CREEPAGE DISTANCE follows the contour of the component, along the shortest path measured on any side of the component.

NOTE 1 When components have a lower MG value than the surface on which they are mounted, the critical distance can be along the surface of the component. If the surface of the component and the surface on which it is mounted have the same MG, the critical CREEPAGE DISTANCE can be the direct path along the surface of the PWB.

NOTE 2 The conductive contacts on a component might be positioned such that the shortest path might be above or beside the component, and not necessarily below the component as shown.



**Figure FF.2 – The path a component mounted to a PWB (side view)**

EXAMPLE Figure FF.2: The path a component mounted to a PWB (side view).

The CLEARANCE is the shortest direct air path across the top of the PWB.

The CREEPAGE DISTANCE follows the insulating links to the contour of the bottom of the component.

The MG of the various surfaces shall be taken into consideration.

NOTE 3 The measurement across the surface of the component starts where the link distance, value from Table FF.1, starting from the conductive contacts meets the surface of the component and continues to where the link distance from the opposite conductive contact meets the surface of the component.

NOTE 4 The conductive contacts on a component might be positioned such that the shortest path might be between these two contacts, or between one conductive contact and the conductive surface on the PWB, and not always between the two conductive surfaces on the PWB surface.

## Bibliography

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

### *Addition:*

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org>)

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60664-5, *Insulation coordination for equipment within low-voltage systems – Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm<sup>1</sup>*

IEC 60715, *Dimensions of low-voltage switchgear and controlgear – Standardized mounting on rails for mechanical support of electrical devices in switchgear and controlgear installations*

IEC 60721-2-3, *Classification of environmental conditions – Part 2-3: Environmental conditions appearing in nature – Air pressure*

IEC 61131-2:2007, *Programmable controllers – Part 2: Equipment requirements and tests*

IEC 61131-6, *Programmable controllers – Part 6: Functional safety*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61326 (all parts), *Electrical equipment for measurement, control and laboratory use – EMC requirements*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61643 (all parts), *Low-voltage surge protective devices*

IEC 61800 (all parts), *Adjustable speed electrical power drive systems*

IEC 62133, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*

IEC 62368 (all parts), *Audio/video, information and communication technology equipment*

IEC Guide 117, *Electrotechnical equipment – Temperatures of touchable hot surfaces*

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<sup>1</sup> Withdrawn.

ANSI/UL 94, *Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances*

UL 508, *Standard for Industrial Control Equipment*

UL 1059, *Standard for Terminal Blocks*

UL 1642, *Standard for Lithium Batteries*

UL 2054, *Standard for Household and Commercial Batteries*

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## COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**EXIGENCES DE SÉCURITÉ POUR APPAREILS ÉLECTRIQUES  
DE MESURAGE, DE RÉGULATION ET DE LABORATOIRE –****Partie 2-201: Exigences particulières pour les équipements de commande****AVANT-PROPOS**

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La Norme internationale IEC 61010-2-201 a été établie par le comité d'études 65 de l'IEC: Mesure, commande et automation dans les processus industriels.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
65/652/FDIS	65/657/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette deuxième édition annule et remplace la première édition parue en 2013. Cette édition constitue une révision technique.

Cette deuxième édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) clarification, modification et suppression des définitions sources de confusion,
- b) modification et clarification de la méthode d'essai des températures,
- c) modification des méthodologies de documentation admises,
- d) modification de quelques marquages de BORNES,
- e) clarification de certaines annexes informatives,
- f) ajout de l'Annexe E qui a elle-même fait l'objet de modifications,
- g) ajout des Annexes AA à FF.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

La présente Partie 2-201 est destinée à être utilisée conjointement avec l'IEC 61010-1. Elle a été établie sur la base de la troisième édition (2010) de cette norme. Les éditions ou amendements futurs de l'IEC 61010-1 peuvent également être pris en considération.

La présente Partie 2-201 complète ou modifie les articles correspondants de l'IEC 61010-1, de façon à transformer cette publication en norme IEC: *Exigences particulières pour les équipements de commande*.

Lorsqu'un paragraphe particulier de la Partie 1 n'est pas mentionné dans cette Partie 2, ce paragraphe s'applique pour autant que cela soit raisonnable. Lorsque la présente partie spécifie "addition", "modification", "remplacement" ou "suppression", il convient d'adapter l'exigence, la spécification d'essai ou la NOTE concernée de la Partie 1 en conséquence.

Dans la présente norme, les caractères d'imprimerie suivants sont employés:

- exigences et définitions: caractères romains;
- NOTES: petits caractères romains;
- *conformité et essais*: caractères italiques;
- termes utilisés dans l'ensemble de la présente norme, qui ont été définis à l'Article 3:  
PETITES MAJUSCULES EN CARACTERES ROMAINS.

Une liste de toutes les parties de la série IEC 61010, publiées sous le titre général *Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire*, peut être consultée sur le site web de l'IEC.

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## INTRODUCTION

Les documents IEC 61010-2-2xx forment une série de normes relatives à la sécurité des appareils de mesure, de régulation et d'automatisation des processus industriels.

La présente partie spécifie l'ensemble des exigences et essais de sécurité relatifs aux équipements de commande (p. ex.: automates programmables), aux composants des systèmes à commande répartie, aux appareils d'E/S et à l'interface homme/machine (IHM).

Les termes de sécurité d'usage général sont définis dans l'IEC 61010-1. Les termes plus spécifiques sont définis dans chaque partie de l'IEC 61010.

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## EXIGENCES DE SÉCURITÉ POUR APPAREILS ÉLECTRIQUES DE MESURAGE, DE RÉGULATION ET DE LABORATOIRE –

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

#### 1 Domaine d'application et objet

L'article de la Partie 1 s'applique avec les exceptions suivantes.

##### 1.1.1 Appareils inclus dans le domaine d'application

*Remplacement:*

- La présente partie de l'IEC 61010 spécifie les exigences de sécurité et les essais de vérification associés pour les produits remplissant la fonction d'équipements de commande et/ou leurs périphériques associés. L'utilisation prévue de ces produits consiste à contrôler et commander les machines, les processus industriels et de fabrication automatisés, par exemple par le biais d'un contrôle discret et continu. Les équipements suivants en sont des exemples: les automates programmables (PLC, Programmable Logic Controller);
- les contrôleurs d'automatisation programmables (PAC, Programmable Automation Controller);
- les systèmes à commande répartie (DCS, Distributed Control Systems);
- les systèmes d'E/S déportés;
- les ordinateurs (individuels) industriels et combinés PC-écran;
- les outils de programmation et de débogage (PADT, Programming and Debugging Tools);
- les affichages et les interfaces homme/machine (IHM);
- les positionneurs.

Les composants des équipements susmentionnés et relevant du domaine d'application de la présente norme sont:

- les alimentations autonomes (auxiliaires);
- les périphériques tels que les E/S numériques et analogiques, ainsi que les E/S déportés;
- les équipements de réseau industriels.

Les équipements de commande et leurs périphériques associés sont conçus pour être utilisés dans un environnement industriel et peuvent être fournis sous la forme d'EQUIPEMENTS OUVERTS ou SOUS ENVELOPPE.

NOTE 1 Les équipements de commande également conçus pour être utilisés dans d'autres environnements ou à d'autres fins (p. ex.: au sein de bâtiments pour commander l'éclairage ou d'autres installations électriques ou à bord de voitures, trains ou bateaux) peuvent faire l'objet d'exigences de conformité supplémentaires définies par la ou les normes de sécurité applicables à ces applications. Ces exigences peuvent concerner, par exemple, l'isolation, les espacements et les restrictions de puissance.

NOTE 2 Les calculateurs et équipements analogues relevant du domaine d'application de l'IEC 60950 (destiné à être remplacé par l'IEC 62368) et satisfaisant à ses exigences sont réputés être aptes à l'utilisation avec les équipements de commande relevant du domaine d'application de la présente norme. Cependant, certaines des exigences de l'IEC 60950 relative à la tenue à l'humidité et aux liquides sont moins sévères que celles de l'IEC 61010-1:2010, 5.4.4, deuxième alinéa.

Les équipements de commande couverts par la présente norme sont destinés à être utilisés dans des installations à basse tension de CATEGORIE DE SURTENSION II, III et IV (IEC 60664-1),

où la tension d'alimentation ASSIGNEE des équipements ne dépasse pas 1 000 V efficace en courant alternatif (50/60 Hz) ou 1 000 V en courant continu.

Les exigences du Guide ISO/IEC 51 et du Guide IEC 104, en rapport avec la présente partie de l'IEC 61010, sont intégrées au présent document.

### 1.1.2 Appareils exclus du domaine d'application

*Remplacement:*

La présente norme ne traite pas des aspects du système automatisé global, par exemple une chaîne de montage complète. Les équipements de commande (p. ex.: systèmes à commande distribuée et automates programmables), leurs programmes d'application et leurs périphériques associés sont considérés comme des composants (les composants dans ce contexte sont des éléments qui n'accomplissent aucune fonction utile) d'un système automatisé global.

Etant donné que les équipements de commande (p. ex.: systèmes à commande répartie et automates programmables) sont des appareils de type composants, les considérations relatives à la sécurité du système automatisé global portant sur l'installation et l'application ne relèvent pas du domaine d'application de la présente norme. Se reporter à la série IEC 60364 ou aux règlements nationaux/locaux applicables pour l'installation électrique et les lignes directrices.

#### 1.2.1 Aspects inclus dans le domaine d'application

*Remplacement:*

Les exigences de la présente norme ont pour objet d'assurer que tous les DANGERS pour l'OPERATEUR, le PERSONNEL D'ENTRETIEN et la zone environnante soient réduits à un niveau acceptable.

NOTE 1 En utilisant les termes "OPERATEUR" et "PERSONNEL D'ENTRETIEN", la présente norme prend en compte la perception des DANGERS en fonction de la formation et des compétences. L'Annexe AA propose une approche générale à cet égard.

Les exigences relatives à la protection contre des types particuliers de DANGERS sont données aux Articles 6 à 17, comme suit:

- a) les chocs électriques ou brûlures (voir Article 6);
- b) les DANGERS mécaniques (voir Articles 7 et 8);
- c) la propagation du feu issu des équipements de commande (voir Article 9);
- d) une température excessive (voir Article 10);
- e) les effets des fluides et de la pression des fluides (voir Article 11);
- f) les effets des radiations, y compris les sources laser, et de la pression acoustique et ultrasonique (voir Article 12);
- g) les émissions de gaz, les explosions et les implosions (voir Article 13);
- h) les dangers résultant d'un mauvais usage raisonnablement prévisible et des facteurs ergonomiques spécifiés (voir Article 16);
- i) une appréciation du RISQUE pour les DANGERS ou environnements qui ne sont pas entièrement couverts ci-dessus (voir Article 17).

NOTE 2 L'attention est attirée sur l'existence d'exigences supplémentaires concernant la santé et la sécurité des personnels.

#### 1.2.2 Aspects exclus du domaine d'application

*Remplacement:*

La présente norme ne couvre pas:

- a) la fiabilité, les fonctionnalités, les performances, ni les autres propriétés de l'équipement de commande qui ne sont pas liées à la sécurité;
- b) les exigences mécaniques ou climatiques relatives à l'exploitation, au transport ou à l'entreposage;
- c) les exigences relatives à la CEM (p. ex.: IEC 61326 ou IEC 61131-2);
- d) les mesures de protection relatives aux atmosphères explosives (p. ex.: série IEC 60079);
- e) la sécurité fonctionnelle (p. ex.: IEC 61508 ou IEC 61131-6).

## 2 Références normatives

L'article de la Partie 1 s'applique avec les exceptions suivantes.

*Addition:*

IEC 60384-14, *Condensateurs fixes utilisés dans les équipements électroniques – Partie 14: Spécification intermédiaire – Condensateurs fixes d'antiparasitage et raccordement à l'alimentation*

IEC 60664-1, *Coordination de l'isolement des matériels dans les systèmes (réseaux) à basse tension – Partie 1: Principes, exigences et essais*

IEC 60695-2-11, *Essais relatifs aux risques du feu – Partie 2-11: Essais au fil incandescent/chauffant – Méthode d'essai d'inflammabilité pour produits finis (GWEPT)*

IEC 60695-11-3, *Essais relatifs aux risques du feu – Partie 11-3: Flammes d'essai – Flammes de 500 W – Appareillage et méthodes d'essai de vérification*

IEC 60947-5-1, *Appareillage à basse tension – Partie 5-1: Appareils et éléments de commutation pour circuits de commande – Appareils électromécaniques pour circuits de commande*

IEC 61010-1:2010, *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 1: Exigences générales*

IEC 61010-2-030, *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 2-030: exigences particulières pour les circuits de test et de mesure*

IEC 61051-2, *Varistances utilisées dans les équipements électroniques – Partie 2: Spécification intermédiaire pour varistances pour limitations de surtensions transitoires*

IEC 61643-21, *Parafoudres basse tension – Partie 21: Parafoudres connectés aux réseaux de télécommunications – Prescriptions de fonctionnement et méthodes d'essais*

IEC 61643-311, *Composants pour parafoudres basse tension – Partie 311: Exigences de performance et circuits d'essai pour tubes à décharge de gaz (TDG)*

IEC 61643-321, *Composants pour parafoudres basse tension – Partie 321: Spécifications pour les diodes à avalanche (ABD)*

IEC 61643-331, *Composants pour parafoudres basse tension – Partie 331: Spécifications pour les varistances à oxyde métallique (MOV)*

### 3 Termes et définitions

L'article de la Partie 1 s'applique avec les exceptions suivantes.

#### 3.2.3

##### BORNE DE TERRE DE PROTECTION

*La correction ne concerne que le texte anglais.*

#### 3.5.11

##### OPERATEUR

*Addition:*

Note 1 à l'article: Voir définition de la Partie 1 et Annexe AA.

*Ajouter les termes et les définitions suivants:*

#### 3.101

##### TEMPERATURE AMBIANTE

température, déterminée dans des conditions prescrites, de l'air entourant l'équipement

#### 3.102

##### EQUIPEMENT SOUS ENVELOPPE

équipement qui comporte une ENVELOPPE dotée d'une fonction de sécurité ou une combinaison associant une ENVELOPPE dotée d'une fonction de sécurité ainsi que des dispositifs d'installation recouvrant toutes ses faces latérales, à l'exception de sa surface de montage parfois, destiné à empêcher le personnel de toucher accidentellement des parties sous TENSION DANGEREUSE, des parties chaudes ou en mouvement à l'intérieur de l'équipement et qui satisfait aux exigences de rigidité mécanique, d'inflammabilité et de stabilité (si applicable)

Note 1 à l'article: Les équipements portables et les EQUIPEMENTS TENUS EN MAIN sont des exemples d'EQUIPEMENT SOUS ENVELOPPE.

Note 2 à l'article: Cette définition est basée sur l'IEC 60050-441:2000, 441-12-02.

#### 3.103

##### ENVELOPPE

enceinte assurant le type et le degré de protection approprié pour l'application prévue

Note 1 à l'article: En général, une ENVELOPPE peut ne pas comporter de fonctions de sécurité, en fonction de son application prévue et de sa construction.

Note 2 à l'article: Dans la présente norme, il est pris pour hypothèse qu'une ENVELOPPE comporte des fonctions de sécurité, sauf spécification contraire.

[SOURCE: IEC 60050-195:1998, 195-02-35, modifiée – les notes à l'article ont été ajoutées.]

#### 3.104

##### CIRCUIT EXTERNE

circuit connecté par un RACCORDEMENT A L'INSTALLATION de l'équipement de commande

#### 3.105

##### RACCORDEMENT A L'INSTALLATION

câblage de l'équipement de commande, qui n'est pas installé dans les locaux du fabricant de l'équipement de commande

Note 1 à l'article: Les câblages d'alimentation, ainsi que les câblages d'entrée et de sortie analogiques et numériques sont des exemples de RACCORDEMENTS A L'INSTALLATION.

Note 2 à l'article: Le câblage (p. ex.: câblage préassemblé ou moulé) réalisé par le fabricant de l'équipement de commande n'est pas considéré comme un RACCORDEMENT A L'INSTALLATION.

**3.106****EQUIPEMENT MODULAIRE**

équipement comportant différents modules tels qu'un châssis, une unité centrale, différents modules d'E/S, des modules de réseau, etc.

Note 1 à l'article: Un EQUIPEMENT MODULAIRE peut:

- a) être un EQUIPEMENT OUVERT ou SOUS ENVELOPPE;
- b) comporter des modules ne pouvant pas fonctionner seuls ou un module principal capable de fonctionner seul et dont les fonctions peuvent être améliorées par des modules complémentaires;
- c) présenter une taille et des fonctionnalités variables selon la combinaison et le nombre de modules;
- d) être combiné à un équipement opérationnel ou être fonctionnellement amélioré grâce à l'ajout de modules par le client.

**3.107****EQUIPEMENT OUVERT**

équipement qui ne protège pas le personnel contre un contact accidentel des parties sous TENSION DANGEREUSE ou des parties en mouvement à l'intérieur de l'équipement et qui ne satisfait pas aux exigences de rigidité mécanique, d'inflammabilité et de la stabilité (si applicable)

Note 1 à l'article: Voir Annexe AA.

**3.108****OPERATEUR**

*Addition:*

Note 1 à l'article: Voir définition de la Partie 1 et Annexe AA du présent document.

**3.109****EQUIPEMENT MONTE SUR PANNEAU**

équipement dont une partie peut faire partie de l'ENVELOPPE

Note 1 à l'article: Voir Figure 103.

**3.110****EQUIPEMENT PORTABLE**

équipement conçu pour être tenu à la main et pas maintenu en position fixe en UTILISATION NORMALE

**3.111****CIRCUIT A TRES BASSE TENSION DE PROTECTION****CIRCUIT TBTP**

circuit électrique relié à la terre de protection dont la tension ne peut pas dépasser les valeurs suivantes:

CONDITION NORMALE et CONDITION DE PREMIER DEFAUT: Les niveaux de tension alternative sont de 30 V efficace, de 42,4 V crête et le niveau de tension continue est de 60 V. Pour un équipement destiné à être utilisé dans des EMBLEMES HUMIDES, les niveaux de tension alternative sont de 16 V efficace, de 22,6 V crête et le niveau de tension continue est de 35 V.

[SOURCE: IEC 60050-826-12-32:2004, modifiée – clarifiée et décrite de façon plus complète ]

**3.112****CIRCUIT A TRES BASSE TENSION DE SECURITE****CIRCUIT TBTS**

circuit électrique non relié à la terre de protection dont la tension ne peut pas dépasser les valeurs suivantes:

CONDITION NORMALE et CONDITION DE PREMIER DEFAUT: Les niveaux de tension alternative sont de 30 V efficace, de 42,4 V crête et le niveau de tension continue est de 60 V. Pour un équipement destiné à être utilisé dans des EMBLEMES HUMIDES, les niveaux de tension alternative sont de 16 V efficace, de 22,6 V crête et le niveau de tension continue est de 35 V.

[SOURCE: IEC 60050-826-12-31:2004, modifiée – clarifiée et décrite de façon plus complète]

### 3.113

#### PERSONNEL D'ENTRETIEN

personne disposant de la formation technique, de l'expérience et de la connaissance appropriées des DANGERS, ainsi que des mesures visant à réduire le plus possible les dangers encourus par elles-mêmes, par d'autres personnes ou par l'équipement de commande, dans un environnement industriel, lors de la modification ou réparation de l'équipement de commande

Note 1 à l'article: Le PERSONNEL D'ENTRETIEN désigne des personnes disposant de la formation technique, de l'expérience et de la connaissance appropriées des DANGERS (p. ex.: DANGERS électriques, DANGERS thermiques et DANGERS relatifs aux incendies) auxquels elles sont exposées en exécutant une tâche donnée, ainsi que des mesures visant à réduire le plus possible les dangers encourus par elles-mêmes, par d'autres personnes ou par l'équipement de commande, dans un environnement industriel.

Note 2 à l'article: Le PERSONNEL D'ENTRETIEN procède à des modifications ou réparations de l'équipement de commande (p. ex.: configuration matérielle ou installation des mises à jour logicielles fournies par le fabricant).

## 4 Essais

L'article de la Partie 1 s'applique avec les exceptions suivantes.

### 4.1 Généralités

*Addition:*

La conformité du produit avec la présente norme est vérifiée dans une configuration d'essai, définie par le fabricant, qui constitue la configuration la moins favorable. Voir 4.3.

Il peut exister différentes configurations d'essai produisant des conditions d'essai défavorables. Par exemple, il peut exister une configuration d'essai défavorable pour les essais en température, et une autre configuration d'essai défavorable pour l'essai de tension. Si tel est le cas, la ou les configurations d'essai les moins favorables appropriées doivent être utilisées selon 4.3.2 et 4.4.

Ces configurations d'essai moins favorables et les conditions d'essai doivent être pratiques et utiles pour les applications prévues.

*Vérification de la conformité: La ou les configurations d'essai ainsi que les conditions d'essai choisies doivent être documentées et justifiées dans le rapport d'essai.*

#### 4.4.2 Application des conditions de défaut

*Ajouter le paragraphe suivant:*

##### 4.4.2.101 Essais des appareils de commutation

###### 4.4.2.101.1 Essai de surcharge

Les appareils de commutation doivent fermer et ouvrir un circuit d'essai présentant les valeurs de courant, de tension et de facteur de puissance données au Tableau 101. Cinquante cycles, chacun se composant de 1 fermeture et de 1 ouverture, doivent être réalisés avec un temps d'OUVERTURE de 1 s et un temps de FERMETURE de 9 s. A la fin

des 50 cycles, l'équipement doit être soumis à l'essai d'endurance mentionné en 4.4.2.101.2, selon les exigences en 14.102.

**Tableau 101 – Valeurs du circuit d'essai de surcharge**

Charge prévue	Courant	Tension	Facteur de puissance
Usage général en AC	1,5 × VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	0,75 à 0,80
Usage général en DC	1,5 × VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	–
Résistance en AC	1,5 × VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	1,0
Résistance en DC	1,5 × VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	–
Essai pilote en AC <sup>a</sup>	VALEUR ASSIGNÉE <sup>a</sup>	1,1 × VALEUR ASSIGNÉE <sup>b</sup>	<0,35
Essai pilote en DC <sup>a</sup>	VALEUR ASSIGNÉE <sup>a</sup>	1,1 × VALEUR ASSIGNÉE <sup>b</sup>	–

NOTE 1 Source: IEC 60947-5-1.

NOTE 2 Essai pilote = caractéristiques assignées à un relais ou un commutateur qui commande la bobine d'un autre relais ou commutateur.

<sup>a</sup> Sauf spécification contraire, le courant d'appel doit être égal à 10 fois le courant en régime établi.

<sup>b</sup> Régler l'équipement à l'essai (EUT, *Equipment Under Test*) à la tension et au courant ASSIGNÉS, puis augmenter la tension de 10 % sans autre réglage de la charge.

*La conformité (réussite/échec) est déterminée lorsque l'équipement termine l'essai sans claquage électrique/mécanique et après un essai de tension diélectrique supplémentaire.*

#### 4.4.2.101.2 Essai d'endurance

A la fin de l'essai de surcharge en 4.4.2.101.1, l'appareil de commutation doit fermer et ouvrir un circuit d'essai présentant les valeurs de courant, de tension et de facteur de puissance données au Tableau 102. 6 000 cycles au total doivent être réalisés, chacun se composant de 1 fermeture et de 1 ouverture. Le cycle de fonctionnement doit être constitué d'un temps de FERMETURE de 1 s et d'un temps d'OUVERTURE de 9 s, sauf pour les 1 000 premiers cycles de l'essai pilote. Les 1 000 premiers cycles de l'essai pilote doivent être exécutés au rythme de 1 cycle par seconde, sauf pour les 10 à 12 premiers cycles qui doivent être aussi rapides que possible.

L'essai d'endurance peut ne pas être réalisé sur les appareils comportant des appareils de sortie statique destinés pour une charge générale ou résistive.

**Tableau 102 – Valeurs du circuit d'essai d'endurance**

Charge prévue	Courant	Tension	Facteur de puissance
Usage général en AC	VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	0,75 à 0,80
Usage général en DC	VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	–
Résistance en AC	VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	1,0
Résistance en DC	VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	–
Essai pilote en AC <sup>a</sup>	VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	<0,35
Essai pilote en DC <sup>a</sup>	VALEUR ASSIGNÉE	VALEUR ASSIGNÉE	–

NOTE 1 Source: IEC 60947-5-1.

NOTE 2 Essai pilote = caractéristiques assignées à un relais ou un commutateur qui commande la bobine d'un autre relais ou commutateur.

<sup>a</sup> Le circuit d'essai est identique au circuit d'essai de surcharge, à la différence que la tension est la tension ASSIGNÉE.

La conformité (réussite/échec) est déterminée lorsque l'équipement termine l'essai sans claquage électrique/mécanique et après un essai de tension diélectrique supplémentaire.

## 5 Marquage et documentation

L'article de la Partie 1 s'applique avec les exceptions suivantes.

### 5.1.5.2 BORNES

*Modification:*

Remplacer le point a) comme suit:

- a) Les BORNES DE TERRE FONCTIONNELLE (c'est-à-dire utilisées à d'autres fins que la sécurité, notamment pour une insensibilité renforcée aux brouillages) doivent être marquées par l'un des symboles suivants:



symbole 5 de la Partie 1, IEC 60417-5017 (2006-08).

Lorsqu'une BORNE est utilisée à la fois en tant que BORNE DE TERRE DE PROTECTION et en tant que BORNE DE TERRE FONCTIONNELLE, le symbole 6 ainsi que les autres exigences relatives à la BORNE DE TERRE DE PROTECTION doivent être appliqués. Lorsqu'une BORNE est utilisée à la fois en tant que BORNE (de liaison) de terre et en tant que BORNE DE TERRE FONCTIONNELLE, le symbole 5 ainsi que les autres exigences relatives aux BORNES de terre doivent être appliqués.

### 5.1.8 Boîtes à BORNES de RACCORDEMENT A L'INSTALLATION

*Ajouter après le premier alinéa:*

Une BORNE de RACCORDEMENT A L'INSTALLATION peut ne pas porter de marquage indiquant la température ASSIGNEE s'il est destiné à assurer la connexion d'un conducteur de circuit de commande seulement.

Un circuit de commande est tout circuit qui ne transporte pas l'alimentation RESEAU et qui est généralement limité à 15 A.

#### 5.4.1 Généralités

*Addition:*

Pour un équipement destiné à être installé par le PERSONNEL D'ENTRETIEN ou bien des installateurs qui ont été formés, la documentation exhaustive peut être fournie par support électronique.

Lorsque cette procédure est appliquée, le symbole 14 du Tableau 1 (ISO 7000-0434B:2004-01) peut être inscrit sur le produit et l'emplacement de la documentation (p. ex.: URL, code QR) peut être indiquée sur le produit, l'emballage ou dans les informations imprimées fournies avec le produit.

#### 5.4.3 Installation des appareils

*Addition:*

- h) EQUIPEMENT OUVERT: Si l'équipement de commande est classé dans la catégorie des EQUIPEMENTS OUVERTS, sa documentation doit spécifier l'ENVELOPPE qui doit être fournie par l'utilisateur (p. ex.: rigidité mécanique, INDICE IP).

NOTE Voir également 7.1.101 et 8.1.101.

*Modification:*

*Remplacer le point d) 1) comme suit:*

- d) 1) exigences relatives à l'alimentation et au RACCORDEMENT A L'INSTALLATION, par exemple l'isolation, les CARACTERISTIQUES ASSIGNEES de température;

#### **5.4.4 Fonctionnement de l'appareil**

*Modification:*

- j) détails des méthodes de réduction des RISQUES de brûlures sur des surfaces dont il est admis qu'elles dépassent les limites de température du 10.1, TABLEAU 19.

## **6 Protection contre les chocs électriques**

L'article de la Partie 1 s'applique avec les exceptions suivantes.

### **6.1.2 Exceptions**

*Remplacement:*

Si, pour des raisons de fonctionnement, il n'est pas possible d'empêcher que les parties suivantes ne soient ACCESSIBLES et ne deviennent des parties sous TENSION DANGEREUSE, elles peuvent être ACCESSIBLES à un PERSONNEL D'ENTRETIEN en UTILISATION NORMALE lorsqu'elles sont des parties sous TENSION DANGEREUSE:

Par exemple:

- a) parties de lampes et de douilles de lampes après retrait des lampes;
- b) parties destinées à être remplacées par un PERSONNEL D'ENTRETIEN (p. ex.: batteries) et qui peuvent devenir des parties sous TENSION DANGEREUSE pendant le remplacement ou une autre action effectuée par le PERSONNEL D'ENTRETIEN, mais seulement si elles ne sont ACCESSIBLES qu'au moyen d'un OUTIL et qu'elles comportent un marquage d'avertissement (voir 5.2);

Si l'une des parties citées dans les exemples a) et b) reçoit une charge d'un condensateur interne, elle ne doit pas devenir une PARTIE ACTIVE DANGEREUSE 10 s après la coupure d'alimentation.

*En cas de charge reçue d'un condensateur interne, la conformité est vérifiée par les mesures en 6.3 afin d'établir que les niveaux de 6.3.1 c) ne sont pas dépassés.*

### **6.2.1 Généralités**

Ce paragraphe de la Partie 1 est applicable à l'EQUIPEMENT SOUS ENVELOPPE.

### **6.2.2 Examen**

Ce paragraphe de la Partie 1 est applicable à l'EQUIPEMENT SOUS ENVELOPPE.

### **6.2.3 Ouvertures au-dessus de parties qui sont sous TENSION DANGEREUSE**

Ce paragraphe de la Partie 1 est applicable à l'EQUIPEMENT SOUS ENVELOPPE.

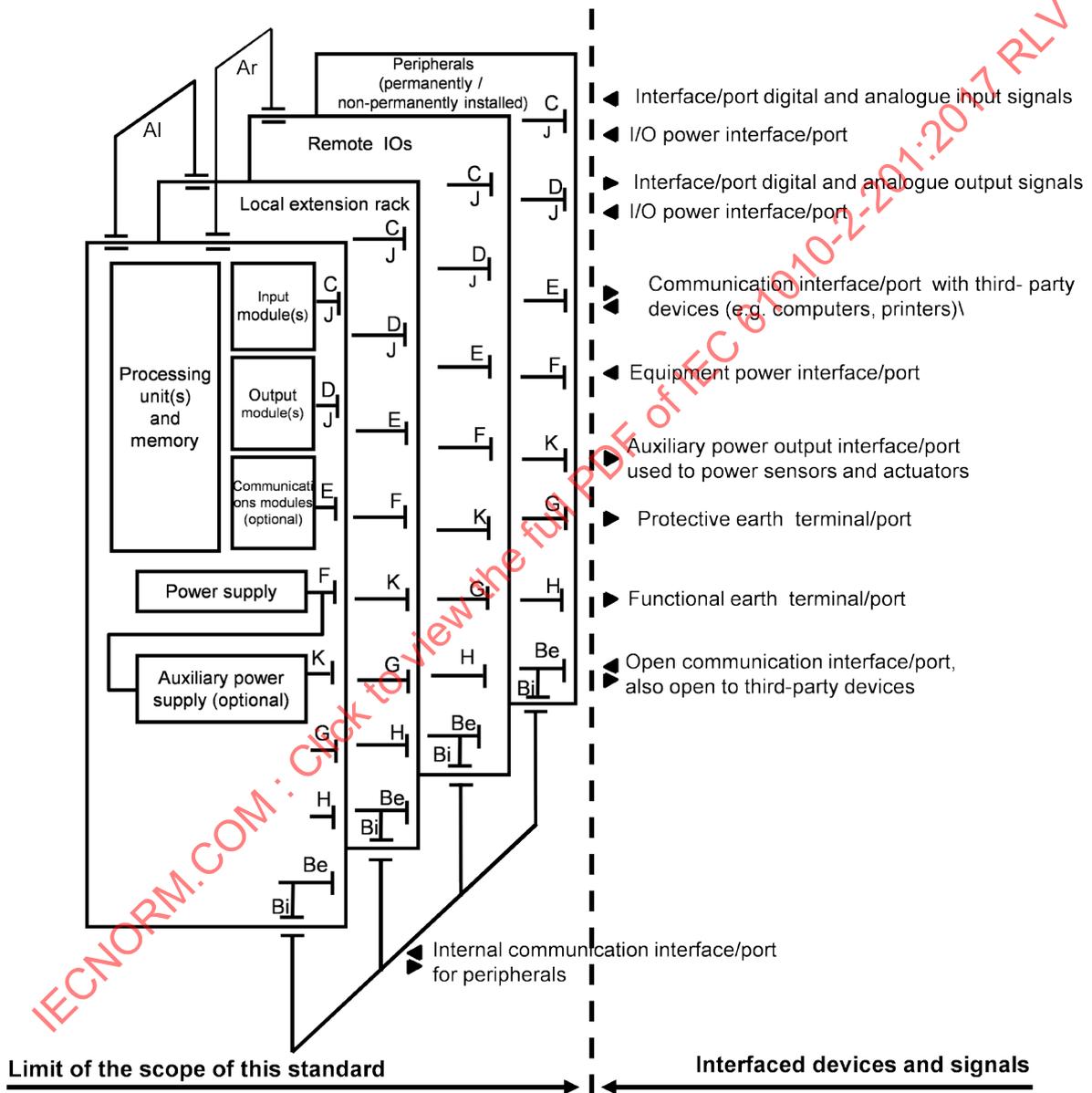
**6.2.4 Ouvertures d'accès aux commandes pré-réglées**

*Addition:*

Premier alinéa: Ce paragraphe de la Partie 1 est applicable à l'EQUIPEMENT SOUS ENVELOPPE. Ce paragraphe s'applique uniquement au PERSONNEL D'ENTRETIEN.

*Ajouter les paragraphes suivants:*

**6.2.101 Accessibilité des BORNES et des accès**



IEC

**Légende**

- AI Interface/accès de communication pour baie d'extension locale
- Ar Interface/accès de communication pour station d'E/S déportée, commande de réseau, bus de terrain
- Be Interface/accès de communication ouvert(e), également ouvert(e) aux appareils tiers, tels qu'un outil de programmation et de mise au point ou un ordinateur personnel utilisé pour la programmation
- Bi Interface/accès de communication interne pour périphériques
- C Interface/accès pour signaux d'entrée numériques et analogiques
- D Interface/accès pour signaux de sortie numériques et analogiques

- E Interfaces/accès de communication série ou parallèle pour la communication des données avec des appareils tiers (p. ex.: ordinateurs, imprimantes)
- F Interface/accès pour l'alimentation d'équipement
- G Accès/BORNE DE TERRE DE PROTECTION
- H Accès/BORNE DE TERRE FONCTIONNEL(LE)
- J Interface/accès d'E/S d'alimentation
- K Interface/accès de sortie d'alimentation auxiliaire utilisé(e) pour alimenter les capteurs et les actionneurs

Anglais	Français
Peripherals (permanently/non-permanently installed)	Périphériques (installés à titre permanent/non permanent)
Remote IOs	E/S à distance
Local extension rack	Baie d'extension locale
Processing unit(s) and memory	Unité(s) de traitement et mémoire
Input module(s)	Module(s) d'entrée
Output module(s)	Module(s) de sortie
Communications modules (optional)	Modules de communication (en option)
Power supply	Alimentation
Auxiliary power supply (optional)	Alimentation auxiliaire (en option)
Interface/port digital and analogue input signals	Interface/accès pour signaux d'entrées numériques et analogiques
I/O power interface/port	Interface/accès d'entrée/sortie d'alimentation
Interface/port digital and analogue output signals	Interface/accès pour signaux de sorties numériques et analogiques
Communication interface/port with third-party devices (e.g. computers, printers)	Interface/accès de communication avec des appareils tiers (par ex. des ordinateurs ou des imprimantes)
Equipment power interface/port	Interface/accès d'alimentation d'équipement
Auxiliary power output interface/port used to power sensors and actuators	Interface/accès de sortie d'alimentation auxiliaire utilisé(e) pour alimenter les capteurs et les actionneurs
Protective earthing terminal/port	Accès/borne de mise à la terre de protection
Functional earthing terminal/port	Accès/borne de terre fonctionnel(le)
Open communication interface/port, also open to third-party devices	Interface/accès de communication ouvert(e), également ouvert(e) aux appareils tiers
Internal communication interface/port for peripherals	Interface/accès de communication interne pour périphériques
Limit of the scope of this standard	Limite du domaine d'application de la présente norme
Interfaced devices and signals	Appareils avec interface et signaux

**Figure 101 – Schéma type d'interfaces/accès des équipements de commande**

Le Tableau 103 définit si les accès de l'équipement de commande sont ACCESSIBLES par l'OPERATEUR et exigent par conséquent une protection contre les chocs électriques. Outre les accès Ar, Be et E, une protection peut être obtenue en intégrant les parties sous TENSION DANGEREUSE à l'accès non ACCESSIBLE.

**Tableau 103 – Accès ACCESSIBLES par l'OPERATEUR pour les EQUIPEMENTS OUVERTS et les EQUIPEMENTS SOUS ENVELOPPE**

Accès	ACCESSIBLE PAR L'OPÉRATEUR <sup>c</sup>	
	EQUIPEMENT OUVERT	EQUIPEMENT SOUS ENVELOPPE
Al Interface/accès de communication pour baie d'extension locale	Non	Oui
Ar Interface/accès de communication pour station d'E/S déportée, commande de réseau, bus de terrain <sup>a</sup>	Oui	Oui
Be Interface/accès de communication ouvert(e), également ouvert(e) aux appareils tiers, tels qu'un outil de programmation et de mise au point ou un ordinateur personnel utilisé pour la programmation <sup>a</sup>	Oui	Oui
Bi Interface/accès de communication interne pour périphériques	Non	Non applicable <sup>b</sup>
C Interface/accès pour signaux d'entrée numériques et analogiques	Non	Oui
D Interface/accès pour signaux de sortie numériques et analogiques	Non	Oui
E Interfaces/accès de communication série ou parallèle pour la communication des données avec des appareils tiers (p. ex.: ordinateurs, imprimantes) <sup>a</sup>	Oui	Oui
F Interface/accès pour l'alimentation d'équipement	Non	Oui
G Accès/BORNE DE TERRE DE PROTECTION	Non	Oui
H Accès/ BORNE DE TERRE FONCTIONNEL(LE)	Non	Oui
J Interface/accès d'E/S d'alimentation	Non	Oui
K Interface/accès de sortie d'alimentation auxiliaire utilisé(e) pour alimenter les capteurs et les actionneurs	Non	Oui
<sup>a</sup> Les accès Ar, Be et E contiennent des circuits qui peuvent être connectés à d'autres équipements et doivent être considérés comme étant ACCESSIBLES. <sup>b</sup> L'accès Bi est un accès de communication interne. Par conséquent, par définition, il ne quitte jamais l'EQUIPEMENT SOUS ENVELOPPE. <sup>c</sup> Dans des circonstances particulières, certains accès d'UN EQUIPEMENT OUVERT ou SOUS ENVELOPPE peuvent ne pas être considérés comme étant ACCESSIBLES par l'OPERATEUR.		

Des dispositions doivent être prises afin que les parties ACCESSIBLES par l'OPERATEUR et les accès définis au Tableau 103 comme ACCESSIBLES par l'OPERATEUR = Oui ne deviennent pas des parties sous TENSION DANGEREUSE en conditions normales et en conditions de défaut simple.

La conformité est vérifiée par examen et, en cas de doute, une mesure et un essai sont réalisés selon 6.2.

**6.2.102 Equipement de commande**

**6.2.102.1 Parties ACCESSIBLES**

Les parties ACCESSIBLES de l'équipement de commande ne doivent pas être, ou en cas de défaut simple devenir, des parties sous TENSION DANGEREUSE. Bien qu'elles soient principalement destinées aux EQUIPEMENTS SOUS ENVELOPPE, ces exigences s'appliquent également aux EQUIPEMENTS OUVERTS. Lorsqu'elles sont appliquées aux EQUIPEMENTS OUVERTS, les équipements de commande doivent être considérés comme étant installés conformément aux instructions du fabricant. Voir également 5.4.3 et l'Annexe AA.

Si le PERSONNEL D'ENTRETIEN doit procéder à des ajustements, par exemple pendant la mise en service d'un EQUIPEMENT OUVERT, la protection contre les DANGERS encourus à proximité de l'ajustement doit être assurée afin d'éviter tout contact. Si le DANGER n'est pas signalé par une étiquette d'avertissement (voir 5.2), d'autres dispositifs doivent être mis en œuvre (p. ex.: ENVELOPPE de sécurité ou BARRIERE DE PROTECTION).

*La conformité est vérifiée par examen et examen selon 6.2.2.*

### **6.2.102.2 Circuits TBTS/TBTP**

Les circuits TBTS/TBTP n'exigent pas d'évaluation supplémentaire du RISQUE de chocs électriques, sous réserve que ces circuits se situent dans des endroits secs.

#### **6.5.2.1 Généralités**

*Addition:*

NOTE 101 Les BORNES de terre de protection et les contacts de mise à la terre ne sont pas connectés directement à la BORNE neutre des équipements. Cela n'empêche pas le raccordement d'appareils convenablement ASSIGNÉS (p. ex.: condensateurs ou limiteurs de surtensions) entre la BORNE DE TERRE DE PROTECTION et le neutre.

#### **6.5.2.6 Ecran de LIAISON DE PROTECTION des transformateurs**

*Modification:*

*Ajouter le second alinéa suivant:*

Si l'équipement de commande ne comporte aucune protection contre les surintensités au niveau de l'enroulement, le courant d'essai doit être égal à deux fois les caractéristiques assignées de l'appareil de protection contre les surintensités de l'équipement de commande (p. ex.: fusible, disjoncteur). Cet appareil de protection contre les surintensités peut être intégré à l'équipement de commande ou être spécifié dans le manuel.

*Ajouter les paragraphes suivants:*

#### **6.5.2.101 Classes d'équipements**

##### **6.5.2.101.1 Généralités**

Les classes d'équipements indiquent les moyens par lesquels la protection contre les chocs électriques est maintenue en CONDITION NORMALE et en conditions de défaut simple de l'équipement installé.

NOTE Découlent de l'IEC 61140:2001, Article 7.

##### **6.5.2.101.2 Equipements de Classe I**

Equipements qui assurent la protection contre les chocs électriques au moyen d'une ISOLATION PRINCIPALE. Ils permettent également de raccorder au conducteur de terre de protection les parties conductrices susceptibles d'être portées à des TENSIONS DANGEREUSES en cas de défaillance de l'ISOLATION PRINCIPALE.

NOTE Les équipements de Classe I peuvent comporter des parties possédant une DOUBLE ISOLATION ou une ISOLATION RENFORCEE, ou bien des parties fonctionnant à très basse tension de sécurité (TBTS).

Si un cordon souple est utilisé, il doit inclure un conducteur de terre de protection devant faire partie du cordon-connecteur.

Les parties conductrices ACCESSIBLES des équipements, qui peuvent devenir des parties sous TENSION DANGEREUSE en cas de défaut simple, doivent être connectées au circuit de protection des équipements. Les parties conductrices, telles que les vis, les rivets et les plaques signalétiques, qui pourraient devenir parties sous TENSION DANGEREUSE en conditions de défaut simple, doivent être protégées par d'autres dispositifs, tels qu'une DOUBLE ISOLATION/ISOLATION RENFORCEE, de manière à ce qu'elles ne deviennent pas des parties sous TENSION DANGEREUSE.

Lorsqu'une partie des équipements est retirée de l'ENVELOPPE à des fins de maintenance normale, par exemple, les circuits de protection couvrant d'autres parties des équipements ne doivent pas être coupés.

Les exigences de terre de protection sont spécifiées en 6.5.2.102 ou 6.5.2.103.

#### **6.5.2.101.3 Equipements de Classe II**

Equipements pour lesquels la protection contre les chocs électriques ne repose pas uniquement sur l'ISOLATION PRINCIPALE, mais également sur des précautions de sécurité supplémentaires (p. ex.: DOUBLE ISOLATION ou ISOLATION RENFORCEE). Il n'existe pas de dispositif de terre de protection ni de fiabilité en ce qui concerne les conditions d'installation.

Une IMPEDANCE DE PROTECTION peut être utilisée à la place d'une DOUBLE ISOLATION.

Des moyens maintenant la continuité des circuits sont admissibles (c'est-à-dire des composants internes mis à la terre ou des surfaces conductrices), à condition que ces circuits soient doublement isolés des circuits ACCESSIBLES de l'équipement.

Une connexion aux BORNES de terre dans un but fonctionnel est acceptable (p. ex.: antiparasitage), sous réserve que le système de DOUBLE ISOLATION soit fourni à des fins de protection.

L'équipement peut appartenir à l'un des types suivants:

- a) à isolation enveloppante avec une ENVELOPPE de matériau isolant durable et essentiellement continue qui entoure toutes les parties conductrices. Les pièces de petite taille (plaques signalétiques, vis et rivets) sont exclues si elles sont isolées des parties sous TENSION DANGEREUSE par une isolation au moins équivalente à une ISOLATION RENFORCEE;
- b) à protection métallique enveloppante comportant une ENVELOPPE en métal essentiellement continue, dans laquelle est utilisée une DOUBLE ISOLATION, sauf pour les parties où est utilisée une ISOLATION RENFORCEE;
- c) combinaison de a) et b).

NOTE 1 L'isolation enveloppante peut faire partie de l'ISOLATION SUPPLEMENTAIRE globale ou de l'ISOLATION RENFORCEE.

NOTE 2 L'utilisation d'une DOUBLE ISOLATION et/ou d'une ISOLATION RENFORCEE complète, avec un contact ou une BORNE DE TERRE DE PROTECTION, est considérée comme étant une construction de Classe I.

NOTE 3 Ces équipements peuvent comporter des parties fonctionnant à très basse tension de sécurité (TBTS).

#### **6.5.2.101.4 Equipements de Classe III**

Equipements qui assurent la protection contre les chocs électriques au moyen de circuits à très basse tension de sécurité (TBTS, TBTP). De plus, les tensions produites par ou dans ces équipements ne dépassent pas les limites de TBTS/TBTP.

Une connexion aux BORNES de terre dans un but fonctionnel est acceptable (p. ex.: antiparasitage).

Les câbles des circuits TBTS/TBTP doivent être isolés des câbles des circuits autres que des TBTS/TBTP, ou l'isolation de tous les conducteurs doit être assignée à la tension la plus élevée. Par ailleurs, un écran de protection relié à la terre ou un appareil d'isolation supplémentaire doit être prévu autour des câbles des circuits TBTS/TBTP ou autour des câbles des autres circuits, sur la base de l'IEC 60364-4-41.

### 6.5.2.102 Exigences de terre de protection pour les EQUIPEMENTS SOUS ENVELOPPE

Les parties ACCESSIBLES des équipements de Classe I (p. ex.: châssis, armature, parties métalliques fixes des ENVELOPPES métalliques) autres que celles qui ne peuvent pas devenir des parties sous TENSION DANGEREUSE, doivent être interconnectées électriquement et raccordées à une BORNE DE TERRE DE PROTECTION.

Cette exigence peut être satisfaite par des parties structurelles, sous réserve qu'elles assurent la continuité électrique adéquate. Elle s'applique aussi bien quand l'équipement est utilisé seul que lorsqu'il est intégré à un assemblage.

Les cordons ou câbles qui alimentent les périphériques des EQUIPEMENTS PORTABLES de Classe I doivent comporter un conducteur de terre de protection.

Les parties conductrices ACCESSIBLES isolées ne sont pas considérées comme un danger si elles sont implantées de telle manière qu'elles excluent tout contact avec les parties actives et qu'elles résistent à la tension d'essai diélectrique du Tableau 5 pour l'ISOLATION RENFORCEE, ce qui correspond à la tension de fonctionnement ASSIGNEE la plus élevée de l'unité.

Les équipements de Classe II peuvent posséder un conducteur fonctionnel interne de mise à la terre, mais ne doivent pas comporter une BORNE DE TERRE DE PROTECTION ou un conducteur de terre de protection dans le cordon d'alimentation de l'équipement.

Si les équipements comportent une BORNE DE TERRE DE PROTECTION (équipements de Classe I), les exigences suivantes s'appliquent également, en plus des spécifications générales de raccordement mentionnées précédemment.

- La BORNE DE TERRE DE PROTECTION doit être facilement ACCESSIBLE et placée de telle sorte que le raccordement des équipements au conducteur de terre de protection soit conservé lorsque le capot ou toute autre partie est retiré(e).
- Les produits destinés à être raccordés à l'aide du cordon d'ALIMENTATION (tels que les périphériques des équipements) doivent comporter une BORNE DE TERRE DE PROTECTION intégrée au capuchon ou à la prise (s'il s'agit d'un cordon-connecteur amovible).
- La BORNE DE TERRE DE PROTECTION doit être du type à vis, à plot ou à pression et doit être constituée de tout matériau approprié résistant à la corrosion.
- Les dispositifs de serrage des BORNES DE TERRE DE PROTECTION doivent être fixés de manière adéquate pour éviter un desserrage accidentel, et ne doivent pas pouvoir être desserrés sans l'aide d'un OUTIL.
- Les BORNES DE TERRE DE PROTECTION et les contacts de mise à la terre ne doivent pas être connectés directement à la BORNE neutre des équipements. Cela n'empêche pas le raccordement d'appareils convenablement assignés (p. ex.: condensateurs ou limiteurs de surtensions) entre la BORNE DE TERRE DE PROTECTION et le neutre.
- La BORNE DE TERRE DE PROTECTION et les autres dispositifs de protection internes à l'équipement doivent satisfaire aux exigences données de 6.5.2.4 ou 6.5.2.5.
- La BORNE DE TERRE DE PROTECTION ne doit pas avoir d'autre fonction.

### 6.5.2.103 Exigences de terre de protection pour les EQUIPEMENTS OUVERTS

Les EQUIPEMENTS OUVERTS doivent satisfaire aux exigences de 6.5.2.4 ou 6.5.2.5, à l'exception de la disposition selon laquelle le raccordement à un conducteur de protection externe peut être remplacé par une liaison à l'ENVELOPPE ACCESSIBLE par l'OPERATEUR.

## 6.6.1 Généralités

*Modification:*

*Remplacer la NOTE 2 comme suit:*

NOTE 2 Pour les câbles d'alimentation RESEAU, voir 6.10.

### **6.6.2 BORNES pour CIRCUITS EXTERNES**

*Modification:*

*Au début du paragraphe, ajouter ce qui suit:*

Toutes les parties des BORNES qui maintiennent le contact et transportent le courant doivent être construites dans un métal de résistance mécanique adéquate.

La conception mécanique des interfaces doit être réalisée de telle manière qu'aucun conducteur ne soit soumis à une flexion d'un rayon de courbure inférieur à six fois son diamètre après retrait des éléments de couverture (armure, gaines, matériaux de bourrage).

*La conformité est vérifiée par examen.*

Les DISTANCES D'ISOLEMENT entre les BORNES et entre la BORNE et les parties mises à la terre sont indiquées en 6.7.101.

### **6.6.3 Circuits avec BORNES qui sont sous TENSION DANGEREUSE**

*Remplacement:*

Ce paragraphe s'applique aux BORNES et aux accès (voir Tableau 103).

Aucune partie conductrice ACCESSIBLE des EQUIPEMENTS SOUS ENVELOPPE ne peut être une partie SOUS TENSION DANGEREUSE. En ce qui concerne les EQUIPEMENTS OUVERTS, les BORNES et les accès définis en Tableau 103 doivent être protégés.

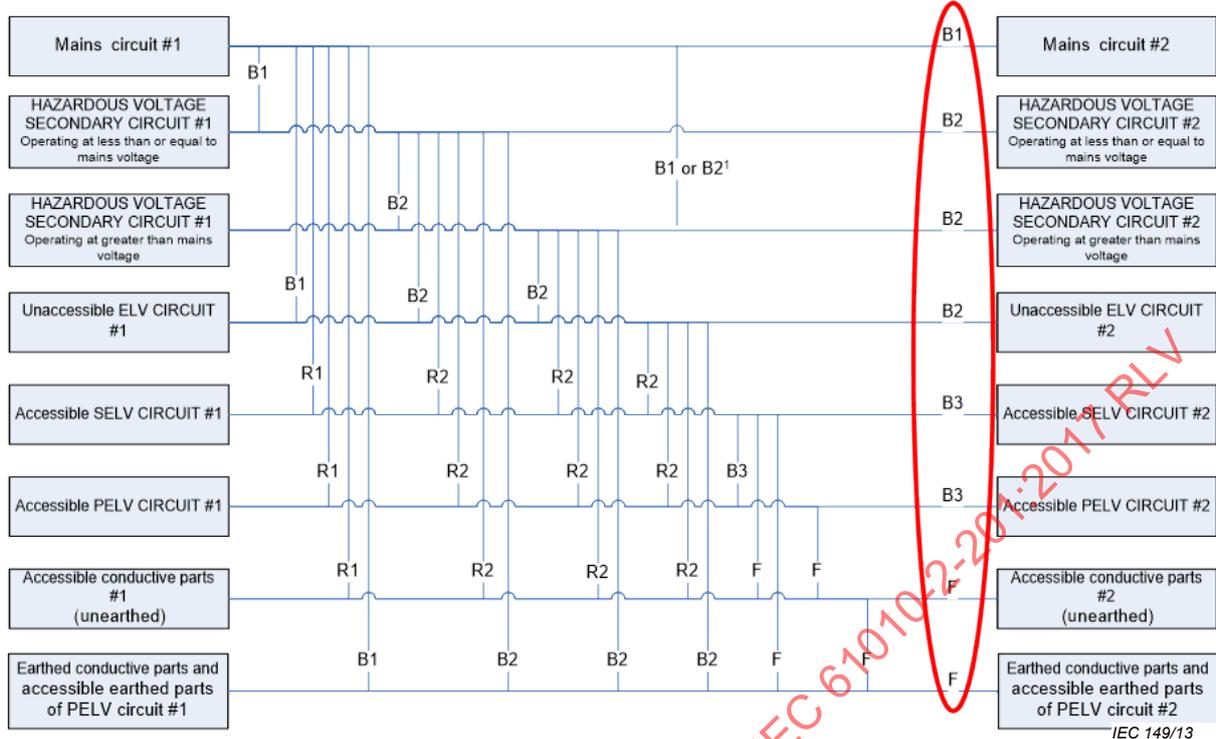
*La conformité est vérifiée par examen.*

#### **6.7.1.1 Généralités**

*Modification:*

*Ajouter après le premier alinéa:*

Les exigences relatives à l'isolation entre les différents circuits et entre les circuits et les parties conductrices ACCESSIBLES sont spécifiées à la Figure 102.



- B1 Le niveau de protection de base doit satisfaire aux exigences de 6.4. Les lignes de fuite, les DISTANCES D'ISOLEMENT et l'isolation solide doivent satisfaire aux exigences de 6.7.2.
- B2 Le niveau de protection de base doit satisfaire aux exigences de 6.4. Les lignes de fuite, les DISTANCES D'ISOLEMENT et l'isolation solide doivent satisfaire aux exigences de 6.7.3.
- B3 Le niveau de protection de base doit satisfaire aux exigences de 6.4. Les lignes de fuite, les DISTANCES D'ISOLEMENT et l'isolation solide doivent satisfaire aux exigences de 6.7.3. Cette règle peut être contournée si les essais de défaut mentionnés en 4.4 ne mettent en évidence aucun DANGER.
- R1 Le niveau de protection double/renforcé doit satisfaire aux exigences de 6.5. Les lignes de fuite, les DISTANCES D'ISOLEMENT et l'isolation solide doivent satisfaire aux exigences de 6.7.2.
- R2 Le niveau de protection double/renforcé doit satisfaire aux exigences de 6.5. Les lignes de fuite, les DISTANCES D'ISOLEMENT et l'isolation solide doivent satisfaire aux exigences de 6.7.3.
- F Isolation fonctionnelle. Aucun niveau spécifique n'est spécifié.

Les parties conductrices mises à la terre doivent satisfaire aux exigences de 6.5.2.4 ou 6.5.2.5.

Sur la droite, les éléments entourés en rouge peuvent uniquement s'appliquer aux considérations relatives à la propagation du feu de l'Article 9.

<sup>1</sup> Niveau d'isolation B1 ou B2 le plus élevé, selon la valeur la plus élevée des TENSIONS DE SERVICE de l'alimentation RESEAU et des circuits secondaires.

Anglais	Français
Mains circuit	Circuit réseau
HAZARDOUS VOLTAGE SECONDARY CIRCUIT	CIRCUIT SECONDAIRE DANGEREUX SOUS TENSION
Operating at less than or equal to mains voltage	Fonctionnant à une tension inférieure ou égale à la tension réseau
Operating at greater than mains voltage	Fonctionnant à une tension supérieure à la tension réseau
Unaccessible ELV CIRCUIT	CIRCUIT TBT inaccessible
Accessible SELV CIRCUIT	CIRCUIT TBTS accessible
Accessible PELV CIRCUIT	CIRCUIT TBTP accessible
Accessible conductive parts (unearthed)	Parties conductrices accessibles (non mises à la terre)
Earthed conductive parts and accessible earthed parts of PELV circuit	Parties conductrices mises à la terre et parties accessibles mises à la terre du circuit PELV
B1 or B2	B1 ou B2

**Figure 102 – Exigences relatives à l'isolation entre les différents circuits et entre les circuits et les parties conductrices ACCESSIBLES**

*Ajouter à la fin du paragraphe:*

Entre 1) les circuits TBTS ACCESSIBLES, 2) les circuits TBTP ACCESSIBLES ou 3) les parties ACCESSIBLES conductrices sans mise à la terre et les parties sous TENSION DANGEREUSE, deux niveaux de protection doivent exister: par exemple, a) DOUBLE ISOLATION, b) ISOLATION RENFORCEE, c) ISOLATION PRINCIPALE + LIAISON DE PROTECTION.

#### **6.7.1.2 DISTANCES D'ISOLEMENT**

*Addition:*

Une interpolation linéaire est admise entre les deux points les plus proches du Tableau 3. La DISTANCE D'ISOLEMENT minimale calculée à l'aide de ce coefficient multiplicateur doit être arrondie à l'incrément du dixième supérieur le plus proche.

#### **6.7.1.5 Exigences pour l'isolation suivant le type de circuit**

*Remplacement:*

Les exigences relatives à l'isolation entre les différents circuits et entre les circuits et les parties conductrices ACCESSIBLES sont spécifiées comme suit:

- a) à la Figure 102;
- b) dans l'IEC 61010-1:2010, Article K.3, pour les circuits présentant une ou plusieurs des caractéristiques suivantes:
  - 1) la surtension transitoire maximale possible est limitée par la source d'alimentation ou dans l'équipement à un niveau donné inférieur au niveau théorique pour le CIRCUIT RESEAU;
  - 2) la SURTENSION TRANSITOIRE maximale possible est supérieure au niveau théorique pour le CIRCUIT RESEAU;
  - 3) la TENSION DE SERVICE est égale à la somme des tensions issues de plusieurs circuits ou correspond à une tension mixte;
  - 4) la TENSION DE SERVICE comprend une tension de crête récurrente qui peut présenter une forme d'onde non sinusoïdale périodique ou une forme d'onde non périodique montrant une certaine régularité;
  - 5) la tension de service a une fréquence supérieure à 30 kHz;
- c) dans l'IEC 61010-1:2010, Article K.1, pour les CIRCUITS RESEAU de CATEGORIE DE SURTENSION III ou IV ou pour les CATEGORIES DE SURTENSION II (au-delà de 300 V);
- d) dans l'IEC 61010-1:2010, Article K.2 pour les circuits secondaires, où la séparation des circuits en c) est réalisée uniquement par un transformateur.

Les exigences relatives à l'isolation des circuits de mesure sont spécifiées dans l'IEC 61010-2-030.

NOTE Pour les exigences relatives aux circuits de commutation tels qu'une alimentation à découpage, voir l'IEC 61010-1:2010, Article K.3.

*Ajouter les paragraphes suivants:*

#### **6.7.1.101 Matériaux non métalliques supportant des parties sous TENSION DANGEREUSE**

Les matériaux non métalliques supportant des parties sous TENSION DANGEREUSE doivent posséder un indice de résistance au cheminement (IRC) supérieur ou égal à 175.

## 6.7.2 Isolation des CIRCUITS RESEAU de CATEGORIES DE SURTENSION II avec une tension nominale d'alimentation de 300 V

Modification:

Pour les CIRCUITS RESEAU dont la tension est supérieure à 300 V, voir l'Annexe K. Pour les Tableaux K.2, K.3 et K.4, une interpolation linéaire de la ligne de fuite est admise, mais la ligne de fuite ne peut jamais être en dessous de la DISTANCE D'ISOLEMENT.

### 6.7.2.1 DISTANCES D'ISOLEMENT et LIGNES DE FUITE

Modification:

Remplacer le Tableau 4 par le suivant:

**Tableau 4 – DISTANCES D'ISOLEMENT et LIGNES DE FUITE des CIRCUITS RESEAU de CATEGORIE DE SURTENSION II avec une tension maximale de 300 V**

Tension entre phase et neutre en courant alternatif efficace V <sup>c</sup>	Valeur des DISTANCES D'ISOLEMENT <sup>d</sup>			Valeur des LIGNES DE FUITE <sup>b</sup>								
	DEGRE DE POLLUTION 1	DEGRE DE POLLUTION 2	DEGRE DE POLLUTION 3	DEGRE DE POLLUTION 1		DEGRE DE POLLUTION 2			DEGRE DE POLLUTION 3			
	mm	mm	mm	CCI MG I, II, III mm	MG I, II, III mm	CCI MG I, II, IIIa mm	MG I mm	MG II mm	MG III mm	MG I mm	MG II mm	MG III mm
≤ 50	0,04	0,2 <sup>a</sup>	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 <sup>a</sup>	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

<sup>a</sup> Pour les cartes de circuit imprimées, les valeurs relatives au DEGRE DE POLLUTION 1 s'appliquent.

<sup>b</sup> Une interpolation linéaire de la ligne de fuite est admise. Cependant, la ligne de fuite ne peut jamais être en dessous de la DISTANCE D'ISOLEMENT.

<sup>c</sup> Les valeurs de crête en courant alternatif ou continu sont égales à  $\sqrt{2} \times$  les valeurs efficaces en courant alternatif indiquées.

<sup>d</sup> L'interpolation pour les DISTANCES D'ISOLEMENT n'est pas admise.

NOTE 1 Le tableau est extrait de l'IEC 60664-1.

NOTE 2 MG I = Groupe de matériaux I, CTI ≥ 600.

NOTE 3 MG II = Groupe de matériaux II, 600 > CTI ≥ 400.

NOTE 4 MG IIIa = Groupe de matériaux IIIa, 400 > CTI ≥ 175.

NOTE 5 MG IIIb = Groupe de matériaux IIIb, 175 > CTI ≥ 100.

NOTE 6 MG III = MG IIIa et MG IIIb.

NOTE 7 CCI = Carte de circuit imprimé.

NOTE 8 Les lignes de fuite indiquées dans ce tableau ont déjà augmenté et ne sont donc pas en dessous de la DISTANCE D'ISOLEMENT.

NOTE 9 Pour les cartes de circuit imprimé, la LIGNE DE FUITE minimale est de 0,04 mm.

Ajouter après la déclaration de conformité:

Dans la mesure où la conformité est vérifiée par examen et par des mesures, l'essai diélectrique n'est pas exigé.

Ajouter après la dernière déclaration de conformité:

NOTE 101 L'Annexe FF donne des exemples de cas particuliers de mesure des DISTANCES D'ISOLEMENT et des LIGNES DE FUITE.

### 6.7.2.2.1 Généralités

Ajouter la première ligne suivante:

Si la tension RESEAU ou secondaire est supérieure à 300 V, se reporter à l'Annexe K.

Remplacer le Tableau 5:

**Tableau 5 – Tensions d'essai de l'isolation solide entre le RESEAU D'ALIMENTATION et entre les CIRCUITS RESEAU et secondaires de CATEGORIE DE SURTENSION II avec une tension maximale de 300 V<sup>d</sup>**

Tension entre phase et neutre en courant alternatif efficace V <sup>a</sup>	Pour l'ISOLATION PRINCIPALE et l'ISOLATION SUPPLEMENTAIRE				Pour l'ISOLATION RENFORCÉE			
	Tensions d'essai, V				Tensions d'essai, V			
	Courant alternatif		Courant continu		Courant alternatif		Courant continu	
	5 s	1 min	5 s	1 min	5 s	1 min	5 s	1 min
≤ 50 <sup>b</sup>	1 250	300	1 750	420	2 500	600	3 500	850
≤ 100 <sup>c</sup>	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 Le tableau est extrait de l'IEC 60664-1.

<sup>a</sup> Les valeurs de crête en courant alternatif ou continu sont égales à  $\sqrt{2}$  × les valeurs efficaces en courant alternatif indiquées.

<sup>b</sup> Pour les produits à courant continu, cette plage se termine à 60 V.

<sup>c</sup> Pour les produits à courant continu, cette plage commence à 60 V.

<sup>d</sup> Aucun essai n'est nécessaire pour les circuits/unités TBTS/TBTP.

Remplacer le deuxième alinéa sur la conformité:

La conformité est vérifiée par inspection, et par l'essai en courant alternatif de 6.8.3.1 ou par l'essai en courant continu de 6.8.3.2, en utilisant la tension applicable du Tableau 5. L'essai de 1 min et l'essai de 5 s doivent être réalisés, ou un seul essai représentant la combinaison la plus défavorable des essais de 1 min et de 5 s.

NOTE 101 Par exemple, si un essai de 1 min à 1,1 kV et un essai de 5 s à 3 kV sont exigés, un seul essai de 1 min à 3 kV suffit.

### 6.7.3.1 Généralités

Modification:

Ajouter à la fin de l'alinéa:

Pour les CIRCUITS RESEAU dont la tension est supérieure à 300 V, voir Annexe K.

### **6.7.3.2 DISTANCES D'ISOLEMENT**

*Modification:*

*Remplacer le Tableau 6:*

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**Tableau 6 – DISTANCES D'ISOLEMENT et tensions d'essai des circuits secondaires dérivés des CIRCUITS RESEAU de CATEGORIE DE SURTENSION II avec une tension maximale de 300 V**

	Tension RESEAU, CATEGORIE DE SURTENSION II					
	≤100 V AC efficace <sup>b</sup>		≤150 V AC efficace <sup>b</sup>		≤300 V AC efficace <sup>b</sup>	
	Tension de choc ASSIGNEE de 500 V		Tension de choc ASSIGNEE de 800 V		Tension de choc ASSIGNEE de 1 500 V	
TENSION DE SERVICE secondaire V AC efficace <sup>b</sup>	DISTANCE D'ISOLEMENT mm <sup>a</sup>	Tension d'essai V AC efficace	DISTANCE D'ISOLEMENT mm <sup>a</sup>	Tension d'essai V AC efficace	DISTANCE D'ISOLEMENT mm <sup>a</sup>	Tension d'essai V AC efficace
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

<sup>a</sup> L'interpolation linéaire est admise.

<sup>b</sup> Les valeurs de crête en courant alternatif ou continu sont égales à  $\sqrt{2}$  × les valeurs efficaces en courant alternatif indiquées.

**6.7.3.3 LIGNES DE FUITE**

Modification:

Remplacer le titre de la première colonne du Tableau 7 de la Partie 1:

TENSION DE SERVICE secondaire en V AC efficace

Ajouter le paragraphe suivant:

### 6.7.101 LIGNES DE FUITE et DISTANCES D'ISOLEMENT minimales au niveau des BORNES DE RACCORDEMENT A L'INSTALLATION RESEAU, jusqu'à 1 000 V

Les DISTANCES D'ISOLEMENT minimales lors du raccordement à l'installation des BORNES, de BORNE à BORNE et de BORNE à ENVELOPPE conductrice, doivent satisfaire aux exigences du Tableau 104.

Les LIGNES DE FUITE minimales pour les BORNES DE RACCORDEMENT A L'INSTALLATION doivent être conformes au Tableau 104.

**Tableau 104 – LIGNES DE FUITE et DISTANCES D'ISOLEMENT minimales V au niveau des BORNES DE RACCORDEMENT A L'INSTALLATION RESEAU<sup>d, e</sup>, jusqu'à 1 000 V**

TENSION DE SERVICE V AC efficace  V <sup>c</sup>	DISTANCE D'ISOLEMENT au niveau des bornes mm			LIGNE DE FUITE au niveau des bornes mm	
	Cas général	CARACTÉRISTIQUES ASSIGNÉES limitées <sup>a, b</sup>	Aux parois des ENVELOPPES métalliques qui peuvent être infléchies	Cas général	CARACTÉRISTIQUES ASSIGNÉES limitées <sup>a, b</sup>
≤ 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 Le tableau est extrait de l'UL 508, de l'UL 1059 et de l'IEC 61131-2:2007.

<sup>a</sup> Applicable aux équipements de commande disposant de caractéristiques assignées inférieures ou égales à 15 A à ≤ 150 V, 10 A à 151 V – 300 V ou 5 A à 301 V – 600 V.

<sup>b</sup> Applicable aux équipements de commande qui commandent plus d'une charge, à condition que la charge totale connectée simultanément ne dépasse pas 30 A à ≤ 150 V, 20 A à 151 V – 300 V ou 10 A à 301 V – 600 V.

<sup>c</sup> Les valeurs de crête en courant alternatif ou continu sont égales à  $\sqrt{2}$  × les valeurs efficaces en courant alternatif indiquées.

<sup>d</sup> Pour la CATÉGORIE DE SURTENSION III et IV, le Tableau 104 et l'Annexe K doivent être appliqués.

<sup>e</sup> Pour les BORNES (et connecteurs) de RACCORDEMENT A L'INSTALLATION à tensions mixtes (p. ex.: TBTS 24 V et 230 V), la DISTANCE D'ISOLEMENT la plus élevée et la LIGNE DE FUITE la plus élevée pour la TENSION DE SERVICE la plus élevée entre les deux, du Tableau 104 ou de 6.7.2 doivent être utilisées.

La conformité est vérifiée par examen et par des mesures.

### 6.10 Raccordement à la source d'alimentation RESEAU et connexions entre les parties de l'appareil

Le paragraphe de la Partie 1 est applicable uniquement aux câbles d'alimentation RESEAU.

### 6.11 Sectionnement de la source d'alimentation

Le paragraphe de la Partie 1 ne s'applique pas.

NOTE 101 Ce paragraphe de la Partie 1 n'est pas utilisé pour la présente norme. Les pratiques et les codes locaux régissent l'aspect de l'installation et l'utilisation de l'équipement de commande.

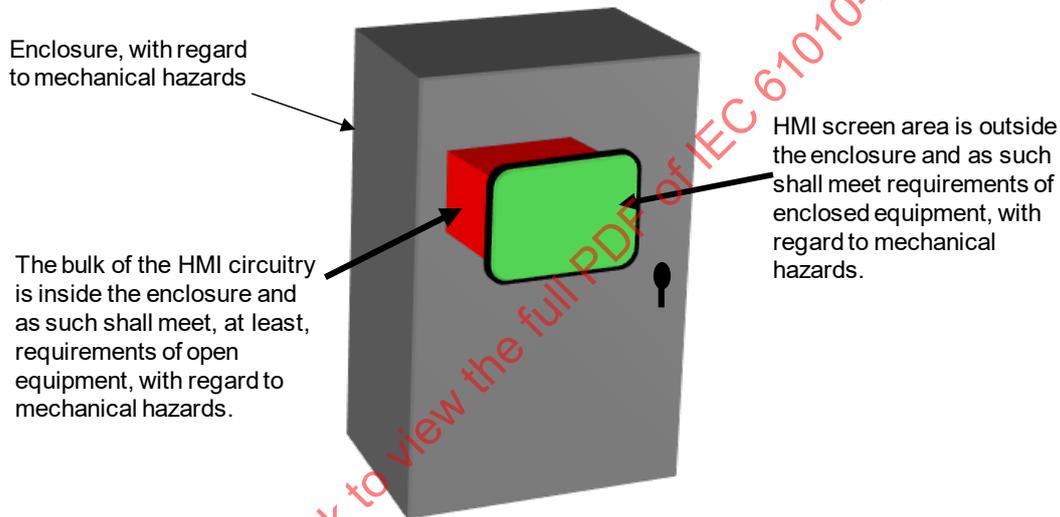
## 7 Protection contre les DANGERS mécaniques

L'article de la Partie 1 s'applique avec les exceptions suivantes.

*Ajouter le paragraphe suivant:*

### 7.1.101 EQUIPEMENTS OUVERTS et MONTES SUR PANNEAU

Les EQUIPEMENTS OUVERTS sont destinés à être installés dans une autre ENVELOPPE qui protège l'OPERATEUR contre les DANGERS, y compris les DANGERS mécaniques. La partie d'un EQUIPEMENT MONTE SUR PANNEAU qui se trouve à l'intérieur de l'ENVELOPPE peut être considérée comme un EQUIPEMENT OUVERT; cependant, la partie d'un équipement de commande qui ne se trouve pas à l'intérieur de l'ENVELOPPE et qui est ACCESSIBLE par un OPERATEUR doit être considérée comme faisant partie d'une ENVELOPPE assurant la protection contre les DANGERS potentiels et doit être évaluée selon l'Article 7.



IEC

Anglais	Français
Enclosure, with regard to mechanical hazard	Enveloppe de protection contre les dangers mécaniques
HMI screen area is outside the enclosure and as such shall meet requirements of enclosed equipment, with regard to mechanical hazards.	L'écran de l'IHM se trouve à l'extérieur de l'enveloppe. Par conséquent, il doit satisfaire aux exigences relatives aux équipements sous enveloppe pour ce qui a trait aux dangers mécaniques.
The bulk of the HMI circuitry is inside the enclosure and as such shall meet, at least, requirements of open equipment, with regard to mechanical hazards.	La plupart des circuits de l'IHM se trouvent à l'intérieur de l'enveloppe. Par conséquent, ces circuits doivent au moins satisfaire aux exigences relatives aux équipements ouverts pour ce qui a trait aux dangers mécaniques.

**Figure 103 – Exigences relatives aux DANGERS mécaniques pour les EQUIPEMENTS MONTES SUR PANNEAU**

## 7.2 Arêtes tranchantes

*Addition:*

NOTE 101 Les parties ou les zones uniquement ACCESSIBLES au PERSONNEL D'ENTRETIEN peuvent être prises en considération.

### 7.3.3 Appréciation du RISQUE pour les DANGERS mécaniques aux parties du corps

*Modification:*

*Ajouter après le premier alinéa, mais avant la déclaration de conformité:*

Si les ventilateurs de refroidissement constituent les seules parties mobiles d'un équipement de commande, seule l'accessibilité doit être vérifiée.

#### **7.3.4 Limitation de la force et de la pression**

Le paragraphe de la Partie 1 ne s'applique pas.

#### **7.3.5 Limitation des écartements entre les parties mobiles**

Le paragraphe de la Partie 1 ne s'applique pas.

#### **7.7 Parties éjectées**

Le paragraphe de la Partie 1 ne s'applique pas.

### **8 Résistance aux contraintes mécaniques**

L'article de la Partie 1 s'applique avec les exceptions suivantes.

#### **8.1 Généralités**

*Modification:*

*Remplacer le deuxième alinéa et sa liste de points par la phrase suivante:*

Le niveau normal de protection énergétique est de 6,8 J  $\pm$  5 %.

*Ajouter les paragraphes suivants:*

##### **8.1.101 EQUIPEMENTS OUVERTS**

Les EQUIPEMENTS OUVERTS sont destinés à être installés dans une autre ENVELOPPE qui assure leur sécurité, protégeant l'OPERATEUR contre les DANGERS.

##### **8.1.102 EQUIPEMENTS MONTES SUR PANNEAU**

La partie d'un EQUIPEMENT MONTE SUR PANNEAU qui se trouve à l'intérieur de l'ENVELOPPE peut être considérée comme un EQUIPEMENT OUVERT; cependant, la partie d'un équipement de commande qui ne se trouve pas à l'intérieur de l'ENVELOPPE et qui est ACCESSIBLE par un OPERATEUR doit être considérée comme faisant partie d'une ENVELOPPE assurant la protection contre les DANGERS potentiels et doit être évaluée selon l'Article 8.

#### **8.2.2 Essai de choc**

*Modification:*

*Remplacer le cinquième alinéa par le texte suivant:*

Chaque point d'essai est soumis à un choc réalisé en laissant tomber une sphère en acier lisse d'environ 50 mm de diamètre.

*Remplacer le neuvième alinéa (au-dessus de la Figure 10) par la phrase suivante:*

La dimension X et la masse sont déterminées par l'équation suivante:  $J = X \times m \times g$

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

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

NOTE 1 Les valeurs de la dimension X et de la masse sont approximativement 1,3 m et 0,5 kg selon cette formule.

NOTE 2 Les formules et les unités d'essai, notamment, sont dérivées à l'aide de la méthode d'essai pendulaire de l'IEC 60068-2-75.

### 8.3 Essai de chute

*Addition:*

Le présent paragraphe est applicable aux EQUIPEMENTS SOUS ENVELOPPE, pas aux EQUIPEMENTS OUVERTS.

## 9 Protection contre la propagation du feu

L'article de la Partie 1 s'applique avec les exceptions suivantes.

### 9.2 Elimination ou réduction de l'allumage à l'intérieur de l'appareil

*Modification:*

*Ajouter ce qui suit au point a) 1):*

NOTE L'isolation dans un circuit à limitation de puissance est considérée comme une isolation fonctionnelle.

*Ajouter au point a) 2), à la fin de l'alinéa, avant la déclaration de conformité:*

Voir également Figure 102.

#### 9.3.2 Exigences de construction

*Modification:*

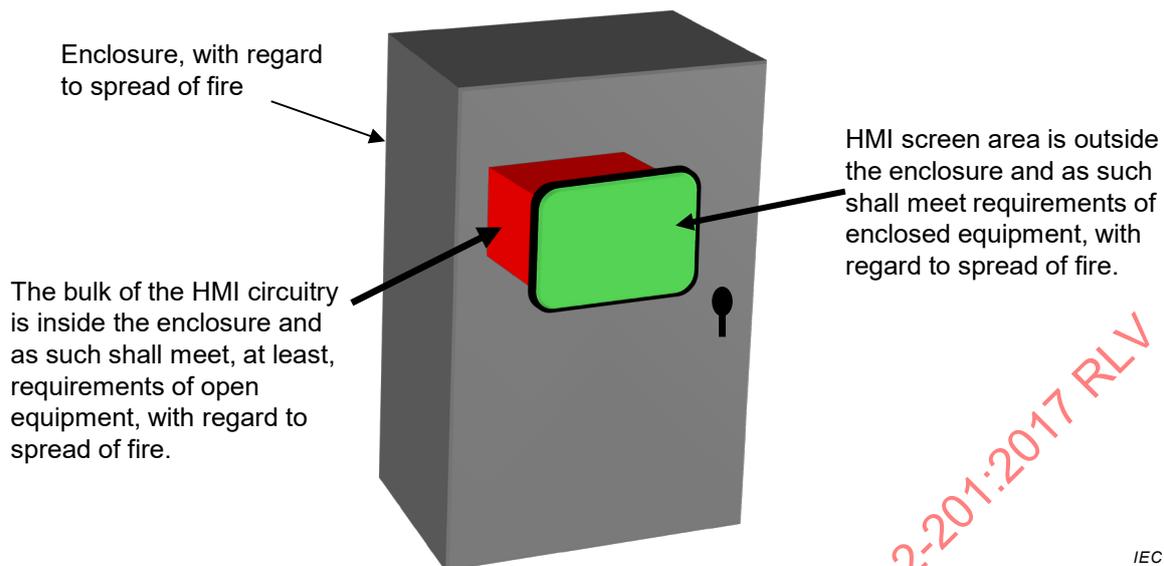
*A la fin du paragraphe, ajouter ce qui suit:*

Pour les éléments d'EQUIPEMENTS OUVERTS, a) et b) s'appliquent.

Pour les EQUIPEMENTS SOUS ENVELOPPE, a), b) et c) s'appliquent.

Si la partie d'un EQUIPEMENT MONTE SUR PANNEAU (voir Figure 104) qui constitue une partie de l'ENVELOPPE dans laquelle elle est montée est faite d'un matériau non métallique, elle doit présenter des CARACTERISTIQUES ASSIGNEES de propagation de la flamme au moins égales à V-1 ou être soumise à l'essai au fil incandescent décrit ci-dessous.

NOTE L'exemple représente un appareil à IHM monté sur panneau s'étendant sur la paroi d'une armoire.



Anglais	Français
Enclosure, with regard to spread of fire	Enveloppe de protection contre la propagation du feu
HMI screen area is outside the enclosure and as such shall meet requirements of enclosed equipment, with regard to spread of fire.	L'écran de l'IHM se trouve à l'extérieur de l'enveloppe. Par conséquent, il doit satisfaire aux exigences relatives aux équipements sous enveloppe, pour ce qui concerne la propagation du feu.
The bulk of the HMI circuitry is inside the enclosure and as such shall meet, at least, requirements of open equipment, with regard to spread of fire.	La plupart des circuits de l'IHM se trouvent à l'intérieur de l'enveloppe. Par conséquent, ces circuits doivent au moins satisfaire aux exigences relatives aux équipements ouverts pour ce qui concerne la propagation du feu.

**Figure 104 – DANGERS relatifs à la propagation du feu pour les EQUIPEMENTS MONTES SUR PANNEAU**

Les matériaux non métalliques qui ne sont pas des chicanes (voir IEC 61010-1:2010, Figure 12) ou des barrières coupe-flamme et qui ne font pas partie de l'ENVELOPPE n'exigent pas de CARACTERISTIQUES ASSIGNEES de propagation de la flamme.

Ajouter sous le point a) à la fin de la déclaration de conformité:

*ou, de manière facultative, en réalisant un essai au fil incandescent à 750 °C avec une application de 30 s et un temps d'extinction inférieur ou égal à 30 s conformément à l'IEC 60695-2-11.*

Remplacer le point c) 2) par le texte suivant:

L'ENVELOPPE et les chicanes ou les barrières coupe-flamme doivent être en métal ou en matériaux non métalliques appartenant au minimum à la classe d'inflammabilité V-1, conformément à l'IEC 60695-11-10. Si un alliage de magnésium est utilisé pour l'ENVELOPPE ou une barrière coupe-flamme, il doit être vérifié de la manière spécifiée à l'Annexe DD.

Remplacer la déclaration de conformité après le point 3) par le texte suivant:

*La conformité est vérifiée par examen. Si l'ENVELOPPE ou la barrière coupe-flamme est constituée d'un alliage de magnésium, l'essai d'inflammabilité de l'exigence c) 2) est réalisé de la manière spécifiée à l'Annexe DD. En cas de doute, la classification d'inflammabilité de l'exigence c) 2) est vérifiée en réalisant l'essai de combustion verticale de l'IEC 60695-11-10 sur des échantillons du matériau utilisé dans les parties concernées.*

## 10 Limites de température de l'appareil et résistance à la chaleur

L'article de la Partie 1 s'applique avec les exceptions suivantes.

### 10.1 Limites de température des surfaces pour la protection contre les brûlures

*Modification:*

*Remplacer le Tableau 19:*

**Tableau 19 – Limites de température de surface en CONDITION NORMALE**

Partie	EQUIPEMENT SOUS ENVELOPPE °C	EQUIPEMENT OUVERT °C
1 Surface extérieure de l'ENVELOPPE ou de la barrière (contact involontaire)		
a) métal nu ou anodisé	65	70
b) métal avec revêtement (peinture, non métallique)	80	85
c) plastique	85	85
d) verre et céramique	80	85
e) zones de petite taille (< 2 cm <sup>2</sup> ) non susceptibles d'être touchées en UTILISATION NORMALE	100	100
2 Boutons et poignées (contact en UTILISATION NORMALE)		
a) métal	55	55
b) plastique	70	70
c) verre et céramique	65	70
d) parties non métalliques qui, en UTILISATION NORMALE, ne sont maintenues que pendant de courtes périodes (entre 1 s et 4 s)	70	85
NOTE 1 En UTILISATION NORMALE, les surfaces pourraient être touchées par un OPERATEUR ou le PERSONNEL D'ENTRETIEN.		
NOTE 2 Ce tableau est basé sur le Guide IEC 117:2010.		

Pour les équipements présentant une température ambiante assignée supérieure à 40 °C, des températures supérieures sont possibles. Voir 10.1 de l'IEC 61010-1:2010. Voir 5.4.4, point j).

### 10.3 Autres mesures de température

*Modification:*

*A la fin du point a), ajouter ce qui suit.*

Cela ne s'applique pas au RACCORDEMENT A L'INSTALLATION des équipements de commande, par exemple les E/S ou les boîtes à BORNES servant au RACCORDEMENT A L'INSTALLATION des équipements de commande qui ne contiennent pas de parties consommant de l'énergie.

*Ajouter le point f):*

La température des BORNES DE RACCORDEMENT A L'INSTALLATION doit être surveillée pendant l'essai de température. Ces données doivent être utilisées en association avec la TEMPERATURE AMBIANTE ASSIGNEE de l'appareil pour déterminer les exigences de température de l'isolation du RACCORDEMENT A L'INSTALLATION.

### 10.4.1 Généralités

Remplacer ce paragraphe de la Partie 1 comme suit:

#### 10.4.1.100 Méthode générale

*L'équipement à l'essai (EUT) doit être soumis à l'essai dans les conditions d'essai de référence. La TEMPERATURE AMBIANTE d'essai de référence doit être identique à la TEMPERATURE AMBIANTE ASSIGNEE maximale, selon l'IEC 61010-1:2010, 1.4.1 c) ou 1.4.2.c).*

NOTE 1 Il peut être fait référence à la TEMPERATURE AMBIANTE ASSIGNEE par d'autres termes, tels que la température assignée de fonctionnement, ou par des abréviations, telles que Ta.

*Sauf spécification contraire relative à une CONDITION DE PREMIER DEFAUT particulière, les instructions du fabricant concernant la ventilation, le liquide de refroidissement, les limitations pour usage intermittent, etc., sont suivies. Tout liquide de refroidissement doit être à la température maximale ASSIGNEE.*

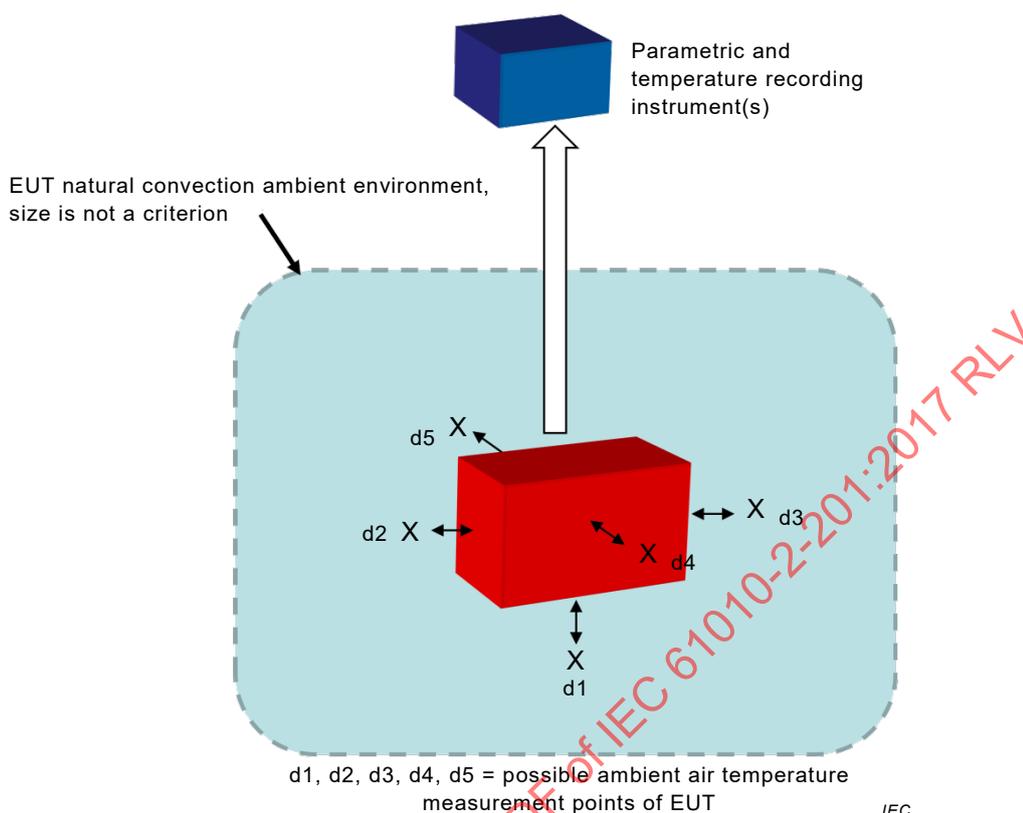
*L'EUT doit être monté dans sa position/son orientation la moins favorable.*

*L'EUT doit produire la dissipation de chaleur la plus défavorable. Cette dissipation peut être provoquée par une certaine combinaison de courant de charge, de tension d'entrée, de fréquence d'entrée, de cycle d'utilisation d'E/S, etc.*

*Le RACCORDEMENT A L'INSTALLATION de l'EUT doit être de la plus petite taille possible, tout en satisfaisant aux CARACTERISTIQUES ASSIGNEES de courant maximal de l'EUT conformément aux instructions du fabricant.*

*L'environnement de la salle/l'enceinte/la boîte d'essai (la taille n'étant pas un critère d'essai) qui entoure l'EUT ne doit pas être soumis à des mouvements d'air provoqués par des sources ne faisant pas partie de l'EUT. En d'autres termes, il doit s'agir d'un environnement par convection naturelle. Voir la Figure 105.*

NOTE 2 Afin de réduire et bloquer le mouvement d'air forcé dans une salle d'essai ou une enceinte climatique autour de l'EUT, l'EUT peut être placé dans une boîte d'essai partiellement ou complètement fermée laissant uniquement passer le mouvement d'air/la convection naturelle produits par l'EUT. Sinon, des barrières constituées d'un matériau adapté pourraient être utilisées autour de l'EUT afin de bloquer le mouvement d'air.



Anglais	Français
EUT natural convection ambient environment, size not a criteria	Environnement ambiant de convection naturelle de l'EUT, la taille n'étant pas un critère
Parametric and temperature recording instrument(s)	Instrument(s) paramétrique(s) et destiné(s) à enregistrer la température
d1, d2, d3, d4, d5 = possible ambient air temperature measurement points of EUT	d1, d2, d3, d4, d5 = points de mesure possibles de la température à l'air ambiant de l'EUT

**Figure 105 – Environnement d'essai de température général**

Les températures sont mesurées lorsque le régime établi est atteint.

Si l'EUT est destiné à fonctionner en tant qu'unité autonome, il doit être soumis à l'essai indépendamment (p. ex.: IHM autonome ou commutateur/routeur de communications).

Si l'EUT n'est pas destiné à fonctionner en tant qu'unité autonome (p. ex.: module d'E/S d'un système d'EQUIPEMENT MODULAIRE), un système représentatif doit être utilisé pour les essais. Ce système doit représenter une combinaison pratique des conditions les plus défavorables pour l'EUT.

NOTE 3 Une combinaison pratique des conditions les plus défavorables désigne une situation réaliste, où l'EUT peut être utilisé dans une application réelle, et non une combinaison théorique qui ne serait jamais utilisée dans la pratique.

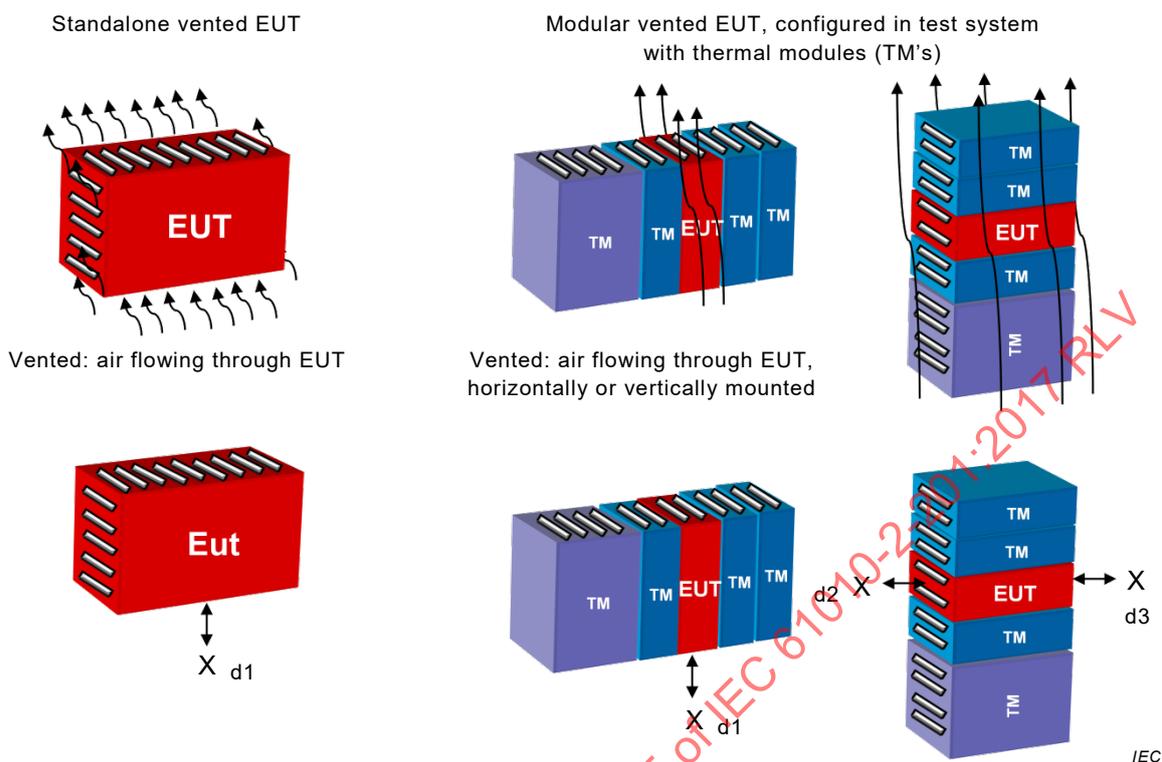
Cette combinaison pratique des conditions les plus défavorables doit inclure, au minimum, les éléments nécessaires au fonctionnement de l'EUT, par exemple l'alimentation, le module de communication (modules thermiques de la Figure 106) et l'EUT. Dans les limites où la documentation du fabricant l'admet, l'EUT doit être encadré de chaque côté par des modules réels ou des "modules de simulation" (module thermique représentatif, TM à la Figure 106) reproduisant les conditions thermiques les plus défavorables pour l'environnement de l'EUT. Autrement dit, l'ajout de davantage de modules autour de l'EUT ne provoque pas d'augmentation de sa température. La configuration de l'essai doit être justifiée dans le rapport d'essai.

Les éléments suivants pourraient constituer des exemples de configurations d'essai d'un EUT avec module d'E/S au sein d'un système modulaire:

- l'EUT (module d'E/S);
- une alimentation;
- un module de communication;
- trois modules d'E/S du même type fonctionnant en pleine charge à la gauche de l'EUT;
- trois modules d'E/S du même type fonctionnant en pleine charge à la droite de l'EUT;
- l'ajout de modules d'E/S complémentaires à gauche ou à droite de l'EUT n'entraîne pas une variation de température de l'EUT.

Pour un équipement ventilé, refroidi par convection naturelle de l'air, la TEMPERATURE AMBIANTE est la température de l'air entrant à un point situé à une distance comprise entre 25 mm et 50 mm du plan du point d'entrée de la circulation d'air de l'équipement. Voir la Figure 106. Les points d1, d2 et d3 de la Figure 106 sont les points de mesure possibles. Il convient de prendre le point présentant la température la plus basse comme TEMPERATURE AMBIANTE.

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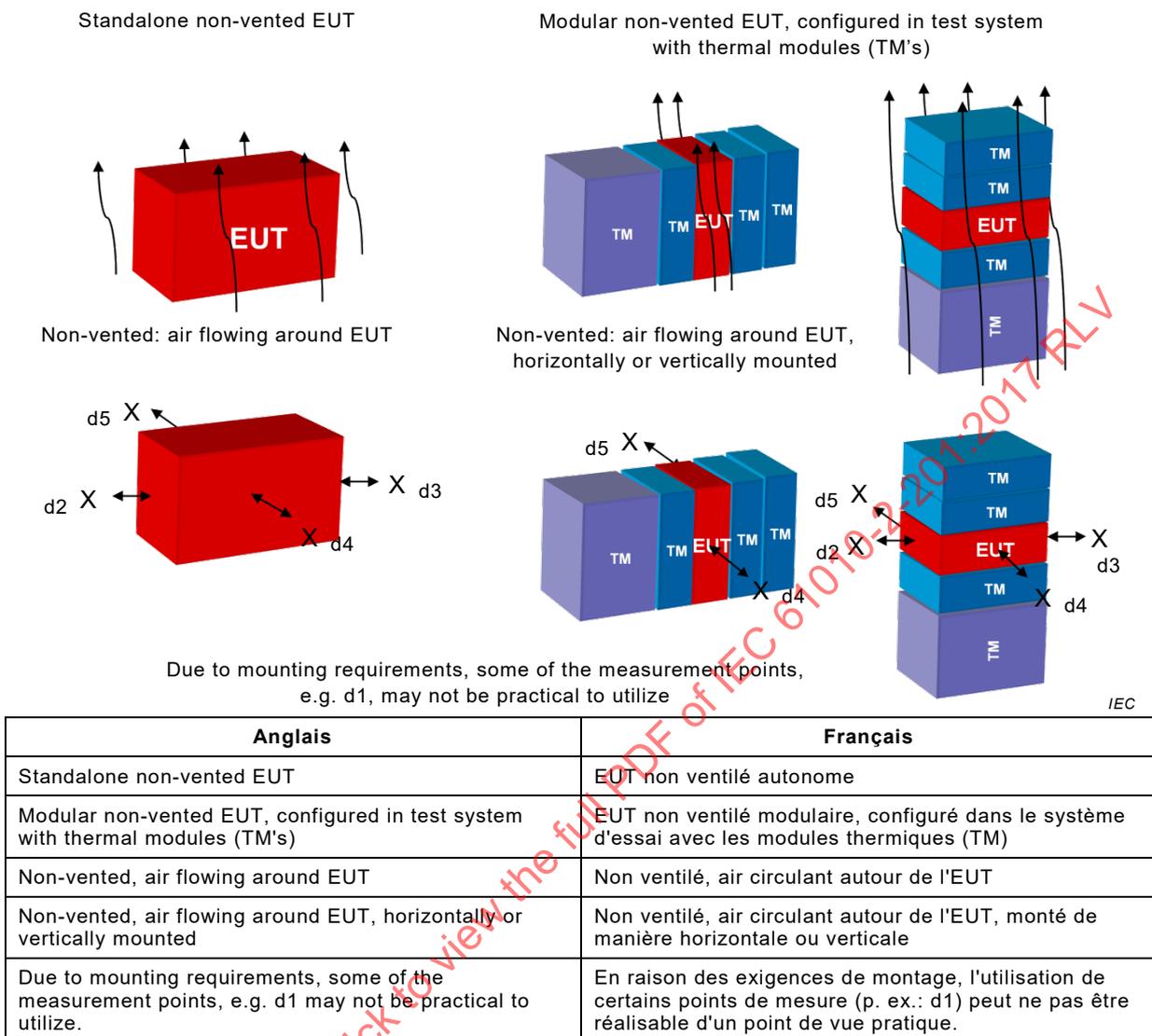
Anglais	Français
Standalone vented EUT	EUT ventilé autonome
Modular vented EUT, configured in test system with thermal modules (TM's)	EUT ventilé modulaire, configuré dans le système d'essai avec les modules thermiques (TM)
Vented, air flowing through EUT	Ventilé, air circulant au travers de l'EUT
Vented, air flowing through EUT, horizontally or vertically mounted	Ventilé, air circulant au travers de l'EUT, monté de manière horizontale ou verticale

**Figure 106 – Equipement ventilé**

NOTE 4 Les ouvertures de ventilation sont des ouvertures d'air dont la finalité est de laisser circuler l'air à travers l'équipement à des fins de refroidissement et ne sont pas des ouvertures accessoires (p. ex.: ouvertures pour un axe de commutation ou une prise de communication).

Pour un équipement non ventilé, refroidi par convection naturelle de l'air, la TEMPERATURE AMBIANTE est la température de l'air à un point situé à une distance comprise entre 25 mm et 50 mm de l'équipement, sur un plan horizontal situé au niveau du point médian vertical de l'équipement. Voir la Figure 107. Les points d2-d5 de la Figure 107 sont les points de mesure possibles. Il convient de prendre le point présentant la température la plus basse comme TEMPERATURE AMBIANTE.

En raison des exigences de montage, l'utilisation de certains points de mesure peut ne pas être réalisable d'un point de vue pratique.



**Figure 107 – Equipement non ventilé**

#### 10.4.1.101 Méthode spéciale, EQUIPEMENT MONTE SUR PANNEAU

L'EQUIPEMENT MONTE SUR PANNEAU présente des considérations spéciales (voir Figure 108).

Le cas échéant, une partie de l'équipement ( $EUT_a$ ) peut se trouver dans un environnement ambiant, par exemple l'environnement ambiant n° 1 et le reste de l'équipement ( $EUT_b$ ) peut se trouver dans un autre environnement ambiant, par exemple l'environnement ambiant n° 2. Les techniques de construction de l'équipement peuvent être assez différentes; par exemple, l'équipement (voir Figure 108) peut être ouvert/ventilé dans l'environnement ambiant n° 1 et sous enveloppe/non ventilé dans l'environnement ambiant n° 2.

Il convient de garder à l'esprit qu'il peut être nécessaire d'appliquer ces deux environnements différents simultanément afin de garantir les conditions les plus défavorables.

Chaque partie de l'équipement ( $EUT_a$  et  $EUT_b$ ) doit être évaluée séparément en fonction de son environnement spécifique.

La méthode générale décrite en 10.4.1.100 relative aux conditions d'essai et à la configuration, l'orientation, etc. les plus défavorables de l'EUT doit être appliquée.

Trois méthodes spéciales d'essai de l'EQUIPEMENT MONTE SUR PANNEAU sont fournies:

- a) *L'équipement doit être monté de manière à ce que les deux parties ( $EUT_a$  et  $EUT_b$ ) de l'EUT se trouvent dans leurs environnements spécifiques.*

NOTE 1 Les résultats les plus précis sont obtenus de cette manière, mais il s'agit de la méthode la plus difficile à élaborer pour un essai.

- b) *La totalité de l'EUT ( $EUT_a + EUT_b$ ) doit être montée dans un environnement unique, qui doit être celui présentant la température ASSIGNEE la plus élevée des deux. Les températures enregistrées de la partie de l'EUT présentant la température ASSIGNEE la plus basse sont corrigées de la différence entre la TEMPERATURE AMBIANTE ASSIGNEE maximale de l'EUT et la TEMPERATURE AMBIANTE d'essai réelle.*

EXEMPLE: Si la TEMPERATURE AMBIANTE ASSIGNEE maximale de la partie  $EUT_a = 60\text{ °C}$  et la TEMPERATURE AMBIANTE ASSIGNEE maximale de la partie  $EUT_b = 50\text{ °C}$ , l'essai doit être réalisé à une TEMPERATURE AMBIANTE d'essai de  $60\text{ °C}$ . Les températures relevées pour  $EUT_b$  seraient corrigées de  $-10\text{ °C}$  ( $50\text{ °C} - 60\text{ °C}$ ).

NOTE 2 Cette méthode n'est pas aussi précise que a), mais elle produit des résultats plus sûrs que c).

- c) *La totalité de l'EUT ( $EUT_a + EUT_b$ ) doit être montée dans un environnement unique, qui doit être celui présentant la température ASSIGNEE la plus faible des deux. Les températures enregistrées de la partie de l'EUT présentant la température ASSIGNEE la plus élevée sont corrigées de la différence entre la TEMPERATURE AMBIANTE ASSIGNEE maximale de l'EUT et la TEMPERATURE AMBIANTE d'essai réelle.*

EXEMPLE: Si la TEMPERATURE AMBIANTE ASSIGNEE maximale de la partie  $EUT_a = 60\text{ °C}$  et la TEMPERATURE AMBIANTE ASSIGNEE maximale de la partie  $EUT_b = 50\text{ °C}$ , l'essai doit être réalisé à une TEMPERATURE AMBIANTE d'essai de  $50\text{ °C}$ . Les températures relevées pour  $EUT_a$  seraient corrigées de  $+10\text{ °C}$  ( $60\text{ °C} - 50\text{ °C}$ ).

NOTE 3 Cette méthode n'est pas aussi précise que a) et produit des résultats moins sûrs que b).

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