IEC 61010-2-120

Edition 1.0 2016-10

INTERNATIONAL STANDARD

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GROUP SAFETY PUBLICATION
PUBLICATION GROUPÉE DE SÉCURITÉ

Safety requirements for electrical equipment for measurement, control, and laboratory use –
Part 2-120: Particular safety requirements for machinery aspects of equipment

Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire –
Partie 2-120: Exigences de sécurité particulières pour les aspects des appareils relatifs aux machines

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2-120: Particular safety requirements for machinery aspects of equipment

FOREWORD

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This part of International Standard IEC 61010 has been prepared by IEC technical committee 66: Safety of measuring, control and laboratory equipment.

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

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

FDIS	Report on voting
66/601/FDIS	66/606/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 publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

This Part 2-120 is intended to be used in conjunction with IEC 61010-1. It was established on the basis of the third edition (2010).

This Part 2-120 supplements or modifies the corresponding clauses in IEC 61010-1, so as to convert that publication into the IEC standard: *Particular safety requirements for machinery aspects of 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 standard states "addition", "modification" or "replacement", the relevant text in Part 1 is to be adapted accordingly.

In this standard,

a) 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.

b) subclauses, figures, tables and notes which are additional to those in Part 1 are numbered starting from 101 and additional list items are numbered from aa). Additional annexes are numbered AA and BB.

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 61010-1 specifies the safety requirements that are generally applicable to all equipment within its scope. For certain types of equipment, the requirements of IEC 61010-1 and its amendments will be supplemented or modified by the special requirements of one, or more than one, particular Part 2s of the standard which are to be read in conjunction with the Part 1 requirements.

This Part 2-120 specifies the safety requirements for equipment that may present HAZARDS from the power driven moving parts incorporated in the equipment.

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

Part 2-120: Particular safety requirements for machinery aspects of equipment

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1 Scope and object

This clause of Part 1 is applicable except as follows:

1.1.1 Equipment included in scope

Addition:

Add the following new paragraph before the first paragraph:

This group safety publication is primarily intended to be used as a product safety standard for the products mentioned in the scope, but shall also be used by technical committees in the preparation of their publications for products similar to those mentioned in the scope of this standard, in accordance with the principles laid down in IEC Guide 104 and ISO/IEC Guide 51.

Replacement:

Replace the first paragraph with the following:

This Part 2 of IEC 61010 specifies particular safety requirements for the following types of electrical equipment and their accessories, wherever they are intended to be used, which fall under a), b), or c) below and present HAZARDS from the power driven moving parts according to one or more of the items 1) to 5) used by the equipment for a specific application.

1) An assembly, fitted with or intended to be fitted with a drive system other than directly applied human or animal effort, consisting of linked parts or components, at least one of which moves, and which are joined together for a specific application.
2) An assembly referred to in item 1), missing only the components to connect it on site or to sources of energy and motion.
3) An assembly referred to in items 1) and 2), ready to be installed and able to function as it stands only if mounted on a means of transport, or installed in a building or a structure.
4) Assemblies referred to in items 1), 2) and 3) or partly completed assemblies which, in order to achieve the same end, are arranged and controlled so that they function as an integral whole.

   A partly completed assembly is equipment which cannot perform a specific application by itself. A partly completed assembly is only intended to be incorporated into, or assembled with, other equipment, thereby forming equipment to which this standard applies.
5) An assembly of linked parts or components, at least one of which moves and which are joined together, intended for lifting loads and whose only power source is directly applied human effort.

Addition:

Add the following paragraph at the end of the subclause:

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If all or part of the equipment falls within the scope of one or more other part 2 standards of IEC 61010 as well as within the scope of this standard, it will also need to meet the requirements of those other Part 2 standards.

1.2.1 Aspects included in scope

Replacement:

Replace the first sentence with:

The purpose of the requirements of this standard is to ensure that HAZARDS to the OPERATOR, SERVICE PERSONNEL and the surrounding area are reduced to a tolerable level.

Addition:

Add the following new paragraphs before the note:

Requirements for CONTROL SYSTEMS and devices related to safety are specified in Clause 101.

Protection against HAZARDS during specific operating conditions of equipment are specified in Clause 102.

Protection against HAZARDS during maintenance and service are specified in Clause 103.

2 Normative references

This clause of Part 1 is applicable except as follows:

Addition:

Add the following new normative references:

IEC 60947-5-5, *Low-voltage switchgear and controlgear – Part 5-5: Control circuit devices and switching elements – Electrical emergency stop device with mechanical latching function*

IEC 62061, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*

IEC 62471, *Photobiological safety of lamps and lamp systems*

IEC TR 62471-2, *Photobiological safety of lamps and lamp systems – Part 2: Guidance on manufacturing requirements relating to non-laser optical radiation safety*

ISO 5349-1, *Mechanical vibration – Measurement and evaluation of human exposure to hand-transmitted vibration – Part 1: General requirements*

ISO 7010, *Graphical symbols – Safety colours and safety signs – Registered safety signs*

ISO 12100, *Safety of machinery – General principles for design – Risk assessment and risk reduction*

ISO 13849-1, *Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*

ISO 13850, *Safety of machinery – Emergency stop function – Principles for design*

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ISO 13857, *Safety of machinery – Safety distances to prevent hazard zones being reached by upper and lower limbs*

3 Terms and definitions

This clause of Part 1 is applicable except as follows:

3.1 Equipment and states of equipment

Addition:

Add the following new terms and definitions:

3.1.101
TRANSPORTABLE EQUIPMENT
equipment that is intended to be moved from one place to another whether or not connected to a supply and without an appreciable restriction of range

Note 1 to entry: An example for TRANSPORTABLE EQUIPMENT is equipment considered as MOBILE EQUIPMENT and PORTABLE EQUIPMENT.

3.1.102
MOBILE EQUIPMENT
TRANSPORTABLE EQUIPMENT intended to be moved, or capable of moving, from one location to another while supported by its own wheels or equivalent means

3.1.103
CONTROL POSITION
OPERATING POSITION
position where the operator will be located when using the equipment controls

Note 1 to entry: There may be one or more CONTROL POSITIONS. The CONTROL POSITION is outside of the equipment.

Note 2 to entry: There may be one or more OPERATING POSITIONS. The OPERATING POSITION is an integral part of the equipment.

3.1.104
CONTROL SYSTEM
all the parts of the equipment forming a system to provide, for example, operational control, monitoring, interlocking, communications, protection or safety-related control functions

Note 1 to entry: These parts include electrical, electronic and programmable electronic parts and devices as well as the mechanical parts.

Note 2 to entry: Safety-related control functions can be performed by a CONTROL SYSTEM that is either integral to or independent of those parts of a CONTROL SYSTEM that performs non-safety-related functions.

3.2 Parts and accessories

3.2.5
PROTECTIVE BARRIER

Replacement:

Replace the definition of 3.2.5 with the following new definition:

part of equipment specifically used to provide protection from a HAZARD by means of a physical barrier

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Addition:

Add the following new terms and definitions:

3.2.101
CHAMBER
part of the equipment which contains the material to be processed

Note 1 to entry: Vessels, tube holders and similar containing material are not considered CHAMBER.

3.5 Safety terms

Addition:

Add the following new terms and definitions:

3.5.101
SERVICE PERSONNEL
persons having appropriate technical training and experience necessary to be aware of HAZARDS to which they are exposed when performing a task and of measures to minimize the danger to themselves or other persons

3.5.102
OPERATING CYCLE
complete set of stages of a process that is carried out in a specified sequence

4 Tests

This clause of Part 1 is applicable.

5 Marking and documentation

This clause of Part 1 is applicable except as follows:

5.1.3 MAINS supply

Table 1 – Symbols

Addition:

Add the following new symbol:

Number	Symbol	Reference	Description
101		Symbol ISO 7010-W010	Warning; Low temperature/freezing conditions

5.1.5.1 General

Replacement:

Replace the second paragraph with the following:

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Push-buttons and actuators of emergency stop devices shall comply with 14.101. Indicators used only to indicate a warning of danger or the need for urgent action shall be coloured red and coded as specified in IEC 60073. If the meaning of colour relates to the safety of persons or the environment, supplementary means of coding shall be provided (see IEC 60073).

5.2 Warning markings

Replacement:

Replace the first paragraph with the following:

Warning markings as required by this standard shall meet the following requirements.

5.4 Documentation

5.4.1 General

Replacement:

Replace item h) with the following:

h) instructions for moving, lifting and carrying (see 7.4.101 and 7.5).

5.4.3 Equipment installation

Addition:

Add the following new items after item g):

aa) instructions relating to installation and assembly for reducing vibration generated by equipment;

bb) where equipment is likely to emit non-ionizing radiation which may cause harm to persons, in particular persons with active or non-active implantable medical devices, information concerning the radiation emitted for the operator and exposed persons;

cc) if the equipment is intended to be used in a hazardous environment, presenting risks to the health and safety of the operator, instructions for protective measures.

5.4.4 Equipment operation

Addition:

Add the following new items after item j):

aa) details of methods of reducing the RISKS of pain, numbness and frostbite from easily ACCESSIBLE, cold, touchable surfaces in 10.101.

NOTE Examples of methods of reducing RISKS are given in ISO 13732-3:2005, Annex E.

bb) information to protect the OPERATOR and other persons if in NORMAL USE the hand-transmitted frequency-weighted r.m.s. acceleration generated by the equipment exceeds the level of 12.101;

cc) the operating method to be followed in case of emergency, malfunction or breakdown; if a blockage of moving parts is likely to occur, the operating method to be followed so as to enable the equipment to be safely unblocked.

5.4.5 Equipment maintenance and service

Addition:

Add a new note before the conformity statement:

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NOTE 101 For further information, see Clause 103.

6 Protection against electric shock

This clause of Part 1 is applicable.

7 Protection against mechanical HAZARDS

This clause of Part 1 is applicable except as follows:

7.3.1 General

Replacement:

Replace the second and third sentences of the first paragraphwith the following:

The conditions specified in 7.3.4, 7.3.5 and 7.3.101 are considered to represent a tolerable level. If these conditions are not met, a RISK assessment shall be carried out according to 7.3.3 or Clause 17.

Replace the conformity statement with the following:

Conformity is checked as specified in 7.3.2, 7.3.3, 7.3.4, 7.3.5, 7.3.101 and Clause 17, as applicable.

7.3.3 Risk assessment for mechanical HAZARDS to body parts

Replacement:

Replace, in Table 12, footnote d, item "B" with:

B = Moderate measures; emergency switches (see ISO 13850), PROTECTIVE BARRIERS or covers removable only with a TOOL, distances (see ISO 13857), or separations (see ISO 13854 or EN 349).

Addition:

Add the following new subclauses:

7.3.101 Limitation of HAZARDS from moving parts

7.3.101.1 General

Protective measures shall be designed and incorporated into the equipment so that:

1) moving parts that could cause a HAZARD cannot start to move while they are in the reach of an OPERATOR or bystander (see ISO 13857 for safety distances); and
2) once the equipment has started to operate, the moving parts that could cause a HAZARD cannot be reached by the OPERATOR or bystander; and
3) during maintenance or set-up operations, movement cannot create a HAZARD for any person within reach of the moving parts.

The equipment is considered to be adequately safe against HAZARDS from moving parts if:

a) it has PROTECTIVE BARRIERS and protective measures against gaining access to hazardous moving parts meeting all the applicable requirements specified in 7.3.101.2 to 7.3.101.7; and

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b) where it is impractical to make the moving parts inaccessible:

i) the movement is in the OPERATOR´s field of view; and

ii) movement of the equipment or its parts is possible only by the continuous activation of the control by the OPERATOR as long as the response of the OPERATOR to deactivate the device can be relied upon to prevent a HAZARD; and

iii) if there is a SINGLE FAULT CONDITION resulting in an intolerable HAZARD due to continuous system activation one or more emergency stopping device(s) is/are provided in the equipment within reach of the OPERATOR.

Conformity is checked by inspection and as specified in 7.3.101.2 to 7.3.101.7.

7.3.101.2 PROTECTIVE BARRIERS and ENCLOSURES

If a PROTECTIVE BARRIER or ENCLOSURE is provided that prevents access to the hazardous moving parts, and if it meets the following requirements, then the hazardous moving parts are not considered to present a mechanical HAZARD.

a) It is of robust construction; and

b) it cannot be bypassed or rendered non-operational without the use of a TOOL; and

c) it does not introduce any additional intolerable RISK.

Conformity is checked by inspection, and as applicable by the requirements of 7.3.102 and by the tests of 8.2.

7.3.101.3 Safety distances

If the hazardous moving parts are located so the OPERATOR or a bystander cannot reach them, then they are not considered to present a mechanical HAZARD. Referenced standards give dimensions that shall be used for determining the distance to prevent the OPERATOR or bystander from reaching hazardous moving parts.

NOTE Information on the aspects of safety distances is given in ISO 13855 and ISO 13857.

Conformity is checked by inspection.

7.3.101.4 Speed of movement

Where contact with moving parts of the equipment or the material being handled by the equipment could result in a HAZARD, the speed of such movement shall be limited safely and sufficiently so that an OPERATOR is able to avoid the HAZARD without introducing an additional intolerable RISK. Where the speed of motion does not exceed 33 mm/s and there is no other condition that would prevent avoidance, this requirement is presumed to be met. The force and mass of the moving part should be considered to determine whether a HAZARD exists. Otherwise, RISK assessment is required.

NOTE Information on the aspects of safely limited speed is given in ISO 11161.

Conformity is checked by inspection and by inspection of the RISK assessment documentation, if applicable.

7.3.101.5 Unintended movement

Controls whose accidental actuation may result in a HAZARD shall be so positioned, recessed, or protected by other means so that they cannot be accidentally actuated.

Conformity is checked by inspection.

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7.3.101.6 Over-travel

The RISK due to over-travel (past range limits) of equipment parts shall be reduced to an acceptable level. End stops or other stopping means shall be provided to act as the ultimate travel limiting measure.

Such means shall have the mechanical strength to withstand the foreseeable overload.

Expelled parts in the event of over-travel are covered in 7.7.

Conformity is checked by inspection.

7.3.101.7 RISKS of uncontrolled movement

If a HAZARD could result, an equipment part shall not drift from one position to another when it is intended to be stopped.

Conformity is checked by inspection and by inspection of the RISK assessment documentation, if applicable.

7.3.102 Requirements for PROTECTIVE BARRIERS

7.3.102.1 Fixed PROTECTIVE BARRIERS

Fixed PROTECTIVE BARRIERS shall be of robust construction, shall be securely held in place, and shall not be removable without the use of a TOOL.

Their fixing means shall remain attached to the PROTECTIVE BARRIERS or to the equipment when the PROTECTIVE BARRIERS are removed. The requirement applies to any fixed PROTECTIVE BARRIERS that are liable to be removed by the SERVICE PERSONNEL during routine cleaning, setting or maintenance operations carried out at the place of use.

Conformity is checked by inspection.

7.3.102.2 Movable PROTECTIVE BARRIERS

Movable PROTECTIVE BARRIERS that can be opened without the use of a TOOL shall meet the following requirements:

a) they shall remain attached to the equipment when opened;

b) they shall be associated with an interlock complying with the requirements of Clause 15 that maintains the equipment in a safe state while the PROTECTIVE BARRIERS are open;

c) gaining access to moving parts for maintenance shall not cause a HAZARD.

Conformity is checked by inspection and by opening the movable PROTECTIVE BARRIER while the equipment is operating to determine whether a HAZARD occurs.

7.4 Stability

This clause of Part 1 is applicable except as follows:

Addition:

Add the following new title for the existing text:

7.4.1 General

Addition:

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Add the following new subclauses:

7.4.101 Manually-moved MOBILE EQUIPMENT

MOBILE EQUIPMENT that is intended to be moved by manual effort shall not require a force greater than 200 N per person along a hard, flat, horizontal surface. The initial force for movement is included. If more than one person is required to move the equipment, the instructions shall include such information (see 5.4.1h)).

Conformity is checked by inspection and, in case of doubt, by test.

7.4.102 Unwanted movement

Equipment that is intended to be used on the floor shall not result in a HAZARD due to unwanted lateral movement.

Brakes of power driven MOBILE EQUIPMENT shall be designed so that they are normally activated and can only be released by continuous actuation of a control.

MOBILE EQUIPMENT shall be fitted with means (such as locking devices) intended to prevent any unwanted movement of the equipment or its parts in the transport position.

MOBILE EQUIPMENT shall be provided with wheel locks or with a braking system appropriate to the intended modes of use and sufficient to ensure that unintended movement is prevented on an incline of 5°.

Conformity is checked by inspection and, in case of doubt, by test.

Addition:

Add the following new subclause:

7.101 Access to a CHAMBER

Access to a CHAMBER during an OPERATING CYCLE shall not be possible if this could cause a mechanical HAZARD.

Conformity is checked by inspection of the door design. In case of doubt a test is made simulating an attempt to open the door using reasonable force.

Means shall be provided to prevent:

a) inadvertent operation of the OPERATING CYCLE while an OPERATOR is completely inside a CHAMBER, and

b) a door (if fitted) closing while an OPERATOR is completely inside a CHAMBER.

The means shall be lockable by a dedicated TOOL or other mechanism and the manufacturer's instructions shall specify that the OPERATOR must retain the TOOL while inside a CHAMBER. A warning marking (see 5.2) shall instruct the OPERATOR to lock the means before entering a CHAMBER and to retain the TOOL at all times while in a CHAMBER.

Conformity is checked by inspection.

8 Resistance to mechanical stresses

This clause of Part 1 is applicable.

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9 Protection against the spread of fire

This clause of Part 1 is applicable.

10 Equipment temperature limits and resistance to heat

This clause of Part 1 is applicable except as follows:

Addition:

Add the following new subclause:

10.101 RISKS from easily accessible cold surfaces

If the temperature of easily touched cold surfaces is below -30 °C, the cold surface shall be marked with symbol 101 of Table 1 to warn the OPERATOR against HAZARD of frostbite (see 5.2).

11 Protection against HAZARDS from fluids

This clause of Part 1 is applicable.

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

This clause of Part 1 is applicable except as follows:

Replacement:

Replace the title with the following:

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

12.3 Ultraviolet (UV) radiation

Replacement:

Replace the title and text with the following:

12.3 Optical radiation

Equipment with lamp and lamp systems emitting ultraviolet, visible, or infrared radiation, including light emitting diodes, shall not permit unintentional escape of radiation that could cause a HAZARD. The radiation sources shall be assessed in accordance with IEC 62471 except for sources considered to be safe (Table 101), or conditionally safe (Table 102). Lamp and lamp systems assessed to be in risk groups 1, 2 or 3 of IEC 62471 shall be labelled in accordance with IEC TR 62471-2. Protective measures, restrictions on use and operating instructions that may be necessary shall be provided, including the applicable conditions of use of Table 102.

NOTE Attention is drawn to the possible existence of additional guidelines or requirements which may be specified by national or other authorities.

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Conformity is checked by inspection, by review of the technical specifications of the lamp manufacturer, and if necessary by measurement of the optical radiation, followed by determination of the applicable risk groups according to IEC 62471.

Table 101 – Lamp or lamp systems considered photobiologically safe

Lamp or lamp system
Indicator LEDs
Personal digital device screens
LCD screens
Computer displays
Photographic flash lamps
Interactive whiteboard presentation equipment
Task lighting with tungsten filament lamps, compact fluorescent tubes, or fluorescent tubes with diffusers

Table 102 – Lamp or lamp systems considered photobiologically safe under certain conditions

Lamp or lamp system	Conditions of use
Fluorescent tubes without diffusers	Safe at normal illumination levels
Metal halide, or high-pressure mercury flood lights	Safe if the front cover glass is intact and if the lamp is not in line of sight
Desktop projectors	Safe if the beam is not looked into
Low-pressure UVA black lights	Safe if not in line of sight and hands are not irradiated while holding the black light

12.5.1 Sound level

Replacement:

Replace the text with the following:

If equipment produces noise at a level which could cause a HAZARD, the manufacturer shall measure the maximum sound pressure level which the equipment can produce (except for sound from alarms and sound from parts remote from the equipment).

Installation instructions shall specify how the RESPONSIBLE BODY can ensure that the sound pressure level from equipment, at its point of use after installation, will not reach a value which could cause a HAZARD. These instructions shall identify readily available and practicable protective materials or measures which may be used, including the fitting of noise-reducing baffles or hoods. The instructions for use shall recommend that the sound pressure level be measured or calculated by the RESPONSIBLE BODY both at the OPERATOR'S position in NORMAL USE and at whichever point 1 m from the enclosure of the equipment has the highest sound pressure level.

The following information on airborne noise emissions shall be given:

1) If the A-weighted emission sound pressure level(s) at the OPERATOR's position or the bystander positions exceed 70 dB(A) above a reference sound pressure of 20 μPa, this fact along with the corresponding position(s) shall be stated in the instructions. If no level exceeds 70 dB(A) above a reference sound pressure of 20 μPa, this fact shall be stated in the instructions.

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2) If any peak C-weighted instantaneous sound pressure value at the OPERATOR's position or the bystander positions exceeds 63 Pa (130 dB in relation to 20 μPa), this/these value(s) along with the corresponding position(s) shall be stated in the instructions. This value is typically only relevant for machinery that emits strong impulsive noise (e. g. a stamping machine).

3) If the A-weighted emission sound pressure level at the OPERATOR's position or bystander positions exceeds 80 dB(A) above a reference sound pressure of 20 μPa, the level(s) of the A-weighted sound power level emitted by the equipment along with the corresponding positions shall be stated in the instructions and marked on the equipment.

NOTE A sound pressure level of 80 dB(A) above a reference sound pressure of 20 μPa is at present regarded by many authorities as the threshold at which a HAZARD may be caused. Special means, such as the use of protective earpieces, can make a higher level non-hazardous to an OPERATOR.

Conformity is checked by inspection and, if necessary, by measuring the maximum A-weighted sound pressure level and the peak C-weighted instantaneous sound pressure value at the OPERATOR's position and at bystander positions and, if necessary, calculating the maximum A-weighted sound power level produced by the equipment, as specified in either ISO 3746 or ISO 9614-1.The following conditions apply:

a) During measurement, any part necessary for the correct operation of the equipment and supplied by the manufacturer as an integral part of such equipment, for example, a pump, is fitted and operated as in NORMAL USE.

b) Sound level meters used in the measurement conform either to type 1 of IEC 61672-1 or, if an integrating sound level meter, to type 1 of IEC 61672-2.

c) Where the available standards are not applied, the sound pressure levels shall be measured using the most appropriate method for the equipment.

d) The equipment is tested with the combination of load and other operating conditions (for example, pressure, flow, temperature) which creates the maximum sound pressure level.

e) Bystander position is considered to be at a distance of 1 m from the surface of the machinery and at a height of 1,6 m from the floor or access platform. The position and value of the maximum sound pressure is to be indicated.

Addition:

Add the following new subclause:

12.101 Hand-transmitted vibration

Information shall be provided to protect the OPERATOR and other persons if in NORMAL USE the hand-transmitted frequency-weighted r.m.s. acceleration generated by the equipment exceeds the values below:

– 2,5 m/s^2 for a cumulative time of 8 h during a 24 h period; and

– 5,0 m/s^2 for a cumulative time of 2 h during a 24 h period.

NOTE Interpolation or extrapolation is possible for allowable acceleration in accordance with the following formula: $2{,}5 \times \sqrt{(8\text{ h} / t)}$, in m/s^2, where t is the cumulative time over a 24 h period. (Example for 4 h instead of 8 h: = 2,5 m/s^2 × √(8 h / 4 h) = 3,54 m/s^2).

Conformity is checked by inspection and, in case of doubt, by measurements at points of equipment in hand contact with the OPERATOR or other persons. Measurements shall be made in accordance with ISO 5349-1.

13 Protection against liberated gases and substances, explosion and implosion

This clause of Part 1 is applicable except as follows:

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13.1 Poisonous and injurious gases and substances

Replacement:

Replace the title and the text with the following:

13.1 Hazardous substances

Equipment shall not liberate dangerous amounts of hazardous substances in NORMAL CONDITION and in SINGLE FAULT CONDITION.

If potentially-hazardous substances are liberated, the OPERATOR shall not be directly exposed to a quantity of the substance that could cause harm.

If normal operation of the equipment requires the discharge of hazardous substances, and if that discharge is intended to be managed by the RESPONSIBLE BODY in accordance with the manufacturer's instructions, then such discharge is not considered to be liberation of hazardous substances.

NOTE Chemical exposure limits and handling and disposal regulations can be found in Occupational Safety and Health Administration (OSHA) publications or national regulatory documentation. Local, national or regional regulations can apply.

The manufacturer's documentation shall state which potentially hazardous substances can be liberated, and the quantities.

Where a HAZARD cannot be eliminated, the equipment shall be so equipped that hazardous substances can be contained, evacuated, precipitated by water spraying, filtered, or treated by another equally effective method.

Equipment shall not expose the OPERATOR to a lack of oxygen.

If a HAZARD could result from the OPERATOR's exposure to the residue of hazardous materials being processed, means shall be provided to purge a CHAMBER of such residue before the OPERATOR can access a CHAMBER.

Conformity is checked by inspection of the manufacturer's documentation. The wide variety of gases and substances makes it impossible to specify conformity tests based on limit values, so reference should be made to tables of occupational threshold limit values.

Withdrawn

14 Components and subassemblies

This clause of Part 1 is applicable except as follows.

Addition:

Add the following new subclause:

14.101 Emergency stopping devices

Where it is considered necessary to have one or more emergency stopping device(s) to prevent a HAZARD caused by the equipment, the emergency stopping device(s) shall comply with the following requirements:

a) the push-button of emergency stop devices shall be coloured red. If a background exists immediately around the push-button, then this background shall be coloured yellow (see also ISO 13850);

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b) emergency stopping devices shall meet the requirements of IEC 60947-5-5 and shall be rated for the energy levels to be encountered in NORMAL CONDITION and SINGLE FAULT CONDITION.

The types of device for emergency stop include:

1) a push-button operated switch with a palm or mushroom head type;
2) a pull-cord operated switch;
3) a pedal-operated switch.

The devices shall have direct opening operation (achievement of contact separation as the direct result of a specified movement of the switch actuator through non-resilient members, for example not dependent upon springs).

Push-button operated emergency stopping devices may be in a break-glass cover.

Conformity is checked by inspection.

15 Protection by interlocks

This clause of Part 1 is applicable except as follows:

15.1 General

Addition:

Add the following new paragraph after the first paragraph:

Interlocks used to protect OPERATORS from HAZARDS shall be evaluated by a RISK reduction method. As a result of this they may have an appropriate safety integrity level (SIL) or performance level (PL) (see Annex J, IEC 62061, ISO 12100 or ISO 13849-1)

16 HAZARDS resulting from application

This clause of Part 1 is applicable except as follows:

16.2 Ergonomic aspects

Addition:

Add the following items to the list:

aa) variability of the OPERATOR's physical strength and endurance,
bb) space for movements of the parts of the OPERATOR's body,
cc) equipment-determined work rate,
dd) monitoring that requires lengthy concentration,
ee) characteristics of the human/equipment interface in relation to the foreseeable characteristics of the OPERATORS.

Addition:

Add the following new subclauses:

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16.101 Multiple operations

If the equipment is intended to carry out several different operations with manual removal of the material being processed between each operation, it shall be designed and constructed in such a way as to enable each element to be used separately without the other elements constituting a HAZARD for exposed persons.

For this purpose, it shall be possible to start and stop each element separately, if a HAZARD could otherwise result.

Conformity is checked by inspection.

16.102 Static electricity

Equipment shall be designed and constructed to prevent or limit the build-up of electrostatic charges which could cause a HAZARD or be fitted with a discharging system.

Limit values for charges present on ACCESSIBLE parts are given in 6.3.1 c) and 6.3.2.

Conformity is checked by inspection and/or review of RISK assessment documentation.

17 RISK assessment

This clause of Part 1 is applicable except as follows:

Addition:

Add the following new subclause:

17.101 Warning of residual RISK

Where RISKS remain despite the inherent safe design measures, safeguarding and complementary protective measures adopted, the necessary warnings, including warning devices, shall be provided.

If a warning device is provided, it shall give an appropriate acoustic or light signal as a warning which shall be unambiguous and easily perceived. The OPERATOR shall have facilities to check the operation of such warning devices at all times.

Warning devices shall comply with IEC 60073.

Conformity is checked by inspection.

Addition:

Add the following new clauses:

101 Requirements for CONTROL SYSTEMs and devices related to safety

101.1 General

CONTROL SYSTEMs shall be designed and constructed in such a way as to prevent HAZARDS from arising.

Above all, they shall be designed and constructed in such a way that:

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