



TEST REPORT EN 60204-1:2018 Safety of machine- Electrical equipment of machines, Part 1: General requirements EN ISO 12100:2010 Safety of machinery – General principles for design – Risk assessment and risk reduction(ISO 12100:2010)	
Report Number.....	HYC2026040167S01
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Name of Testing Laboratory	Shenzhen HyCert Co., Ltd.
Address	201, Building A, Hongwan Science and Technology Park, No. 30 Xijing Road, Gushu Community, Xixiang Street, Bao'an District, Shenzhen, China
Applicant's name	Foshan Nanhai Hongrui Machinery Manufacturing Co., Ltd.
Address	No. 66, Shang Yuan Xi Industrial Zone, Xia Nan Er Community, Gui Cheng Sub-district, Nanhai District, Foshan City, Guangdong Province, P.R. CHINA
Test specification:	
Standard	EN 60204-1:2018; EN ISO12100:2010;
Test procedure.....	CE-MD, CE-LVD
Non-standard test method.....	N/A
Test item description.....	Buffer Storage
Trade name/mark	N/A
Manufacturer	Foshan Nanhai Hongrui Machinery Manufacturing Co., Ltd.
Address.....	No. 66, Shang Yuan Xi Industrial Zone, Xia Nan Er Community, Gui Cheng Sub-district, Nanhai District, Foshan City, Guangdong Province, P.R. CHINA
Model/Type reference	HR-HCT3018, HR-HCT3035, HR-HCT3028, I01, I02, I03, I04
Ratings	AC 110-600V, 0-60Hz, 1.5-27A, 3.3kW

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Enquiry form for the electrical equipment of machines	(Annex B)
Modifications allowed for within this standard?	No
1 Special conditions (see Clause 1):	
a) Is the machine to be used in the open air?	<input type="checkbox"/> Yes : specification: <input checked="" type="checkbox"/> No
b) Will the machine use, process or produce explosive or flammable material?	<input type="checkbox"/> Yes : specification: <input checked="" type="checkbox"/> No
c) Can the machine present special hazards when producing or consuming certain materials?	<input type="checkbox"/> Yes : specification: <input checked="" type="checkbox"/> No
d) Can the machine present special hazards when producing or consuming certain materials	<input type="checkbox"/> Yes : specification: <input checked="" type="checkbox"/> No
e) Is the machine for use in mines?	<input type="checkbox"/> Yes : specification: <input checked="" type="checkbox"/> No
2 Electrical supplies and related conditions (see 4.3):	
a) Anticipated voltage fluctuations (if more than $\pm 10\%$)	Less than $\pm 10\%$
b) Anticipated frequency fluctuations (if more than $\pm 2\%$)	<input checked="" type="checkbox"/> Continuous <input type="checkbox"/> Short time
c) Indicate possible future changes in electrical equipment that will require an increase in the electrical supply requirements	N/A
d) Specify voltage interruptions in supply if longer than specified in Clause 4 where electrical equipment has to maintain operation under such conditions	N/A
3 Physical environment and operating conditions (see 4.4)	
a) Electromagnetic environment (see 4.4.2) Special conditions or requirements	<input type="checkbox"/> Industrial environment <input checked="" type="checkbox"/> Residential, commercial or light industrial environment
b) Ambient temperature range ($^{\circ}\text{C}$):	+5 $^{\circ}\text{C}$ - +40 $^{\circ}\text{C}$
c) Humidity range:	25% to 95%
d) Altitude:	2000m
e) Special environmental conditions (for example corrosive atmospheres, dust, wet environments)	Not applicable
f) Radiation:	Not applicable
g) Vibration, shock:	Not applicable
h) Special installation and operation requirements (for example flame-retardant cables and conductors)	Professional installation
i) Transportation and storage (for example temperatures outside the range specified in Subclause 4.5)	-25 $^{\circ}\text{C}$ + 55 $^{\circ}\text{C}$ applied
5 Protection against electric shock (see Clause 6)	
a) For which of the following classes of persons is access to the interior of enclosures required during normal operation of the equipment?	<input checked="" type="checkbox"/> Electrically skilled persons <input type="checkbox"/> Electrically instructed persons

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b) Are locks with removable keys to be provided for securing the doors or covers? (see 6.2.2)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
6 Protection of equipment (see Clause 7)	
a) Will the user or the supplier provide the overcurrent protection of the supply conductors? (see 7.2.2)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
- type and rating of overcurrent protective device :	Circuit breaker
b) Largest (kW) three-phase a.c. motor that may be started direct-on-line	N/A
c) May the number of motor overload detection devices be reduced? (see 7.3)	N/A
7 Operation:	
-For cableless control systems, specify the time delay before automatic machine shutdown is initiated in the absence of a valid signal.	N/A
8 Operator interface and machine-mounted control devices (see Clause 10)	
Special colour preferences (for example to align with existing machinery):	
-Start	
-Stop	Push button (red)
-Other	
9 Controlgear	
-Degree of protection of enclosures (see Subclause 11.3) or special conditions:	IP22
10 Wiring practices (see Clause 13)	
Is there a specific method of identification to be used for the conductors? (see 13.2.1)	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Type	
11 Accessories and lighting (see Clause 15)	
a) Is a particular type of socket-outlet required?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
If yes, which type?	N/A
b) Are the socket-outlets for maintenance to be provided with additional protection by the use of Residual Current protective Devices (RCD)?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
c) Where the machine is equipped with local lighting:	No
- highest permissible voltage:	No
- if lighting circuit voltage is not obtained directly from the power supply, state preferred voltage :	--
12 Marking, warnings and reference designations (see Clause 16)	
Functional identification:	Electric shock symbol
Inscriptions / special markings:	

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- mark of certification:	CE symbol provided
- on electrical equipment:	Ratings
- language	English
13 Technical documentation (see 17)	
a) Technical documentation (see 17.1)	
-On what media?	Printed sheet
-In which language?	English
b) Size, location and purpose of ducts, open cable trays or cable supports to be provided by the user (see 17.5)	N/A
Indicate special limitations on size or weight which affect the transport of a particular machine or control gear assemblies to the installation site:	N/A
- maximum dimensions:	N/A
- maximum weight:	N/A
Certificate for operating tests	N/A
- with the loaded machine to be supplied (specially built machines):	N/A
- on a loaded prototype machine to be supplied (normal machines):	N/A

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<p>Possible test case verdicts:</p> <ul style="list-style-type: none">- 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)
<p>Testing:</p> <p>Date of receipt of test items : Apr. 22, 2026</p> <p>Date(s) of performance of tests : Apr. 22, 2026 to Apr. 29, 2026</p>
<p>General remarks:</p> <p>"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report.</p> <p>General disclaimer:</p> <p>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 Shenzhen HyCert Co., Ltd. The authenticity of this Test Report and its contents can be verified by contacting the Shenzhen HyCert Co., Ltd., responsible for this Test Report.</p> <p>Model difference:</p> <p>All models share the same protective structure, differing only in appearance and model names. All tests were conducted on the main tested model HR-HCT3018.</p>
<p>Copy of marking plate:</p> <div data-bbox="496 1093 1094 1424" style="border: 1px solid black; padding: 10px; margin: 10px auto; width: fit-content;"><p>Name: Buffer Storage Model: HR-HCT3018 Foshan Nanhai Hongrui Machinery Manufacturing Co., Ltd. S/N: XXX Date: Apr. , 2026</p><p style="text-align: center; font-size: 2em; font-weight: bold;">CE</p></div> <p>It is recommended that this information is provided adjacent to the main incoming supply</p> <div data-bbox="539 1514 1053 1599" style="border: 1px solid black; padding: 5px; margin: 10px auto; width: fit-content;"><p>AC 110-600V, 0-60Hz, 1.5-27A, 3.3kW</p></div>
<p>Remark:</p> <ol style="list-style-type: none">1, The above label is draft of the artwork for marking plate pending approval by National Certification Bodies and they shall not be affixed to products prior to such approvals.2. Due to similarity of rating labels, only above representative model's label are listed, other models are technical identical except with model number.



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Clause	Requirement – Test	Result - Remark	Verdict
4.	GENERAL REQUIREMENTS		—
4.1	General considerations		P
	Hazard and risk assessment		P
4.2	Electrical components/devices suitable for their intended use		P
	and conform to the relevant IEC or EN standards		P
4.3	Power supply and related conditions:		—
4.3.1	Electrical equipment to be designed for correct operation with conditions of mains power supply		P
4.3.2	Supply Voltage		P
	Frequency		P
	Harmonics		P
	Voltage unbalance		N/A
	Voltage interruption		N/A
	Voltage dips :		N/A
4.3.3	DC Supplies Voltage :		N/A
	Voltage interruption		N/A
	Ripple (peak-peak) :		N/A
4.3.4	Onboard power supply acc. to cl.4.3.2 and 4.3.3		N/A
4.4	Physical environment and operating conditions		P
4.4.1	Electrical equipment to be suitable for use in physical environment and operating conditions		P
4.4.2	Electromagnetic compatibility (EMC)		P
	Equipment not to generate electromagnetic disturbances above harmful levels: (applicable EMC-standard: EN50081-2)		P
	Equipment has adequate level of immunity to EMC: (applicable EMC- standards: EN 50082-2)		P
4.4.3	Electrical equipment to be capable for correct operation at intended ambient air temperature	+5°C - +40°C	P
4.4.4	Electrical equipment to be capable for correct operation at specified relative humidity:	25% - 95%	P
4.4.5	Electrical equipment capable of operating correctly at altitudes up to 1000 m above m.s.l.		P
4.4.6	Electrical equipment shall be adequately protected against ingress of solid properties and liquids see clause 11.3	IP22	P



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Clause	Requirement – Test	Result - Remark	Verdict
4.4.7	Ionizing and non-ionizing radiation Electrical equipment subject to radiation, additional measures to be taken to avoid equipment malfunction		P
4.4.8	Undesirable effects of vibration, shock and bump avoided		P
4.5	Electrical equipment designed to withstand the effects of transportation and storage within a temperature range of -25 to +55 °C	-25 to +55 °C	P
4.6	Heavy or bulky electrical equipment of the machine provided with suitable means for handling		P
4.7	Electrical equipment installed and operated in accordance with the supplier's instruction	Skilled person for installing and See instruction	P
5.	INCOMING SUPPLY CONDUCTOR TERMINATIONS AND DEVICES FOR DISCONNECTING AND SWITCHING OFF		—
5.1	Incoming supply conductor terminal		P
	electrical equipment of a machine connected to a single power supply		P
	power supply conductors terminated to main disconnecting device of electrical equipment		P
	neutral conductor "N" clearly indicated in technical documentation.		P
	no connection between neutral conductor and protective bonding circuit nor combined PEN-terminals.		P
	All terminals of incoming supply clearly marked (symbols acc. to EN60445) and clause 16.1		P
5.2	Terminal for connection to external protective earthing system		—
	Terminal for connection of external protective conductor provided and marked with "PE"		P
	Cross section of incoming PE conductor acc. to cl. 5.2, table 1		P
	Terminals allow connection of external protective earth conductors PE		P
	other protective earth identified either by graphic symbol, letters "PE", or bicolour combination green / yellow		P
5.3	Supply disconnecting device		—
5.3.1	Power supply disconnecting device provided for electrical equipment		P
5.3.2	The power supply disconnecting device shall be one of the following type:		—
	a) Switch-disconnector, acc. to EN60947-3 for appliance category AC-23 B or DC-23 B		P



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	b) Disconnecter with or without fuses, with aux. contact (acc. to EN60947-3)		N/A
	c) Power CB suitable for isolation(acc. to EN 60947-2)		N/A
	d) any other switching device in accordance with an IEC product standard for that device and which meets the isolation requirements of IEC 60947-1 as well as a utilization category defined in the product standard as appropriate for on-load switching of motors or other inductive loads;		N/A
	e) a plug/socket combination for a flexible cable supply.		P
5.3.3	When supply disconnecting device is a switch-disconnector or a circuit- breaker		—
	Isolate electrical equipment from supply(acc. to EN 60947-2)		P
	One OFF (isolated) and one ON position only		P
	Clearly marked with "0" and "I"		P
	CB's with additional reset position between "0" and "I"		P
	visible isolating distance or		P
	Position indication which cannot indicate the OFF-position until all contacts are actually open		P
	External operating device provided(except power operated CB's)		P
	Colour black or grey preferred.		P
	If used as an emergency stop, red/yellow combination selected		P
	Locking means provided to lock inOFF-position		P
	In locked position an unintended closing for local or remote operation mode possible		P
	Disconnection of all live conductors (Exception: TN-supply systems, neutral conductor)		P
	Sufficient breaking capacity		P
	- a) to f) of clause 13.4.5 Plug/socket combinations		P
5.3.4	Handle of disconnecting device to be easily accessible		N/A
	Handle located between 0.6m and 1.9m above service level		N/A
5.3.5	Following circuits not disconnect by supply disconnecting device:		—
	Lighting circuits during maintenance or repair		N/A
	Plug/socket outlets exclusively used for maintenance or repair		N/A
	Undervoltage protection circuits used for automatic tripping only at power supply failures		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	Circuits of equipment to remain normally energised for satisfactory operation		N/A
	Control circuits for interlocking purposes		N/A
	Circuits which are not disconnected by supply disconnecting device:		—
	Permanent warning labels placed in proximity of supply disconnectors		N/A
	Appropriate remark in maintenance manual		N/A
	Warning label in proximity of circuit concerned		N/A
	or wiring separated from other wiring		N/A
	Wiring of safety interlocking circuits installed with different colour of insulation.		N/A
5.4	Devices for switching off for prevention of unexpected start-up:		—
	Means shall be provided to prevent inadvertent and / or mistaken closure of the disconnecting device		N/A
	Such devices appropriate and convenient for intended use		N/A
	Suitable placed		N/A
	Readily identifiable		N/A
	The following devices that fulfil the isolation function may be provided for this purpose:		—
	– devices described in 5.3.2,		N/A
	– disconnectors, withdrawable fuse links and withdrawable links only if located in an enclosed electrical operating area (see 3.19).		N/A
	Devices that do not fulfil the isolation function (for example a contactor switched off by a control circuit) may only be provided where intended to be used for situations that include:		N/A
	– inspections;		N/A
	– adjustments;		N/A
	– work on the electrical equipment where: - there is no hazard arising from electric shock (see Clause 6) and burn; - the switching off means remains effective throughout the work; - the work is of a minor nature (for example replacement of plug-in devices without disturbing existing wiring).		N/A
	NOTE 1 This part of IEC 60204 does not address all provisions for prevention of unexpected start up. See ISO 14118 (EN 1037).		—
5.5	Devices provided for disconnecting electrical equipment	Isolating switch	P
	Supply-disconnecting device used		P

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Clause	Requirement – Test	Result - Remark	Verdict
	Disconnecting device provided for each separated part of the machine or partial machine where necessary		N/A
	Disconnectors, fuse links etc. used only in enclosed electrical operating areas	Located at operating area	P
	Such disconnecting devices appropriate and convenient for intended use and		P
	Suitably located and		P
	readily identifiable to which part it serves and		P
5.6	Provided with adequate means to prevent unauthorised, inadvertent and /or mistaken closing		P
	Devices acc. to cl. 5.4 and 5.5 provided with locking means		P
	Locking means provided with device		P
	Where a non-lockable disconnecting device (for example withdrawable fuse-links, withdrawable links) other means of protection against reconnection (for example warning labels in accordance with 16.1) may be provided.		N/A
	However, when a plug/socket combination according to 5.3.2 e) 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 need not be provided.		N/A
6	PROTECTION AGAINST ELECTRIC SHOCK		—
6.2	Protection against direct contact:		—
6.2.1	- by means of protection by enclosure		N/A
	- by means of insulation of live parts		P
	- by means of protection against residual voltages		N/A
6.2.2	Protection by enclosure:		N/A
	Live parts located inside enclosures conform to relevant requirements of clauses 4, 12 and 15 Protection against direct contact at least IP2X or IPXXB		N/A
	Where top surfaces of enclosures are readily accessible, degree of protection against direct contact is IP4X or IPXXD.		N/A
	Opening of enclosure possible only under one of the following conditions:		—
	a) use of a key or a tool. Special requirements for enclosed electrical operating areas may apply		N/A
	live parts inside of doors with protection degree of IP1X or IPXXA		N/A
	live parts likely to be touched during resetting or adjustment with protection degree IP2X or IPXXB		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	b) disconnection of live parts inside enclosure prior to opening of enclosure		N/A
	at door interlocking safety circuit, door will open only when main isolator is in open position		N/A
	For skilled persons a special device provided, to defeat interlocking circuit under following conditions:		—
	Special device or tool provided to permit skilled persons to defeat the interlock provided that:		—
	- opening of disconnecter possible at all times while interlock is defeated		N/A
	- upon closing the door, interlock is automatically restored		N/A
	If more than one door allows access to live parts, care must be taken, at implementation of this subclause		N/A
	All parts remaining live after switching off mains supply to be protected against direct contact with at least IP2X or IPXXB		N/A
	Such parts marked with warning symbol acc. to cl.17.2		N/A
	Excepted from this requirement for marking are:		—
	- Parts that can be live only due to connection to interlocking circuits, distinguished by colour as potentially live acc. to cl. 14.2.4		N/A
	- Terminals of supply disconnecting device when latter mounted alone in a separate enclosure		N/A
	c) opening of doors without use of key or tool and without disconnection of live parts possible only when all live parts are protected against direct contact by IP2X or IPXXB		N/A
	where protection is provided by barriers, tools required for their removal or		N/A
	all live parts automatically disconnected when barrier is removed		N/A
6.2.3	Protection by insulation of live parts:		—
	Live parts completely covered with insulation		P
	insulation can be removed only by destruction		P
	insulation capable to withstand mechanical, chemical, electrical and thermal stress occurring under normal service conditions		P
	Paint, varnish lacquer etc. not used as insulation		N/A
6.2.4	Protection of residual voltage:		—



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Clause	Requirement – Test	Result - Remark	Verdict
	Live parts with residual voltage =60V after disconnection, to be discharged to = 60V within 5s after disconnection Except are components with charges of = 60 μ C		N/A
	where pins of plugs or similar devices after withdrawal are exposed, discharge time = 1s		N/A
	such conductors protected against direct contact by at least IP2X or IPXXB		N/A
	if above requirements cannot be achieved, additional disconnecting devices or appropriate warning devices shall be applied. (see cl.13.8.4)		N/A
6.2.5	For protection by barriers, 412.2 of IEC 60364-4-41 shall apply.		N/A
6.2.6	For protection by placing out of reach, 412.4 of IEC 60364-4-41 shall apply. For protection by obstacles, 412.3 of IEC 60364-4-41 shall apply.		N/A
	For conductor wire systems or conductor bar systems with a degree of protection less than IP2X, see 12.7.1.		N/A
6.3	Protection against indirect contact:		—
6.3.2	Measures to prevent the occurrence of a hazardous touch voltage		—
6.3.2.2	use of class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation acc. to EN60536)		N/A
	use of switchgear and control gear assemblies with total insulation acc. to EN 60439-1		P
	application of supplementary or reinforced insulation acc. to EN60364-4-41, 413.2		P
6.3.2.3	Electrical separation of an individual circuit to prevent hazardous touch voltage acc. to EN 60364-4-41, cl. 413.5		P
6.3.3	Protection by automatic disconnection of supply:		—
	This measure necessitates co-ordination between:		—
	– the type of supply and earthing system;		P
	– the impedance values of the different elements of the protective bonding system;		P
	– the characteristics of the protective devices that detect insulation fault(s).		P
	Automatic disconnection of the supply of any circuit affected by an insulation fault is intended to prevent a hazardous situation resulting from a touch voltage.		P
	This protective measure comprise both:		—



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Clause	Requirement – Test	Result - Remark	Verdict
	-Connection of all exposed conductive parts to protective earth bonding circuit		P
	And		—
	a) overcurrent protective devices for the automatic disconnection of the supply on detection of an insulation fault in TN systems, or		P
	b) residual current protective devices to initiate the automatic disconnection of the supply on detection of an insulation fault from a live part to exposed conductive parts or to earth in TT systems, or		N/A
	c) insulation monitoring or residual current protective devices to initiate automatic disconnection of TT systems.		N/A
	This insulation monitoring device shall initiate an audible and/or visual signal which shall continue as long as the fault persists.		P
6.4	Protection by application of PELV circuit which have to fulfil following requirements:		—
6.4.1	a) nominal voltage not to exceed 25 AC (r.m.s.) or 60 DC (ripple-free) or		N/A
	6VAC or 15VDC for all other cases		N/A
	b) one side of PELV- circuit or one point of source of supply to be connected to PE- circuit		N/A
	c) live parts of PELV- circuits to be electrically separated from other live circuits.		N/A
	Electrical separation shall be not less than that required between the primary and secondary circuits of a safety isolating transformer (see IEC 61558-1 and IEC 61558-2-6);		N/A
	d) conductors of each PELV circuit to be physically separated from those of any other circuit.		N/A
	When this requirement is impracticable, the insulation provisions of 13.1.3 shall apply;		N/A
	e) plugs and socket outlets for PELV- circuits shall conform to following requirements:		N/A
	plugs shall not be able to enter socket outlets of other voltage systems		N/A
	socket outlets shall not admit plugs of other voltage systems		N/A
6.4.2	Sources for PELV- circuits to be one of the following:		—
	– a safety isolating transformer in accordance with IEC 61558-1 and IEC 61558-2-6;		N/A

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	– a source of current providing a degree of safety equivalent to that of the safety isolating transformer (for example a motor generator with winding providing equivalent isolation);		N/A
	– an electrochemical source (for example a battery) or another source independent of a higher voltage circuit (for example a diesel-driven generator);		N/A
	-electronic power supply conforming to appropriate standards		N/A
7	PROTECTION EQUIPMENT		—
7.2	Overcurrent protection:		—
7.2.1	Overcurrent protection device provided		P
7.2.2	Supply conductors		—
	Overcurrent protective device at incoming feeder to the electrical equipment (see to cl. 7.2.10 and cl. 18.5)		P
	Electrical equipment supplier state data for overcurrent protective device		P
7.2.3	Power circuits:		
	Devices for detection and interruption of overcurrent, selected in accordance with 7.2.10, shall be applied to each live conductor.		P
	The following conductors, as applicable, shall not be disconnected without disconnecting all associated live conductors:		P
	– the neutral conductor of a.c. power circuits;		P
	– the earthed conductor of d.c. power circuits;		N/A
	– d.c. power conductors bonded to exposed conductive parts of mobile machines.		N/A
	Cross section area of neutral conductor to be at least equal to phase conductor, no overcurrent protective/ disconnecting device required	2.5mm ²	P
	For neutral earth conductors with cross sections smaller than phase conductors, measures acc. to item b, cl 473.3.2.1 of IEC 60364-4-473 will apply		N/A
	For IT-systems use of neutral earth conductor (N) is not recommended. Nevertheless if an N-conductor is used, measures acc. to cl. 473.3.2.2 of IEC 60364-4-473 shall apply.		N/A
7.2.4	Control circuits:		—
	Conductors of control circuits directly connected to supply voltage and circuits feeding control voltage transformers protected against overcurrent acc. to cl. 7.2.3		N/A

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	Conductors of control circuits supplied by a control circuit transformer or d.c. supply shall be protected against overcurrent (see also 9.4.3.1):		N/A
	– in control circuits connected to the protective bonding circuit, by inserting an overcurrent protective device into the switched conductor;		N/A
	– in control circuits not connected to the protective bonding circuit;		N/A
	- where the same cross sectional area conductors are used in all control circuits, by inserting an overcurrent protective device into the switched conductor, and;		N/A
	- where different cross sectional areas conductors are used in different sub-circuits, by inserting an overcurrent protective device into both switched and common conductors of each sub-circuit.		N/A
7.2.5	Socket outlets and their associated conductors:		—
	Overcurrent protection devices for socket outlets provided for non- earthed live conductors of each circuit feeding such socket outlets		N/A
7.2.6	Lighting circuits:		—
	All unearthed conductors of local lighting circuits protected by overcurrent protective devices		N/A
7.2.7	Transformers:		—
	Transformers shall be protected against overcurrent in accordance with the manufacturer's instructions. Such protection shall (see also 7.2.10):		P
	– avoid nuisance tripping due to transformer magnetizing inrush currents;		P
	– avoid a winding temperature rise in excess of the permitted value for the insulation class of transformer when it is subjected to the effects of a short circuit at its secondary terminals.		P
	The type and setting of the overcurrent protective device should be in accordance with the recommendations of the transformer supplier.		P
7.2.8	Location of protective devices:		P
	Overcurrent protective device located at point where conductor is connected to the supply		P
	Current carrying capacity of conductors at least equal to that required for electrical load		P
	Each connecting conductor to overcurrent protective devices not longer than 3 meters		P
	Conductor protected by enclosure or duct		P



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Clause	Requirement – Test	Result - Remark	Verdict
7.2.9	Overcurrent protective devices:		—
	Rated short-circuit breaking capacity at least equal to prospective fault current at point of installation		P
	Current other than those coming from supply side taken into account		P
	Reduced breaking capacity is permitted, where another protective device is installed at supply side with the necessary breaking capacity		P
	Back-up protection carefully checked, no destruction of conductor or overcurrent protective device may result		N/A
	Co-ordination with other protective devices in circuit required		N/A
	Overcurrent protective devices in power circuits include fuses and circuit breakers. Electronic current limiting devices may also be used in protected circuits		P
7.2.10	Rating and setting of overcurrent protective devices:		—
	Rated current of fuses or overcurrent setting of other protective devices selected as low as possible, but adequate for anticipated overcurrents.		P
	Settings of overcurrent protective devices appropriately listed in technical documentation		P
7.3	Protection of motors against overheating		P
7.3.1	Overload protection for all motors provided for ratings of > 0.5 kW in continuous operation.		P
	Protective device may be omitted for motors which cannot be overloaded		P
	Protection of motors against overheating can be achieved by:		N/A
	– overload protection (7.3.2),		N/A
	– over-temperature protection(7.3.3),		N/A
	– current-limiting protection(7.3.4).		N/A
	Automatic restarting of any motor after the operation of protection against overheating shall be prevented where this can cause a hazardous situation or damage to the machine or to the work in progress.		N/A
7.3.2	Where overload protection is provided, detection of overload(s) shall be provided in each live conductor except for the neutral conductor.		N/A
	However, where the motor overload detection is not used for cable overload protection (see also Clause D.2), the number of overload detection devices may be reduced at the request of the user (see also Annex B).		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	For motors having single-phase or d.c. power supplies, detection in only one unearthed live conductor is permitted		N/A
	Where overload protection is achieved by switching off, the switching device shall switch off all live conductors. The switching of the neutral conductor is not necessary for overload protection.		N/A
	Appropriate protective devices designed to accommodate special duty motors or over-temperature protection (see 7.3.3) can be necessary. (for example, motors for rapid traverse, locking, rapid reversal, sensitive drilling)		N/A
	For motors that cannot be overloaded (for example torque motors, motion drives that either are protected by mechanical overload protection devices or are adequately dimensioned), overload protection is not required.		N/A
7.3.3	The provision of motors with over-temperature protection (see IEC60034-11) is recommended in situations where the cooling can be impaired		N/A
	Depending upon the type of motor, protection under stalled rotor or loss of phase conditions is not always ensured by over-temperature protection, and additional protection should then be provided.		N/A
	Over-temperature protection is also recommended for motors that cannot be overloaded (for example torque motors, motion drives that are either protected by mechanical overload protection devices or are adequately dimensioned), where the possibility of over-temperature exists (for example due to reduced cooling).		N/A
7.3.4	Where protection against the effects of overheating in three phase motors is achieved by current limitation, the number of current limitation devices may be reduced from 3 to 2 (see 7.3.2).		N/A
	For motors having single phase a.c or d.c. power supplies, current limitation in only one unearthed live conductor is permitted.		N/A
7.4	Abnormal temperature protection:		—
	Resistance heating or similar devices which cause excessive heat, equipped with suitable overtemperature detection		P
7.5	Protection against supply interruption or voltage reduction and subsequent restoration		—
	Undervoltage protection provided for applications where loss of supply or undervoltage causes a hazardous condition		P




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Clause	Requirement – Test	Result - Remark	Verdict
	If interruption or reduction of supply voltage is allowed for a short period of time, delayed undervoltage protection provided.		P
	Undervoltage protection not impair any stopping control of the machine		P
	Upon restoration of supply voltage, automatic or unexpected restarting of machine prevented		P
	Undervoltage protection to initiate appropriate control responses to ensure co-ordination the groups of machines working together		N/A
7.6	Motor overspeed protection:		—
	Overspeed protection provided where overspeeding causes a hazardous condition		N/A
	Overspeed protection initiates appropriate control response and prevents automatic restarting		N/A
7.7	Earth fault / residual current protection:		—
	To reduce damage to equipment due to earth fault currents below detection level, earth fault/residual protect used		P
	Detection level for earth fault protection set as low as possible		P
7.8	Phase sequence protection:		—
	Protection from incorrect phase sequence of supply voltage provided	Single phase	N/A
7.9	Protection against overvoltages due to lightning strike or switching action:		—
	Protective devices for the suppression of overvoltages caused by lightning strikes or switching surges provided		N/A
	Devices for suppression of overvoltages due to lightning, connected at incoming terminals of the supply disconnecting device		N/A
	Devices for suppression of overvoltages due to switching surges connected across terminals of all equipment requiring such protection		N/A
8	EQUIPOTENTIAL BONDING		P
8.2.1	General:		—
	All parts of protective bonding circuit capable to withstand max. thermal and mechanical stress, caused by earth-fault currents		P
	Where the conductance of structural parts of the electrical equipment or of the machine is less than that of the smallest protective conductor connected to the exposed conductive parts, a supplementary bonding conductor shall be provided.		P



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Clause	Requirement – Test	Result - Remark	Verdict
	This supplementary bonding conductor shall have a cross-sectional area not less than half that of the corresponding protective conductor.	2.5mm ²	P
	Any structural part of electrical equipment or of a machine used as part of protective bonding circuit		P
	If an IT distribution system is used, the machine structure shall be part of the protective bonding circuit and insulation monitoring shall be provided. See 6.3.3 c).		N/A
	Conductive structural parts of equipment in accordance with 6.3.2.2 need not be connected to the protective bonding circuit.		N/A
	Extraneous conductive parts which form the structure of the machine need not be connected to the protective bonding circuit where all the equipment provided is in accordance with 6.3.2.2.		N/A
	Exposed conductive parts of equipment in accordance with 6.3.2.3 shall not be connected to the protective bonding circuit.		N/A
8.2.2	Protective conductors:		--
	Identification and marking of protective conductors acc. to cl. 13.2.2		P
	Copper conductors used as protective conductors	copper	P
	Other conductor materials allowed, if cross section of such conductors is not less than 16mm ²		N/A
	Cross-sectional area of protective conductors determined acc. to IEC60364-5-54, cl. 543 or EN 60439-1, cl. 7.4.3.1.7, table 4	Earth wire 2.5mm ²	P
	Relationship between cross-section area of phase conductor and PE acc. to table 1		N/A
8.2.3	Continuity of protective bonding circuit:		—
	All exposed conductive parts of electrical equipment and machine(s) connected to protective bonding circuit.		P
	In case of removal of parts of PE system, remaining parts not to be interrupted		P
	Current-carrying capacity of connections and bonding points not impaired by mechanical, chemical or electrochemical influences		P
	Particular consideration should be given if enclosure consists of aluminium and its alloys	Not alloys	N/A
	Metal ducts and cable sheaths not used as protective conductors and not connected to protective bonding circuit		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	If electrical equipment is mounted on lids, doors or cover plates, continuity of protective bonding circuit ensured		N/A
	Continuity of protective conductor ensured at cables which are exposed to damage		N/A
8.2.4	Exclusions of switching devices from protective bonding circuit:		—
	The protective bonding circuit shall not incorporate a switching device or an overcurrent protective device (for example switch, fuse).		P
	No means of interruption of the protective bonding conductor shall be provided.		P
	Exception: links for test or measurement purposes that cannot be opened without the use of a tool and that are located in an enclosed electrical operating area.		N/A
	Where the continuity of the protective bonding circuit can be interrupted by means of removable current collectors or plug/socket combinations, the protective bonding circuit shall be interrupted by a first make last break contact.		N/A
	This also applies to removable or withdrawable plug-in units (see also 13.4.5).		N/A
8.2.5	Equipment parts that need not to be connected to protective bonding circuit:		—
	Parts which cannot be touched on large surfaces or grasped by hand due to its small size (less than approx. 50 x 50 mm), small parts such as screws, rivets, nameplates or		P
	are located in such way, that either contact with live parts or an insulation failure is unlikely		N/A
8.2.6	Protective conductor connecting points:		—
	PE conductor connecting points have no other functions and not used for connection of appliances or other parts		P
	Each PE connecting point identified by using the protective earth symbol		P
	Alternatively, terminals for connection of protective conductors identified by bicolour combination GREEN-YELLOW or letter PE	Green-yellow	P
8.2.7	Mobile machines		—
	On mobile machines with on-board power supplies, protective circuits, exposed conductive parts connected to a protective bonding terminal		N/A

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Clause	Requirement – Test	Result - Remark	Verdict
	when mobile machines will be connected to an external incoming power supply, protective bonding terminal (PE) fixed to connecting point for the protective conductor.		N/A
8.2.8	Additional protective bonding requirements for electrical equipment having earth leakage currents higher than 10 mA a.c. or d.c.	<10mA	N/A
	Where electrical equipment has an earth leakage current (for example adjustable speed electrical power drive systems and information technology equipment) that is greater than 10 mA a.c. or d.c. in any incoming supply, one or more of the following conditions for the associated protective bonding circuit shall be satisfied:		N/A
	a) the protective conductor shall have a cross-sectional area of at least 10 mm ² Cu or 16 mm ² Al, through its total run;		N/A
	b) where the protective conductor has a cross-sectional area of less than 10 mm ² Cu or 16 mm ² Al, a second protective conductor of at least the same cross-sectional area shall be provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm ² Cu or 16 mm ² Al.		N/A
	c) automatic disconnection of the supply in case of loss of continuity of the protective conductor.		N/A
	In addition, a warning label shall be provided adjacent to the PE terminal, and where necessary on the nameplate of the electrical equipment.		N/A
	The information provided under 17.2 b)1) shall include information about the leakage current and the minimum cross-sectional area of the external protective conductor.		N/A
8.3	Functional bonding		—
	Protection against maloperation as a result of insulation failures can be achieved by connecting to a common conductor in accordance with 9.4.3.1.		N/A
	For recommendations regarding functional bonding to avoid maloperation due to electromagnetic disturbances, see 4.4.2.		N/A
8.4	Measures to limit the effects of high leakage current		—
	The effects of high leakage current can be restricted to the equipment having high leakage current by connection of that equipment to a dedicated supply transformer having separate windings.		N/A
	The protective bonding circuit shall be connected to exposed conductive parts of the equipment and, in addition, to the secondary winding of the transformer.		N/A

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Clause	Requirement – Test	Result - Remark	Verdict
	The protective conductor(s) between the equipment and the secondary winding of the transformer shall comply with one or more of the arrangements described in 8.2.8.		N/A
9	CONTROL CIRCUITS AND CONTROL FUNCTIONS		—
9.1.1	Control circuits supplied by transformers have separately isolated windings		P
	If several transformers used, secondary voltages in phase		N/A
	DC- control circuits connected to PE circuit supplied from a separate winding of the control circuit transformer or supplied from another control circuit transformer		N/A
	Transformers not mandatory for machines with a single motor starter and maximum of two control devices		N/A
9.1.2	Nominal voltage not exceed 277VAC when supplied from a transformer		P
9.1.3	Control circuits shall be provided with overcurrent protection in accordance with 7.2.4 and 7.2.10.		P
9.2	Control functions:		—
9.2.1	NOTE Subclause 9.2 does not specify requirements for the devices used to implement control functions. Examples of requirements for devices are given in Clause 10.		N/A
9.2.2	Categories of Stop functions:		—
	Category 0: Stopping by immediate removal of power to machine actuators	Power off	P
	Category 1: A controlled stop with power available to machine actuators. Then removal of power when stop condition has been achieved.		N/A
	Category 2: A controlled stop with power left available to machine actuators		N/A
9.2.3	Operation		N
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		P
	Start functions shall operate by energizing the relevant circuit.		P



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Clause	Requirement – Test	Result - Remark	Verdict
	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.		P
	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.		P
	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		N/A
	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).	Stop category 0	P
	Stop functions shall override related start functions		P
	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
9.2.3.4.1	Emergency stop or emergency switching off commands shall be sustained until it is reset.	Switch used for stop test instrument	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
	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



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Clause	Requirement – Test	Result - Remark	Verdict
9.2.3.4.3	Emergency switching off should be provided where: <ul style="list-style-type: none"> - 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		P
	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)		P
	Mode selection by itself does not initiate machine operation. A separate actuation of the start control has to be stated by the operator.		P
	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)		P
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		N/A
9.2.3.7	Hold-to-run controls shall require continuous actuation of the control device(s) to achieve operation		N/A
9.2.3.8	Two-hand controls shall be one of the following types and have the following features		N/A
	Type I: this type requires: <ul style="list-style-type: none"> - 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



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Clause	Requirement – Test	Result - Remark	Verdict
	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		N/A
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		N/A
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.		N/A
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
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



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Clause	Requirement – Test	Result - Remark	Verdict
	- 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
9.3	Protective interlocks:		—
9.3.1	Reclosing or resetting of an interlocking safeguard not to initiate a machine motion or operation which can produce a hazardous condition	No motion hazard	P
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	Where non-operation of devices for auxiliary functions causes a hazardous condition, damage to the machine or to the process, appropriate interlocking be provided		N/A
9.3.4	Interlocks of contactors, relays, etc. between different operations and for opposite motions, interlocks against such incorrect operation provided		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	Reversing contactors interlocked in such way, that in normal service no short circuit occurs during switching operation		N/A
	Where, for safety or for continuous operation, certain functions on the machine are required to be interrelated, proper co-ordination ensured by suitable interlocks		N/A
	For a group of machines working together in a co-ordinated manner and having more than one controller, provisions made for co-ordination of this controller		N/A
	If a failure of a mechanical brake actuator can result that the brake, is applied when the associated machine actuator is energised and a hazardous condition results, interlocks be provided to switch off the machine actuator		N/A
9.3.5	Reverse current breaking on a motor, effective measures taken to avoid motor starting in opposite direction at end of breaking where that reversal causes a hazardous condition, damage to the machine or to the process		N/A
	Control circuits arranged so, that rotation of a motor shaft, not to result in a hazardous condition		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:		—
	Measures to reduce those risks include but are not limited to:		—
	protective devices on the machine, (e.g. interlocking guards, trip devices)		P
	protective interlocking of electrical circuit		N/A
	use of proven circuit techniques and components (see cl. 9.4.2.)		P
	provision of partial or complete redundancy (see cl. 9.4.2.2) or diversity (see cl. 9.4.2.3)		P
	provision for functional tests (see cl. 9.4.2.4)		P



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Clause	Requirement – Test	Result - Remark	Verdict
	single failures only are to be considered		P
	for higher levels of risks, it may be necessary to ensure, that more than one failure cannot result in a hazardous condition		P
9.4.2	Measures to reduce the risk in case of failure:		—
9.4.2.1	bonding of control circuits to protective circuit for operational purposes (see cl. 9.4.3.1)		P
	connection of control devices in accordance with cl. 9.1.4		P
	stopping by de-energising (see cl.9.2.2)		P
	switching of all live conductors to device being controlled (see cl.9.4.3.1)		P
	use of switching devices having positive (or direct) opening operation (see IEC 60947-5-1)		P
	circuit design to reduce possibility of failures causing undesirable operations		P
9.4.2.2	on-line redundancy for normal operation		N/A
	off-line redundancy for protective functions, effective only when operating function fails		N/A
	where off-line redundancy is use, suitable measures taken, to ensure that those control circuits are available when required		N/A
9.4.2.3	Use of control circuits having different principles of operation or using different types of devices may reduce faults and failures. Examples include:		—
	Combination of normally open and normally closed contacts operated by interlocking guards		N/A
	Use of different types of circuit components in control circuit		N/A
	Combination of electromechanical and electronic circuits in redundant configurations		N/A
	Combination of electrical and non- electrical systems (e.g. mechanical, hydraulic, pneumatic) may perform redundant functions and provide diversity		N/A
9.4.2.4	Automatic functional test carried out by the control system		N/A
	Manual function tests by inspection		P
	Tests at start-up and at predetermined intervals or as a		N/A
	Combination as appropriate (see cl.18.2 and 18.6)		N/A
9.4.3	Protection against malfunction of control circuits		—



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Clause	Requirement – Test	Result - Remark	Verdict
9.4.3.1	Measures shall be provided to reduce the probability that insulation faults on any control circuit can cause malfunction	Method (b)	P
	Methods to meet these requirements include but are not limited to the following:		—
	a) Control circuits, fed by control transformers:		P
	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
	Method b) – Non-earthed control circuits fed by transformers shall either		P
	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		P
	3) where 2) above would increase the risk, it can be sufficient to provide an insulation monitoring device that 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
	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	Computer	P



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Clause	Requirement – Test	Result - Remark	Verdict
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		—
10.1.1	Devices to be selected, mounted and identified or coded acc. to IEC61310 and IEC 60447		P
10.1.2	Machine-mounted control devices readily accessible for service and maintenance and		P
	Mounted to minimise possibility of damage from activities such as material handling		P
	Actuators of hand-operated control devices selected and installed as follows:		—
	Mounted not less than 0.6 m above servicing level, and within easy reach for operator (normal working position)		P
	Placed so that operator is not exposed to a hazardous situation when operating them		P
	Possibility of inadvertent operation is minimised		P
	The actuators of foot-operated control devices shall be selected and installed so that:		—
	– 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	Degree of protection sufficient for expected use against:		—
	Effects of aggressive liquids, vapours or gases in environment of machine	No such environment	N/A
	Ingress of contaminants		N/A
	Operator interface control devices have a minimum degree of protection against direct contact of IPXXD	IP22	P
10.1.4	Position sensors arranged so, that they will not be damaged in the event of over travel		N/A
	Position sensors use in circuits with safety-related functions either have positive opening operation or provide similar reliability		N/A
10.1.5	Portable or pendant operator control stations and control devices selected or arranged in such ways as to minimise possibility of inadvertent machine operations caused by shocks and vibrations		N/A
10.2	Push-buttons		P
10.2.1	Pushbutton actuators colour-coded acc. To table 2	Red/yellow for emergency switch	P
10.2.2	Recommendation that pushbuttons are preferably marked directly on actuator with symbols acc. To table 3		P



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Clause	Requirement – Test	Result - Remark	Verdict
10.3	Indicator lights and displays	Three color light	P
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).		P
	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		P
10.3.2	Unless otherwise agreed between the supplier and the user (see Annex B), indicator lights shall be colour-coded with respect to the condition (status) of the machine in accordance with Table 4.		P
	Indicating towers on machines should have the applicable colours in the following order from the top to down; RED, YELLOW, BLUE, GREEN and WHITE.	Three color light	P
10.3.3	Flashing lights for further information may be used for following purposes:		—
	to attract attention or		P
	to request immediate action or		P
	to indicate a discrepancy between command and actual state or		N/A
	to indicate a change in process(flashing during transition)		N/A
	higher frequency of flashing lights (pulse/pause ratios) recommended for higher priority of information		N/A
	Where flashing lights or displays are used to provide higher priority information, audible warning devices should also be provided.		N/A
10.4	Illuminated push-buttons		N/A
	Illuminated push-button actuators shall be colour-coded in accordance with Tables 2 and 4.		N/A
	WHITE colour shall be use, if it is difficult in assigning an appropriate colour		N/A
	RED colour shall be use, for emergency stop actuators, not depending upon illumination conditions (ON /OFF status) only		P
10.5	Rotary control devices		N/A
	Rotary control devices having a rotational member such as potentiometers and selector switches, mounted in such way as to prevent rotation of stationary member		N/A
10.6	Start devices		N/A
	Start devices use to initiate start functions or movement of machine or elements designed and mounted such as to minimise inadvertent operation		N/A

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Clause	Requirement – Test	Result - Remark	Verdict
	Mushroom - type actuators use for two-hand control devices		N/A
10.7	Devices for emergency stop:		—
10.7.1	Devices for emergency stop 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.		P
10.7.2	Types of devices for emergency stop include following elements:		—
	push-button operated switch or	Push-button	P
	pull-cord operated switch or		N/A
	pedal-operated switch without mechanical guard		N/A
	The devices shall be in accordance with IEC 60947-5-5.		P
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)		P
	Where intended for emergency use, the supply disconnecting device shall meet the colour requirements of 10.2.1		N/A
10.8	Devices for emergency switching off:		—
10.8.1	Location of emergency switching- off devices normally placed separate from operator control station		N/A
	Operator control station equipped with separate emergency stop device, since function effects a category 0 emergency stop		N/A
10.8.2	Types of emergency switching-off devices include: Push-button operated switch or		N/A
	Pull-cord operated switch		N/A
	Devices of self-latching type and ensure positive (or direct) opening operation		N/A
	Push-button operated switch in break-glass enclosure		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

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Clause	Requirement – Test	Result - Remark	Verdict
10.9	Enabling control device		—
	When an enabling control device is provided as a part of a system, it shall signal the enabling control to allow operation when actuated in one position only. In any other position, operation shall be stopped or prevented.		N/A
	Enabling control devices shall be selected and arranged so as to minimize the possibility of defeating.		N/A
	Enabling control devices shall be selected that have the following features:		—
	-Designed in consideration with ergonomic principles		N/A
	-Requirements for a two-position type:		—
	Position 1: OFF-function of switch(actuator is not operated)		N/A
	Position 2: enabling function(actuator is operated)		N/A
	-Requirements for a three-position type:		—
	Position 1: OFF-function of switch, (actuator is not operated)		N/A
	Position 2: enabling function of switch, (actuator is operated and in its mid position)		N/A
	Position 3: OFF-function of switch, (actuator is operated past its mid position)		N/A
	When returning from position 3 to 2, function not enabled		N/A
11	CONTROLGEAR: LOCATION, MOUNTING, AND ENCLOSURES		—
11.1	All control gear located and mounted so, as to cover the following points:facilitate accessibility and maintain ability		P
	facilitate protection against external influences or operating conditions under which operation is intended		P
	facilitate easy access for operation and maintenance of the machine and its associated equipment		P
11.2	Location and mounting:		—
11.2.1	all control-gear components placed and oriented so, that identification is possible without moving them or the associated wiring	No such control gear	N/A
	Components checked for correct operation or possible replacement without dismantling other equipment or parts of the machine		N/A
	Terminals not associated with control gear also to conform to this requirement		N/A
	Operation and maintenance of all control gear possible from front of cabinet		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	Special tools for removal of electronic devices provided with the equipment		N/A
	Access for regular maintenance or adjustment to equipment, relevant devices located between 0.4m to 2.0 m above servicing level		N/A
	Terminals located at least 0.2 m above servicing level and placed such, that conductors and cables can be easily connected		N/A
	No devices mounted on doors, except those for operating, indicating, measuring and cooling purposes on normally removable access-covers of enclosure		N/A
	Plug-in type control devices belonging functionally together, their association made clear by type (shape), marking or reference designation single or in combination (see cl. 13.4.5)		N/A
	Plug-in type control devices, that are handled during normal operation, shall be designed with non-interchangeable characteristics, where lack of such facility can result in malfunctioning		N/A
	Plug/socket combinations, handled during normal operation, shall be located and mounted so as to provide unobstructed access		N/A
	If test points are provided, they should be:		—
	mounted so as to provide unobstructed access		N/A
	clearly marked to correspond with the documentation (see cl. 17.3)		N/A
	adequately insulated		N/A
	sufficiently spaced for connection of test equipment or means		N/A
11.2.2	Non-electrical parts and devices, not directly associated with the electrical equipment, not located within enclosures containing control gear		N/A
	Devices such as solenoid valves separated from other electrical equipment		N/A
	Control devices mounted at same location and connected to the main supply voltage, or to both main supply and control voltage, are grouped separately from those connected to control voltage only		N/A
	Terminals separated into groups for: power circuits or		N/A
	associated control circuits or		N/A
	other control circuits, fed from external sources		N/A
	Terminal groups mounted adjacently, providing that each group is readily identified		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	When arranging the location of devices, clearances and creepage distances specified for them shall be maintained, taking into account external influences or physical conditions of its environment(IEC60664-1)		N/A
11.2.3	Heat generating components located so, that temperature of each component in its vicinity remains within the permitted limits		P
11.3	Degrees of protection:		—
	Protection of control gear against ingress of solid foreign objects and liquids shall be adequate. External influences under which the equipment is intended to operate is to be taken into account and is to be		N/A
	Its protection sufficient against dust, coolants and swarf		P
	Enclosures of control gear provide a degree of protection of at least IP22	IP22	P
	Exceptions:		—
	a) Where an electrical operating area is use as a protective enclosure for an appropriate degree of protection against ingress of solid bodies and liquids		N/A
	b) Where removable collectors on collector bar systems are use, and IP22 is not achieved but measures of cl. 6.2.5 are applied		N/A
11.4	Enclosures doors and openings:		—
11.4	Enclosures to withstand mechanical, electrical and thermal stress as well as effects of humidity during normal service		P
	Fasteners for doors or covers of captive type		P
	Windows for viewing internally mounted indicating devices, made of material suitable to withstand mechanical stress and chemical attack		P
	Doors of enclosure not wider than0,9 meter		N/A
	Doors with vertical hinges, preferably lift-off type		N/A
	Doors with opening angle of at least 95 °		N/A
	Gaskets of doors, lids, covers and enclosures withstand the chemical effects of aggressive liquids, vapours or gases use on the machine		P
	Means use to maintain degree of protection of an enclosure of doors, lids and covers that require opening or removed for operational or maintenance shall:		—
	be securely attached to either door, cover or enclosure		P
	not deteriorate due to removal or replacement of door or cover and so impair degree of protection		P



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Clause	Requirement – Test	Result - Remark	Verdict
	all openings in enclosure closed by supplier(s), ensuring degree of protection specified for equipment		P
	openings for cable entries at enclosure to be easily re-opened on site		P
	suitable opening in base of enclosure within the machine provided, as to enable drainage of moisture due to condensation		P
	no opening between enclosure containing electrical equipment and compartment containing coolant, lubricating or hydraulic fluids		N/A
	holes in enclosure for mounting purposes not impair required degree of protection		P
	If equipment could attain a surface temperature sufficient to cause a risk of fire during normal or abnormal operation:		—
	located within an enclosure, that can withstand, without risk of fire or harmful effect, the heat emitted by the equipment or		N/A
	mounted and located at sufficient distance from adjacent equipment, so as to allow safe dissipation of heat or		N/A
	otherwise screened by material that can withstand, without risk of fire or harmful effect, the heat emitted by the equipment		N/A
11.5	Access to control gear:		—
	Minimum dimensions of doors and corridors for access to electrical operating areas:at least 0.7 meter wide and 2.0 meter high		N/A
	Doors open outwards		N/A
	Doors equipped with means to allow opening from inside without the use of a key or tool		N/A
	Enclosures which readily allow a person to fully enter shall be provided with means to allow escape, for example panic bolts on the inside of doors.		N/A
	Enclosures intended for such access, for example for resetting, adjusting, maintenance, shall have a clear width of at least 0,7 m anda clear height of at least 2,1 m.		N/A
	In cases where: –equipment is likely to be live during access; and – conducting parts are exposed,		N/A
	the clear width shall be at least 1,0 m. In cases where such parts are present on both sides of theaccess way, the clear width shall be at least 1,5 m.		N/A
12	CONDUCTORS AND CABLES		—



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Clause	Requirement – Test	Result - Remark	Verdict
12.1	Conductors and cables selected so as to be suitable for operating conditions and external influences that are existing		P
	Requirements not applicable for integral wiring of assemblies, subassemblies and devices that are manufactured and tested acc. to their relevant standard		P
12.2	Conductors		P
	Generally conductors shall be of copper		P
	Where aluminium conductors are used, the cross-sectional area shall be at least 16 mm ² .	No aluminium wire	N/A
	To ensure adequate mechanical strength, the cross-sectional area of conductors should not be less than as shown in Table 5		N/A
	Class 1 and class 2 conductors are primarily intended for use between rigid, non-moving parts.		P
	All conductors that are subject to frequent movement (for example one movement per hour of machine operation) shall have flexible stranding of class 5 or class 6.	No such movement	N/A
12.3	Insulation		P
	Where insulation of conductors or cables can constitute hazards due to propagation of fire or emission of toxic/corrosive fumes, guidance from cable supplier to be sought		N/A
	Special attention to 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:		P
	Dielectric strength of insulation adequate for required test voltage with a 5min. of 2000VAC for cables operating with voltages >50VAC or >120 VDC	2000VAC for a duration of 5 minutes	P
	For separate PELV circuits, dielectric strength adequate for test voltage of 500VAC for a duration of 5 minutes		P
	The insulation shall be such that it cannot be damaged in operation or during laying, especially for cables pulled into ducts.		P
12.4	Current-carrying capacity in normal service in accordance with table 6.		P
	Or in accordance with suppliers recommendation.		N/A
12.5	The voltage drop from the point of supply to the load in any power circuit cable shall not exceed 5 % of the nominal voltage under normal operating conditions.		P



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Clause	Requirement – Test	Result - Remark	Verdict
	In control circuits, the voltage drop shall not reduce the voltage at any device below the manufacturer's specification for that device, taking into account inrush currents.		N/A
12.6	Flexible cables		P
12.6.1	Flexible cables have cl. 5 or cl. 6 conductors(see table C.4)		P
	cables exposed to severe duties shall be of adequate construction to protect against:		—
	abrasion due to mechanical handling and dragging across rough surfaces	Not use at severe duty	N/A
	kinking to operation without cable guides		N/A
	stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums		N/A
12.6.2	Cable handling system of machine designed such, as to keep tensile stress of conductors as low as practicable during machine operation		N/A
	tensile stress for copper conductors not to exceed 15N/mm ² of copper cross section area		N/A
	where tensile stress of conductors is exceeding 15 N/mm ² , cables of special design are use		N/A
	maximum stress for flexible cables agreed with the cable manufacturer		N/A
12.6.3	Cables wound on drums selected such, as the maximum allowable conductor temperature is not exceeded		N/A
	cables for circular cross-section area, installed on drums, max. current-carrying capacity in free air as declared acc. to table 7		N/A
12.7.1	Collector wires, collector bars and slip-ring assemblies:		—
	They shall be installed or enclosed in such way, that during normal access to the machine, protection against direct contact is achieved by application by one of the following protective measures:		—
	protection by partial insulation of live parts	No sliding current collector	N/A
	protection by enclosure or barriers provide a degree of protection of at least IP2X		N/A
	horizontal top surfaces of barriers or enclosures which are readily accessible provide a degree of protection of at least IP4X		N/A
	if required degree of protection is not achieved, protection by placing live parts out of reach in combination with emergency switching-off acc. to cl. 9.2.5.4.3 applied		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	collector wires and bares placed such and / or protected as to prevent contact, especially for unprotected wires and bars, with conductive items such as, cords of pull-cord switches, strain-relief devices and drive chains and		N/A
	prevent damage from a swinging load		N/A
12.7.2	Where collector wires, collector bars and slip-ring assemblies are installed as part of the PE-circuit, they do not carry current in normal operation		N/A
12.7.3	Protective conductors of current collectors have a shape or are designed such, so that they are not interchangeable with other current collectors of the sliding contacttype		N/A
12.7.4	Removable current collectors with disconnecter function are designed such, that PE-circuit is interrupted only after live conductors have been disconnected and the continuity of the PE-circuit is re- established before any live conductor is reconnected		N/A
12.7.5	Clearances between respective conductors and between adjacent systems of collector wires, bars, slip-ring assemblies and their current collectors designed for operation in pollution degree 3 conditions and an overvoltage category III in accordance with IEC60664-1		N/A
12.7.6	Creepage distances suitable for operation in pollution degree 3		N/A
	In abnormally dusty, moist or corrosive environments, following creepage distances apply:		—
	for unprotected collector wires, bars and slip-ring assemblies equipped with insulators, the minimum creepage distance is 60 mm		N/A
	for enclosed collector wires, insulated multipole collector bars and insulated individual collector bars, the minimum creepage distance is 30 mm		N/A
	gradual reduction of insulation values due to unfavourable ambient conditions regarded		N/A
12.7.7	Suitable design measures taken, in order to prevent energisation of adjacent sections by current collectors themselves		N/A
12.7.8	Collector wires, collector bar systems and slip-ring assemblies use for power circuits kept separately from those use for control circuit applications		N/A
	above systems capable of withstanding without damage to mechanical forces and thermal effects of short circuit currents		N/A
	removable covers to above systems, laid underground or under floor, designed that they cannot be opened by one person without the use of a tool		N/A

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Clause	Requirement – Test	Result - Remark	Verdict
	collector bars which are installed in a common metal enclosure, the individual section of it bonded together and earthed at several points depending upon their length		N/A
	Metal covers of collector bars laid underground or under floor, bonded together end earthed		N/A
	Underground and under floor collector bar ducts have drainage facilities		N/A
13	WIRING PRACTICES		—
13.1.1	All connections, especially those of the protective bonding circuit, secured against accidental loosening		P
	Means of connection suitable for cross-sectional areas and nature of conductors being terminated		P
	Connection of two or more conductors to one terminal only where terminal is designed for that purpose		N/A
	Only one PE-conductor connected to one terminal connecting point		P
	Soldered connections only, where terminals are provided which are suitable for soldering connections		N/A
	Terminals on terminal blocks plainly identified to correspond with markings on wiring diagrams		P
	Installation of flexible conduits and cables such, that liquids are drained away from fittings and joints		P
	Means to retain stranded conductors together when terminating conductors at terminals/ devices provided		P
	Solder not use for that purpose		N/A
	Shielded conductors terminated so, as to prevent fraying of strands and to permit easy disconnection		N/A
	Identification tags legible, permanent and appropriate for physical environment		P
	Terminal blocks mounted and wired so, that internal and external wiring does not cross over terminals		P
13.1.2	Conductors and cables shall be run from terminal to terminal without splices or joints		P
	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		P
	Exceptions are possible as described		N/A
	Terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors		P



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Clause	Requirement – Test	Result - Remark	Verdict
	Protective conductor shall be placed close to the associated live conductors in order to decrease the impedance of the loop		P
	Conductors and cables shall be run from terminal to terminal without splices or joints		P
13.1.3	Conductors of different circuits		P
	Conductors of different circuits laid side by side and occupy the same duct or be in same multiconductor cable, provided that such arrangement does not impair proper functioning of respective circuits		P
	Where circuits operate at different voltage levels, conductors separated by suitable barriers or insulated for maximum voltage to which any conductor within the same duct is subjected		P
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
13.1.5	The cable between the pick-up and the pick-up converter as specified by the manufacturer of the inductive power supply shall be:		N/A
	– as short as practicable;		N/A
	– adequately protected against mechanical damage.		N/A
13.2	Identification of conductors:		—
13.2.1	Conductors identifiable at each termination point acc. to technical documentation(see Clause 17).		P
	It is recommended (for example to facilitate maintenance) that conductors be identified by number, alphanumeric, colour (either solid or with one or more stripes), or a combination of colour and numbers or alphanumeric.		P
	When numbers are used, they shall be Arabic; letters shall be Roman (either upper or lower case).		P
13.2.2	Protective conductor readily distinguishable by shape, location, marking or colour		P
	Bicolour combination GREEN-AND- YELLOW use throughout the length of the conductor	GREEN-AND- YELLOW use throughout the length	P
	For insulated conductors, the bicolour combination GREEN- AND-YELLOW shall be such that on any 15 mm length, one of the colours covers at least 30 % and not more than 70 % of the surface of the conductor, the other colour covering the remainder of the surface.		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	This colour identification is strictly reserved for the protective conductor, so that it can be easily identified by its shape		N/A
	Ends or accessible positions of a protective conductor clearly identified by graphical symbol or by bicolour combination GREEN-AND- YELLOW		N/A
13.2.3	Where a circuit includes a neutral conductor identified by colour, the colour is LGHT BLUE		P
	LIGHT BLUE must not be use for identification of any other conductor where confusion is possible		N/A
	Where bare conductors are use as neutral conductors and identification by colour is use, they either be coloured by LIGHT BLUE stripes, 15 to 100 mm wide in each compartment or unit, or at each accessible position		N/A
	Bare conductor colour colouredLIGHT BLUE over its full length		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		P
	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		P
	Conductors inside enclosures shall be supported where necessary		P
	Non-metallic supports shall be made with a flame-retardant insulating material (see IEC 60332 series)		P
	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		P
13.4	Wiring outside enclosures:		—
13.4.1	Conductors of a circuit shall not be distributed over different multi-core cables, conduits, etc.		P
13.4.2	External ducts		P
	Conductors and their connections external to the electrical equipment shall be placed in suitable ducts (see cl.13.5) Exceptions: --Cables with special suitable protection. -Position switches or proximity switches supplied with a dedicated cable which is sufficiently short		P



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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		P
	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	Socket bank excluded	P
	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
	The installation of plug/socket combinations shall fulfil the following requirements as applicable:		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	a) The component which remains live after disconnection shall have a degree of protection of at least IP2X or IPXXB		N/A
	b) Metallic housings of plug/socket combinations shall be connected to the protective bonding circuit		N/A
	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		N/A
	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		N/A
	e) 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	Dismantling for shipment		P
	If wiring needs to be disconnected for shipment, terminals or plug/socket combinations are provided at the disconnecting points		P
13.4.7	Additional wiring for maintenance or repair purposes provided		N/A
13.5	Ducts, connection boxes and other boxes:		—
13.5.1	Ducts shall provide a degree of protection suitable for the application (see IEC 60529).	No ducts or box	N/A
	All sharp edges, flash, burrs, rough surfaces or threads which the insulation of conductors may come into contact, removed from ducts and conduits		N/A
	In order to avoid confusion between conduits for electrical installation and those for oil, water or air, either physically separated or suitably identified		N/A
	Ducts or cable trays rigidly supported and positioned at sufficient distance from moving parts		N/A
	Ducts or cable trays mounted at least 2 meters above the working surface in areas where human passage is required		N/A
	Ducts provided only for mechanical protection (see cl. 8.2.3)		N/A
	Cable trays which are partially covered, not to serve as cable trays or installation trunking		N/A
	Conductors and cables suitable for installation in cable trays		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
13.5.2	Cable trays dimensioned or located such, as to enable easy access for installation of additional conductors and cables		N/A
	Consideration given on percentage of filling of such ducts.		N/A
13.5.3	Rigid metal conduits or trays consist of galvanised steel or corrosion-resistant material, suitable for the environmental conditions.		N/A
	Application of cable trays of different metal avoided, due to electrolytic corrosion		N/A
	Installation conduits secured, held in place and supported at each end		N/A
	Joints and fittings compatible with conduits and appropriate for its application		N/A
	Conduit-bends fabricated such, as to avoid damage or reduction of internal cross-section		N/A
13.5.4	Flexible metallic conduits and fittings consist of flexible metal tubing or wire mesh armour.		N/A
	They are suitable for its application and environmental conditions		N/A
13.5.5	Flexible non-metallic conduits are resistant to buckling and with similar characteristics as the sheath of multicore cables		N/A
	They shall be suitable for its application and environmental conditions		N/A
	Joints and fittings compatible with conduits and appropriate for its application		N/A
13.5.6	Cable trunking systems outside of enclosures are rigidly supported and kept clear of moving and contaminating parts of the machine		N/A
	Covers of cable trunking designed such, as to overlap at both sides of cable trunking(see cl. 14.5.6)		N/A
13.5.7	Installation of cables layed in cable trays with covers permitted within the machine-foundations, providing that they are completely closed and separated from coolant and lubrication systems(see cl. 14.5.6)		N/A
13.5.8	Cable connection boxes and junction boxes use for wiring purposes are readily accessible for maintenance (see cl. 12.3)		N/A
	provide protection against ingress of solids or liquids, taking into account external influences during operation of the machine (see cl. 12.3)		N/A



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Clause	Requirement – Test	Result - Remark	Verdict
	Junction boxes not have openings for cable entries and are designed so, as to avoid ingress of entrained dust, lubricants and coolant		N/A
13.5.9	Motor terminal boxes use for motor cable connection and for devices attached to the motor		N/A
14.	ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT		—
14.1	Electric motors are conform to EN60034-1		N/A
	Electric motors and associated equipment protected against following risks:		—
	overcurrent (see cl. 7.2)		N/A
	thermal overload (see cl. 7.3)		N/A
	overspeed (see cl. 7.6)		N/A
	Compliance ensured with the requirements stated (see clauses 5.3, 5.4, 5.5, 7.5, 7.6 and 9.4)		N/A
	Motor control equipment located and mounted acc. to cl. 12		N/A
14.2	Selection of motor enclosure recommended acc. to EN 60034-5		N/A
	Degree of protection at least IP23		N/A
	Incorporated motors mounted such, as to provide adequate protection against mechanical damage		N/A
14.3	Dimensions of motors conform to those given in IEC regulations(see EN 60072-1 and EN 60072-2)		N/A
14.4	Each motor with associated coupling, belt, pulley or chain mounted such, as to provide adequate protection and easy access for inspection, maintenance, adjustment or alignment, lubrication and replacement		N/A
	Motors mounted such, as to allow easy access to all terminal boxes		N/A
	Motors mounted such, as to ensure proper cooling Temperature rise to be within limits of relevant insulation class		N/A
	Temperature rise within limits of relevant insulation class		N/A
	If possible, motor compartments stay clean and dry and when required, ventilated directly to the outside of the machine		N/A
	Motor-vents at an acceptable level and designed such, as to avoid ingress of swarf, dust or water spray		N/A
	No opening between motor compartment and any other compartment, which does not fulfil the requirement for motor compartments		N/A





EN 60204-1			
Clause	Requirement – Test	Result - Remark	Verdict
14.5	Electric motors selected acc. to service and environmental conditions		N/A
	Design criteria for evaluation include: type of motor and		N/A
	type of duty cycle (see IEC 60034-1) and		N/A
	fixed speed or variable speed operation and		N/A
	mechanical vibrations and		N/A
	type of converter for motor speed control and		N/A
	influence of the harmonic spectrum of voltage and/or current when supplied from static converter on the temperature rise and		N/A
	method of starting and possible influence of inrush current		N/A
	variation of counter torque load with time and speed		N/A
	influence of loads with large inertia and		N/A
	influence of constant torque or constant power operation and		N/A
	possible need of inductive reactors between motor and converter		N/A
14.6	Operation of overload or overcurrent protective devices for mechanical brake-actuators initiate simultaneous de-energisation (release) of associated machine actuators		N/A
15.	ACCESSORIES AND LIGHTING		—
	No accessories and lighting		—
15.1	Where the machine or its associated equipment is provided with socket-outlets for auxiliary equipment, the following will apply:		—
	socket-outlets are conform to regulations		N/A
	if not possible, they are clearly marked with voltage and current ratings		N/A
	continuity of protective bonding circuit to be ensured		N/A
	all unearthed conductors connected to socket-outlets, protected against overcurrent		N/A
	when required, protection against overload in accordance with cl. 7.2 and cl. 7.3 separately from protection of other circuits		N/A
	if power supply to socket-outlets is not disconnected, than requirements of cl.5.3.5 apply		N/A
15.2.1	Connection to PE-circuit acc. to cl.8.2.2		N/A
	ON-OFF switch not incorporated in lampholder or in flexible connecting cord		N/A
	Stroboscopic effects from lights avoided		N/A



EN 60204-1			
Clause	Requirement – Test	Result - Remark	Verdict
	If fixed lighting is provided in an enclosure, electromagnetic compatibility (EMC) taken into account		N/A
	Application of EMC requirements acc. to principles stated in cl. 4.4.2		N/A
15.2.2	Nominal voltage of local lighting circuits not exceeding 50 V		N/A
	If higher voltages are applied, value not exceeding 250 V between conductors		N/A
	Lighting circuits supplied from one of the following sources:		—
	from a dedicated isolating transformer connected to load side or		N/A
	overcurrent protection provided in secondary circuit or		N/A
	a dedicated isolating transformer connected to line side provided or		N/A
	source permitted for maintenance purpose or		N/A
	lighting circuits placed in control enclosures only or		N/A
	overcurrent protection provided in secondary circuit or		N/A
	from a machine-circuit with dedicated overcurrent protection or		N/A
	from an isolating transformer connected to line side of supply disconnecting device, when a dedicated primary disconnecting means and a secondary overcurrent protection are provided or		N/A
	for an externally supplied lighting circuit, which is only permitted in a control enclosures		N/A
	where fixed lighting is out of reach for operator during normal operations, provisions of this subclause do not apply		N/A
15.2.3	local lighting circuits protected		N/A
15.2.4	adjustable lighting fittings suitable for the physical environment provided		N/A
	lampholders in accordance with relevant IEC-publications and		N/A
	designed of an insulating material protecting the lamp cap, as to prevent unintentional contact		N/A
	reflectors supported by a bracket and not by the lampholder		N/A
	where fixed lighting is out of reach for operator during normal operations, provisions of this subclause do not apply		N/A
16.	MARKING, WARNING SIGNS AND REFERENCE DESIGNATIONS		—

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Clause	Requirement – Test	Result - Remark	Verdict
16.1	Warning signs, nameplates, markings- and identification plates of sufficient durability to withstand the physical environment involved		P
16.2	Warning signs		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
	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	Hot surfaces hazard		N/A
	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 		N/A
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)	See marking plate	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 provided with electrical equipment		—
	The following shall be supplied:		—

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Clause	Requirement – Test	Result - Remark	Verdict
	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
	c) information on installation and mounting including: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • metallic pipes • fences • ladders • handrails 		N/A
	e) information on the functioning and operation as applicable: <ul style="list-style-type: none"> • 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



EN 60204-1			
Clause	Requirement – Test	Result - Remark	Verdict
	f) information on maintenance, as appropriate: <ul style="list-style-type: none"> • 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
	g) information on handling, transportation and storage		P
	h) information for proper disassembly and handling of components		N/A
18	TESTING AND VERIFICATION		—
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): <ul style="list-style-type: none"> 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) 		P
	The results of the verification shall be documented		P
18.2	Verification of conditions for protection by automatic disconnection of supply		P



EN 60204-1			
Clause	Requirement – Test	Result - Remark	Verdict
18.2.1	<p>Test 1 verifies the continuity of the protective bonding circuit.</p> <p>Test 2 verifies the conditions for protection by automatic disconnection of the supply in TN systems</p> <p>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</p> <p>For TT systems, see Clause A.2</p> <p>For IT systems, see IEC 60364-6</p>		P
	Where RCDs are used in the electrical equipment, their function shall be verified in accordance with the manufacturer's instructions. The test procedure and test interval shall be specified in the maintenance instructions		P
18.2.2	Test 1: Verification of the continuity of the protective bonding circuit		P
	Test 1 verifies 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	See appended table	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
	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		N/A
	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		N/A



EN 60204-1			
Clause	Requirement – Test	Result - Remark	Verdict
18.2.4	Application of the test methods for TN-systems		P
	When Test 2 of 18.2.3 is carried out by measurement, it shall always be preceded by Test 1 of 18.2.2		P
	The tests that are necessary for machines of different status are specified in Table 9		P
18.3	Insulation resistance tests (optional)		P
	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	>1 MΩ	P
	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		P
18.4	Voltage tests (optional)		P
	The test voltage shall be at a nominal frequency of 50 Hz or 60 Hz.		P
	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	1000V	P
	The test voltage shall be applied between the power circuit conductors and the protective bonding circuit for at least 1 s		—
	Components and devices that are not rated to withstand the test voltage and surge protection devices shall be disconnected		P
18.5	Protection against residual voltages		P
	Where appropriate, tests shall be performed to ensure compliance with 6.2.4		P
18.6	Functional tests		
	The functions of electrical equipment shall be tested		P
18.7	Retesting		
	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		N/A
ANNEX A	PROTECTION AGAINST INDIRECT CONTACT IN TN-SYSTEM		P



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EN 60204-1			
Clause	Requirement – Test	Result - Remark	Verdict
A1	General	Disconnecting time far less than 5 s.	P
A2	Conditions for protection by automatic disconnection of the supply by overcurrent protective devices		P
A3	Condition for protection by reducing the touch voltage below 50 V		P
A4	Verification of conditions for protection by automatic disconnection of the supply		P

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EN ISO 12100

TEST REPORT
EN ISO 12100:2010
Safety of machinery – General principles for design–
Riskassessment and risk reduction(ISO 12100:2010)

Standard..... : EN ISO 12100:2010

I. Introduction.

In general this risk assessment report evaluation was carried out in accordance with the requirements of Machinery Directive and the standards of EN ISO 12100:2010, in which an explicit risk level is evaluated with 4 factors S-A-G-W described in next clause.

While taking appropriate provisions for the existing risks, the procedures and principles to eliminate the risk according to the most general B-type standard for any kind of machine, EN 12100:2010, are followed, i.e.:

- First step: consider the possibility of eliminating risk at design stage.
- Second step: if impossible, protect the dangerous zone with appropriate design of safety guard or safety device.
- Third step: If above impossible, give warning signs to draw attention of operators about the residual risks.

In addition, some check list drawn from the explicit C-type EN standards, which are found suitable for or near the characteristic of this machine, are used to help developing the provisions for the elimination of the risks.

Finally the risk assessment was carried out again to ensure this machine and its relative documents are totally compliance with the Machinery Directive.

II. Risk assessment Methodology

This risk assessment report is based on the methods mentioned in the EN ISO 12100:2010 standards, and the 4 factors S-A-G-W have been used for evaluating the level of risks.

(a) S: Severity of harm

- S1: Slight (normally reversible)
- S2: Serious (normally irreversible)
- S3: Cause a few men die
- S4: Calamity or cause many men die

(b) A: Frequency and duration of exposure

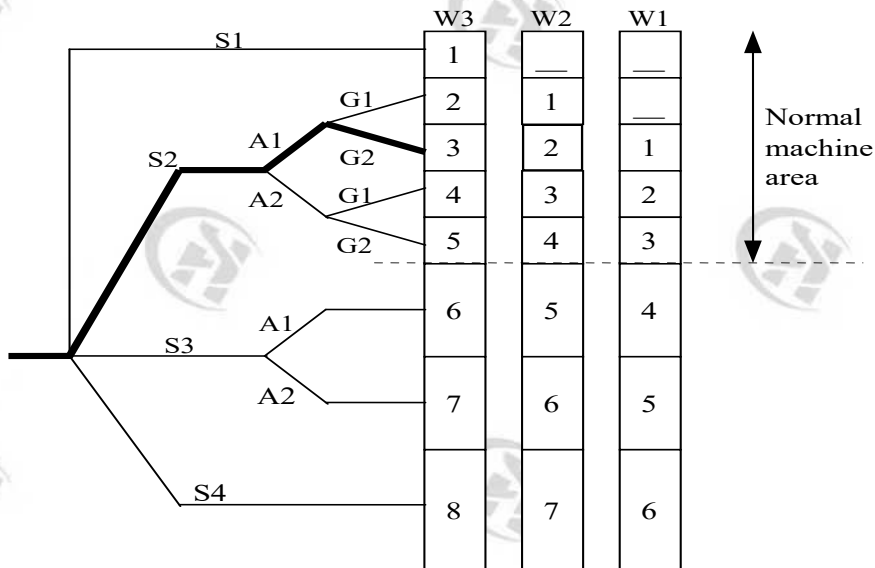
- A1: Seldom to very often
- A2: Frequent to continuous

(c) G: Possibilities of avoidance

- G1: Possible
- G2: Impossible

(d) W: Probability of occurrence of harm

- W1: Low
- W2: Medium
- W3: High



Solutions for the level of hazards:

- 1:** Protected by warning sign
- 2:** Protected by guard and warning sign
- 3:** Consider the other design, choose the best one, and add both guard and warning sign
- 4:** Consider another two designs, choose the best one, and add both guard and warning sign
- 5:** Consider another three designs, choose the best one, and add both guard and warning sign





EN ISO 12100							
No.	Clause	Hazards source	S	A	G	W	Level

Mechanical hazards according to Annex B

1.1	6.2.2.1	Being run over					N/A
1.2	6.2.2.2	Being thrown					N/A
1.3	6.2.3 a)	Crushing	S2	A2	G1	W1	2
1.4	6.2.3 b)	Cutting or severing					N/A
1.5	6.2.6	Drawing in or trapping	S2	A2	G1	W1	2
1.6	6.2.10	Entanglement					N/A
1.7	6.3.1	Friction or abrasion					N/A
1.8	6.3.2	Impact					N/A
1.9	6.3.3	Injection					N/A
1.10	6.3.5.2	Shearing					N/A
1.11	6.3.5.4	Slip, trip and fall of person	S2	A2	G1	W1	2
1.12	6.3.5.5	Stabbing or puncture					N/A
1.13	6.4.1	Suffocation					N/A
	6.4.3						N/A
	6.4.4						N/A

Electrical hazards

2.1		Burn					N/A
2.2		chemical effects					N/A
2.3	6.2.9	effects on medical implants					N/A
2.4	6.3.2	electrocution	S2	A2	G1	W1	2
2.5	6.3.3.2	falling, being thrown					N/A
2.6	6.3.5.4	Fire					N/A
2.7	6.4.4	projection of molten particles					N/A
2.8	6.4.5	Shock					N/A

Thermal hazards

3.1		Burn					N/A
3.2	6.2.4 b)	Dehydration;					N/A
3.3	6.2.8 c)	Discomfort;					N/A
3.4	6.3.2.7	Frostbite					N/A
3.5	6.3.3.2.1	Injuries by the radiation of heat sources					N/A
3.6	6.3.4.5	Scald					N/A



EN ISO 12100								
No.	Clause	Hazards source	S	A	G	W	Level	

Hazards generated by noise

4.1		Discomfort	S2	A2	G1	W1	2	
4.2	6.2.2.2	Loss of awareness					N/A	
4.3	6.2.3 c)	Loss of balance					N/A	
4.4	6.2.4 c)	Permanent hear loss					N/A	
4.5	6.2.8 c)	Stress					N/A	
4.6	6.3.1	Tinnitus					N/A	
4.7	6.3.2.1 b)	Tiredness					N/A	
4.8	6.3.2.5.1	Any other (for example, mechanical,electrical) as a consequence ofan interference with speechcommunication or with acousticsignals.					N/A	
	6.3.3.2.1							
	6.3.4.2							
	6.4.3							
	6.4.5.1 b) and c)							

Hazards generated by vibration

5.1		Discomfort					N/A	
5.2	6.2.2.2	Low-back morbidity					N/A	
5.3	6.2.3 c)	Neurological disorder					N/A	
5.4	6.2.8 c)	Osteo-articular disorder					N/A	
5.5	6.3.3.2.1	Trauma of the spine					N/A	
5.6	6.3.4.3	Vascular disorder					N/A	
	6.4.5.1 c)							

Hazards generated by radiation

6.1		Burn					N/A	
6.2	6.2.2.2	Damage to eyes and skin					N/A	
6.3	6.2.3 c)	Effects on reproductive capability					N/A	
6.4	6.3.3.2.1	Genetic mutation					N/A	
6.5	6.3.4.5	Headache, insomnia,					N/A	
	6.4.5.1 c)							

Hazards generated by materials and substances processed or used by the machinery

7.1		Breathing difficulties, suffocation					N/A	
7.2	6.2.2.2	Cancer					N/A	
7.3	6.2.3 b)	Corrosion					N/A	
7.4	6.2.3 c)	Effects on reproductive capability					N/A	
7.5	6.2.4 a)	Explosion					N/A	
7.6	6.2.4 b)	Fire					N/A	
7.7	6.3.1	Infection					N/A	
7.8	6.3.3.2.1	Mutation					N/A	
7.9	6.3.4.4	Poisoning					N/A	
7.10	6.4.5.1 c)	Sensitization					N/A	
	6.4.5.1 g)							

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EN ISO 12100							
No.	Clause	Hazards source	S	A	G	W	Level

Hazards generated by neglecting ergonomic principles in machine design							
8.1	6.2.2.1	Discomfort					N/A
8.2	6.2.7	Fatigue					N/A
8.3	6.2.8	Musculoskeletal disorder					N/A
8.4	6.2.11.8	Stress					N/A
8.5	6.3.2.1	Any other (e.g. mechanical, electrical) as a consequence of human error					N/A
	6.3.3.2.1						N/A

Hazards associated with the environment in which the machine is used							
9.1		Light					N/A
9.2		Dust / fog					N/A
9.3	6.2.6	Water / moisture					N/A
9.4	6.2.11.11	Pollution					N/A
9.5	6.3.2.1	Temperature					N/A
9.6	6.4.5.1 b)	Snow / ice					N/A
9.7		Wind					N/A
9.8		Lack of oxygen					N/A

This list is not fully complete compared to the list presented in EN ISO 12100:2010. Especially those hazards connected to events such as lifting and the using of mobile equipments are excluded. (1. of 2. amendment of the Machinery directive)

Id. No. gives reference to the hazard listed in EN ISO 12100:2010.

NOTE: "N/A" means that the hazard is not required to assess



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EN ISO 12100						
No.	Hazards source	S	A	G	W	Level
1.3	Crushing	S2	A2	G1	W1	2
Where	Lifting platform, material transfer mechanism, and gap between boards and the warehouse frame.					
When	During automatic lifting/lowering of the platform, material stacking/unstacking, and manual adjustment of the mechanism.					
Improvement result: Anti-pinch safety sensor + mechanical buffer						
Method						
1. Install anti-pinch photoelectric sensors in the lifting path and transfer area to stop the mechanism immediately when an obstacle is detected.		S1	A1	G1	W1	1
2. Add mechanical buffer devices at the contact points of moving parts.						
3. Set safety interlock to prevent lifting when personnel are in the working area.						
4. Mark warning signs at all potential pinch points.						
1.5	Drawing in or trapping	S2	A2	G1	W1	2
Where	Chain drive mechanism, sprocket, lifting rails, gap between moving components and frame, and roller conveyor of the buffer warehouse.					
When	During automatic lifting/transfer of boards, material loading/unloading, cleaning of moving parts, and maintenance of drive systems.					
Improvement result: Safety guard + door/cover interlock switch						
Method						
1. Install safety guards and interlock switches on all access points to moving parts (machine stops immediately when guard/cover is opened).		S1	A1	G1	W1	1
2. Only trained/authorized personnel shall operate and maintain the machine.						
3. Power off and lockout/tagout (LOTO) before opening guards for cleaning or maintenance.						
4. Mark clear warning signs at all potential nip points.						
1.11	Slip, trip and fall of person	S2	A2	G1	W1	2
Where	Surrounding working area, cable routing, and uneven floor near the roller conveyor of the buffer warehouse.					
When	During material loading/unloading, maintenance work, and movement around the machine.					
Improvement result: Cable management + anti-slip floor + safety walkway marking						
Method						

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EN ISO 12100						
No.	Hazards source	S	A	G	W	Level

1. Route all cables in enclosed cable trays to prevent tripping hazards. 2. Install anti-slip foot pads at the machine base and mark clear safety walkways. 3. Keep the working area clean and free of debris, boards, and packaging materials. 4. Mark warning signs for uneven floors and cable routes.	S1	A1	G1	W1	1
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2.4	Electrocution	S2	A2	G1	W1	2
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Where	Control panel, drive motors, electrical control cabinet, internal wiring terminals, and power components of the buffer warehouse.					
--------------	---	--	--	--	--	--

When	During machine operation, wiring inspection, electrical troubleshooting, and maintenance of electrical systems.					
-------------	---	--	--	--	--	--

Improvement result: Reliable protective earthing + leakage protector (RCD)

Method

1. Ensure reliable protective earthing for all electrical components and install leakage protectors (RCDs) in the power supply. 2. Enclose all electrical connections in a sealed control box to prevent dust intrusion. 3. Only maintenance by qualified electricians is allowed. 4. Conduct regular inspection of cable insulation, terminal connections, and safety interlock circuits.	S1	A1	G1	W1	1
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4.1	Discomfort	S2	A2	G1	W1	2
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Where	Chain drive motors, roller conveyor, and lifting mechanism of the buffer warehouse.					
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When	During continuous automatic operation, especially under high-speed material transfer.					
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Improvement result: Vibration dampers + regular maintenance + operator ear protection

Method

1. Add vibration dampers to the drive motors and chain mechanism to reduce operational noise. 2. Perform regular maintenance of the chain, sprocket, and rollers to reduce abnormal noise caused by wear. 3. Require operators to wear ear protection (earplugs/earmuffs) during long-term operation. 4. Set reasonable operation cycles to avoid continuous high-noise exposure.	S1	A1	G1	W1	1
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Photo documentation



Figure 1



Figure 2

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Figure 3

※END OF REPORT※