TEST REPORT

Product Name:	GRABO High Flow
Trade Mark:	GRABO
Model Number:	GHF-V1
Prepared For:	Nemo Power Tools Limited
Address:	21st Floor, CMA Building 64 Connaught Road Central Hong Kong
Prepared By:	Shenzhen DL Testing Technology Co., Ltd.
Address:	101-201, Comprehensive Building, Tongzhou Electronics Longgang Factory Area, No.1 Baolong Fifth Road, Baolong Community, Baolong Street, Longgang District, Shenzhen, China
Date of Receipt:	Jun. 28, 2024
Test Date:	Jun. 28, 2024 - Jul. 09, 2024
Date of Report:	Jul. 09, 2024
Report No.:	DL-240703004SR

TEST REPORT
BS EN 60204-1
Safety of machinery - Electrical equipment of machines
Part 1: General requirements

Report Number. :	DL-240703004SR
Tested by (name) :	Jimi Wu
Reviewed by (name) :	Nick Cheng
Approved by (name) :	Jade Yang
Date of issue :	Jul. 09, 2024
Total number of pages :	96 pages
Name of Testing Laboratory preparing the Report :	Shenzhen DL Testing Technology Co., Ltd.
Applicant's name :	Nemo Power Tools Limited
Address :	21st Floor, CMA Building 64 Connaught Road Central Hong Kong
Test specification:	
Standard :	BS EN 60204-1:2018 BS EN ISO 12100:2010
Test procedure :	Test report
Non-standard test method :	N/A
Test Report Form No. :	IEC60204_1C
Test Report Form(s) Originator :	DL-test
Master TRF :	Dated: 2019-11-15
Test item description :	GRABO High Flow
Trade Mark :	GRABO
Manufacturer :	Nemo Power Tools(Huizhou) Co.,Ltd 2/F, 4th Industrial Area, Luokeng Village, Xiaotie Zone, Xiaojinkou Town, Huicheng District, Huizhou City, Guangdong Province, China
Model/Type reference :	GHF-V1 (See pages 1 for other models)
Ratings :	Input: 21V⎓4A

List of Attachments (including a total number of pages in each attachment):

Attachment No.1: European group differences and national differences (3 pages)

Attachment No.2: photos (9 pages)

Summary of testing:

Tests performed (name of test and test clause):	**Testing location:**
The submitted samples were tested and found to comply with the requirements of: BS EN 60204-1:2018 BS EN ISO 12100:2010	101-201, Comprehensive Building, Tongzhou Electronics Longgang Factory Area, No.1 Baolong Fifth Road, Baolong Community, Baolong Street, Longgang District, Shenzhen, China

Summary of compliance with National Differences (List of countries addressed):

N/A

Statement concerning the uncertainty of the measurement systems used for the tests

☒ **Statement not required by the standard used for type testing**

(Note: When IEC or ISO standard requires a statement concerning the uncertainty of the measurement systems used for tests, this should be reported above. The informative text in parenthesis should be delete in both cases after selecting the applicable option)

General disclaimer:

The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing DL Testing Laboratory. The authenticity of this Test Report and its contents can be verified by contacting the DL Testing, responsible for this Test Report.

Copy of marking plate:

The artwork below may be only a draft.

GRABO High Flow

Model: GHF-V1

Input: 21V⎓4A

Nemo Power Tools(Huizhou) Co.,Ltd

Made in China

The above markings are the minimum requirements required by the safety standard. For the final production samples, the additional markings which do not give rise to misunderstanding may be added.

Possible test case verdicts:	
- test case does not apply to the test object....:	N/A
- test object does meet the requirement.....:	P (Pass)
- test object does not meet the requirement....:	F (Fail)
Testing:	
Date of receipt of test item .....:	Jun. 28, 2024
Date (s) of performance of tests .....:	Jun. 28, 2024 - Jul. 09, 2024
General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. **Throughout this report a ☐ comma / ☒ point is used as the decimal separator.**	
Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:	
The application for obtaining a Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided .....:	☐ **Yes** ☒ **Not applicable**
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies) ..... :	Nemo Power Tools(Huizhou) Co.,Ltd 2/F, 4th Industrial Area, Luokeng Village, Xiaotie Zone, Xiaojinkou Town, Huicheng District, Huizhou City, Guangdong Province, China
General product information and other remarks: **General product information:** 1: The products are GRABO High Flow. 2: This kind of machine belongs to simple machine with low risk when using it. All possible risk have been analysis in the risk assessment report and been prevent by suitable ways.	

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Clause	Requirement + Test	Result - Remark	Verdict

4	**GENERAL REQUIREMENTS**		P
4.1	**General**		P
	Hazards relevant to the electrical equipment are assessed as part of the overall risk assessment of the machine as described		P
4.2	**Selection of equipment**		P
4.2.1	Electrical components and devices shall be: - suitable for their intended use - conform to IEC standards where such exist - be applied in accordance with supplier's instructions		P
4.2.2	Where possible electrical equipment in compliance with the IEC 60439 series.	Comply with relevant IEC standard	P
4.3	**Electrical supply**		--
4.3.1	Electrical equipment to be designed for correct operation within the conditions of mains power supply	See 4.3.2	N/A
	as stated below (4.3.2 or 4.3.3)		N/A
	or as specified by the user		N/A
	or as specified by the supplier (4.3.4)		N/A
4.3.2	AC supplies		N/A
	Supply Voltage: Steady state voltage: 0,9 ... 1,1 of nominal voltage		N/A
	Frequency: 0,99 ... 1,01 of nominal frequency continuously; 0,98 ... 1,02 short time.		N/A
	Harmonics: not exceeding 10 % of the total r.m.s. etc.		N/A
	Voltage unbalance: not exceeding 2% deviation.		N/A
	Voltage interruption: interrupted or at zero voltage for not more than 3 ms at any random time in the supply cycle with more than 1 s between successive interruptions.		N/A
	Voltage dips not exceeding 20 % of the peak voltage of the supply for more than one cycle with more than 1 s between successive dips.		N/A
4.3.3	DC supplies		P
	Supply Voltage: - other:0,85 to 1,15 of nominal voltage; - battery-operated vehicles: 0,7 to 1,2 of nom. volt. - from converting equipment: 0,9 to 1,1 of nom. volt.		P
	Voltage interruption: - other: not exceeding 5 ms - converting equipment: not exceeding 20 ms		N/A
	Ripple (peak-to-peak): not exceed. 0,15 of nom. volt.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
4.3.4	Special supply systems; e.g. on board generators limits acc. 4.3.2 /.3 exceeded, but equipment designed acc. exceeded limits.		N/A
4.4	**Physical environment and operating conditions**		P
4.4.1	Electrical equipment suitable for the physical environment and operating conditions of its intended use.		P
4.4.2	Immunity and/or emission tests required unless	Meet the requirements	P
	incorporated devices and components comply with the relevant product standard and		P
	installation and wiring according supplier instructions or Annex H:		P
4.4.3	Electrical equipment shall be capable of operating correctly in the intended ambient air temperature. (Minimum requirement: air temperatures of +5 °C and +40 °C)		P
4.4.4	Electrical equipment shall be capable of operating correctly when the relative humidity is up to 50 % at a maximum temperature of +40 °C		P
	Harmful effects of condensation shall be avoided		P
4.4.5	Electrical equipment shall be capable of operating correctly at altitudes up to 1 000 m above mean sea level.		P
	For equipment to be used at higher altitudes the reduction of dielectric strength, switching capability and cooling effects shall be taken into account		P
4.4.6	Electrical equipment shall be adequately protected against the ingress of solids and liquids (see 11.3)	Have enough protection	P
4.4.7	When equipment is subjected to radiation, additional measures shall be taken		N/A
4.4.8	Undesirable effects of vibration, shock and bump avoided by suitable mans		P
4.5	Electrical equipment designed to withstand the effects of transportation and storage within a temperature range of - 25 to + 55 °C.		P
4.6	Heavy or bulky electrical equipment of the machine provided with suitable means for handling.		P
5	**INCOMING SUPPLY CONDUCTOR TERMINATIONS AND DEVICES FOR DISCONNECTING AND SWITCHING OFF**		P
5.1	**Incoming supply conductor terminations**		P
5.1	Recommendation that electrical equipment of a machine is connected to a single supply (For large complex machinery, there can be a need for more than one incoming supply)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Unless a plug is provided, supply conductors should be terminated at the supply disconnecting device		N/A
	Neutral conductor clearly indicated in technical documentation with "N" (see cl. 16.1)		N/A
	A separate terminal, labelled N provided (it may be part of the supply disconnecting device)		N/A
	No connection between neutral conductor and protective bonding circuit	Meet the requirements	N/A
	Exception: a connection may be made between the neutral terminal and the PE terminal at the point of the connection of the electrical equipment to a TN-C supply system.		N/A
	For machines supplied from parallel sources the requirements of IEC 60364-1 apply		N/A
	All terminals of incoming supply clearly marked in ac. with IEC 60445)		N/A
5.2	**Terminal for connection of external protective conductor (PE)**		N/A
	For each incoming supply, a terminal shall be provided in the same compartment as the line conductor terminals for connection to the external protective conductor		N/A
	Terminal size according to table 1 in relation to the line conductors		N/A
	Where an external protective conductor other than copper is used, the terminal size and type shall be selected accordingly		N/A
	At each incoming point this terminal shall be marked or labelled with the letters PE		N/A
5.3	**Supply disconnecting device**		P
5.3.1	A supply disconnecting device shall be provided: – for each incoming source of supply to a machine – for each on-board power supply.		P
	Where two or more such devices exist, interlocks shall be provided to prevent hazardous situations		N/A
5.3.2	The supply disconnecting device shall be one of the following:		—
	a) Switch-disconnector, acc. to EN 60947-3 for appliance category AC-23 B or DC-23 B		N/A
	b) Disconnector with or without fuses, with aux. contact (acc. to EN 60947-3		N/A
	c) Power circuit breaker suitable for isolation (acc. to EN 60947-2)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	d) any other switching device in accordance with an IEC product standard for that device and which meets the isolation requirements and the appropriate utilization category and/or specified endurance requirements		N/A
	e) a plug/socket combination for a flexible cable supply		N/A
5.3.3	A disconnection device acc. to 5.3.2 a) to d) has to fulfil all of the following requirements		—
	- isolate the electrical equipment from the supply and have one OFF (isolated) and one ON position marked with "O" and "I"		N/A
	- have a visible contact gap or a position indicator which cannot indicate OFF (isolated) until all contacts are actually open and the requirements for the isolating function have been satisfied		N/A
	- have an operating means (see 5.3.4)		N/A
	- be provided with a means permitting it to be locked in the OFF position (padlocks). When so locked, remote as well as local closing shall be prevented		N/A
	- disconnect all live conductors of its power supply circuit For TN supply systems, the neutral conductor may or may not be disconnected except in countries where disconnection of the neutral conductor (when used) is compulsory		N/A
	- have a braking capacity to interrupt the system, when the largest motor is stalled		N/A
	Where a plug/socket combination is used as a disconnection device it shall: - comply with 13.4.5 - have a braking capacity to interrupt the system, when the largest motor is stalled		N/A
	Where a plug/socket combination is used as a disconnection device, an appropriate switching device shall be provided for switching the machine on and off		N/A
5.3.4	Operating means of supply disconnecting devices (e.g. a handle) shall be external to the enclosure		N/A
	Exception: for power-operated switchgear this can be some other means (e.g. pushbutton) instead of a handle		N/A
	The operating means shall be easily accessible and located between 0,6 m and 1,9 m above the servicing level (upper limit of 1,7 m is recommended)		N/A
	Where intended for emergency operation, see 10.7.3 or 10.8.3		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Where not intended for emergency operation - the colours black or grey are recommended - a supplementary cover or door that can be readily opened without a key or tool may be provided. It shall clearly show its function, e.g. by relevant symbols		N/A
5.3.5	The following circuits need not be disconnected by the supply disconnecting device: - lighting circuits for lighting needed during maintenance or repair; - socket outlets for the exclusive connection of repair or maintenance tools and equipment; - undervoltage protection circuits that are only provided for automatic tripping in the event of supply failure; - circuits supplying equipment that should normally remain energized for correct operation Such circuits should be provided with their own disconnecting device.	No such circuit	N/A
	Where expected circuits are not disconnected by the supply disconnecting device:		N/A
	permanent warning labels shall be placed close to the operating means		N/A
	a statement shall be included in the maintenance manual and		N/A
	- the conductors are identified by colour, taking into account the recommendation of Cl.13.2.4, or - expected circuits are separated from other circuits, or - expected circuits are identified by permanent warning labels		N/A
5.4	**Devices for removal of power for prevention of unexpected start-up**		—
	Devices for removal of power for the prevention of unexpected start-up shall be provided where this can create a hazard		N/A
	They shall be appropriate and convenient for the intended use, suitably placed, and readily identifiable as to their function and purpose		P
	Where not obvious, they shall be marked to indicate the extent of removal of power		P
	Devices in accordance with 5.3.2 may be used for this purpose		N/A
	Disconnectors, withdrawable fuse links and withdrawable links only used, if located in enclosed electrical operator area (see 3.1.23)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Devices that do not fulfil the isolation function (e.g. a contactor switched off by a control circuit etc.) only used for tasks such as: – inspections; – adjustments; – work on the electrical equipment where there are only minor risks (as described)		N/A
5.5	**Devices for disconnecting electrical equipment**		—
	Devices shall be provided for isolating electrical equipment or parts of it to enable work		P
	Such devices shall be: - appropriate and convenient for the intended use; - suitably placed; - readily identifiable as to which part or circuit of the equipment is served. They shall be marked unless their function and purpose is obvious		P
	Where it is necessary to work on individual parts of the electrical equipment of a machine, or on one of a number of machines fed by a common conductor bar, conductor wire or inductive power supply system, a disconnecting device is provided for each part, or for each machine, requiring separate isolation		P
	In addition, the following devices that fulfil the isolation function may be provided for this purpose: - devices described in 5.3.2; - disconnectors, withdrawable fuse links and withdrawable links only used, if located in enclosed electrical operator area (see 3.1.23) and information provided (see cl 17)		P
5.6	**Protection against unauthorized, inadvertent and/or mistaken connection**		—
	Where devices acc. to cl. 5.4 and 5. are located outside an enclosed electrical operator area, locking means in OFF position shall be provided When so secured, local and remote reconnection shall be prevented		P
	Where these devices are located inside an enclosed electrical operator area, other means of protection against unintended reconnection can be sufficient		P
	Where a plug/socket combinations is so positioned that it can be kept under the immediate supervision of the person carrying out the work, means for securing in the disconnected state are not needed		N/A
6	**PROTECTION AGAINST ELECTRIC SHOCK**		N/A
6.1	The electrical equipment shall provide protection against electric shock by basic protection and fault protection	Class III	N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Where the measures for protection as in 6.2, 6.3 and 6.4 are not practicable, other measures from IEC 60364-4-41 may be used (e.g. SELV)		N/A
6.2	**Basic protection**		N/A
6.2.1	For each circuit the measures of 6.2.2, 6.2.3 and, where applicable, 6.2.4 shall apply		N/A
	Where not appropriate, other measures as defined in IEC 60364-4-41 may be applied (see also 6.2.5 and 6.2.6)		N/A
	For equipment in places open to all persons including children, 6.2.2 with a minimum protection of IP4X or IPXXD, or 6.2.3 shall be applied		N/A
6.2.2	Live parts shall be located inside enclosures that provide protection against contact with live parts of at least IP2X or IPXXB.		N/A
	Where the top surfaces of the enclosure are readily accessible, the minimum degree of protection against contact with live parts provided by the top surfaces shall be IP4X or IPXXD.		N/A
	Opening an enclosure (i.e. opening doors, lids, covers, etc) shall be possible only under one of the following conditions:		—
6.2.2 b	a) The use of a key or tool is necessary for access All live parts (including those on the inside of doors) likely to be touched when resetting or adjusting devices intended for such operations while the equipment is still connected, are protected against contact to at least IP2X or IPXXB Other live parts on the inside of doors are protected against unintentional direct contact to at least IP1X or IPXXA.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	b) The disconnection of live parts inside the enclosure before it can be opened (see explanation) Exception: a key or tool as prescribed by the supplier can be used to defeat the interlock, provided that the following conditions are met: - it is possible at all times while the interlock is defeated to open the disconnecting device and lock the disconnecting device in the OFF position or otherwise prevent unauthorised closure of the disconnecting device; - upon closing the door, the interlock is automatically restored - all live parts (), likely to be touched … are protected against unintentional contact to at least IP2X or IPXXB and other live parts on the inside of doors shall be protected against unintentional contact to at least IP1X or IPXXA - relevant information about the procedure for the defeat of the interlock is provided with the instructions for use of the electrical equipment - means are provided to restrict access to live parts behind doors that are not directly interlocked with the disconnecting means to skilled or instructed persons All parts still alive after switching off the disconnecting device shall be protected against direct contact to at least IP 2X or IP XXB and be marked with a warning sign in accordance with 16.2.1 except for: - parts that can be live only because of connection to interlocking circuits and that are distinguished by colour as potentially live in accordance with 13.2.4 - the supply terminals of the supply disconnecting device when the latter is mounted alone in a separate enclosure		N/A
	c) Opening without the use of a key or a tool and without disconnection of live parts shall be possible only when all live parts are protected against contact to at least IP2X or IPXXB. Where barriers provide this protection, either they shall require a tool for their removal or all live parts protected by them shall be automatically disconnected when the barrier is removed. Where a hazard can be caused by manual action of devices () , such action shall be prevented by barriers or obstacles that require a tool for their removal		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
6.2.3	Live parts protected by insulation shall be completely covered with insulation that can only be removed by destruction and that is capable of withstanding the mechanical, chemical, electrical, and thermal stresses to which it can be subjected under normal operating conditions		N/A
	Note: Paint, varnish lacquer etc. alone are generally considered inadequate		N/A
6.2.4	Live parts having a residual voltage greater than 60 V when disconnected, shall be discharged to 60 V or less within 5 s, if this does not interfere with the proper functioning of the equipment		N/A
	Exempted are components having stored charges of 60 µC or less		N/A
	Where not possible , an appropriate warning shall be placed according to the details given		N/A
	In case of pins of plugs etc. the discharge time shall not exceed 1s. Otherwise such conductors shall be protected to at least IP2X or IPXXB.		N/A
	If above requirements cannot be achieved, additional disconnecting devices or appropriate warning devices shall be provided		N/A
	When equipment is accessible to all persons incl. children, warnings are not sufficient and a protection of IP4X or IPXXD is required		N/A
6.2.5	For protection by barriers, the requirements of IEC 60364-4-41 shall apply (412.2)		N/A
6.2.6	For protection by placing out of reach or protection by obstacles, the requirements of IEC 60364-4-41 shall apply (412.4 and 412.3)		N/A
	For conductor wire or bar systems with less than IP2X or IPXXB, see 12.7.1		N/A
6.3	**Fault protection**		N/A
6.3.1	For each circuit or part of el. equipment at least one of the measures of 6.3.2 to 6.3.3 shall be applied:		—
	Prevention of the occurrence of a touch voltage		N/A
	Protection by automatic disconnection of supply		N/A
6.3.2	Prevention of the occurrence of a touch voltage		N/A
6.3.2.2	Protection by provision of one or more of the following:		—
	- class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation in accordance with IEC 61140) or		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	- switchgear and control gear assemblies having total insulation in accordance with IEC 61439-1or		N/A
	- supplementary or reinforced insulation in accordance with IEC 60364-4-41(413.2)		N/A
6.3.2.3	For protection by electrical separation the requirements of IEC 60364-4-41 apply (413.5)		N/A
6.3.3	Protection by automatic disconnection of supply.		
	This measure consists of the interruption of one or more line conductors in a time within the limits specified in Annex A for TN and TT systems		N/A
	This requires co-ordination between: - the type of supply, the source impedance and the earthing system - several impedance values - characteristics of protective devices (For details see 18.2)		N/A
	This protective measure comprises both:		N/A
	protective bonding of exposed parts (8.2.3)		N/A
	one of the following:		N/A
	a) In TN systems, the following protective devices may be used:		N/A
	overcurrent protective device or		N/A
	residual current protective devices (RCDs) and associated overcurrent protective devices		N/A
	b) In TT systems either:		N/A
	RCDs and associated overcurrent protective devices or		N/A
	overcurrent protective devices provided a low fault loop impedance is assured		N/A
	c) In IT-Systems the requirements of IEC 60364-4-41 shall be fulfilled		N/A
	During an insulation fault an acoustic and an optical signal shall be sustained. The acoustic signal may manually be muted		N/A
	Where automatic disconnection is provided under a) and disconnection acc. to A.1.1 cannot be assured, supplementary protective bonding shall be provided to fulfil A.1.3		N/A
	Where protection of a PDS (power drive system) is not provided by the converter, the necessary protection shall be acc. to the converter manufacturer's instructions		N/A
6.4	**Protection by the use of PELV**		N/A
6.4.1	PELV circuits shall satisfy all of the following conditions:		—

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Clause	Requirement + Test	Result - Remark	Verdict
	a) the nominal voltage does not exceed: - 25 V AC r.m.s. or 60 V ripple-free AC when the equipment is normally used in dry locations and when large area contact of live parts with the human body is not expected; or 6 V AC r.m.s. or 15 V ripple-free DC in all other cases;		N/A
	b) one side of the circuit or one point of the source of the supply of that circuit is connected to the protective bonding circuit;		N/A
	c) live parts of PELV circuits shall be electrically separated from other live circuits (see IEC 61558)		N/A
	d) conductors of each PELV circuit shall be physically separated from those of any other circuit. If this requirement is impracticable, the insulation provisions of 13.1.3 shall apply		N/A
	e) plugs and socket-outlets for a PELV circuit shall conform to the following: - plugs shall not to enter socket-outlets of other voltage systems socket-outlets shall not admit plugs of other voltage systems		N/A
6.4.2	The sources for PELV shall be one of the following:		—
	- a safety isolating transformer in accordance with IEC 61558-1 and IEC 61558-2-6 or		N/A
	- a source of current with a degree of safety equi-valent to that of the safety isolating transformer or		N/A
	- a source independent of circuit with higher voltage (e.g. battery or diesel –driven) or		N/A
	- electronic power supply conforming to appropriate standards		N/A
7.	**PROTECTION OF EQUIPMENT**		P
7.2	**Overcurrent protection**		P
7.2.1	Overcurrent protection shall be provided where the current in any circuit can exceed the rating of a component or the capacity of a conductor		P
7.2.2	Supply conductors		P
	Unless otherwise specified by the user, the supplier of the electrical equipment is not responsible for providing the supply conductors or the overcurrent protective device for it		P
	In the installation documents, the data necessary for conductor dimensioning and selecting the overcurrent protective device are stated (see 7.2.10 and 17.4)		P
7.2.3	Power circuits		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Devices for detection and interruption of overcurrent, selected in accordance with 7.2.10, are applied to each live conductor including supplies to control circuit transformers.		N/A
	The following conductors shall not be disconnected without disconnecting all associated live conductors: - the neutral conductor of AC power circuits; - the earthed conductor of DC power circuits; DC power conductors bonded to exposed conductive parts of mobile machines.		N/A
	Where the cross-section area of the neutral conductor is at least equal to the line conductor, no overcurrent detection nor disconnecting device is required for that conductor		N/A
	Otherwise the measures detailed in 524 of IEC 60364-5-52:2009 shall apply		N/A
	In IT-Systems, it is recommended that no neutral conductor is used. Where a neutral conductor is used, the measures detailed in 431.2.2 of IEC 60364-4-43:2008 shall apply		N/A
7.2.4	Control circuits		—
	Conductors of control circuits directly connected to the supply shall be protected against overcurrent in accordance with 7.2.3.		N/A
	Conductors of control circuits supplied by a transformer or DC supply shall be protected against overcurrent (see also 9.4.3.1.1):		—
	In control circuits, connected to the protective bonding circuit, by an overcurrent protective device in the switched conductor		N/A
	- In circuits, not connected to the protective bonding circuit: • Where all control circuits have the same current carrying capacity, by an overcurrent protective device in the switched conductor Otherwise, by an overcurrent protective device in both, switched and common conductors of each control circuit		N/A
	Exception: Where a supply unit provides current limiting below the capacity of the conductors and the connected components, no overcurrent protective device is required		N/A
7.2.5	Overcurrent protection shall be provided for circuits feeding general purpose socket outlets		N/A
7.2.6	Unearthed conductors of lighting circuits shall be protected separately from other circuits.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
7.2.7	Transformers shall be protected in accordance with the manufacturer's instructions and includes: - avoiding tripping due to transformer magnetizing inrush currents avoiding a winding temperature rise in excess of the permitted value for the insulation class when there is a short circuit at the secondary terminals		N/A
7.2.8	Location of overcurrent protective devices		N/A
	It shall be located at the point where a reduction in the cross sectional area of the conductors or another change reduces the current-carrying capacity of the conductors except:		N/A
	- current carrying capacity of the conductors is at least equal to that of the load and - conductors between the point of reduction of current-carrying capacity and the position of the overcurrent protective device is ≤ 3 m and the conductor is protected e.g. by an enclosure or duct.		N/A
7.2.9	Overcurrent protective devices		N/A
	The rated short-circuit breaking capacity Icn shall be at least equal to the prospective fault current at the point of installation. Additional currents other than from the supply (e.g. from motors, from power factor correction capacitors) shall be taken into consideration.		N/A
	Where fuses are provided as overcurrent protective devices, a type readily available in the country of use shall be selected, or arrangements shall be made for the supply of spare parts.		N/A
7.2.10	Rating and setting of overcurrent protective devices:		N/A
	Rated current of fuses or overcurrent setting of other protective devices selected as low as possible, but adequate for anticipated overcurrents.		N/A
	The rated current of overcurrent protective device for conductors is determined by the current carrying capacity of the conductors to be protected in accordance with Cl. 12.4, D.2 and the maximum allowable interrupting time *t* in accordance with Clause D.3.		N/A
7.3	**Protection of motors against overheating**		P
7.3.1	Protection shall be provided for each motor rated at more than 0.5 kW.		P
	Exception: In applications where an automatic interruption of the motor operation is unacceptable (for example fire pumps), the means of detection shall give a warning signal to which the operator can respond.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Automatic restarting prevented where this can cause a hazard		P
7.3.2	Protection achieved by overload protection device: - detection in each live conductor - switching off of all live conductors (not necessary to switch of neutral conductor)		P
	For special duty motors, appropriate protective devices are recommended		P
	For motors that cannot be overloaded, overload protection is not required.		P
7.3.3	Protection achieved by over-temperature protection device: Is recommended in situations where the cooling can be impaired (for example dusty environments)		P
7.4	Equipment shall be protected against abnormal temperatures that can result in a hazardous situation.		P
7.5	**Protection against the effects of supply interruption or voltage reduction and subsequent restoration**		N/A
	Where a supply interruption or a voltage reduction can cause a hazardous situation, damage to the machine, or to the work in progress, undervoltage protection is provided.		N/A
	Upon restoration of supply voltage, automatic or unexpected restarting of machine prevented.		N/A
	Undervoltage protection does initiate appropriate control responses to ensure necessary coordination of groups of machines working together		N/A
7.6	Motor overspeed protection shall be provided where overspeeding can occur and could possibly cause a hazardous situation.		N/A
7.8	Phase sequence protection shall be provided, where an incorrect phase sequence of the supply voltage can cause a hazardous situation or damage to the machine.		N/A
7.9	Surge protective devices (SPDs) can be provided to protect against the effects of overvoltages due to lightning or to switching surges.		N/A
7.10	The short-circuit current rating of the electrical equipment shall be determined by the application of design rules or by calculation or by test.		N/A
8	**EQUIPOTENTIAL BONDING**		N/A
8.2	**Protective bonding circuit**		N/A
8.2.1	All parts of the protective bonding circuit shall be so designed that they are capable of withstanding the highest thermal and mechanical stresses		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Protective conductors which does not form part of a cable shall not be less than:		—
	2.5 mm^2 Cu or 16 mm^2 Al if protection against mechanical damage is provided		N/A
	4 mm^2 Cu or 16 mm^2 Al if protection against mechanical damage is not provided		N/A
	Exposed conductive parts of equipment in accordance with 6.3.2.3 (Protection by electrical separation) shall not be connected to the protective bonding circuit.		N/A
8.2.2	Protective conductors		—
	Protective conductors shall be identified in accordance with 13.2.2.		N/A
	Copper conductors are preferred.		N/A
	Where other material is used, its electrical resistance per unit length shall not exceed that of the allowable copper conductor and such conductors shall be not less than 16 mm^2 in cross-sectional area.		N/A
	Metal enclosures or frames or mounting plates may be used as protective conductors if they satisfy the following three requirements: - protection against mechanical, chemical or electrochemical deterioration - compliant with 543.1 of IEC 60364-5-54: permit the connection of other protective conductors where foreseen		N/A
	The cross-section of protective conductors shall be calculated according to 543.1.2 of IEC 60364-5-54, or selected in accordance with Table 1.		N/A
	Each protective conductor shall: - be part of a multicore cable, or; - be in a common enclosure with the line conductor, or; - have a cross-sectional area of at least; • 2.5 mm2 Cu or 16 mm2 Al with protection against mechanical damage • 4 mm2 Cu or 16 mm2 Al without protection against mechanical damage		N/A
	A protective conductor not forming part of a cable is considered to be mechanically protected if it is installed in a conduit, trunking or protected in a similar way.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The following parts shall be connected to the protective bonding circuit but shall not be used as protective conductors: - conductive structural parts of the machine; - metal ducts of flexible or rigid construction; - metallic cable sheaths or armouring; - metallic pipes containing flammable materials such as gases, liquids, powder. - flexible or pliable metal conduits; - constructional parts subject to mechanical stress in normal service; • flexible metal parts; support wires; cable trays and cable ladders.		N/A
8.2.3	Continuity of the protective bonding circuit		
	Where a part is removed the protective bonding circuit for the remaining parts isn't interrupted.		N/A
	Current-carrying capacity of connection and bonding points not impaired by mechanical, chemical, or electrochemical influences (e.g. electrolytic corrosion on aluminium parts)		N/A
	Where the electrical equipment is mounted on lids, doors, or cover plates, continuity of the protective bonding circuit shall be ensured. The use of a protective conductor (see 8.2.2) is recommended.		N/A
	For cables that are exposed to damage (for example flexible trailing cables) the continuity of the protective conductors are ensured by appropriate measures (for example monitoring).		N/A
	Where the continuity can be interrupted, a first make last break contact is required.		N/A
8.2.4	Protective conductor connecting points are not intended to attach appliances or parts.		N/A
	Each connecting point shall be marked or labelled as such using the symbol IEC 60417-5019 or the letters PE or by use of bicolour GREEN / YELLOW 		N/A
8.2.5	Mobile machines with on-board power supplies: The protective bonding system is connected to a single protective bonding terminal. This protective bonding terminal is the connection point for a possible additional external incoming power supply		N/A
8.2.6	**Additional requirements for electrical equipment having earth leakage currents higher than 10 mA**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Where electrical equipment has an earth leakage current greater than 10 mA AC or DC the associated protective bonding circuit shall satisfy one of the following:		—
	the protective conductor is completely enclosed or otherwise protected		N/A
	the protective conductor has a cross-sectional area of at least 10 mm^2 Cu or 16 mm^2 Al		N/A
	a second protective conductor of at least the same cross-sectional area is provided		N/A
	the supply is automatically disconnected in case of loss of continuity of the protective conductor		N/A
	where a plug-socket combination is used, an industrial connector in accordance with IEC 60309 series is provided		N/A
	A statement shall be given in the instructions for installation that the equipment shall be installed as described in this 8.2.6.		N/A
8.3	Measures to restrict the effects of high leakage current can be taken as described		N/A
8.4	If functional bonding is used, the connecting points should be marked with symbol IEC 60417-5020 		N/A
9	**CONTROL CIRCUITS AND CONTROL FUNCTIONS**		--
9.1.	**Control circuit**		N/A
9.1.1	Where control circuits are supplied from an AC source, transformers having separate windings shall be used to separate the power supply from the control supply.		N/A
	Examples include: control transformers acc. to IEC 61558-2-2, SMPS acc. to IEC 61558-2-16 power supplies acc. to IEC 61204-7		N/A
	Where several transformers are used, it is recommended that the secondary voltages are in phase.		N/A
	Exception: Transformers or switch mode power supply units fitted with transformers are not mandatory for machines with a single motor starter and/or a maximum of two control devices		N/A
	Where DC control circuits derived from an AC supply are connected to the protective bonding, they shall be supplied from a separate winding		N/A
9.1.2	The nominal voltage of control circuits should preferably not exceed - 230 V @ 50 Hz - 277 V @ 60 Hz 220 V @ DC		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
9.1.3	Control circuits are provided with overcurrent protection in accordance with 7.2.4 and 7.2.10.		N/A
9.2.	**Control functions**		N/A
9.2.2	Categories of stop functions are stop category 0, 1, 2		N/A
9.2.3	Operation		N/A
9.2.3.1	Where a machine has more than one control station, measures shall be provided to ensure that initiation of commands from different control stations do not lead to a hazardous situation.		N/A
9.2.3.2	Start functions shall operate by energizing the relevant circuit.		N/A
	Start of an operation shall be possible only when all of the relevant safety functions and/or protective measures are in place and are operational.		N/A
	Where safety functions and/or protective measures cannot be applied for certain operations, manual control of such operations are by hold-to-run controls, together with enabling devices, as appropriate.		N/A
	In the case of machines requiring the use of more than one control station to initiate a start, each of these control stations shall have a separate manually actuated start control device. The conditions to initiate a start are: - all required conditions for machine operation shall be met and - all start control devices shall be in the released (off) position, then all start control devices have to be actuated concurrently (see 3.1.7).		N/A
9.2.3.3	Stop category 0 and/or stop category 1 and/or stop category 2 stop functions are provided as indicated by the risk assessment and the functional requirements of the machine (see 4.1).		N/A
	Stop functions shall override related start functions		N/A
	Where more than one control station is provided, stop commands from any control station is effective when required by the risk assessment of the machine.		N/A
9.2.3.4	Emergency operations (emergency stop, emergency switching off)		N/A
9.2.3.4.1	Emergency stop or emergency switching off commands shall be sustained until it is reset.		N/A
	This reset shall be possible only by a manual action at that location where the command has been initiated.		N/A
	The reset of the command shall not restart the machinery but only permit restarting.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	It shall not be possible to restart the machinery until all emergency stop commands are reset.		N/A
	It shall not be possible to reenergize the machinery until all emergency switching off commands are reset.		N/A
9.2.3.4.2	The emergency stop does function either as a stop category 0 or as a stop category 1.		N/A
	- it shall override all other functions and operations in all modes - it shall stop the hazardous motion as quickly as practicable without creating other hazards a reset shall not initiate a restart		N/A
9.2.3.4.3	Emergency switching off should be provided where: - Protection against direct contact is achieved only by placing out of reach or by obstacles (see 6.2.6) or there is the possibility of other hazards or damage caused by electricity		N/A
	Emergency switching off is accomplished by electromechanical switching devices, effecting a stop category 0 of machine actuators connected to this incoming supply		N/A
9.2.3.5	Operating modes		N/A
	Where machinery uses several control or operating modes requiring different protective measures and having a different impact on safety, it shall be fitted with a mode selector which can be locked in each position		N/A
	Another selection method can be used (for example an access code)		N/A
	Mode selection by itself does not initiate machine operation. A separate actuation of the start control has to be stated by the operator.		N/A
	Indication of the selected operating mode shall be provided (e.g. the position of a mode selector, the provision of an indicating light, a visual display indication)		N/A
9.2.3.6	Movement or action that can result in a hazardous situation shall be monitored by providing, for example, overtravel limiters, motor overspeed detection, mechanical overload detection or anti-collision devices		P
9.2.3.7	Hold-to-run controls shall require continuous actuation of the control device(s) to achieve operation		P
9.2.3.8	Two-hand controls shall be one of the following types and have the following features		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Type I: this type requires: - the provision of two control devices and their concurrent actuation by both hands; - continuous concurrent actuation during the hazardous situation; machine operation shall cease upon the release		N/A
	Type II: a Type I control requiring the release of both control devices before machine operation can be reinitiated		N/A
	Type III: a Type II control requiring concurrent actuation of the control devices as follows: - it shall be necessary to actuate the control devices within a certain time limit of each other, not exceeding 0.5 s - where this time limit is exceeded, both control devices shall be released before machine operation can be initiated		P
9.2.3.9	Enabling control shall be so arranged as to minimize the possibility of defeating, for example by requiring the de-activation of the enabling control device before machine operation may be reinitiated		P
9.2.3.10	Combined start and stop controls: Push-buttons etc. that alternately initiate and stop motion shall only be provided for functions, which cannot result in a hazardous situation.		P
9.2.4	Cableless control system		N/A
9.2.4.1	The CCS shall have functionality and a response time suitable for the application based on the risk assessment.		N/A
9.2.4.2	The ability of a CCS to control a machine shall be automatically monitored, either continuously or at suitable intervals.		N/A
	If the communication signal has degraded (e.g., reduced signal level, low battery power) a warning shall be given		N/A
	When the ability to control a machine has been lost, an automatic stop of the machine shall be initiated.		N/A
	Its restoration shall not restart the machine.		N/A
9.2.4.3	Measures shall be taken to prevent the machine from responding to signals other than those from the intended operator control station(s).		N/A
	Cableless operator control station(s) shall only control the intended machine(s) and shall affect only the intended machine functions.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
9.2.4.4	When more than one cableless operator control station is used, then:		—
	only one control station shall be enabled at a time except as necessary for the operation		N/A
	transfer of control shall require a deliberate manual action at the station having control		N/A
	transfer shall only be possible if both stations are in the same mode		N/A
	a transfer shall not change the mode of operation or function		N/A
	on the station that has control, a visual indication shall indicate this		N/A
9.2.4.5	Portable cableless operator control stations shall be provided with means to prevent unauthorized use		N/A
	Each machine should have an indication when it is under cableless control		N/A
	When possible to be connected to several machines, means shall be provided on the portable device to select		N/A
	Selecting a machine shall not initiate control commands.		N/A
9.2.4.6	A deliberate disabling shall meet the requirements of 9.2.4.2.		N/A
	Where disabling without interrupting machine operation is necessary, appropriate means shall be provided to transfer control		N/A
9.2.4.7	Emergency stop devices on portable cableless operator control stations shall not be the sole means of initiating an emergency stop		N/A
	Confusion between active and inactive emergency stop devices shall be avoided		N/A
9.2.4.8	Restarting of a cableless control shall not result in a reset of an emergency stop condition		N/A
	The instructions shall state that a reset shall only be performed when it can be seen that the reason has been cleared		N/A
9.2.4.5	Portable cableless operator control stations shall be provided with means to prevent unauthorized use		N/A
9.3	**Protective interlocks**		N/A
9.3.1	The reclosing or resetting of an interlocking safeguard does not initiate hazardous machine operation		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
9.3.2	Where an operating limit (for example speed, pressure, position) can be exceeded leading to a hazardous situation, means shall be provided to detect when a predetermined limit(s) is exceeded and initiate an appropriate control action		N/A
9.3.3	The correct operation of auxiliary functions shall be checked by appropriate devices		N/A
	Where the non-operation of a device can cause a hazard, appropriate interlocking shall be provided		N/A
9.3.4	Interlocks between different operations and for contrary motions shall be provided, if these operations can lead to hazardous situations		N/A
9.3.5	Where braking of a motor is accomplished by current reversal, measures shall prevent the motor starting in the opposite direction at the end of braking where that reversal can cause a hazardous situation or damage to the machine or to the work in progress		N/A
	For this purpose, a device operating exclusively as a function of time is not permitted		N/A
	Control circuits shall be so arranged that rotation of a motor shaft, for example manually, does not result in a hazardous situation		N/A
9.3.6	Where it is necessary to suspend safety functions and/or protective measures, the control or operating mode selector shall simultaneously:		N/A
	disable all other operating (control) modes		N/A
	- permit operation only by the use of a hold-to-run device or by a similar control device positioned so as to permit sight of the hazardous elements		N/A
	- prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors		N/A
	If these four conditions cannot be fulfilled, the mode selector shall activate other protective measures to ensure a safe intervention zone. In addition, the operator shall be able to control operation of the parts he is working on from the adjustment point.		N/A
9.4	Control functions in the event of failure		N/A
9.4.1	The electrical control system(s) shall have an appropriate performance that has been determined from the risk assessment of the machine		N/A
	The requirements for safety-related control functions of IEC 62061 and/or ISO 13849-1, ISO 13849-2 shall apply		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Where memory retention is achieved for example, by battery power, measures shall be taken to prevent hazardous situations arising from failure, undervoltage or removal of the battery		N/A
	Means shall be provided to prevent unauthorized or inadvertent memory alteration by, for example, requiring the use of a key, access code or tool		N/A
9.4.2	Measures to minimize risk in the event of failure		N/A
9.4.2.2	Use of proven circuit techniques and components (see examples)		N/A
9.4.2.3	Provisions of partial or complete redundancy		N/A
9.4.2.4	Provision of diversity (see examples)		N/A
9.4.2.5	Provision for functional tests		N/A
9.4.3	Protection against malfunction of control circuits		N/A
9.4.3.1.1	Measures shall be provided to reduce the probability that insulation faults on any control circuit can cause malfunction		N/A
9.4.3.1.2	Method a) – Earthed control circuits fed by transformers		N/A
	The common conductor shall be connected to the protective bonding circuit at the point of supply.		N/A
	All control elements are to be inserted on the other side of the components		N/A
9.4.3.1.3	Method b) – Non-earthed control circuits fed by transformers shall either		N/A
	1) have 2-pole control switches that operate on both conductors; or		N/A
	2) be provided with a device that interrupts the circuit automatically in the event of an earth fault; or		N/A
	3) where 2) above would increase the risk, it can be sufficient to provide an insulation monitoring device hat will initiate an acoustic and optical signal		N/A
9.4.3.1.4	Method c) – Control circuits fed by transformer with an earthed centre-tap winding shall have overcurrent protective devices that break both the conductors		N/A
	The control switches shall be 2-pole types that operate on both conductors		N/A
9.4.3.1.5	Method d) – Control circuits not fed by a transformer are only allowed for machines with a maximum of one motor starter and/or maximum of two control devices, in accordance with 9.1.1		N/A
	Possible cases are:		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	1) directly connected to an earthed supply system (TN- or TT-system)		N/A
	If powered between two lines, multi-pole control switches are required		N/A
	2) directly connected to a supply system that is not earthed or is earthed through a high impedance (IT-system)		N/A
	A device shall be provided that interrupts the circuit automatically in the event of an earth fault		N/A
9.4.3.2	Where the loss of memory due to a power failure can result in a hazardous situation, appropriate measures shall be taken		N/A
9.4.3.3	Where the loss of continuity of control circuits depending upon sliding contacts can result in a hazard, appropriate measures shall be taken		N/A
10	**OPERATOR INTERFACE AND MACHINE-MOUNTED CONTROL DEVICES**		P
10.1.1	Control devices for operator interface shall, as far as is practicable, be selected, mounted, and identified or coded in accordance with IEC 61310 series		P
10.1.2	As far as is practicable, machine-mounted control devices shall be:		P
	readily accessible for service and maintenance		P
	mounted in such a manner as to minimize the possibility of damage from activities such as material handling		P
	The actuators of hand-operated control devices are selected and installed so that:		P
	they are not less than 0,6 m above the servicing level and are within easy reach of the normal working position of the operator		P
	the operator is not placed in a hazardous situation when operating them		P
	The actuators of foot-operated control devices are selected and installed so that:		N/A
	they are within easy reach of the normal working position of the operator		P
	the operator is not placed in a hazardous situation when operating them		P
10.1.3	The degree of protection (IP rating in accordance with IEC 60529) together with other appropriate measures shall provide protection against:		N/A
	– the effects of liquids, vapours, or gases found in the physical environment or used on the machine		N/A
	– the ingress of contaminants (for example swarf, dust, particulate matter)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The operator interface control devices shall have a minimum degree of protection against contact with live parts of IPXXD (see IEC 60529)		N/A
10.1.4	Position sensors (for example position switches, proximity switches) are so arranged that they will not be damaged in the event of overtravel		N/A
	Position sensors in circuits with safety-related control functions shall have direct opening action (see IEC 60947-5-1) or shall provide similar reliability (see 9.4.2)		N/A
10.1.5	Portable and pendant operator control stations and their control devices are so selected and arranged as to minimize the possibility of machine operations caused by inadvertent actuation, shocks and vibrations		N/A
10.2	**Actuators**		N/A
10.2.1	Actuators shall be colour-coded as follows:		N/A
	The colours for START/ON actuators should be WHITE, GREY, BLACK or GREEN with a preference for WHITE. RED shall not be used		N/A
	The colour RED shall be used for emergency stop and emergency switching off actuators		N/A
	If a background exists, it shall be coloured YELLOW		N/A
	The colours for STOP/OFF actuators should be BLACK, GREY, or WHITE with a preference for BLACK. GREEN shall not be used. RED is permitted		N/A
	WHITE, GREY, or BLACK are the preferred colours for actuators that alternately act as START/ON and STOP/OFF actuators. The colours RED, YELLOW, or GREEN shall not be used		N/A
	The same is applicable for “hold-to-run” actuators		N/A
	Reset actuators shall be BLUE, WHITE, GREY, or BLACK. Where they also act as a STOP/OFF actuator, the colours WHITE, GREY, or BLACK are preferred with the main preference being for BLACK. GREEN shall not be used.		N/A
	The colour YELLOW is reserved for use in abnormal conditions		N/A
	Where the same colours are used for various functions, a supplementary means of coding shall be used for the identification		N/A
10.2.2	Recommended markings for actuators are given in table 2 and 3		N/A
10.3	**Indicator lights and displays**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
10.3.1	Indicator lights and displays shall be selected and installed in such a manner as to be visible from the normal position of the operator (see also IEC 61310-1).		N/A
	Circuits used for visual or audible devices used to warn persons of an impending hazardous event shall be fitted with facilities to check the operability of these devices		N/A
10.3.2	Indicator lights should be colour-coded with respect to the condition (status) of the machine in accordance with Table 4.		N/A
	Indicating towers on machines have the applicable colours in the following order from the top down; RED, YELLOW, BLUE, GREEN and WHITE.		N/A
10.3.3	For further distinction or information and especially to give additional emphasis, flashing lights and displays can be provided		N/A
	Where flashing lights or displays are used to provide higher priority information, additional acoustic warnings should be considered		N/A
10.4	illuminated push-button actuators shall be colour-coded in accordance with Tables 2 and 4. Where there is difficulty in assigning an appropriate colour, WHITE is used.		N/A
	The colour RED for the emergency stop actuator shall not depend on the illumination of its light.		N/A
10.5	Devices having a **rotational member**, such as potentiometers and selector switches, shall have means of prevention of rotation of the stationary member. Friction alone isn't considered sufficient.		N/A
10.6	Actuators used to initiate a start function or the movement of machine elements shall be constructed and mounted so as to minimize inadvertent operation		N/A
10.7	**Emergency stop devices**		--
10.7.1	Devices for emergency stop are readily accessible		P
	Emergency stop devices shall be provided at each location where the initiation of an emergency stop can be required		P
	In circumstances where confusion can occur between active and inactive emergency stop devices caused by disabling the operator control station, means (for example, information for use) are provided to minimise confusion.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
10.7.2	The types of device for emergency stop include, but are not limited to: – a push-button device for actuation by the palm or the fist (e.g. mushroom) – a pull-cord operated switch – a pedal-operated switch without mechanical guard		N/A
	The devices shall be in accordance with IEC 60947-5-5.		N/A
10.7.3	Where a stop category 0 is suitable, the supply disconnecting device may serve the function of emergency stop where: – it is readily accessible to the operator; and – it is of the type described in 5.3.2 a), b), c), or d)		N/A
	Where intended for emergency use, the supply disconnecting device shall meet the colour requirements of 10.2.1		N/A
10.8	**Emergency switching off devices**		--
10.8.1	Such devices shall be located as necessary for the given application.		N/A
	Means are provided, where necessary, to avoid confusion between these devices.		N/A
10.8.2	The types of device for emergency switching off include: – a push-button operated switch with a palm or mushroom head type of actuator – a pull-cord operated switch		N/A
	The devices shall have direct opening action		N/A
10.8.3	Where the supply disconnecting device is to be locally operated for emergency switching off, it shall be readily accessible and shall meet the colour requirements of 10.2.1		N/A
10.9	**Enabling control device**		N/A
	Enabling control devices shall be selected and arranged so as to minimize the possibility of defeating		N/A
	They shall be designed in accordance with ergonomic principles		N/A
	Functions of two-position types: - position 1: off-function of the switch (actuator is not operated); position 2: enabling function (actuator is operated)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Functions of three-position types: - position 1: off-function of the switch (actuator is not operated) - position 2: enabling function (actuator is operated in its mid position) - position 3: off-function (actuator is operated past its mid position) when returning from position 3 to position 2, the enabling function is not activated		N/A
11	**CONTROLGEAR: LOCATION, MOUNTING AND ENCLOSURES**		P
11.2.1	All items of controlgear (inclusively terminals that are not part of controlgear components or devices) are placed and oriented so that they can be identified without moving them or the wiring.		P
	For items that require checking for correct operation or that are liable to need replacement, those actions should be possible without dismantling other equipment or parts of the machine (except opening doors or removing covers, barriers or obstacles).		P
	All controlgear are mounted so as to facilitate its operation and maintenance from the front.		P
	Necessary tools to adjust, maintain, or remove a device are supplied.		P
	Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0,4 m and 2,0 m above the servicing level.		P
	Recommendation, that terminals be least 0.2 m above the servicing level and so placed that conductors and cables can be easily connected		P
	Only operating, indicating, measuring, and cooling devices are mounted on doors or on normally removable access covers of enclosures.		P
	Where connected through plug-in arrangements, their association shall be made clear by type (shape), marking or reference designation		P
	Plug-in devices that are handled during normal operation shall be provided with non-interchangeable features		P
	Plug/socket combinations that are handled during normal operation are unobstructedly accessible.		N/A
	Test points for connection of test equipment shall be: – mounted to provide unobstructed access – clearly identified to correspond with the documentation – adequately insulated – sufficiently spaced		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
11.2.2	Physical separation or grouping		N/A
	Non-electrical parts and devices, not directly associated with the electrical equipment, shall not be located within enclosures containing controlgear		N/A
	Devices such as solenoid valves should be separated from the other electrical equipment (for example in a separate compartment)		N/A
	Control devices mounted in the same location and connected to the supply voltage, or to both supply and control voltages, should be grouped separately from those connected only to the control voltages		N/A
	Terminals shall be separated into groups for: – power circuits – associated control circuits – other control circuits, fed from external sources (for example for interlocking)		N/A
11.2.3	The temperature rise inside electrical equipment enclosures shall not exceed the ambient temperature specified by the component manufacturers		P
	Heat generating components (for example heat sinks, power resistors) are located so, that the temperature of each component in the vicinity remains within the permitted limit		P
11.3	**Degrees of protection**		N/A
	The protection of controlgear against ingress of solid foreign objects and of liquids shall be adequate taking into account the external influences under which the machine is intended to operate and shall be sufficient against dust, coolants, lubricants and swarf		N/A
	Enclosures of controlgear provide a degree of protection of at least IP22 (see IEC 60529)		N/A
	Exception, where: a) an electrical operating area provides an appropriate degree of protection b) removable collectors on conductor wire or conductor bar systems are used and the measures of 12.7.1 are applied		N/A
11.4	**Enclosures, doors and openings**		N/A
	Enclosures shall be constructed using materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity and other environmental factors that are likely to be encountered in normal service		N/A
	Fasteners used to secure doors and covers should be of the captive type		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Windows of enclosures shall be of a material suitable to withstand expected mechanical stress and chemical attack		N/A
	It is recommended that enclosure doors having vertical hinges be not wider than 0,9 m, with an angle of opening of at least 95°		N/A
	Joints or gaskets of doors, lids, etc. shall withstand the chemical effects of the aggressive liquids, vapours, or gases used on the machine.		N/A
	They shall: - be securely attached not deteriorate due to removal or replacement of the door		N/A
	Openings in enclosures (for example, for cable access), including those towards the floor or foundation or to other parts of the machine shall be equipped with means to ensure the degree of protection specified for the equipment.		N/A
	A suitable opening may be provided in the base of enclosures within the machine so that moisture due to condensation can drain away		N/A
	Openings for cable entries shall be easily re-opened on site		N/A
	There shall be no opening between enclosures containing electrical equipment and compartments containing coolant, lubricating or hydraulic fluids, or those into which oil, other liquids, or dust can penetrate.		N/A
	Holes in an enclosure for mounting shall not impair the required protection.		N/A
	Equipment that, in normal or abnormal operation, can attain a surface temperature sufficient to cause a risk of fire or harmful effect to an enclosure material shall: – be located within an enclosure that will withstand, such temperatures; and – be located at a sufficient distance from adjacent equipment allowing safe dissipation of heat (see also 11.2.3); or – be otherwise screened by material that can withstand to the harmful effect.		N/A
11.5	**Access to electrical equipment**		N/A
	Doors in gangways for access to electrical operating areas shall: - be at least 0.7 m wide and 2.0 m high - open outwards have a means (for example panic bolts) to allow opening from the inside without the use of a key or tool		N/A
12	**CONDUCTORS AND CABLES**		—

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Clause	Requirement + Test	Result - Remark	Verdict
12.1	Conductors and cables shall be selected so as to be suitable for the operating conditions and external Influences that can exist		N/A
	These requirements do not apply to the integral wiring of assemblies, subassemblies, and devices that are manufactured and tested in accordance with their relevant IEC standard (for example IEC 61800 series).		—
12.2	Conductors should be of copper. Where aluminium conductors are used, the cross-sectional area shall be at least 16 mm^2.		N/A
	The cross-sectional area of conductors should not be less than as shown in Table 5		N/A
	Smaller cross-sectional areas or other constructions than shown in Table 5 may be used, provided adequate mechanical strength is achieved by other means		N/A
	Class 1 and class 2 conductors are primarily intended for use between rigid, non-moving parts where vibration is not likely to cause damage		N/A
	All conductors that are subject to frequent movement should have flexible stranding of class 5 or class 6.		N/A
12.3	Where the insulation of conductors and cables can constitute hazards due for example to the propagation of a fire or the emission of toxic or corrosive fumes adequate means are provided. Special attention is given to the integrity of a circuit having a safety-related function		N/A
	The insulation of cables and conductors used, shall be suitable for a test voltage:		—
	- not less than 2 000 V AC for a duration of 5 min for operation at voltages higher than 50 V AC or 120 V DC, or		N/A
	- not less than 500 V AC for a duration of 5 min for PELV circuits (see IEC 60364-4-41, class III equipment).		N/A
	The insulation shall be such that it cannot be damaged in operation or during laying, especially for cables pulled into ducts.		N/A
12.4	Current-carrying capacity in normal service in accordance with table 6. Or in accordance with suppliers recommendation.		N/A
12.6	**Flexible cables**		N/A
12.6.1	Flexible cables shall have Class 5 or Class 6 conductors		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	Cables that are subjected to severe duties shall be of adequate construction to protect against: - abrasion due to mechanical handling and dragging across rough surfaces - kinking due to operation without guides stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums		N/A
12.6.2	The tensile stress applied to copper conductors shall not exceed 15 N/mm^2 of cross-sectional area Or special measures are taken to withstand the applied stress		N/A
	For material other than copper the applied stress shall be within the cable manufacturer's specification		N/A
12.6.3	For cables of circular cross-sectional area installed on drums, the maximum current should be derated in accordance with Table 7		N/A
12.7	**Conductor wires, conductor bars and slip-ring assemblies**		N/A
12.7.1	During normal access to the machine, **protection** to conductor wires, conductor bars and slip-ring assemblies shall be achieved by the application of one of the following protective measures:		N/A
	protection by partial insulation of live parts, or where this is not practicable		N/A
	protection by enclosures or barriers of at least IP2X or IPXXB		N/A
	Horizontal top surfaces of barriers or enclosures that are readily accessible shall provide a degree of protection of at least IP4X or IPXXD		N/A
	Where the required degree of protection is not achieved, protection by placing live parts out of reach in combination with emergency switching off in accordance with 9.2.5.4.3 shall be applied		N/A
	Conductor wires and conductor bars shall be so placed and/or protected as to:		N/A
	- prevent contact, especially for unprotected conductor wires and conductor bars, with conductive items such as the cords of pull-cord switches, strain-relief devices and drive chains		N/A
	prevent damage from a swinging load		N/A
12.7.2	Protective conductor circuit (PE) and the neutral conductor (N) each use a separate conductor wire, conductor bar or slip-ring		N/A
	The continuity of the protective conductor circuit using sliding contacts shall be ensured by taking appropriate measures (for example, duplication of the current collector, continuity monitoring)		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
12.7.3	Protective conductor current collectors shall have a shape or construction so that they are not interchangeable with the other current collectors. Such current collectors shall be of the sliding contact type		N/A
12.7.4	Removable current collectors with disconnector function: The protective conductor circuit interrupts after and reconnects before any live conductor		N/A
12.7.5	Clearances in air between conductors and adjacent systems shall be suitable for at least a rated impulse voltage of an overvoltage category III in accordance with IEC 60664-1		N/A
12.7.6	Creepage distances between conductors and adjacent systems shall be suitable suitable for operation in the intended environment, e.g. open air, inside buildings, protected by enclosures		N/A
	In abnormally dusty, moist or corrosive environments, the following creepage distance requirements apply:		N/A
	unprotected conductor wires, conductor bars, and slip-ring assemblies: 60 mm		N/A
	- enclosed conductor wires, insulated multipole conductor bars and insulated individual conductor bars: 30 mm		N/A
12.7.7	Conductor system divided into isolated sections: suitable design measures shall be employed to prevent the energization of adjacent sections by the current collectors themselves		N/A
12.7.8	Conductor wires, conductor bars and slip-ring assemblies in power circuits shall be grouped separately from those in control circuits		N/A
	They shall be capable of withstanding, without damage, the mechanical forces and thermal effects of short-circuit currents		N/A
	Removable covers cannot be opened by one person without the aid of a tool		N/A
	Where common metal enclosures are used, the individual sections shall be bonded together and connected to the protective bonding circuit		N/A
	Conductor bar ducts that can be subject to accumulation of liquid shall have drainage facilities		N/A
13	**WIRING PRACTICES**		P
13.1	Connections and routing		P
13.1.1	All connections are secured against accidental loosening.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The means of connection are suitable for the cross-sectional areas and nature of the conductors being terminated.		P
	No connection of two or more conductors to one terminal, unless the terminal is designed for it.		P
	No soldered connections to terminals unless they are suitable for it.		P
	Terminals on terminal blocks are plainly marked or labelled corresponding with the diagrams.		P
	Installations of flexible conduits and cables are such that liquids drain away from the fittings.		N/A
	Retaining means for conductor strand and shields provided (no soldering for that purpose)		P
	Indentification tags legible, permanent, and appropriate for the physical environment.		P
	Terminal blocks mounted and wired so that the internal and external wiring does not cross over the terminals (see IEC 60947-7-1).		P
13.1.2	Conductors and cables shall be run from terminal to terminal without splices or joints		N/A
	Connections using plug/socket combinations with suitable protection against accidental disconnection are not considered to be splices or joints for the purpose of this subclause		N/A
	Exceptions are possible as described		N/A
	Terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors		N/A
	Protective conductor shall be placed close to the associated live conductors in order to decrease the impedance of the loop		N/A
13.1.3	Conductors for circuits that operate at different voltages are separated by suitable barriers, or are insulated for the highest voltage that occurs within the same duct		N/A
13.1.4	Conductors of AC circuits installed in ferromagnetic enclosures shall be arranged so that all conductors of each circuit, including the protective conductor of each circuit, are contained in the same enclosure		N/A
	Single-core cables armoured with steel wire or steel tape should not be used for AC circuits		N/A
13.2	The cable between the pick-up and the pick-up converter of an inductive power supply system shall be:		N/A
	as short as practicable		N/A
	adequately protected against mechanical damage		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
13.2.1	Each conductor shall be identifiable at each termination in accordance with the technical documentation		N/A
13.2.2	When identification of the protective conductor is by colour alone, the bicolour combination GREEN-AND-YELLOW shall be used throughout the length of the conductor		N/A
	Where the protective conductor can be easily identified colour coding throughout its length is not necessary, but the ends or accessible locations are clearly identified by the graphical symbol or by the bicolour combination GREEN-AND-YELLOW		N/A
	Exception: Protective bonding conductors may be marked with the letters PB and/or the symbol IEC 60417-5021		N/A
13.2.3	Where a neutral conductor is identified by colour alone, the colour shall be BLUE (preferably light blue)		N/A
	In this case that colour shall not be used for identifying any other conductor where confusion is possible		N/A
	Bare conductors used as neutral conductors shall have at minimum a stripe in LIGHT BLUE 15 mm to 100 mm wide in each compartment or unit and at each accessible location		N/A
13.2.4	Where colour-coding is used, BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE (including LIGHT BLUE), VIOLET, GREY, WHITE, PINK, TURQUOISE may be used		N/A
	GREEN and YELLOW should not be used where there is a possibility of confusion with the bicolour combination GREEN-AND-YELLOW		N/A
13.3	**Wiring inside enclosures**		N/A
	Conductors inside enclosures shall be supported where necessary		N/A
	Non-metallic supports shall be made with a flame-retardant insulating material (see IEC 60332 series)		N/A
	Connections to devices mounted on doors or to other movable parts shall be made using flexible conductors in accordance with 12.2 and 12.6.		N/A
	Conductors and cables that do not run in ducts shall be adequately supported		N/A
13.4	**Wiring outside enclosures**		N/A
13.4.1	Conductors of a circuit shall not be distributed over different multi-core cables, conduits, etc.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
13.4.3	Connections to moving parts shall take into account the foreseeable frequency of movement and shall be made using conductors in accordance with 12.2 and 12.6		N/A
	The bending radius of the cable shall be at least 10 times the diameter of the cable		N/A
	Flexible cables of machines shall be so installed or protected as to minimize the possibility of external damage (run over, forces, rubbing, heat, etc.)		N/A
	Cables close to moving parts, shall maintain a space of at least 25 mm between the moving parts and the cables or barriers are provided		N/A
	Cable handling systems: Lateral cable angles not exceeding 5°, at being wound on and off cable drums or approaching and leaving cable guidance devices. The bending radius shall be in accordance with Table 8		N/A
	Flexible conduit shall not be used for connections subject to rapid or frequent movements except when specifically designed for that purpose		N/A
13.4.4	Where several machine-mounted devices are connected in series or in parallel, it is recommended that the connections between those devices be made through terminals forming intermediate test points		N/A
13.4.5	**Plug/socket combinations**		N/A
	Components or devices inside an enclosure, terminated by fixed plug/socket combinations (no flexible cable), or components connected to a bus system by a plug/socket combination, are excluded		N/A
	Where the plug/socket contains a contact for the protective bonding circuit, it shall have a first make last break contact (see also 8.2.4).		N/A
	Plug/socket combinations intended to be connected or disconnected during load conditions shall have sufficient load-breaking capacity		N/A
	Where the plug/socket combination is rated at 30 A, or greater, it shall be interlocked		N/A
	Plug/socket combinations that are rated at more than 16 A shall have a retaining means to prevent unintended or accidental disconnection.		N/A
	Where an unintended or accidental disconnection of plug/socket combinations can cause a hazardous situation, they shall have a retaining means.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	The installation of plug/socket combinations shall fulfil the following requirements as applicable: a) The component which remains live after disconnection shall have a degree of protection of at least IP2X or IPXXB b) Metallic housings of plug/socket combinations shall be connected to the protective bonding circuit c) Plug/socket combinations intended to carry power loads but not to be disconnected during load conditions shall have a retaining means to prevent unintended or accidental disconnection and shall be clearly marked accordingly d) Where more than one plug/socket combination is provided in the same electrical equipment, the associated combinations shall be clearly identifiable. Mechanical coding is recommended Plug/socket combinations used in control circuits shall fulfil the applicable requirements of IEC 61984. Exception: combinations in accordance with IEC 60309-1, only those contacts shall be used for control circuits which are intended for those purposes. This exception does not apply to control circuits using high frequency signals superimposed on the power circuits.		N/A
13.4.6	Where it is necessary that wiring be disconnected for shipment, terminals or plug/socket combinations shall be provided at the sectional points.		N/A
13.4.7	When spare conductors are provided, they shall be connected to spare terminals or isolated to prevent contact with live parts		N/A
13.5	**Ducts, connection boxes and other boxes**		N/A
	Ducts shall provide a degree of protection (see IEC 60529) suitable for the application		N/A
	No sharp edges, flash, burrs, rough surfaces, or threads with which the insulation of the conductors can come into contact		N/A
	Where human passage is required, least 2 m above the working surface		N/A
	Where cable trays are only partially covered, the cables used shall be of a type suitable for installation on open cable trays.		N/A
13.5.2	Rigid metal conduit and fittings shall be of galvanized steel or of a corrosion-resistant material		N/A
	Fittings shall be compatible with the conduit and should be threaded		N/A
	Conduit bends shall be properly made		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
13.5.3	A flexible metal conduit shall consist of a flexible metal tubing or woven wire armour		N/A
13.5.4	Flexible non-metallic conduit shall be resistant to kinking		N/A
13.5.5	Cable trunking systems external to enclosures shall be rigidly supported and clear of all moving and of sources of contamination		N/A
	Where furnished in sections, the joints shall fit tightly but need not be gasketed		N/A
	The only openings permitted shall be those required for wiring or for drainage		N/A
13.5.6	The use of compartments or cable trunking systems within the column or base of a machine to enclose conductors is permitted provided they are isolated from coolant or oil reservoirs and are entirely enclosed		N/A
	Conductors shall be so secured		N/A
13.5.7	Connection boxes and other boxes used for wiring purposes shall be accessible for maintenance.		N/A
	Those boxes shall provide protection against the ingress of solid bodies and liquids		N/A
	They shall not have opened but unused knockouts nor any other openings		N/A
13.5.8	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices (e.g. brakes, temperature sensors		N/A
14	**ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT**		P
14.1	Electric motors should conform to the relevant parts of IEC 60034 series		P
14.2	Enclosures for motors should be in accordance with IEC 60034-5		P
	The degree of protection shall be dependent on the application and the physical environment		P
	The dimensions of motors shall conform to those given in the IEC 60072 series		P
14.4	Motors and its accessories shall be so mounted that they are adequately protected and are easily accessible for inspection, maintenance, etc.		P
	Proper cooling shall be ensured and the temperature rise shall remain within the limits of the insulation class (see IEC 60034-1)		P
	There shall be no opening between the motor compartment and any other compartment that does not meet the motor compartment requirements		P

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Clause	Requirement + Test	Result - Remark	Verdict
14.5	The characteristics of motors and associated equipment shall be selected in accordance with the anticipated service and physical environmental conditions		P
14.6	Operation of the overload and overcurrent protective devices for mechanical brake actuators shall initiate the simultaneous de-energization (release) of the associated machine actuators		P
15	**ACCESSORIES AND LIGHTING**		N/A
15.1	For socket-outlets intended for accessory equipment, the following apply:		N/A
	- they should conform to IEC 60309-1. Where not practicable, they should be clearly marked with the voltage and current ratings		N/A
	- the continuity of the protective bonding circuit to the socket-outlet shall be ensured		N/A
	- all unearthed conductors connected to the socket-outlet shall be protected against overcurrent and, when required, overload		N/A
	– where the power supply to the socket-outlet is not disconnected by the supply disconnecting device for the machine or the section of the machine, the requirements of 5.3.5 apply		N/A
	– where fault protection is provided by automatic disconnection of supply, the disconnection time shall be in accordance with Table A.1 for TN systems or Table A.2 for TT systems		N/A
	–socket-outlets with a rating not exceeding 20 A shall be provided with an RCD not exceeding 30 mA		N/A
15.2	**Local lighting of the machine and of the equipment**		N/A
15.2.1	The ON/OFF switch shall not be incorporated in the lampholder or in the flexible connecting cord		N/A
	Stroboscopic effects from lights shall be avoided		N/A
15.2.2	The nominal voltage of the local lighting circuit shall not exceed 250 V between conductors. A voltage not exceeding 50 V is recommended		N/A
	Lighting circuits shall be supplied from one of the following sources:		N/A
	– a dedicated isolating transformer connected to the supply disconnecting device. Overcurrent protection shall be provided in the secondary circuit		N/A
	– a dedicated isolating transformer connected before the supply disconnecting device. This is permitted for maintenance lighting in control enclosures only. Overcurrent protection shall be provided in the secondary circuit		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	– a circuit of the electrical equipment of the machine for lighting, with dedicated overcurrent protection		N/A
	– an isolating transformer connected before the supply disconnecting device, provided with a dedicated primary disconnecting means (see 5.3.5) and secondary overcurrent protection, and mounted within the control enclosure adjacent to the supply disconnecting device		N/A
	– an externally supplied lighting circuit (for example factory lighting supply). This shall be permitted in control enclosures only, and for the machine work light(s) where their total power rating is not more than 3 kW		N/A
	– power supply units, for DC supply to LED light sources, fitted with isolating transformers		N/A
	Exception: where fixed lighting is out of reach of operators during normal operations, the provisions of this 15.2.2 do not apply		N/A
15.2.3	Local lighting circuits shall be protected in accordance with 7.2.6		N/A
15.2.4	Adjustable lighting fittings shall be suitable for the physical environment		N/A
	The lampholders shall be:		N/A
	– in accordance with the relevant IEC standard		N/A
	– constructed with an insulating material protecting the lamp cap so as to prevent unintentional contact		N/A
	Reflectors shall be supported by a bracket and not by the lampholder		N/A
	Exception: where fixed lighting is out of reach of operators during normal operations, the provisions of this 15.2.4 do not apply		N/A

16	**MARKING, WARNING SIGNS AND REFERENCE DESIGNATIONS**		P
16.1	Warning signs, nameplates, markings, labels and identification plates shall be of sufficient durability		P
16.2.1	Enclosures that do not otherwise clearly show that they contain electrical shall be marked with the graphical symbol ISO 7010-W012 		P

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Clause	Requirement + Test	Result - Remark	Verdict
	It may be omitted (see also 6.2.2 b)) for: – an enclosure equipped with a supply disconnecting device – an operator-machine interface or control station – a single device with its own enclosure (for example position sensor)		P
16.2.2	Where the risk assessment shows the need to warn against the possibility of hazardous surface temperatures, the graphical symbol ISO 7010-W017 shall be used 		P
16.3	Control devices and visual indicators, shall be clearly and durably marked with regard to their functions		P
16.4	The following information shall be legibly and durably marked - plainly visible after installation on enclosures that receive incoming power supplies: • name or trade mark of supplier • certification mark or other marking where applicable • type designation or model, where applicable • serial number where applicable • main document number (see IEC 62023) where applicable • rated voltage, number of phases and frequency (if AC), and full-load current for each incoming supply It is recommended that this information is provided adjacent to the main incoming supply(ies)		P
16.5	All enclosures, assemblies, control devices, and components shall be plainly identified with the same reference designation as shown in the technical documentation		P

17	**TECHNICAL DOCUMENTATION**		P
17.1	The information necessary for identification, transport, installation, use, maintenance, decommissioning and disposal of the electrical equipment shall be supplied		P
	Annex I should be considered as guidance for the preparation of information and documents		P
17.2	**Information related to the electrical equipment**		P
	The following shall be supplied:		P
	a) where more than one document is provided, a main document for the electrical equipment as a whole, listing the complementary documents		P
	b) identification of the electrical equipment		P

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Clause	Requirement + Test	Result - Remark	Verdict
	c) information on installation and mounting including: • a description of installation and mounting, and its connection to the electrical and other supplies • short-circuit current rating for each incoming power supply • rated voltage, number of phases and frequency (if AC.), type of distribution system (TT, TN, IT) and full-load current for each incoming supply • any additional electrical supply(ies) requirements (for example maximum supply source impedance, leakage current) for each incoming supply • space required for servicing • installation requirements regarding cooling • environmental limitations (for example lighting, vibration, EMC environment, atmospheric contaminants) • functional limitations (for example peak starting currents and permitted voltage drops) • precautions to be taken for the installation regarding electromagnetic compatibility		P
	d) an instruction for the connection of conductive-parts in the vicinity of the machine to the protective bonding circuit: • metallic pipes • fences • ladders • handrails		P
	e) information on the functioning and operation as applicable: • an overview of the structure of the electrical equipment • procedures for programming or configuring • procedures for restarting after an unexpected stop • a sequence of operation		P
	f) information on maintenance, as appropriate: • frequency and method of functional testing • instructions for safe maintenance and where necessary suspend a safety function and/or protective measure (see 9.3.6) • guidance on the adjustment, repair, and frequency and method of preventive maintenance • details of the interconnections subject to replacement • required special devices or tools; • spare parts; • possible residual risks, indication of particular training and specification of personal protective equipment • instructions to restrict availability of keys or too(s to skilled or instructed persons • settings (DIP-switches, programmable parameter values, etc); • information for validation of safety related control functions after repair or modification, and for periodic testing where necessary;		P

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Clause	Requirement + Test	Result - Remark	Verdict
	g) information on handling, transportation and storage		P
	h) information for proper disassembly and handling of components		P
18	**VERFICATION**		P
18.1	The extent of verification will be given in the dedicated product standard for a particular machine. Where there is no such standard, the verifications shall always include the items a), b), c) and h) and may include one or more of the items d) to g): a) verification that the electrical equipment complies with its technical documentation b) verification of continuity of the protective bonding circuit (Test 1 of 18.2.2) c) in case of fault protection by automatic disconnection of supply, conditions shall be verified according to 18.2; d) insulation resistance test (see 18.3) e) voltage test (see 18.4) f) protection against residual voltage (see 18.5) g) verification that the relevant requirements of 8.2.6 are met h) functional tests (see 18.6)		—
	The results of the verification shall be documented		P
18.2	Verification of conditions for protection by automatic disconnection of supply		P
18.2.1	Test 1 verifies the continuity of the protective bonding circuit. Test 2 verifies the conditions for protection by automatic disconnection of the supply in TN systems For TN-systems, those test methods are described in 18.2.2 and 18.2.3; their application for different conditions of supply are specified in 18.2.4 For TT systems, see Clause A.2 For IT systems, see IEC 60364-6		N/A
18.2.2	Test 1: Verification of the continuity of the protective bonding circuit		P
	The resistance between the PE terminal (see 5.2 and Figure 4) and relevant points that are part of the protective bonding circuit shall be measured with a current between 0.2 A and approximately 10 A derived from an electrically separated supply source having a maximum no-load voltage of 24 V		P
	The resistance measured shall be in the expected range		P
18.2.3	Test 2: Fault loop impedance verification and suitability of the associated overcurrent protective device		P
	The connections of each power supply including the connection of the associated protective conductor to the PE terminal of the machine, shall be verified by inspection		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The conditions for the protection by automatic disconnection of supply in accordance with 6.3.3 and Annex A shall be verified by both		P
	a) verification of the fault loop impedance by - calculation, or - measurement in accordance with A.4, and		P
	b) confirmation that the setting and characteristics of the associated overcurrent protective device are in accordance with the requirements of Annex A, and		P
	Where a power drive system (PDS) is used, confirmation that the setting and characteristics of the protective device(s) are in accordance with the converter manufacturer's and protective device manufacturer's instructions		P
18.2.4	Application of the test methods for TN-systems		N/A
	When Test 2 of 18.2.3 is carried out by measurement, it shall always be preceded by Test 1 of 18.2.2		N/A
	The tests that are necessary for machines of different status are specified in Table 9		N/A
18.3	**Insulation resistance tests (optional)**		N/A
	When insulation resistance tests are performed, the insulation resistance measured at 500 V DC between the power circuit conductors and the protective bonding circuit shall be not less than 1 MΩ		N/A
	If the electrical equipment of the machine contains surge protection devices which are likely to operate during the test, it is permitted to either: – disconnect these devices, or – reduce the test voltage to a value lower than the voltage protection level of the surge protection devices		N/A
18.4	**Voltage tests (optional)**		N/A
	The test voltage shall be at a nominal frequency of 50 Hz or 60 Hz.		N/A
	The maximum test voltage shall have a value of twice the rated supply voltage of the equipment or 1 000 V, whichever is the greater		N/A
	The test voltage shall be applied between the power circuit conductors and the protective bonding circuit for at least 1 s		N/A
	Components and devices that are not rated to withstand the test voltage and surge protection devices shall be disconnected		N/A
18.5	**Protection against residual voltages**		N/A
	Where appropriate, tests shall be performed to ensure compliance with 6.2.4		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
18.6	**Functional tests**		P
	The functions of electrical equipment shall be tested		P
18.7	**Retesting**		P
	Where a portion of the machine or its associated equipment is changed or modified, the need for re-verification and testing of the electrical equipment shall be considered		P

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Clause	Requirement + Test	Result - Remark	Verdict
A	**ANNEX A (NORMATIVE)** **FAULT PROTECTION BY AUTOMATIC DISCONNECTION OF SUPPLY**		P
A.1	**Fault protection for machines supplied from TN-systems**		P
A.1.1	Fault protection shall be provided by an overcurrent protective device within a sufficiently short disconnecting time.		P
	5 s is considered sufficiently short for machines that are neither hand-held nor portable.		P
	Where not possible, supplementary protective bonding shall be provided in accordance with A.1.3		P
	For Class 1 hand-held equipment or portable equipment table A.1 specifies the maximum disconnecting times		P
A.1.2	Conditions for protection by overcurrent protective devices fulfilled		N/A
A.1.3	Condition for protection by reducing the touch voltage below 50 V fulfilled		N/A
A.1.4	Verification of conditions for protection by automatic disconnection of the supply (A.1.2) by		N/A
	verification of the characteristics of the associated protective device and		N/A
	measurement of the fault loop impedance (Zs)		N/A
	Exception: Verification of the continuity of the protective conductors may replace the measurement where appropriate		N/A
A.2	**Fault protection for machines supplied from TT-systems**		N/A
	Expand if applicable		N/A
B	**ANNEX B (INFORMATIVE)** **ENQUIRY FORM FOR THE ELECTRICAL EQUIPMENT OF MACHINES**		N/A
	The use of this form can facilitate an exchange of information between the user and supplier		N/A
C	**ANNEX C (INFORMATIVE)** **EXAMPLES OF MACHINES COVERED BY THIS PART OF IEC 60204**		N/A
	Non exhaustive list of examples This standard does not apply to machines within the scope of the IEC 60335 series		N/A
D	**ANNEX D (INFORMATIVE)** **CURRENT-CARRYING CAPACITY AND OVERCURRENT PROTECTION OF CONDUCTORS AND CABLES**		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
D.2.1	Correction factors for PVC conductors at higher temperatures		N/A
D.2.2	Methods of installation		N/A
D.2.3	Grouping and derating factors		N/A
D.4	Guidance for overcurrent protection of conductors		N/A
E	**ANNEX E (INFORMATIVE)** **EXPLANATION OF EMERGENCY OPERATION FUNCTIONS**		P
	Description of emergency stop, start, switching off, switching on		P
F	**ANNEX (INFORMATIVE)** **GUIDE FOR THE USE OF THIS PART OF IEC 60204**		P
	This standard gives a large number of general requirements that may or may not be applicable to the electrical equipment of a particular machine.		P
G	**ANNEX (INFORMATIVE)** **COMPARISON OF TYPICAL CONDUCTOR CROSS-SECTIONAL AREAS**		N/A
	Comparison of the American Wire Gauge (AWG), square millimetres, square inches, and circular mil		N/A
H	**ANNEX (INFORMATIVE)** **MEASURES TO REDUCE THE EFFECTS OF ELECTROMAGNETIC INFLUENCES**		N/A
	Expand if applicable		N/A
H.3.1	Only electrical equipment which meets the requirements of the appropriate EMC standards, or the EMC requirements of the relevant product standard, should be used		N/A
I	**ANNEX I (INFORMATIVE)** **DOCUMENTATION / INFORMATION**		N/A
	Table I.1 gives a list of Documentation / Information that can be applicable		N/A

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Clause	Requirement + Test	Result - Remark	Verdict

18.3	Insulation resistance tests		N/A
Test Point		Test Result (MΩ)	Required value (MΩ)
--		--	--
Supplementary information:			

18.4	Voltage test		N/A
Test Point		Test voltage	Breakdown Yes / No
--		--	--
Supplementary information:			

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Clause	Requirement + Test	Result - Remark	Verdict
4	**Strategy for risk assessment and risk reduction**		**P**
	To implement risk assessment and risk reduction the designer shall take the following actions, in the order given (see Figure 1):	These requirements have been complied with	P
	a) determine the limits of the machinery, which include the intended use and any reasonably foreseeable misuse thereof;	These requirements have been complied with.	P
	b) identify the hazards and associated hazardous situations;		P
	c) estimate the risk for each identified hazard and hazardous situation;		P
	d) evaluate the risk and take decisions about the need for risk reduction;		P
	e) eliminate the hazard or reduce the risk associated with the hazard by means of protective measures.		P
	The objective to be met is the greatest practicable risk reduction, taking into account the four below factors.	These requirements have been complied with.	P
	- the safety of the machine during all the phases of its life cycle;		P
	- the ability of the machine to perform its function;		P
	- the usability of the machine;		P
	- the manufacturing, operational and dismantling costs of the machine.		P
5	Risk assessment		P
5.1	General		P
	-- risk analysis, comprising		P
	1) determination of the limits of the machinery,		P
	2) hazard identification, and		P
	3) risk estimation		P
	-- risk evaluation		P
	Risk analysis provides information required for the risk evaluation, which in turn allows judgments to be made about whether or not risk reduction is required.		P
	These judgments shall be supported by a qualitative or, where appropriate, quantitative estimate of the risk associated with the hazards present on the machinery.		P
5.2	Information for risk assessment		P
	The information for risk assessment should include the following.		P
	a) Related to machinery description:		P

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Clause	Requirement + Test	Result - Remark	Verdict
	1) user specifications;		P
	2) anticipated machinery specifications, including		P
	i) a description of the various phases of the whole life cycle of the machinery, ii) design drawings or other means of establishing the nature of the machinery, and iii) required energy sources and how they are supplied;		N/A
	3) documentation on previous designs of similar machinery		N/A
	4) information for use of the machinery		P
	b) Related to regulations, standards and other applicable documents:		P
	1) applicable regulations;		P
	2) relevant standards;		P
	3) relevant technical specifications;		P
	c) Related to experience of use:		P
	1) any accident, incident or malfunction history of the actual or similar machinery;		P
	2) the history of damage to health resulting, for example, from emissions (noise, vibration, dust, fumes, etc.), chemicals used or materials processed by the machinery;		P
	3) the experience of users of similar machines and, whenever practicable, an exchange of information with the potential users.	-	P
	d) Relevant ergonomic principles.		P
	The information shall be updated as the design develops or when modifications to the machine are required. Comparisons between similar hazardous situations associated with different types of machinery are often possible, provided that sufficient information about hazards and accident circumstances in those situations is available		P
5.3	Determination of limits of machinery		P
5.3.1	General		P
5.3.1	General		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Risk assessment begins with the determination of the limits of the machinery, taking into account all the phases of the machinery life. This means that the characteristics and performances of the machine or a series of machines in an integrated process, and the related people, environment and products, should be identified in terms of the limits of machinery as given in 5.3.2 to 5.3.5.		P
5.3.2	Use limits		P
	Use limits include the intended use and the reasonably foreseeable misuse. Aspects to be taken into account include the following:		P
	a) the different machine operating modes and different intervention procedures for the users, including interventions required by malfunctions of the machine;		P
	b) the use of the machinery (for example, industrial, non-industrial and domestic) by persons identified by sex, age, dominant hand usage, or limiting physical abilities (visual or hearing impairment, size, strength,etc.);	Not applicable.	N/A
	c) the anticipated levels of training, experience or ability of users including		P
	1) operators,		P
	2) maintenance personnel or technicians,		P
	3) trainees and apprentices, and		P
	4) the general public;		N/A
	d) exposure of other persons to the hazards associated with the machinery where it can be reasonably foreseen:		N/A
	persons likely to have a good awareness of the specific hazards, such as operators of adjacent machinery;		P
	persons with little awareness of the specific hazards but likely to have a good awareness of site safety procedures, authorized routes, etc., such as administration staff;		P
	persons likely to have very little awareness of the machine hazards or the site safety procedures, such as visitors or members of the general public, including children.		P
	If specific information is not available in relation to b), above, the manufacturer should take into account general information on the intended user population (for example, appropriate anthropometric data).		P
5.3.3	Space limits		N/A
	Aspects of space limits to be taken into account include		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	a) the range of movement,		N/A
	b) space requirements for persons interacting with the machine, such as during operation and maintenance,		N/A
	c) human interaction such as the operator–machine interface, and		N/A
	d) the machine–power supply interface.		N/A
5.3.4	Time limits		N/A
	Aspects of time limits to be taken into account include		N/A
	a) the life limit of the machinery and/or of some of its components (tooling, parts that can wear, electromechanical components, etc.), taking into account its intended use and reasonably foreseeable misuse, and		N/A
	b) recommended service intervals.		N/A
5.3.5	Other limits		N/A
	Examples of other limits include		P
	a) properties of the material(s) to be processed,		P
	b) housekeeping — the level of cleanliness required, and		P
	c) environmental — the recommended minimum and maximum temperatures, whether the machine can be operated indoors or outdoors, in dry or wet weather, in direct sunlight, tolerance to dust and wet, etc.		P
5.4	Hazard identification		P
	After determination of the limits of the machinery, the essential step in any risk assessment of the machinery is the systematic identification of reasonably foreseeable hazards (permanent hazards and those which can appear unexpectedly), hazardous situations and/or hazardous events during all phases of the machine life cycle, i.e.:		P
	- transport, assembly and installation; - commissioning; - use; - dismantling, disabling and scrapping.		P
	a) Human interaction during the whole life cycle of the machine		P
	Task identification should consider all tasks associated with every phase of the machine life cycle as given above. Task identification should also take into account, but not be limited to, the following task categories:		P
	- setting;		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- testing;		P
	- teaching/programming;		P
	- process/tool changeover;		P
	- start-up;		P
	- all modes of operation;		P
	- feeding the machine;		P
	- removal of product from machine;		N/A
	- stopping the machine;		P
	- stopping the machine in case of emergency;		P
	- recovery of operation from jam or blockage;		P
	- restart after unscheduled stop;		N/A
	- fault-finding/trouble-shooting (operator intervention);		P
	- preventive maintenance;		P
	- cleaning and housekeeping;		P
	- corrective maintenance.		P
b)	Possible states of the machine		P
	1) the machine performs the intended function (the machine operates normally);		P
	2) the machine does not perform the intended function (i.e. it malfunctions) due to a variety of reasons,including		P
	- variation of a property or of a dimension of the processed material or of the workpiece,		P
	- failure of one or more of its component parts or services,		P
	- external disturbances (for example, shocks, vibration, electromagnetic interference),		P
	- design error or deficiency (for example, software errors),		P
	- disturbance of its power supply, and		P
	- surrounding conditions (for example, damaged floor surfaces).		P
c)	Unintended behaviour of the operator or reasonably foreseeable misuse of the machine		P
	- loss of control of the machine by the operator (especially for hand-held or mobile machines),		P
	- reflex behaviour of a person in case of malfunction, incident or failure during the use of the machine,		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- reflex behaviour of a person in case of malfunction, incident or failure during the use of the machine,		P
	- behaviour resulting from lack of concentration or carelessness,		P
	- behaviour resulting from taking the “line of least resistance” in carrying out a task,		P
	- behaviour resulting from pressures to keep the machine running in all circumstances, and		P
	- behaviour of certain persons (for example, children, disabled persons).		P
5.5	Risk estimation		P
5.5.1	General		P
	After hazard identification, risk estimation shall be carried out for each hazardous situation by determining the elements of risk given in 5.5.2.		P
	- estimate the risk associated with the emissions,		P
	- evaluate the effectiveness of the protective measures implemented at the design stage,		P
	- provide potential buyers with quantitative information on emissions in the technical documentation, and		P
	- provide users with quantitative information on emissions in the information for use.		P
5.5.2	Elements of risk		P
5.5.2.1	General		P
	The risk associated with a particular hazardous situation depends on the following elements:		P
	a) the severity of harm;	No this kind of situation has been found.	P
	b) the probability of occurrence of that harm, which is a function of		P
	1) the exposure of person(s) to the hazard		P
	2) the occurrence of a hazardous event, and		P
	3) the technical and human possibilities to avoid or limit the harm		P
5.5.2.2	Severity of harm		P
	The severity can be estimated by taking into account the following:		P
	a) the severity of injuries or damage to health, for example,		P
	- slight,		P
	- serious,		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- death.		P
	b) the extent of harm, for example, to		P
	- one person,		P
	- several persons.		P
5.5.2.3	Probability of occurrence of harm		P
5.5.2.3.1	Exposure of persons to the hazard		P
	The exposure of a person to the hazard influences the probability of the occurrence of harm. Factors to be taken into account when estimating the exposure are, among others,		P
	a) the need for access to the hazard zone (for normal operation, correction of malfunction, maintenance or repair, etc.),		P
	b) the nature of access (for example, manual feeding of materials),		N/A
	c) the time spent in the hazard zone,		N/A
	d) the number of persons requiring access, and		N/A
	e) the frequency of access.		N/A
5.5.2.3.2	Occurrence of a hazardous event		N/A
	The occurrence of a hazardous event influences the probability of occurrence of harm. Factors to be taken into account when estimating the occurrence of a hazardous event are, among others,		N/A
	a) reliability and other statistical data,		N/A
	b) accident history,		N/A
	c) history of damage to health, and		N/A
	d) comparison of risks (see 5.6.3).		P
5.5.2.3.3	Possibility of avoiding or limiting harm		P
	The possibility of avoiding or limiting harm influences the probability of occurrence of harm. Factors to be taken into account when estimating the possibility of avoiding or limiting harm are, among others, the following:		P
	a) different persons who can be exposed to the hazard(s), for example,		P
	- skilled,		N/A
	- unskilled;		P
	b) how quickly the hazardous situation could lead to harm, for example,		N/A
	- suddenly,		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	- quickly,		N/A
	- slowly;		N/A
	c) any awareness of risk, for example,		P
	- by general information, in particular, information for use,		P
	- by direct observation,		P
	- through warning signs and indicating devices, in particular, on the machinery;		P
	d) the human ability to avoid or limit harm (for example, reflex, agility, possibility of escape);		P
	e) practical experience and knowledge, for example,		P
	- of the machinery,		P
	- of similar machinery,		P
	- no experience.		N/A
5.5.3	Aspects to be considered during risk estimation		P
5.5.3.1	Persons exposed		P
	Risk estimation shall take into account all persons (operators and others) for whom exposure to the hazard is reasonably foreseeable.		P
5.5.3.2	Type, frequency and duration of exposure		P
	The estimation of the exposure to the hazard under consideration (including long-term damage to health) requires analysis of, and shall account for, all modes of operation of the machinery and methods of working. In particular, the analysis shall account for the needs for access during loading/unloading, setting, teaching, process changeover or correction, cleaning, fault-finding and maintenance.		P
5.5.3.3	Relationship between exposure and effects		P
	The relationship between an exposure to a hazard and its effects shall be taken into account for each hazardous situation considered. The effects of accumulated exposure and combinations of hazards shall also be considered. When considering these effects, risk estimation shall, as far as practicable, be based on appropriate recognized data.		P
5.5.3.4	Human factors		P
	Human factors can affect risk and shall be taken into account in the risk estimation, including, for example,		P
	a) the interaction of person(s) with the machinery, including correction of malfunction,		P
	b) interaction between persons,		P

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Clause	Requirement + Test	Result - Remark	Verdict
	c) stress-related aspects,		P
	d) ergonomic aspects,		P
	e) the capacity of persons to be aware of risks in a given situation depending on their training, experience and ability,		P
	f) fatigue aspects, and		P
	g) aspects of limited abilities (due to disability, age, etc.).		P
	Training, experience and ability can affect risk; nevertheless, none of these factors shall be used as a substitute for hazard elimination, risk reduction by inherently safe design measure or safeguarding, wherever these protective measures can be practicably implemented.		P
5.5.3.5	Suitability of protective measures		P
	Risk estimation shall take into account the suitability of protective measures and shall		P
	a) identify the circumstances which can result in harm,		P
	b) whenever appropriate, be carried out using quantitative methods to compare alternative protective measures (see ISO/TR 14121-2), and		P
	c) provide information that can assist with the selection of appropriate protective measures.		P
5.5.3.6	Possibility of defeating or circumventing protective measures		N/A
	For the continued safe operation of a machine, it is important that the protective measures allow its easy use and do not hinder its intended use. Otherwise, there is a possibility that protective measures might be bypassed in order for maximum utility of the machine to be achieved.		N/A
	a) the protective measure slows down production or interferes with another activity or preference of the user,		N/A
	b) the protective measure is difficult to use,		N/A
	c) persons other than the operator are involved, or		N/A
	d) the protective measure is not recognized by the user or not accepted as being suitable for its function.		N/A
5.5.3.7	Ability to maintain protective measures		P
	Risk estimation shall consider whether the protective measures can be maintained in the condition necessary to provide the required level of protection.		P
5.5.3.8	Information for use		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Risk estimation shall take into account the information for use, as available. See also 6.4.		P
5.6	Risk evaluation		P
5.6.1	General		P
	After risk estimation has been completed, risk evaluation shall be carried out to determine if risk reduction is required. If risk reduction is required, then appropriate protective measures shall be selected and applied.		P
5.6.2	Adequate risk reduction		P
	Application of the three-step method described in 6.1 is essential in achieving adequate risk reduction.		P
	Following the application of the three-step method, adequate risk reduction is achieved when		P
	- all operating conditions and all intervention procedures have been considered,		P
	- the hazards have been eliminated or risks reduced to the lowest practicable level,		P
	- any new hazards introduced by the protective measures have been properly addressed		P
	- users are sufficiently informed and warned about the residual risks		P
	- protective measures are compatible with one another,		P
	- sufficient consideration has been given to the consequences that can arise from the use in a nonprofessional/ non-industrial context of a machine designed for professional/industrial use, and		P
	- the protective measures do not adversely affect the operator's working conditions or the usability of the machine.		P
5.6.3	Comparison of risks		P
	As part of the process of risk evaluation, the risks associated with the machinery or parts of machinery can be compared with those of similar machinery or parts of machinery, provided the following criteria apply:		P
	- the similar machinery is in accordance with the relevant type-C standard(s);		P
	- the intended use, reasonably foreseeable misuse and the way both machines are designed and constructed are comparable;		P
	- the hazards and the elements of risk are comparable;		P
	- the technical specifications are comparable;		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- the conditions for use are comparable.		P
	The use of this comparison method does not eliminate the need to follow the risk assessment process as described in this International Standard for the specific conditions of use.		N/A
6	Risk reduction		P
6.1	General		P
	The objective of risk reduction can be achieved by the elimination of hazards, or by separately or simultaneously reducing each of the two elements that determine the associated risk:		P
	- severity of harm from the hazard under consideration;		P
	- probability of occurrence of that harm.		P
	Inherently safe design measures eliminate hazards or reduce the associated risks by a suitable choice of design features of the machine itself and/or interaction between the exposed persons and the machine.		P
	Taking into account the intended use and the reasonably foreseeable misuse, appropriately selected safeguarding and complementary protective measures can be used to reduce risk when it is not practicable to eliminate a hazard, or reduce its associated risk sufficiently, using inherently safe design measures.	This requirement has been complied with	P
	Where risks remain despite inherently safe design measures, safeguarding and the adoption of complementary protective measures, the residual risks shall be identified in the information for use.		P
	The information for use shall include, but not be limited to, the following:		P
	- operating procedures for the use of the machinery consistent with the expected ability of personnel who use the machinery or other persons who can be exposed to the hazards associated with the machinery;		P
	- the recommended safe working practices for the use of the machinery and the related training requirements adequately described;		P
	- sufficient information, including warning of residual risks for the different phases of the life of the machinery;		P
	- the description of any recommended personal protective equipment, including detail as to its need as well as to training needed for its use.		P
6.2	Inherently safe design measures		P
6.2.1	General		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Inherently safe design measures are the first and most important step in the risk reduction process. This is because protective measures inherent to the characteristics of the machine are likely to remain effective,		P
6.2.2	Consideration of geometrical factors and physical aspects		P
	Such factors include the following. a) The form of machinery is designed to maximize direct visibility of the working areas and hazard zones from the control position — reducing blind spots, for example — and choosing and locating means of indirect vision where necessary (mirrors, etc.) so as to take into account the characteristics of human vision, particularly when safe operation requires permanent direct control by the operator, for example:		P
	- the travelling and working area of mobile machines;	They have been used according to these requirements.	P
	- the zone of movement of lifted loads or of the carrier of machinery for lifting persons;		P
	- the area of contact of the tool of a hand-held or hand-guided machine with the material being worked.		P
	b) The form and the relative location of the mechanical components parts: for instance, crushing and shearing hazards are avoided by increasing the minimum gap between the moving parts, such that the part of the body under consideration can enter the gap safely, or by reducing the gap so that no part of the body can enter it		P
	c) Avoiding sharp edges and corners, protruding parts: in so far as their purpose allows, accessible parts of the machinery shall have no sharp edges, no sharp angles, no rough surfaces, no protruding parts likely to cause injury, and no openings which can “trap” parts of the body or clothing. In particular, sheet metal edges shall be deburred, flanged or trimmed, and open ends of tubes which can cause a “trap” shall be capped.	All the parts have been connected.	P
	d) The form of the machine is designed so as to achieve a suitable working position and provide accessible manual controls		P
6.2.2.2	Physical aspects		P
	a) limiting the actuating force to a sufficiently low value so that the actuated part does not generate a mechanical hazard;		P
	b) limiting the mass and/or velocity of the movable elements, and hence their kinetic energy;		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	c) limiting the emissions by acting on the characteristics of the source using measures for reducing		P
	1) noise emission at source		P
	2) the emission of vibration at source, such as redistribution or addition of mass and changes of process parameters	Appropriate protection has been provided.	N/A
	3) the emission of hazardous substances, including the use of less hazardous substances or dust-reducing processes		N/A
	4) radiation emissions, including, for example, avoiding the use of hazardous radiation sources, limiting the power of radiation to the lowest level sufficient for the proper functioning of the machine, designing the source so that the beam is concentrated on the target, increasing the distance between the source and the operator or providing for remote operation of the machinery		N/A
6.2.3	Taking into account general technical knowledge of machine design		P
	This general technical knowledge can be derived from technical specifications for design (standards, design codes, calculation rules, etc.), which should be used to cover		P
	a)mechanical stresses such as		P
	- stress limitation by implementation of correct calculation, construction and fastening methods as regards, for example, bolted assemblies and welded assemblies,		P
	- stress limitation by overload prevention		P
	- avoiding fatigue in elements under variable stresses (notably cyclic stresses), and		P
	- static and dynamic balancing of rotating elements,		P
	b) materials and their properties such as		P
	- resistance to corrosion, ageing, abrasion and wear,		P
	- hardness, ductility, brittleness,		P
	- homogeneity,		P
	- toxicity, and		P
	- flammability, and		P
	c) emission values for		P
	- noise,		P
	- vibration,		P
	- hazardous substances, and		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- radiation.		P
6.2.4	Choice of appropriate technology		P
	One or more hazards can be eliminated or risks reduced by the choice of the technology to be used in certain applications such as the following:		P
	a) on machines intended for use in explosive atmospheres, using		P
	- appropriately selected pneumatic or hydraulic control system and machine actuators,		P
	- intrinsically safe electrical equipment		P
	b) for particular products to be processed (for example, by a solvent), by using equipment that ensures the temperature will remain far below the flash point;		P
	c) the use of alternative equipment to avoid high noise levels, such as		P
	- electrical instead of pneumatic equipment,		P
	- in certain conditions, water-cutting instead of mechanical equipment.		N/A
6.2.5	Applying principle of positive mechanical action		P
	Positive mechanical action is achieved when a moving mechanical component inevitably moves another component along with it, either by direct contact or via rigid elements.		P
6.2.6	Provisions for stability		P
	Machines shall be designed so that they have sufficient stability to allow them to be used safely in their specified conditions of use. Factors to be taken into account include		P
	- the geometry of the base,		P
	- the weight distribution, including loading,		P
	- the dynamic forces due to movements of parts of the machine, of the machine itself or of elements held by the machine which can result in an overturning moment,		P
	- vibration,		P
	- oscillations of the centre of gravity,		P
	- characteristics of the supporting surface in case of travelling or installation on different sites		P
	- external forces, such as wind pressure and manual forces.		P
	Stability shall be considered in all phases of the life cycle of the machine, including handling, travelling, installation, use, dismantling, disabling and scrapping.		P

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Clause	Requirement + Test	Result - Remark	Verdict
6.2.7	Provisions for maintainability		P
	When designing a machine, the following maintainability factors shall be taken into account to enable maintenance of the machine:		P
	- accessibility, taking into account the environment and the human body measurements, including the dimensions of the working clothes and tools used;		P
	- ease of handling, taking into account human capabilities;		P
	- limitation of the number of special tools and equipment.		P
6.2.8	Observing ergonomic principles		P
	Ergonomic principles shall be taken into account in designing machinery so as to reduce the mental or physical stress of, and strain on, the operator. These principles shall be considered when allocating functions to operator and machine (degree of automation) in the basic design.		P
	a) Avoid the necessity for stressful postures and movements during the use of the machine		P
	b) Design machines, especially hand-held and mobile machines, so as to enable them to be operated easily, taking into account human effort, actuation of controls and hand, arm and leg anatomy.		P
	c) Limit as far as possible noise, vibration and thermal effects such as extreme temperatures.		P
	d) Avoid linking the operator's working rhythm to an automatic succession of cycles.		P
	e) Provide local lighting on or in the machine for the illumination of the working area and of adjusting, setting-up and frequent maintenance zones when the design features of the machine and/or its guards render the ambient lighting inadequate. Flicker, dazzling, shadows and stroboscopic effects shall be avoided if they can cause a risk.		P
	f) Select, locate and identify manual controls (actuators) so that		P
	- they are clearly visible and identifiable, and appropriately marked where necessary		P
	- they can be safely operated without hesitation or loss of time and without ambiguity		P
	- their location (for push-buttons) and their movement (for levers and hand wheels) are consistent with their effect		P
	- their operation cannot cause additional risk.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	g) Select, design and locate indicators, dials and visual display units so that		P
	- they fit within the parameters and characteristics of human perception,		P
	- information displayed can be detected, identified and interpreted conveniently, i.e. long-lasting, distinct, unambiguous and understandable with respect to the operator's requirements and the intended use, and		P
	- the operator is able to perceive them from the control position.		P
6.2.9	Electrical hazards		P
	For the design of the electrical equipment of machines, IEC 60204-1 gives general provisions about disconnection and switching of electrical circuits and for protection against electric shock. For requirements related to specific machines		P
6.2.10	Pneumatic and hydraulic hazards		P
	Pneumatic and hydraulic equipment of machinery shall be designed so that		P
	- the maximum rated pressure cannot be exceeded in the circuits		P
	- no hazard results from pressure fluctuations or increases, or from loss of pressure or vacuum,		P
	- no hazardous fluid jet or sudden hazardous movement of the hose (whiplash) results from leakage or component failures,		P
	- air receivers, air reservoirs or similar vessels (such as in gas-loaded accumulators) comply with the applicable design standard codes or regulations for these elements,		P
	- all elements of the equipment, especially pipes and hoses, are protected against harmful external effects,		P
	- as far as possible, reservoirs and similar vessels (for example, gas-loaded accumulators) are automatically depressurized when isolating the machine from its power supply (see 6.3.5.4) and, if not possible, means are provided for their isolation, local depressurizing and pressure indication		P
	- all elements which remain under pressure after isolation of the machine from its power supply are provided with clearly identified exhaust devices, and there is a warning label drawing attention to the necessity of depressurizing those elements before any setting or maintenance activity on the machine.		P
6.2.11	Applying inherently safe design measures to control systems		P

BS EN ISO 12100			
Clause	Requirement + Test	Result - Remark	Verdict
6.2.11.1	General		P
	The design measures of the control system shall be chosen so that their safety-related performance provides a sufficient amount of risk reduction		P
	Typical causes of hazardous machine behaviour are		P
	- an unsuitable design or modification (accidental or deliberate) of the control system logic,		P
	- a temporary or permanent defect or failure of one or several components of the control system,		P
	- a variation or a failure in the power supply of the control system,		P
	- inappropriate selection, design and location of the control devices.		P
	Typical examples of hazardous machine behaviour are		N/A
	- unexpected start-up		N/A
	- uncontrolled speed change,		N/A
	- failure to stop moving parts,		N/A
	- dropping or ejection of part of the machine or of a workpiece clamped by the machine, and		N/A
	- machine action resulting from inhibition (defeating or failure) of protective devices.		N/A
	In order to prevent hazardous machine behaviour and to achieve safety functions, the design of control systems shall comply with the principles and methods presented in this subclause (6.2.11) and in 6.2.12.		P
	Control systems shall be designed to enable the operator to interact with the machine safely and easily. This requires one or several of the following solutions:		P
	- systematic analysis of start and stop conditions;		P
	- provision for specific operating modes		P
	- clear display of the faults;		P
	- measures to prevent accidental generation of unexpected start commands (for example, shrouded start device) likely to cause dangerous machine behaviour		P
	- maintained stop commands (for example, interlock) to prevent restarting that could result in dangerous machine behaviour.		P
6.2.11.2	Starting of an internal power source/switching on an external power supply		P
	The starting of an internal power source or switching-on of an external power supply shall not result in a hazardous situation.		P

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Clause	Requirement + Test	Result - Remark	Verdict
6.2.11.3	Starting/stopping of a mechanism		P
	The primary action for starting or accelerating the movement of a mechanism should be performed by the application or an increase of voltage or fluid pressure, or — if binary logic elements are considered — by passage from state 0 to state 1		P
6.2.11.4	Restart after power interruption		P
	If a hazard could be generated, the spontaneous restart of a machine when it is re-energized after power interruption shall be prevented		N/A
6.2.11.5	Interruption of power supply		P
	Machinery shall be designed to prevent hazardous situations resulting from interruption or excessive fluctuation of the power supply. At least the following requirements shall be met:		P
	- the stopping function of the machinery shall remain;		P
	- all devices whose permanent operation is required for safety shall operate in an effective way to maintain safety		P
	- parts of machinery or workpieces and/or loads held by machinery which are liable to move as a result of potential energy shall be retained for the time necessary to allow them to be safely lowered.		P
6.2.11.6	Use of automatic monitoring		P
	Automatic monitoring is intended to ensure that a safety function or functions implemented by a protective measure do not fail to be performed if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed such that hazards are generated.		P
	- the stopping of the hazardous process,		P
	- preventing the restart of this process after the first stop following the failure,		P
	- the triggering of an alarm.		P
6.2.11.7	Safety functions implemented by programmable electronic control systems		P
6.2.11.7.1	General		P
	A control system that includes programmable electronic equipment can, where appropriate, be used to implement safety functions at machinery.		P
6.2.11.7.2	Hardware aspects		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The hardware (including, for example, sensors, actuators and logic solvers) shall be selected, and/or designed and installed, to meet both the functional and performance requirements of the safety function(s) to be performed, in particular, by means of		P
	- architectural constraints (the configuration of the system, its ability to tolerate faults, its behaviour on detection of a fault, etc.),		P
	- selection, and/or design, of equipment and devices with an appropriate probability of dangerous random hardware failure, and		P
	- the incorporation of measures and techniques within the hardware so as to avoid systematic failures and control systematic faults.		P
6.2.11.7.3	Software aspects		N/A
	The software, including internal operating software (or system software) and application software, shall be designed so as to satisfy the performance specification for the safety functions		N/A
	When the application requires reprogramming by the user, the access to the software dealing with safety functions should be restricted		N/A
	Application software should not be reprogrammable by the user. This may be achieved by use of embedded software in a non-reprogrammable memory		N/A
6.2.11.8	Principles relating to manual control		P
	a) Manual control devices shall be designed and located according to the relevant ergonomic principles given in 6.2.8, item f).		P
	b) A stop control device shall be placed near each start control device.		P
	c) Manual controls shall be located out of reach of the danger zones (see IEC 61310-3), except for certain controls where, of necessity, they are located within a danger zone, such as emergency stop or teach pendant.		P
	d) Whenever possible, control devices and control positions shall be located so that the operator is able to observe the working area or hazard zone.		P
	1) The driver of a ride-on mobile machine shall be able to actuate all control devices required to operate the machine from the driving position, except for functions which can be controlled more safely from other positions.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	2) On machinery intended for lifting persons, controls for lifting and lowering and, if appropriate, for moving the carrier shall generally be located in the carrier. If safe operation requires controls to be situated outside the carrier, the operator in the carrier shall be provided with the means of preventing hazardous movements.		P
	e) If it is possible to start the same hazardous element by means of several controls, the control circuit shall be so arranged that only one control is effective at a given time.		P
	f) Control actuators shall be designed or guarded so that their effect, where a risk is involved, cannot occur without intentional operation.		P
6.2.11.9	Control mode for setting, teaching, process changeover, fault-finding, cleaning or maintenance		P
	Where, for setting, teaching, process changeover, fault-finding, cleaning or maintenance of machinery, a guard has to be displaced or removed and/or a protective device has to be disabled, and where it is necessary for the purpose of these operations for the machinery or part of the machinery to be put into operation, the safety of the operator shall be achieved using a specific control mode which simultaneously		P
	a) disables all other control modes		P
	b) permits operation of the hazardous elements only by continuous actuation of an enabling device, a two-hand control device or a hold-to-run control device,		P
	c) permits operation of the hazardous elements only in reduced risk conditions		P
	d) prevents any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.		P
6.2.11.10	Selection of control and operating modes		P
	If machinery has been designed and built to allow for its use in several control or operating modes requiring different protective measures and/or work procedures, it shall be fitted with a mode selector which can be locked in each position.		P
6.2.11.11	Applying measures to achieve electromagnetic compatibility (EMC)		N/A
	For guidance on electromagnetic compatibility, see IEC 60204-1 and IEC 61000-6.		N/A
6.2.11.12	Provision of diagnostic systems to aid fault-finding		P
	Diagnostic systems to aid fault-finding should be included in the control system so that there is no need to disable any protective measure.		P

BS EN ISO 12100			
Clause	Requirement + Test	Result - Remark	Verdict
6.2.12	Minimizing probability of failure of safety functions		P
6.2.12.1	General		P
	Safety of machinery is not only dependent on the reliability of the control systems but also on the reliability of all parts of the machine.		P
	The continued operation of the safety functions is essential for the safe use of the machine.		P
6.2.12.2	Use of reliable components		P
	“Reliable components” means components which are capable of withstanding all disturbances and stresses associated with the usage of the equipment in the conditions of intended use (including the environmental conditions), for the period of time or the number of operations fixed for the use, with a low probability of failures generating a hazardous malfunctioning of the machine. Components shall be selected taking into account all factors mentioned above		P
6.2.12.3	Use of “oriented failure mode” components		P
	“Oriented failure mode” components or systems are those in which the predominant failure mode is known in advance and which can be used so that the effect of such a failure on the machine function can be predicted.		P
6.2.12.4	Duplication (or redundancy) of components or subsystems		P
	In the design of safety-related parts of the machine, duplication (or redundancy) of components may be used so that, if one component fails, another component or components continue to perform the respective function(s), thereby ensuring that the safety function remains available.		P
	In order to allow the proper action to be initiated, component failure shall be detected by automatic monitoring (see 6.2.11.6) or in some circumstances by regular inspection, provided that the inspection interval is shorter than the expected lifetime of the components.		P
	Diversity of design and/or technology can be used to avoid common cause failures (for example, from electromagnetic disturbance) or common mode failures.		P
6.2.13	Limiting exposure to hazards through reliability of equipment		P
	Increased reliability of all component parts of machinery reduces the frequency of incidents requiring intervention, thereby reducing exposure to hazards.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	This applies to power systems (operative part, see Annex A) as well as to control systems, and to safety functions as well as to other functions of machinery.		P
	Safety-related components (for example, certain sensors) of known reliability shall be used.		P
6.2.14	Limiting exposure to hazards through mechanization or automation of loading (feeding)/ unloading (removal) operations		P
	Mechanization and automation of machine loading/unloading operations and, more generally, of handling operations — of workpieces, materials or substances — limits the risk generated by these operations by reducing the exposure of persons to hazards at the operating points.		P
	Automation can be achieved by, for example, robots, handling devices, transfer mechanisms and air-blast equipment.		P
	While automatic feeding and removal devices have much to offer in preventing accidents to machine operators, they can create danger when any faults are being corrected. Care shall be taken to ensure that the use of these devices does not introduce further hazards, such as trapping or crushing, between the devices and parts of the machine or workpieces/materials being processed.		P
	Automatic feeding and removal devices with their own control systems and the control system of the associated machine shall be interconnected after thorough study of how all safety functions are performed in all the control and operation modes of the entire equipment.		P
6.2.15	Limiting exposure to hazards through location of setting and maintenance points outside danger zones		N/A
	The need for access to danger zones shall be minimized by locating maintenance, lubrication and setting points outside these zones.		N/A
6.3	Safeguarding and complementary protective measures		P
6.3.1	General		P
	Guards and protective devices shall be used to protect persons whenever an inherently safe design measure does not reasonably make it possible either to remove hazards or to sufficiently reduce risks.		P
6.3.2	Selection and implementation of guards and protective devices		P
6.3.2.1	General		P

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Clause	Requirement + Test	Result - Remark	Verdict
	This subclause gives guidelines for the selection and the implementation of guards and protective devices the primary purpose of which is to protect persons against hazards generated by moving parts, according to the nature of those parts (see Figure 4) and to the need for access to the danger zone(s).		P
	The exact choice of a safeguard for a particular machine shall be made on the basis of the risk assessment for that machine.		P
	In selecting an appropriate safeguard for a particular type of machinery or hazard zone, it shall be borne in mind that a fixed guard is simple and shall be used where the access of an operator into a danger zone is not required during the normal operation (operation without malfunction) of the machinery.		P
	As the need for frequency of access increases, this inevitably leads to the fixed guard not being replaced.		P
	A combination of safeguards can sometimes be required. For example, where, in conjunction with a fixed guard, a mechanical loading (feeding) device is used to feed a workpiece into a machine, thereby removing the need for access to the primary hazard zone, a trip device can be required to protect against the secondary drawing-in or shearing hazard between the mechanical loading (feeding) device, when reachable, and the fixed guard.		P
	a) hazards from falling or ejected objects, using, for example, protection in the form of a falling object protection structure (FOPS),		P
	b) emission hazards (protection against noise, vibration, radiation, substances hazardous to health, etc.),		P
	c) hazards due to the environment (protection against heat, cold, foul weather, etc.),		P
	d) hazards due to tipping over or rolling over of machinery, using, for example, protection in the form of roll-over or tip-over protection structures (ROPS and TOPS).		P
	The design of enclosed work stations, such as cabs and cabins, shall take into account ergonomic principles concerning visibility, lighting, atmospheric conditions, access, posture.		N/A
6.3.2.2	Where access to the hazard zone is not required during normal operation		N/A
	Where access to the hazard zone is not required during normal operation of the machinery, safeguards should be selected from the following:		N/A
	a) fixed guards;		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	b) interlocking guards with or without guard locking		N/A
	c) self-closing guards		N/A
	d) sensitive protective equipment, such as electrosensitive protective equipment or pressure-sensitive protective devices		N/A
6.3.2.3	Where access to the hazard zone is required during normal operation		P
	Where access to the hazard zone is required during normal operation of the machinery, safeguards should be selected from the following:		P
	a) interlocking guards with or without guard locking		P
	b) sensitive protective equipment, such as electrosensitive protective equipment;		P
	c) adjustable guards;		N/A
	d) self-closing guards;		P
	e) two-hand control devices		N/A
	f) interlocking guards with a start function		P
6.3.2.4	Where access to the hazard zone is required for machine setting, teaching, process changeover, fault-finding, cleaning or maintenance		P
	As far as possible, machines shall be designed so that the safeguards provided for the protection of the production operator also ensure the protection of personnel carrying out setting, teaching, process changeover, fault-finding, cleaning or maintenance, without hindering them in the performance of their task.		P
6.3.2.5	Selection and implementation of sensitive protective equipment		P
6.3.2.5.1	Selection		P
	Due to the great diversity of the technologies on which their detection function is based, all types of sensitive protective equipment are far from being equally suitable for safety applications.		P
	The following provisions are intended to provide the designer with criteria for selecting, for each application, the most suitable device(s).		P
	Types of sensitive protective equipment include		P
	- light curtains,		N/A
	- scanning devices, for example, laser scanners,		N/A
	- pressure-sensitive mats, and		P
	- trip bars, trip wires.		P
	Sensitive protective equipment can be used		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- for tripping purposes,		P
	- for presence sensing,		N/A
	- for both tripping and presence sensing, or		N/A
	- to re-initiate machine operation — a practice subject to stringent conditions.		P
	The following characteristics of the machinery, among others, can preclude the sole use of sensitive protective equipment:		--
	- tendency for the machinery to eject materials or component parts;		N/A
	- necessity to guard against emissions;		N/A
	- erratic or excessive machine stopping time;		N/A
	- inability of a machine to stop part-way through a cycle.		N/A
6.3.2.5.2	Implementation		P
	Consideration should be given to		P
	a) the size, characteristics and positioning of the detection zone		P
	b) the reaction of the device to fault conditions		P
	c) the possibility of circumvention, and		P
	d) detection capability and its variation over the course of time		P
	Sensitive protective equipment shall be integrated in the operative part and associated with the control system of the machine so that		P
	- a command is given as soon as a person or part of a person is detected		N/A
	- the withdrawal of the person or part of a person detected does not, by itself, restart the hazardous machine function(s), and therefore the command given by the sensitive protective equipment is maintained by the control system until a new command is given		N/A
	- restarting the hazardous machine function(s) results from the voluntary actuation by the operator of a control device placed outside the hazard zone, where this zone can be observed by the operator		N/A
	- the machine cannot operate during interruption of the detection function of the sensitive protective equipment, except during muting phases		N/A
	- the position and the shape of the detection field prevents, possibly together with fixed guards, a person or part of a person from entering or being present in the hazard zone without being detected.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
6.3.2.5.3	Additional requirements for sensitive protective equipment when used for cycle initiation		N/A
	In this exceptional application, the starting of the machine cycle is initiated by the withdrawal of a person or of the detected part of a person from the sensing field of the sensitive protective equipment, without any		N/A
	additional start command, hence deviating from the general requirement given in the second point of the dashed list in 6.3.2.5.2, above. After switching on the power supply, or when the machine has been stopped by the tripping function of the sensitive protective equipment, the machine cycle shall be initiated only by voluntary actuation of a start control.		N/A
	Cycle initiation by sensitive protective equipment shall be subject to the following conditions:		N/A
	a) only active optoelectronic protective devices (AOPDs) complying with IEC 61496 series shall be used;		N/A
	b) the requirements for an AOPD used as a tripping and presence-sensing device are satisfied — in particular, location, minimum distance, detection capability, reliability and monitoring of control and braking systems;		N/A
	c) the cycle time of the machine is short and the facility to re-initiate the machine upon clearing of the sensing field is limited to a period commensurate with a single normal cycle		N/A
	d) entering the sensing field of the AOPD(s) or opening interlocking guards is the only way to enter the hazard zone;		N/A
	e) if there is more than one AOPD safeguarding the machine, only one of the AOPDs is capable of cycle re-initiation;		N/A
	f) with regard to the higher risk resulting from automatic cycle initiation, the AOPD and the associated control system comply with a higher safety-related performance than under normal conditions.		N/A
6.3.2.6	Protective measures for stability		P
	If stability cannot be achieved by inherently safe design measures such as weight distribution (see 6.2.6), it shall be maintained by the use of protective measures such as		P
	- anchorage bolts,		P
	- locking devices,		P
	- movement limiters or mechanical stops,		P
	- acceleration or deceleration limiters,		P

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Clause	Requirement + Test	Result - Remark	Verdict
	- load limiters, and		P
	- alarms warning of the approach to stability or tipping limits.		P
6.3.2.7	Other protective devices		P
	When a machine requires continuous control by the operator (for example, mobile machines, cranes) and an error of the operator can generate a hazardous situation, this machine shall be equipped with the necessary devices to enable the operation to remain within specified limits, in particular		P
	- when the operator has insufficient visibility of the hazard zone,		P
	- when the operator lacks knowledge of the actual value of a safety-related parameter		P
	- when hazards can result from operations other than those controlled by the operator.		P
	The necessary devices include		P
	a) devices for limiting parameters of movement (distance, angle, velocity, acceleration),		P
	b) overloading and moment limiting devices,		P
	c) devices to prevent collisions or interference with other machines,		P
	d) devices for preventing hazards to pedestrian operators of mobile machinery or other pedestrians,		P
	e) torque limiting devices, and breakage points to prevent excessive stress of components and assemblies,		P
	f) devices for limiting pressure or temperature,		P
	g) devices for monitoring emissions,		N/A
	h) devices to prevent operation in the absence of the operator at the control position,		N/A
	i) devices to prevent lifting operations unless stabilizers are in place,		N/A
	j) devices to limit inclination of the machine on a slope, and		P
	k) devices to ensure that components are in a safe position before travelling.		P
	Automatic protective measures triggered by such devices that take operation of the machinery out of the control of the operator (for example, automatic stop of hazardous movement) should be preceded or accompanied by a warning signal to enable the operator to take appropriate action		P

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Clause	Requirement + Test	Result - Remark	Verdict
6.3.3	Requirements for design of guards and protective devices		P
6.3.3.1	General requirements		P
	Guards and protective devices shall be designed to be suitable for the intended use, taking into account mechanical and other hazards involved. Guards and protective devices shall be compatible with the working environment of the machine and designed so that they cannot be easily defeated. They shall provide the minimum possible interference with activities during operation and other phases of machine life, in order to reduce any incentive to defeat them.		P
	Guards and protective devices shall		P
	a) be of robust construction,		P
	b) not give rise to any additional hazard,		P
	c) not be easy to bypass or render non-operational,		P
	d) be located at an adequate distance from the danger zone		P
	e) cause minimum obstruction to the view of the production process, and		P
	f) enable essential work to be carried out for the installation and/or replacement of tools and for maintenance by allowing access only to the area where the work has to be carried out — if possible, without the guard having to be removed or protective device having to be disabled.		P
6.3.3.2	Requirements for guards		P
6.3.3.2.1	Functions of guards		P
	The functions that guards can achieve are		P
	- prevention of access to the space enclosed by the guard, and/or		P
	- containment/capture of materials, workpieces, chips, liquids which can be ejected or dropped by the machine, and reduction of emissions that can be generated by the machine.		P
6.3.3.2.2	Requirements for fixed guards		P
	Fixed guards shall be securely held in place either - permanently (for example by welding), or		P
	- by means of fasteners (screws, nuts) making removal/opening impossible without using tools; they should not remain closed without their fasteners		P
6.3.3.2.3	Requirements for movable guards		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Movable guards which provide protection against hazards generated by moving transmission parts shall a) as far as possible when open remain fixed to the machinery or other structure , and		P
	b) be interlocking		P
	Movable guards against hazards generated by non-transmission moving parts shall be designed and associated with the machine control system so that		P
	- moving parts cannot start up while they are within the operator's reach and the operator cannot reach moving parts once they have started up, with this able to be achieved by interlocking guards, with guard locking when necessary,		P
	- they can be adjusted only by an intentional action, such as the use of a tool or a key, and		P
	- the absence or failure of one of their components either prevents starting of the moving parts or stops them, with this able to be achieved by automatic monitoring		P
6.3.3.2.4	Requirements for adjustable guards		N/A
	Adjustable guards may only be used where the hazard zone cannot for operational reasons be completely enclosed. Manually adjustable guards shall be		N/A
	- designed so that the adjustment remains fixed during a given operation, and		N/A
	- readily adjustable without the use of tools.		N/A
6.3.3.2.5	Requirements for interlocking guards with a start function (control guards)		N/A
	An interlocking guard with a start function may only be used provided that		N/A
	a) all requirements for interlocking guards are satisfied		N/A
	b) the cycle time of the machine is short,		N/A
	c) the maximum opening time of the guard is preset to a low value (for example, equal to the cycle time) and when this time is exceeded, the hazardous function(s) cannot be initiated by the closing of the interlocking guard with a start function and resetting is necessary before restarting the machine,		N/A
	d) the dimensions or shape of the machine do not allow a person, or part of a person, to stay in the hazard zone or between the hazard zone and the guard while the guard is closed		N/A
	e) all other guards, whether fixed (removable type) or movable, are interlocking guards,		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	f) the interlocking device associated with the interlocking guard with a start function is designed such that —for example, by duplication of position detectors and use of automatic monitoring (see 6.2.11.6) — its failure cannot lead to an unintended/ unexpected start-up, and		N/A
	g) the guard is securely held open such that it cannot initiate a start while falling by its own weight.		N/A
6.3.3.2.6	Hazards from guards		P
	Care shall be taken to prevent hazards which could be generated by		P
	- the guard construction		P
	- the movements of the guards		P
6.3.3.3	Technical characteristics of protective devices		P
	Protective devices shall be selected or designed and connected to the control system such that correct implementation of their safety function(s) is ensured.		P
	Protective devices shall be selected on the basis of their having met the appropriate product standard or shall be designed according to one or several of the principles formulated in ISO 13849-1 or IEC 62061.		P
	Protective devices shall be installed and connected to the control system so that they cannot be easily defeated.		P
6.3.3.4	Provisions for alternative types of safeguards		P
	Provisions should be made to facilitate the fitting of alternative types of safeguards on machinery where it is known that it will be necessary to change the safeguards because of the range of work to be carried out.		P
6.3.4	Safeguarding to reduce emissions		P
6.3.4.1	General		P
	If the measures for the reduction of emissions at source specified in 6.2.2.2 are not adequate, the machine shall be provided with additional protective measures.		P
6.3.4.2	Noise		P
	Additional protective measures against noise include		P
	- enclosures,		P
	- screens fitted to the machine, and		N/A
	- silencers.		N/A
6.3.4.3	Vibration		N/A

BS EN ISO 12100			
Clause	Requirement + Test	Result - Remark	Verdict
	Additional protective measures against vibration include		N/A
	- vibration isolators, such as damping devices placed between the source and the exposed person,		N/A
	- resilient mounting, and		N/A
	- suspended seats.		N/A
	For measures for vibration isolation of stationary industrial machinery see EN 1299.		N/A
6.3.4.4	Hazardous substances		P
	Additional protective measures against hazardous substances include		P
	- encapsulation of the machine (enclosure with negative pressure),		P
	- local exhaust ventilation with filtration,		P
	- wetting with liquids, and		P
	- special ventilation in the area of the machine		P
6.3.4.5	Radiation		N/A
	Additional protective measures against radiation include		N/A
	- use of filtering and absorption, and		N/A
	- use of attenuating screens or guards.		N/A
6.3.5	Complementary protective measures		N/A
6.3.5.1	General		N/A
	Protective measures which are neither inherently safe design measures, nor safeguarding, nor information for use, could have to be implemented as required by the intended use and the reasonably foreseeable misuse of the machine. Such measures include, but are not limited to, those dealt with in 6.3.5.2 to 6.3.5.6.		N/A
6.3.5.2	Components and elements to achieve emergency stop function		P
	If, following a risk assessment, a machine needs to be fitted with components and elements to achieve an emergency stop function for enabling actual or impending emergency situations to be averted, the following requirements apply:		P
	- the actuators shall be clearly identifiable, clearly visible and readily accessible;	the actuators are clearly identifiable	P
	- the hazardous process shall be stopped as quickly as possible without creating additional hazards, but if this is not possible or the risk cannot be reduced, it should be questioned whether implementation of an emergency stop function is the best solution;		P

BS EN ISO 12100			
Clause	Requirement + Test	Result - Remark	Verdict
	- the emergency stop control shall trigger or permit the triggering of certain safeguard movements where necessary.		P
6.3.5.3	Measures for the escape and rescue of trapped persons		P
	Measures for the escape and rescue of trapped persons may consist, among others, of		P
	- escape routes and shelters in installations generating operator-trapping hazards,		P
	- arrangements for moving some elements by hand, after an emergency stop,		P
	- arrangements for reversing the movement of some elements,		P
	- anchorage points for descender devices,		P
	- means of communication to enable trapped operators to call for help.		P

Attachment No. 1			
Clause	Requirement + Test	Result - Remark	Verdict
ATTACHMENT TO TEST REPORT IEC 60204-1 EUROPEAN GROUP DIFFERENCES AND NATIONAL DIFFERENCES Safety of machinery - Electrical equipment of machines Part 1: General requirements			
Differences according to.....: EN 60204-1:2018			
Attachment Form No. .....: EU_GD_IEC60204_1C			
Attachment Originator .....: Eurofins Electrosuisse			
Master Attachment .....: 2019-03-15			
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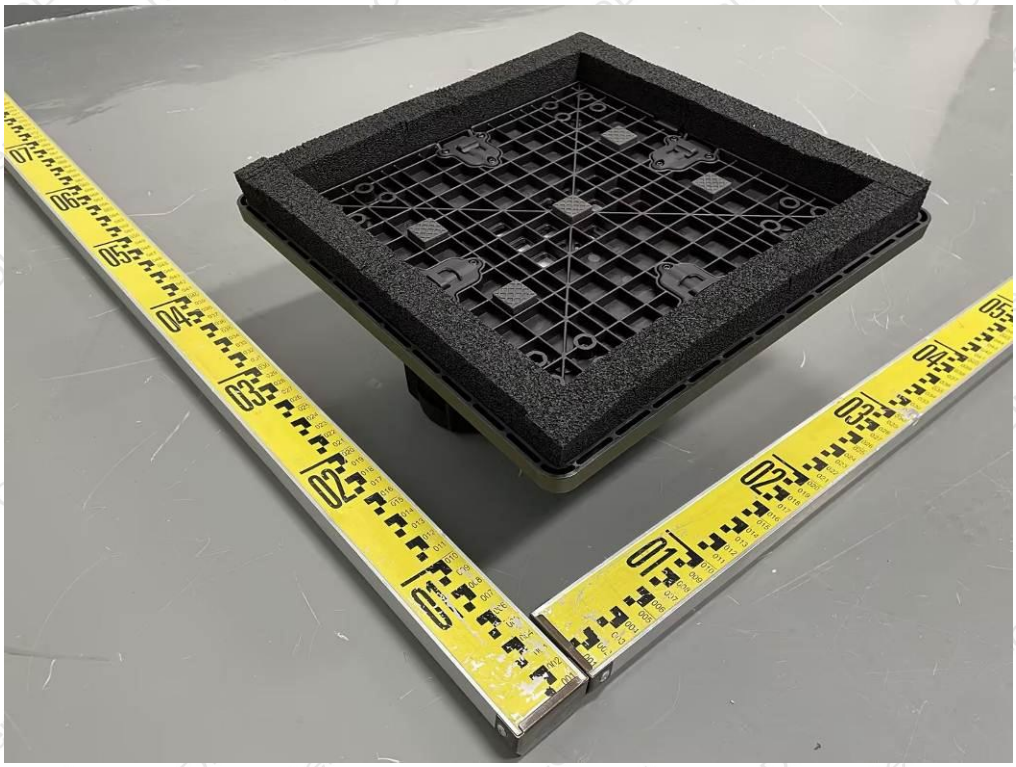
	CENELEC COMMON MODIFICATIONS (EN)		P
4.4.2	Delete the 2nd paragraph and related bulleted list		P
4.4.5	Replace the text of the 2nd paragraph before the hyphened list with: “For equipment to be used at higher altitudes, it is necessary to take into account changes in parameters for example, the reduction of:”		P
	Add the start of the 3rd paragraph: “Other parameters of different components can also alter with altitude.”		P
6.3.1	Replace Note 1 with: “The risk of harmful physiological effects from touch voltages depends upon a number of factors. These include but are not limited to; touch voltage, duration of possible exposure, environmental factors, skin condition”		P
9.2.3.2	Replace the 4th paragraph with: “The provision of acoustic and/or visual warning signals before the starting of hazardous machine operation shall be considered during the risk assessment. Where the risk assessment determines that either or both are required the emission level of noise/light shall be suitable for the intended environment."		N/A
9.2.4.1	Replace the 2nd paragraph with: “Where a safety function of a CCS relies on data transmission the transmission reliability shall be considered.”		N/A
9.2.4.8	Replace the last paragraph with: “Where the risk assessment shows that resetting of an emergency stop actuator on the portable cableless operator control station is not adequate then one or more supplementary fixed resets shall be provided.”		N/A
11.4	In the 8th paragraph, replace “harmful” with “detrimental”		N/A
12.3	In the 1st paragraph, replace “should” with “shall”		N/A

13.5.2	First paragraph, 2nd sentence, replace with “Where galvanic action is possible between dissimilar metals these metal combinations shall not be used”.		N/A
16.1	Add to the first paragraph: “The markings shall be sufficiently durable to remain legible for the foreseen lifetime of the machine.”		P
16.4	Delete the 2nd bullet		N/A
18.1	Add to paragraph 2: “Where the sequence cannot be followed verification a) and b) shall be conducted first.”		N/A
	Add the following annexes		N/A
ZA	**Annex ZA (normative)** **Normative references to international publications with their corresponding European publications**		P
	A list of documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document		P
ZZA	**Annex ZZA (informative)** **Relationship between this European Standard and the essential requirements of Directive 2006/42/EC aimed to be covered**		P
	This European Standard provides one voluntary means of conforming to essential requirements of Directive 2006/42/EC		P
	Once cited in the Official Journal of the European Union, compliance with the normative clauses of this standard given in Table ZZA.1 confers, within the limits of the scope of this standard, a presumption of conformity		P
	Table ZZA.1 shows the correspondence between this European Standard and Annex 1 of Directive 2006/42/EC		P
	Not considered are in this standard: - noise (1.7.4.2 and 1.5.8 of Annex I of the directive) - EMC (1.5.10 and 1.5.11)		N/A
	WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union		P
	WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.		P

ZZB	**Annex ZZB (informative)** **Relationship between this European Standard and the essential requirements of Directive 2014/35/EC aimed to be covered**		N/A
	This European Standard provides one voluntary means of conforming to essential requirements of Directive 2014/35/EC		N/A
	Once cited in the Official Journal of the European Union, compliance with the normative clauses of this standard given in Table ZZB.1 confers, within the limits of the scope of this standard, a presumption of conformity		N/A
	Table ZZB.1 shows the correspondence between this European Standard and Annex 1 of Directive 2014/35/EC		N/A
	Remarks about certain objectives of Annex I:		N/A
	2b): For electromagnetic fields, this standard does not provide performance requirements for either immunity or emissions. Only general advice is given. EMF is not covered. Ionizing radiation is not considered.		N/A
	2c): Noise is not considered in this standard. Functional safety is not fully covered. Explosion of batteries has not been covered by this standard. Optical radiation is not covered		N/A
	3a): The standard only considers the mechanical requirements for electrical parts of a machine		N/A
	3b): For EMC, this standard does not provide performance requirements for either immunity or emissions. Only general advice is given Hazard associated with EMC and functional safety are not covered Safety-related security is not covered		N/A
	WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union		N/A
	WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.		N/A

Attachment No. 2:

EUT PHOTOGRAPHS

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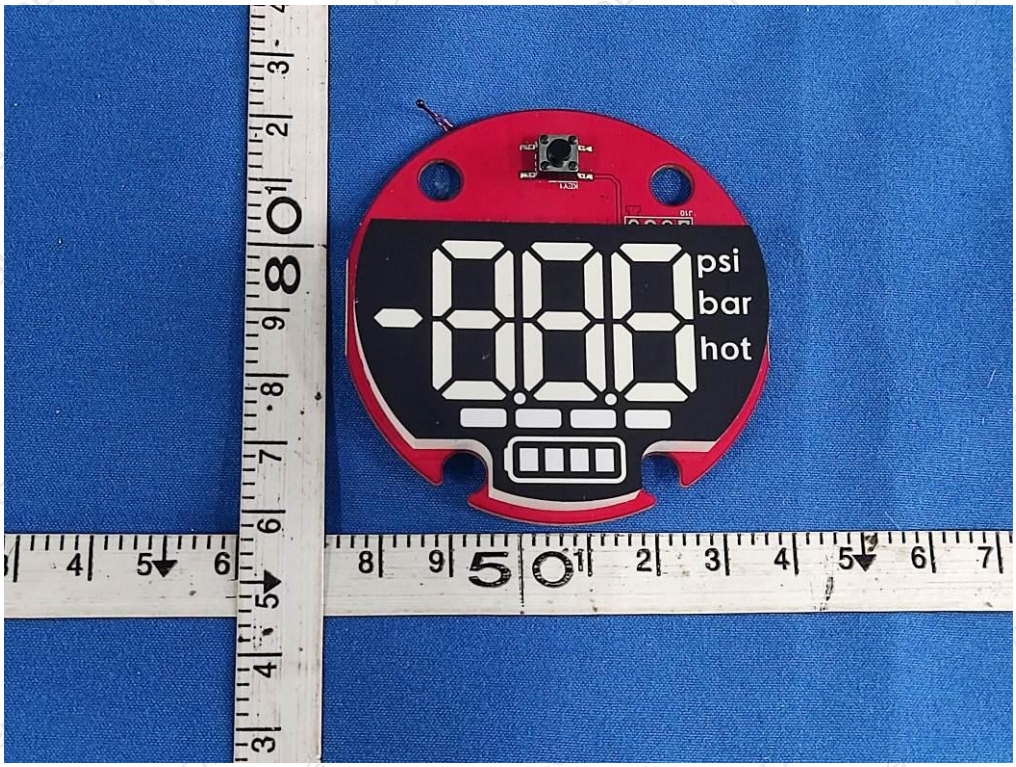
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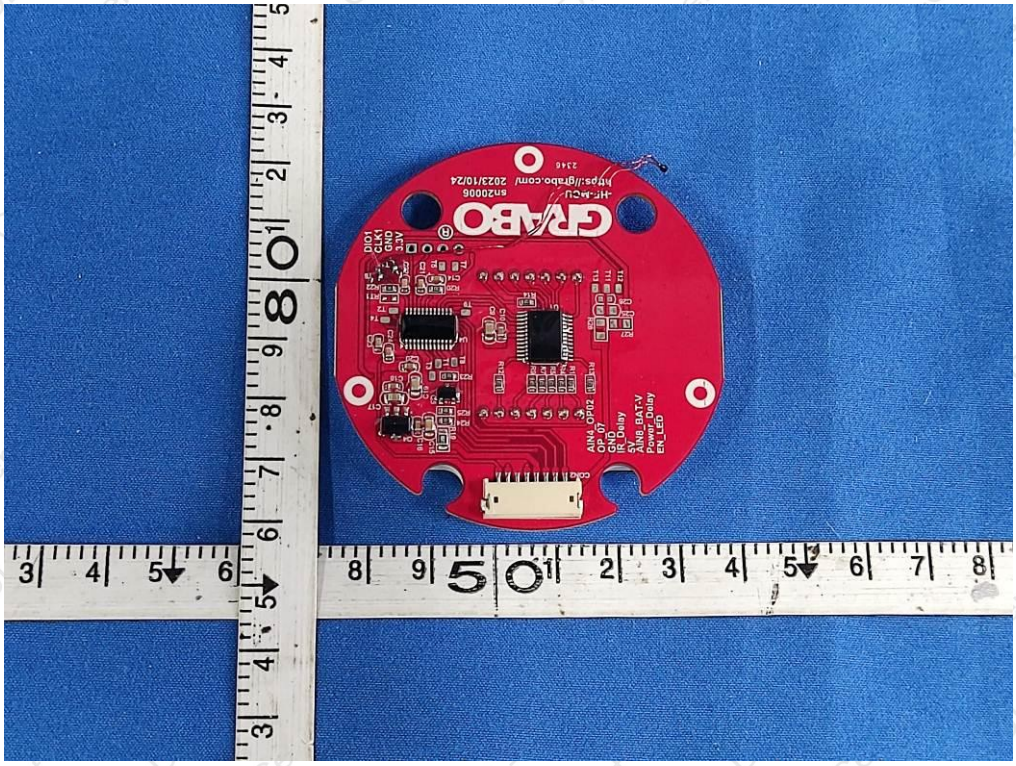
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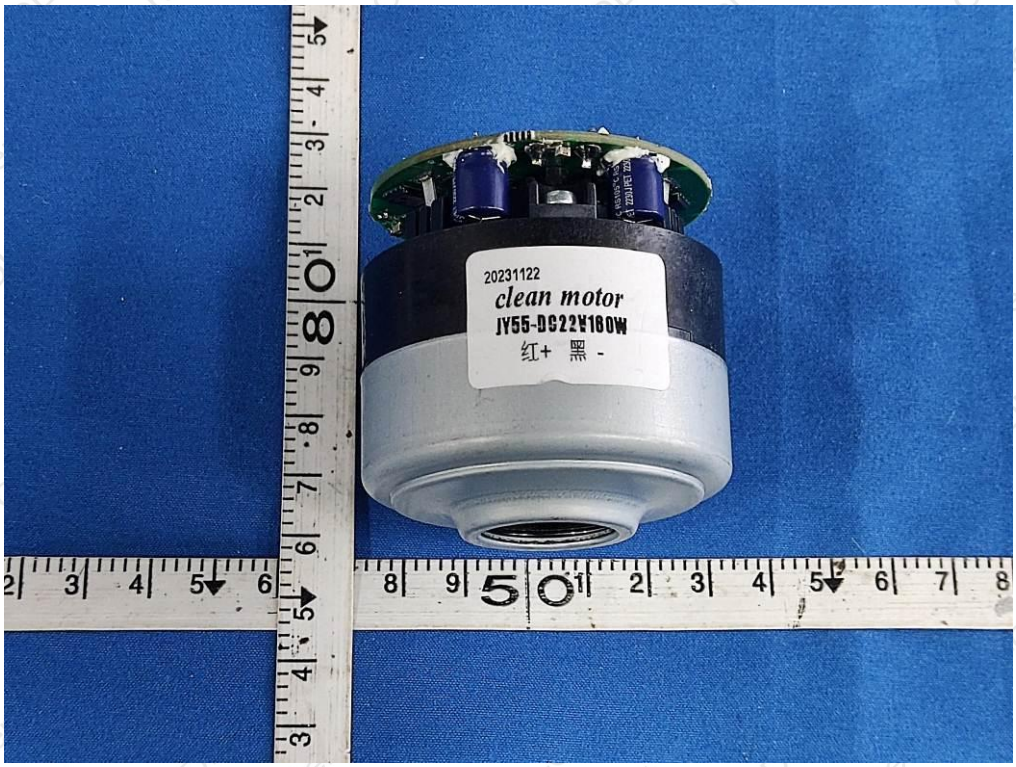
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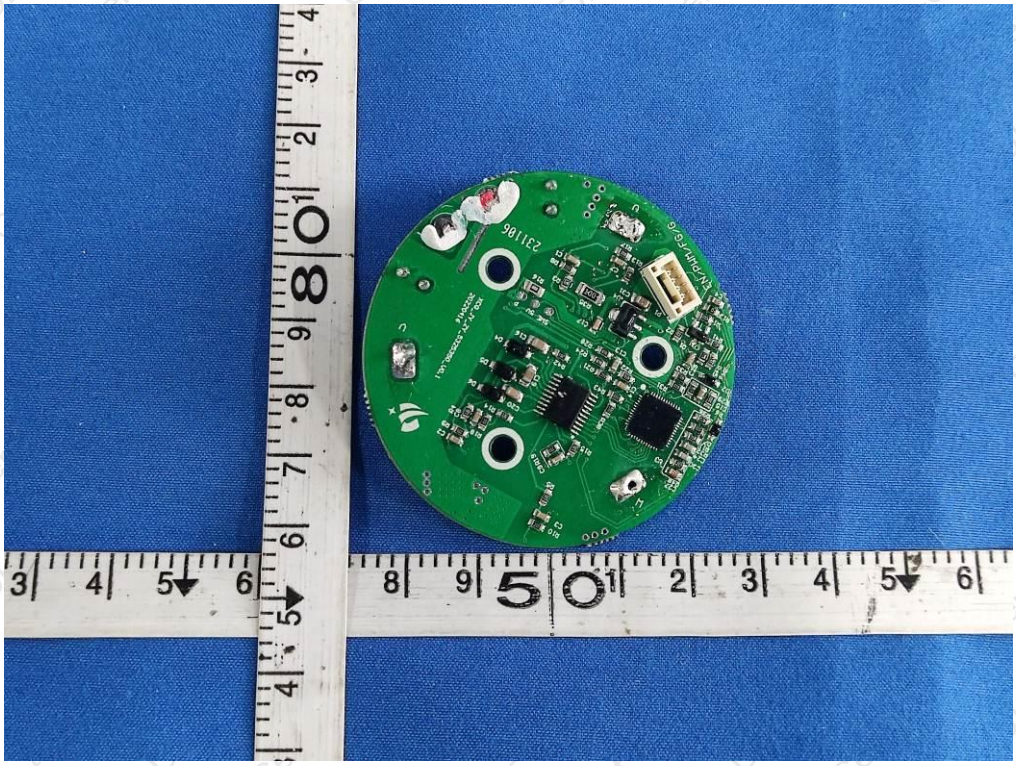

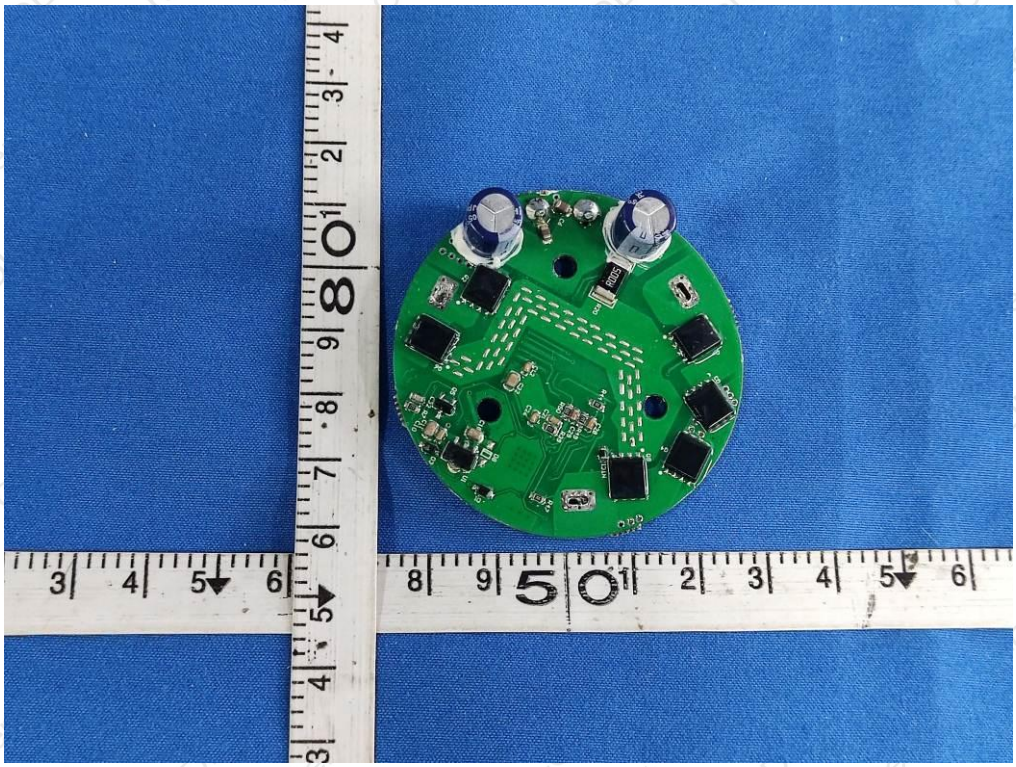


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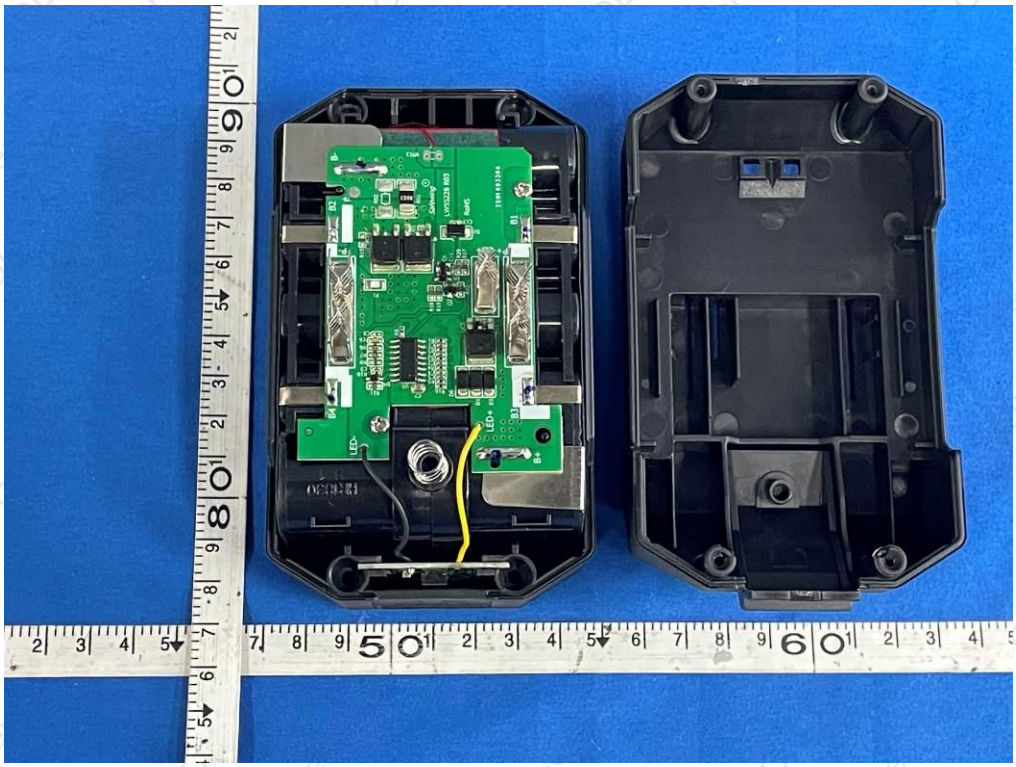

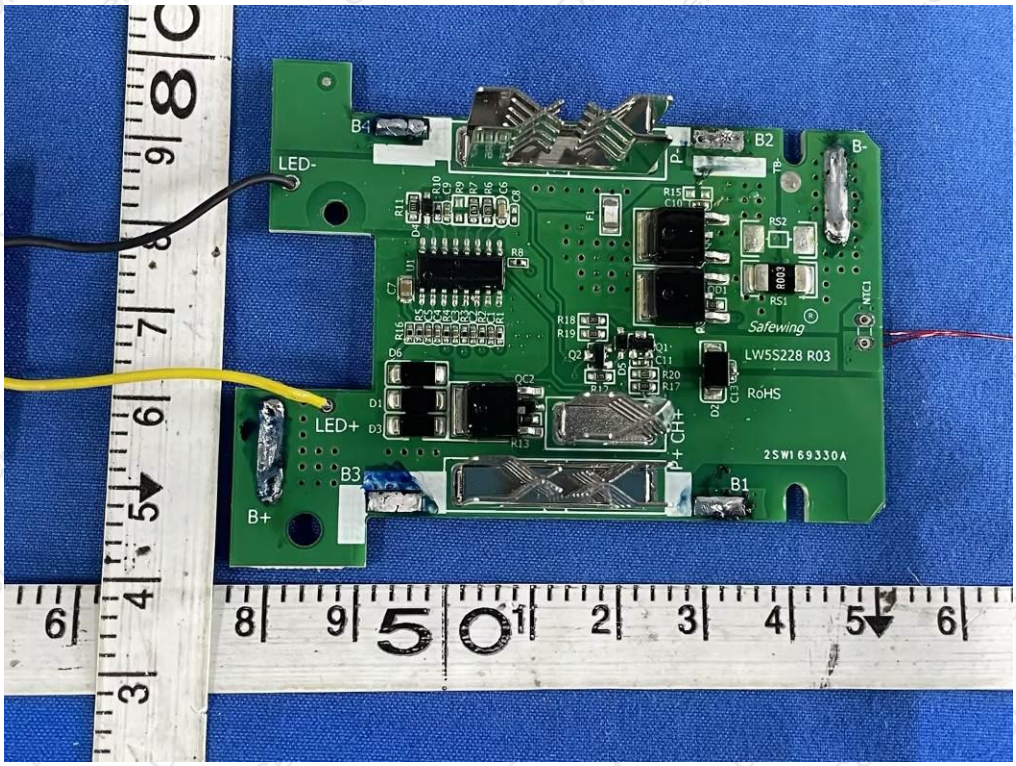
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B-
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LED+
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B+
P+
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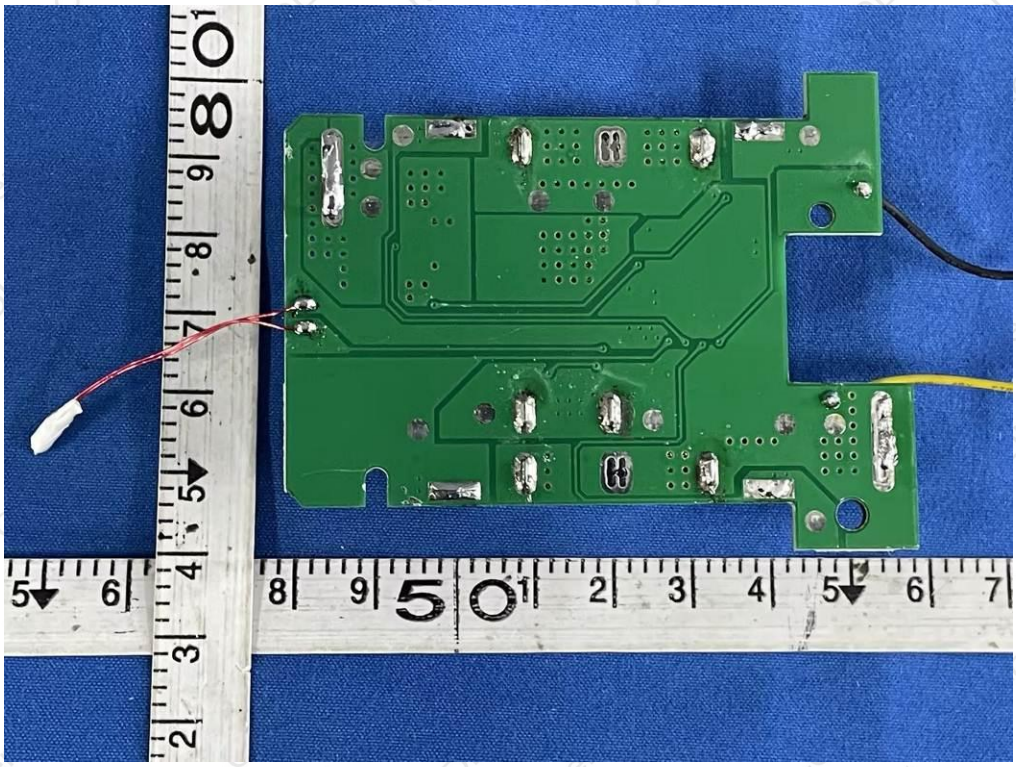

※※※※※ END OF REPORT ※※※※※