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BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

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

Part 2-201: Particular requirements for control equipment

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

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



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

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

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

XA

ICS 13.110; 17.020; 19.020; 25.040.40

ISBN 978-2-83220-588-4

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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**

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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
65/515/FDIS	65/521/RVD

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

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

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

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

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

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

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

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

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INTRODUCTION

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

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

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

This part incorporates the safety related requirements of Programmable Controllers.

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

Withdrawn

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

Part 2-201: Particular requirements for control equipment

1 Scope and object

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

1.1.1 Equipment included in scope

Replacement:

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

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

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

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

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

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

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

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

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

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

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

1.1.2 Equipment excluded from scope

Replacement:

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

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

1.2.1 Aspects included in scope

Replacement:

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

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

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

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

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

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

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

1.2.2 Aspects excluded from scope

Replacement:

This standard does not cover:

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

2 Normative references

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

Addition of the following references to the list:

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

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

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

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

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

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

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

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

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

3 Terms and definitions

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

Additional terms and definitions:

3.101

enclosed equipment

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

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

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

3.102

enclosure

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

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

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

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

3.103

field wiring

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

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

3.104

hand-held equipment

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

3.105

modular equipment

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

Note 1 to entry: Modular equipment

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

3.106

open equipment

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

Note 1 to entry: See Annex AA.

3.107

operator

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

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

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

3.108

portable equipment

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

3.109

protective extra-low voltage circuit

PELV circuit

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

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

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

3.110

safety extra-low voltage circuit

SELV circuit

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

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

3.111

service personnel

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

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

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

4 Tests

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

4.1 General

Addition:

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

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

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

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

4.3.2 State of equipment

Addition:

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

4.4 Testing in single fault condition

Addition of first line after 4.4:

For test and verification conditions, see 4.1.

Additional subclause:

4.4.1.101 Switching devices tests

4.4.1.101.1 Overload test

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

Table 101 – Overload test circuit values

Intended use	Current	Voltage	Power factor
AC general use	$1,5 \times \text{rated}$	Rated	0,75 to 0,80
DC general use	$1,5 \times \text{rated}$	Rated	1,0
AC resistance	$1,5 \times \text{rated}$	Rated	1,0
DC resistance	$1,5 \times \text{rated}$	Rated	1,0
AC pilot duty ^a	Rated ^a	$1,1 \times \text{rated}^b$	<0,35
DC pilot duty ^a	Rated ^a	$1,1 \times \text{rated}^b$	1,0
^a Unless otherwise specified, the inrush current shall be 10 times the steady-state current.			
^b Set up the EUT at its rated voltage and current and then increase the voltage by 10 % without further adjustment of the load.			
NOTE Source IEC 61131-2:2007			

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

4.4.1.101.2 Endurance test

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

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

Table 102 – Endurance test circuit values

Intended use	Current	Voltage	Power factor
AC general use	Rated	Rated	0,75 to 0,80
DC general use	Rated	Rated	1,0
AC resistance	Rated	Rated	1,0
DC resistance	Rated	Rated	1,0
AC pilot duty ^a	Rated	Rated	<0,35
DC pilot duty ^a	Rated	Rated	1,0
^a The test circuit is identical to the overload test circuit except that the voltage is the rated voltage.			
NOTE Source IEC 61131-2:2007			

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

5 Marking and documentation

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

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, e.g. safety enclosure mechanical rigidity, IP rating.

Replacement of item d) 1):

d) 1): supply and field wiring requirements, e.g. insulation, temperature rating

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 a 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 an 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.

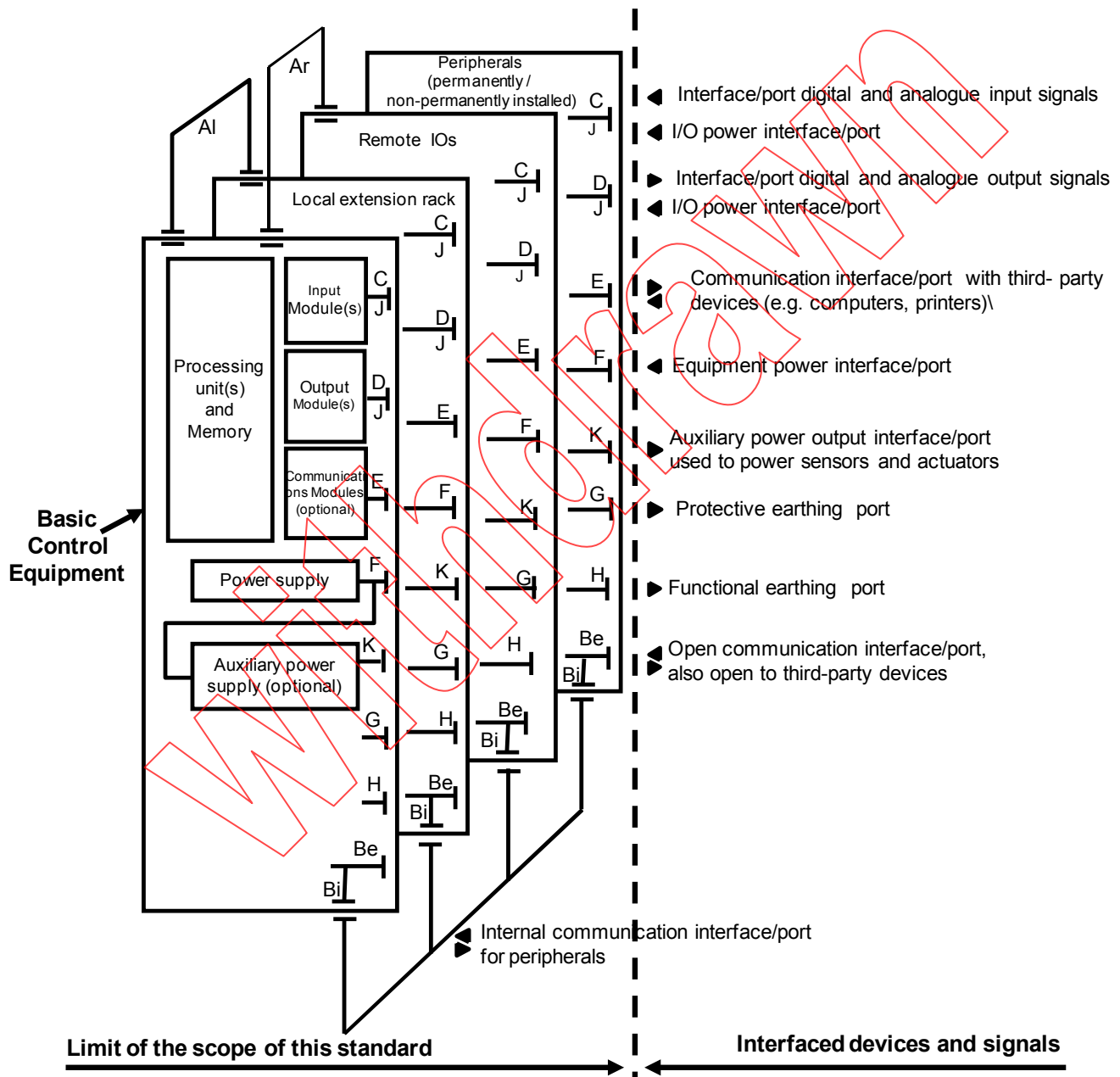
6.2.4 Openings for pre-set controls

Addition:

First paragraph: This subclause of Part 1 is applicable to enclosed equipment. This subclause applies to service personnel.

Additional subclauses:

6.2.101 Accessibility of interfaces/ports/terminals



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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. Devices with F ports have requirements on keeping downstream devices intelligent during power up, power down and power interruptions.
- G Protective earthing port
- H Functional earthing 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 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 live parts within the port inaccessible as determined by 6.2.

Table 103 – Operator accessibility for open and enclosed equipment

Port	Open equipment	Enclosed equipment
Al communication interface/port for local extension rack	No	Yes
Ar communication interface/port for remote IO station, control network, fieldbus ^a	Yes	Yes
Be open communication interface/port, also open to third-party devices; e.g. PADT, personal computer used for programming ^a	Yes	Yes
Bi internal communication interface/port for peripherals	No	Not applicable ^b
C interface/port for digital and analogue input signals	No	Yes
D interface/port for digital and analogue output signals	No	Yes
E serial or parallel communication interfaces/ports for data communication with third-party devices; e.g. computers and printers ^a	Yes	Yes
F equipment power interface/port	No	Yes
G protective earthing port	No	Yes
H functional earthing port	No	Yes
J I/O power interface/port	No	Yes
K auxiliary power output interface/port used to power sensors and actuators	No	Yes
^a Ports Ar, Be and E contain circuits which may be connected to other equipment and shall be considered accessible.		
^b Port Bi is an internal communication port and thus never leaves the enclosed equipment, by definition.		

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, 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 they 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 means by e.g. safety enclosure or barrier is required.

Conformity is checked by inspection and examination according to 6.2.2.

6.2.102.2 SELV circuits

SELV 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

Addition:

NOTE Protective earthing terminals and earthing contacts are not connected directly to the neutral terminal within the system. 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:

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

6.5.2.6 Transformer protective bonding screen

Addition of 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.

Additional 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 a means of connecting the conductive parts, which are otherwise capable of assuming hazardous 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 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 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) and where voltages generated do not exceed the limits for SELV.

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 (for example, chassis, frame and fixed metal parts of metal enclosures) other than those which cannot become hazardous 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 and 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

Replacement of Note 2 as follows:

NOTE 2 For cord connected mains supply see 6.10.

6.6.2 Terminals for external circuits

Addition 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 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 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 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.

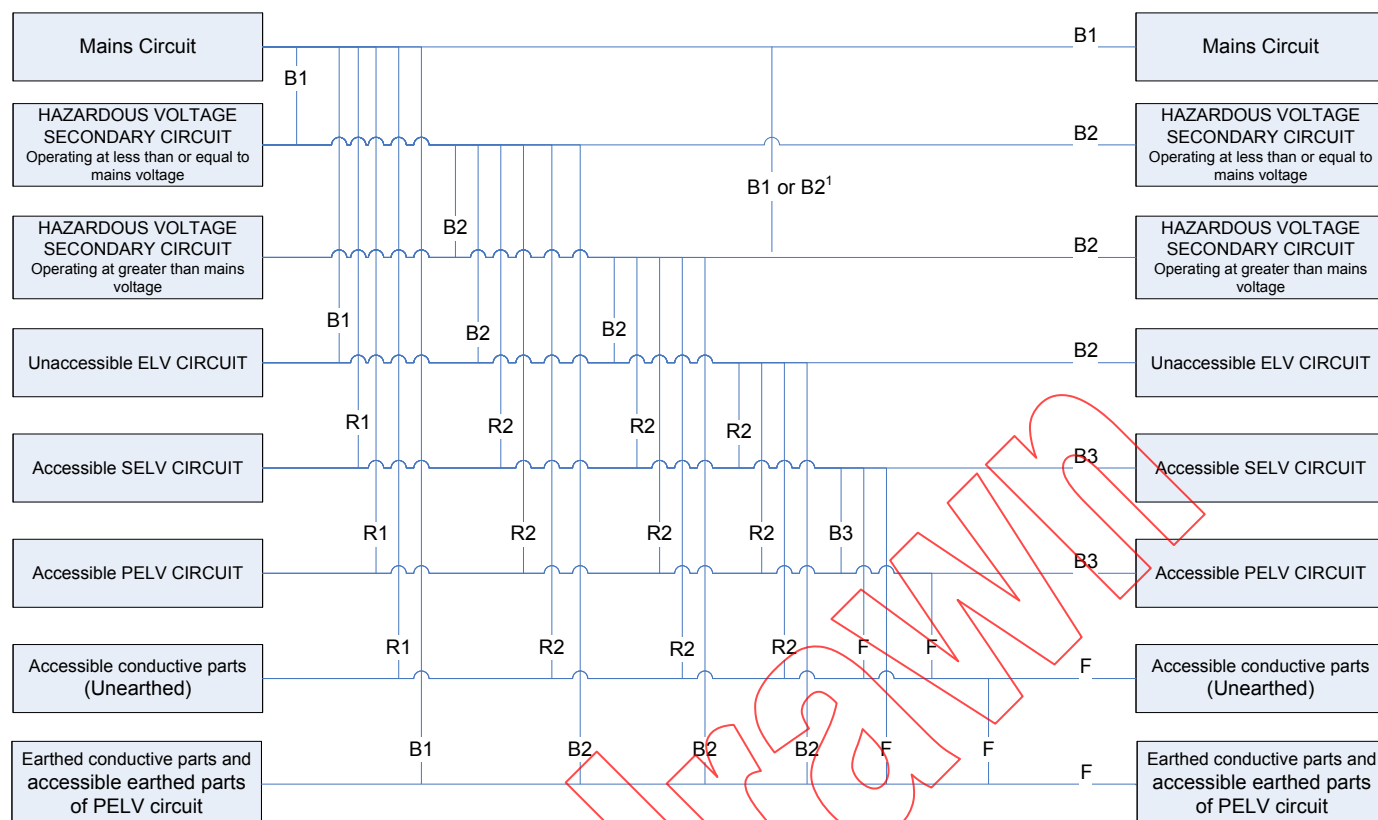
Conformity is checked by measurement with a stranded conductor of 8 mm length or by inspection.

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

6.7.1.1 General

Addition 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 Clause 4 demonstrates no hazard occurs.

R1 - Supplementary/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/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.

¹ The greater of B1 or B2 insulation, depending on the higher of the working voltages of the mains and secondary circuits.

Figure 102 – Requirements for insulation between separate circuits and between circuits and accessible conductive parts

Addition 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.

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 or
- b) in IEC 61010-1:2010, 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;

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

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

Additional 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.

6.7.2.1 Clearances and creepage distances

Replacement of Table 4:

Table 4 – Clearance and creepage distances for mains circuits of overvoltage category II up to 300 V

Voltage line-to- neutral a.c. r.m.s. V ^c	Values for clearance distances			Values for creepage distances ^{a, b}								
	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 ^a	0,8	0,04	0,18	0,04	0,6	0,85	1,2	1,5	1,7	1,9
≤ 100	0,1	0,2 ^a	0,8	0,1	0,25	0,16	0,71	1,0	1,4	1,8	2,0	2,2
≤ 150	0,5	0,5	0,8	0,5	0,5	0,5	0,8	1,1	1,6	2,0	2,2	2,5
≤ 300	1,5	1,5	1,5	1,5	1,5	1,5	1,5	2,1	3	3,8	4,2	4,7
^a For printed wiring board, the values for pollution degree 1 apply. ^b Linear interpolation of creepage is allowed. But creepage can never be below clearance. ^c d.c. or a.c. peak values are $\sqrt{2} \times$ a.c.r.m.s. values shown.												
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.												

6.7.2.2.1 General

Addition of the following first line:

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

Replacement of Table 5:

Table 5 – Test voltages for solid insulation between mains and between mains and secondary circuits overvoltage category II up to 300 V^d

Voltage line-to-neutral a.c. r.m.s. V ^a	For basic and supplementary Insulation			For reinforced Insulation		
	Rated Impulse voltage 1,2/50µs V	Test voltages for up to 2000 m V		Rated Impulse voltage 1,2/50µs V	Test voltages for up to 2000 m V	
		a.c. 1 min	d.c. 1 min		a.c. 1 min	d.c. 1 min
≤ 50 ^b	500	1 250	1 750	800	2 500	3 500
≤ 100 ^c	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
^a d.c. or a.c. peak values are $\sqrt{2} \times$ a.c.r.m.s. values shown. ^b For d.c. products this range ends at 60 V. ^c For d.c. products this range begins at 60 V. ^d No test is needed for SELV/PELV circuits/units.						
NOTE Table derived from IEC 60664-1 and IEC 60364.						

Replacement of the second paragraph on conformity:

Conformity is checked by inspection, and by the a.c. test of 6.8.3.1, or for circuits stressed only by d.c., the d.c. test of 6.8.3.2, using the applicable voltage from Table 5. Both the 1 minute and 5 sec test shall be performed or a single test which is the worst case combination of the 1 minute and 5 s tests.

6.7.3 Insulation for secondary circuits derived from mains circuits of overvoltage category II up to 300 V

Modification:

For mains circuits above 300 V, see Annex K.

6.7.3.2 Clearances

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

^a Linear interpolation allowed.

^b d.c. or a.c. peak values are $\sqrt{2} \times$ a.c.r.m.s. values shown.

Modification:

Item 3) does not apply.

6.7.3.3 Creepage distances

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

Secondary working voltage a.c.r.m.s V^c.

Addition of new footnote to Table 7 of Part 1:

^c d.c. or a.c. peak values are $\sqrt{2} \times V$ a.c.r.m.s. values shown.

Additional 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 creepages and clearances in air of overvoltage category II up to 1 000 V at field-wiring terminals

Working voltage a.c. V r.m.s. V ^c	Termination clearances mm			Termination creepages mm	
	General use	Limited ratings a, b	To walls of metallic enclosures which may be deflected	General use	Limited ratings a, b
≤ 50	3,2	1,6	12	3,2	3,2
≤ 150	3,2	1,6	12	6,4	3,2
≤ 300	6,4	1,6	12	9,5	3,2
≤ 600	9,5	4,8	12	12,7	9,5
≤ 1 000	14	-	14	21,6	-
a Applicable to control equipment having ratings not more than 15 A at ≤150 V, 10 A at 151 V-300 V, or 5 A at 301 V-600 V. b Applicable to control equipment which control more than one load, provided that the total load connected at one time does not exceed 30 A at ≤150 V, 20 A at 151 V-300 V, or 10 A at 301 V-600 V. c d.c. or a.c. peak values are $\sqrt{2} \times$ a.c.r.m.s. values shown.					
NOTE Table derived from UL508 and UL1059.					

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 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.

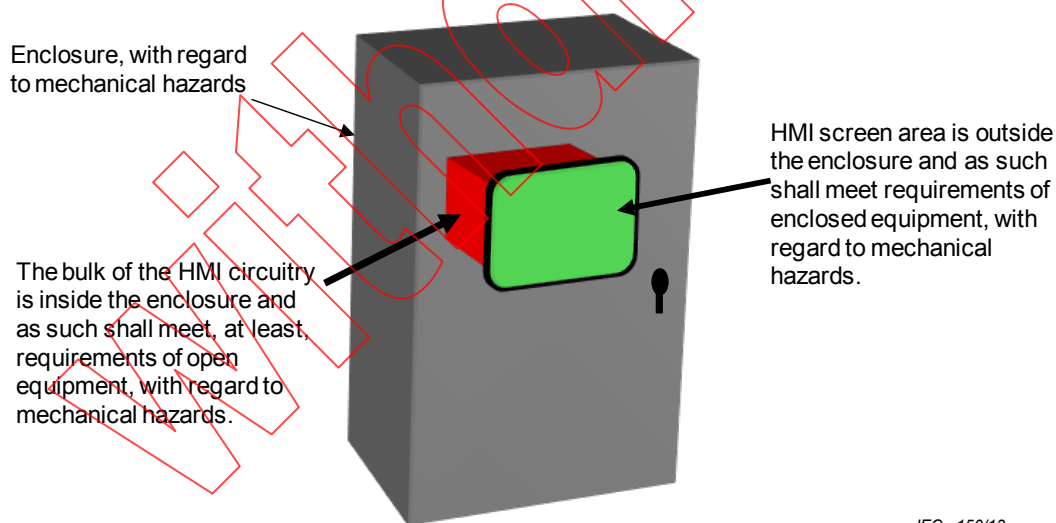
7 Protection against mechanical hazards

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

Additional subclause:

7.1.101 Open and panel mounted equipment

Open equipment is intended to be installed within another enclosure which supplies the safety aspects protecting the operator from mechanical hazards. Panel mounted equipment may be considered as open equipment; 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 and shall be evaluated to this subclause.



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Figure 103 – Mechanical hazards requirements for 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.

7.3.3 Risk assessment for mechanical hazards to body parts

Addition:

If a control equipment has only cooling fans as moving parts, then only check of 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.

Additional 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; 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 and shall be evaluated to Clause 8.

8.2.2 Impact test

Modification:

The X test distance is 1,3 m.

8.3 Drop test

Addition:

This subclause is applicable for enclosed equipment, not for open equipment.

Table 105 – Drop tests

	Portable equipment (any weight)	Hand-held equipment and direct plug-in equipment (any weight) c	Test procedure reference standard IEC 60068-2-31:2008, Test Ec	Comments
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

Addition to a) 1):

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

9.3.2 Constructional requirements

Addition 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, it shall have a flame spread rating of V-1 or better or utilize the glow wire test described below.

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

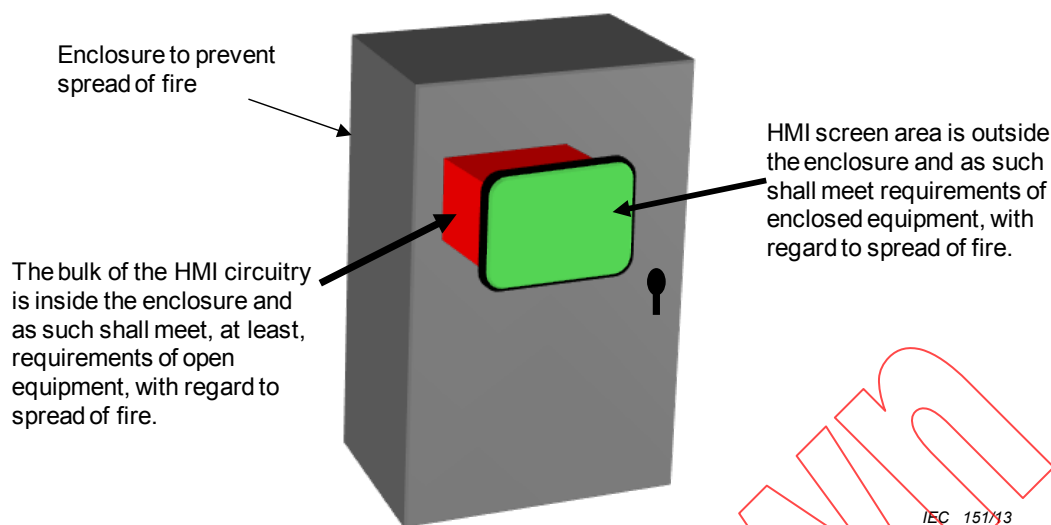


Figure 104 – Safety enclosure with HMI installed through a wall

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.

Addition under a):

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.

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

Replacement of 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, nonmetallic)	80	85
c) plastics	85	85
d) glass and ceramics	80	85
e) small areas (< 2 cm ²) that are not likely to be touched in normal use	100	100
2 Knobs and handles (normal use contact)		
a) metal	55	55
b) plastics	70	70
c) glass and ceramics	65	70
d) non-metallic parts that in normal use are held only for short periods (1 s-4 s)	70	85
NOTE 1 Normal use contact could be surfaces touched by an operator in normal use or by service personnel.		
NOTE 2 This table is based on IEC Guide 117:2010.		

10.3 Other temperature measurements

Addition:

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) Field wiring terminals shall be monitored for their temperature during the temperature test. This data is to be used in conjunction with the devices rated ambient temperature to determine the field wiring insulation temperature rating.

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.

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.

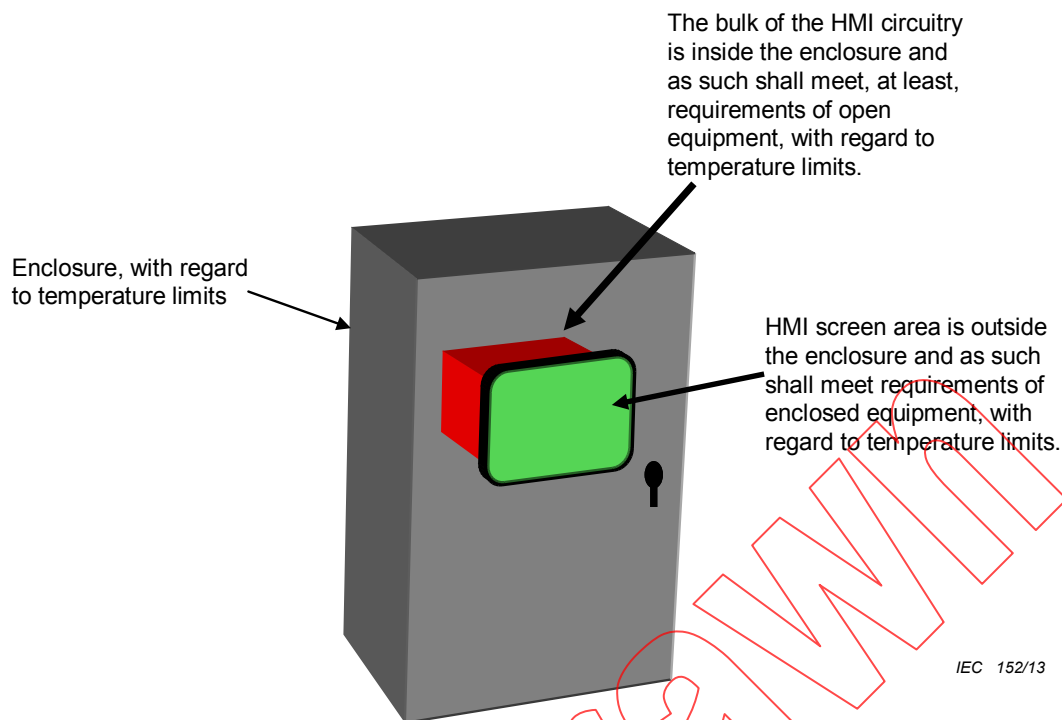


Figure 105 – Panel mounted HMI device extending through the wall of a cabinet

10.5.2 Non-metallic enclosures

Addition 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 some stated degree of protection, e.g. from IEC 60529, it shall resist the entry of material to the extent specified.

Conformity is checked by inspection and by subjecting the equipment to the appropriate tests of the quoted standard. After tests against ingress of water the voltage test, 6.8, without humidity preconditioning has to be made.

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.

Additional 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 and 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.

This does 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 dismantled for the high-voltage type test.

NOTE Dismounting could be feasible, 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 4.4.1.101.1 and 4.4.1.101.2, 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 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.

Annexes

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

Annex F (normative)

Routine tests

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

F.2 Protective earth

Addition between the paragraph and the note:

The resistance shall not exceed 0,1 Ω .

F.3.1 General

Addition at the end of the subclause:

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 at the end of clause:

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

Additional clause:

F.101 Supply circuits other than mains and floating circuits

These are supply circuits other than those define in F.3 and F.4.

A test voltage is applied between:

- a) the supply circuit, and
- b) 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 a.c. or d.c. or impulse, and is selected from IEC 61010-1:2010, Table F.1 for the appropriate overvoltage category. For the a.c. and d.c. tests, the test voltage is raised to its specified value within 5 s, and maintained for at least 2 s. Impulse tests are the 1,2/50 μ s test specified in IEC 61180, conducted for a minimum of three pulses of each polarity at 1 s minimum intervals.

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