TEST REPORT
IEC 60204-1/EN60204-1
Safety of machinery - Electrical equipment of machines
Part 1: General requirements

Report Reference No.....:	J55-RSJ-22139
Date of issue.....:	July 30, 2024
Testing laboratory .....:	Rudong Feiju Laser Technology Co.,Ltd
Address .....:	Caobu Industrial Park Zone, Rudong County, Nantong City, Jiangsu, China
Testing procedure.....:	CE
Applicant's name.....:	Nantong Sanjing Chemglass Co., Ltd
Address .....:	Caobu Industrial Park Zone, Rudong County, Nantong City, Jiangsu, China
Manufacturer's name .....:	Rudong Feiju Laser Technology Co.,Ltd
Address .....:	Caobu Industrial Park Zone, Rudong County, Nantong City, Jiangsu, China
Factory's name .....:	Same as Manufacturer
Address .....:	
Test specification:	
Standard .....:	☒ EN 60204-1:2018
	☐ IEC 60204-1:2016
Test procedure .....:	Commission Test
Non-standard test method……..:	N/A
Test Report Form No. .....:	
TRF Originator.....:	SBD
Master TRF.....:	Dated 2019-03
Test item description.....:	CO_2 Laser Tube
Trade Mark .....:	No Brand
Model/Type reference.....:	C70, C80, C100, C130, C150
Ratings .....:	220-240V 50Hz Max 150W

Model check list and parameter

Model	Rated power	Lengh	Diameter	Remark
C70	70W	1200	55	
C80	80W	1600	60	
C100	100W	1450	80	
C130	130W	1650	80	
C150	150W	1850	80	

Copy of marking plate:	
CO_2 Laser Tube Model xxx Brand: No Brand 220-240V 50Hz Max 150W Rudong Feiju Laser Technology Co.,Ltd Caobu Industrial Park Zone, Rudong County, Nantong City, Jiangsu, China Made in China	xxx= C70, C80, C100, C130, C150
Summary of testing: This test sample complies with ☐ IEC 60204-1, ☒ EN60204-1	
Test Report Content This test report consists of: Main report Annex I: Photo Documentation	

Test item particulars:	
Degree of protection against access to hazardous parts and against harmful ingress of solid foreign objects .....:	IP5X
Degree of protection against harmful ingress of water .....:	IPX4
Test case verdicts:	
Test case does not apply to the test object ...:	N/A
Test object does meet the requirement .....:	Pass (P)
Test object does not meet the requirement ..:	Fail (F)
Testing:	
Date of receipt of test item .....:	July 16, 2024
Date(s) of performance of test .....:	July 16, 2024 to July 30, 2024

General remarks:

The test results presented in this report relate only to the item(s) tested.

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"(see remark #)" refers to a remark appended to the report.

"(see Annex #)" refers to an annex appended to the report.

"(see appended table)" refers to a table in the Test Report.

Throughout this report a comma (point) is used as the decimal separator.

IEC 60204-1 / EN 60204 -1			
Clause	Requirement – Test	Result - Remark	Verdict
	GENERAL REQUIREMENTS		-
4.1	General		-
	Hazards relevant to the electrical equipment are assessed as part of the overall risk assessment of the machine.		P
4.2	Selection of equipment		P
4.2.1	Electrical components/devices suitable for their intended use and applied in accordance with supplier's instructions.		P
4.2.2	Where possible electrical equipment in compliance with the IEC 60439 series.		P
4.3	Electrical supply		P
4.3.1	Electrical equipment to be designed for correct operation within the conditions of mains power supply - as stated below (cl. 4.3.2 or 4.3.3)		P
	or as stated by the user (record specs in this TR)		N
	or as stated by the supplier[1]		P
4.3.2	AC supplies		P
	Supply Voltage: Steady state voltage: 0,9 ... 1,1 of nominal voltage		P
	Frequency: 0,99 ... 1,01 of nominal frequency continuously; 0,98 ... 1,02 short time.		P
	Harmonics: not exceeding 10 % of the total r.m.s. etc.		P
	Voltage unbalance: not exceeding 2% deviation.		P
	Voltage interruption: interrupted or at zero voltage for not more than 3 ms at any random time in the supply cycle with more than 1 s between successive interruptions.		P
	Voltage dips not exceeding 20 % of the peak voltage of the supply for more than one cycle with more than 1 s between successive dips.		P
4.3.3	DC supplies Supply Voltage:		N N

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Clause	Requirement – Test	Result - Remark	Verdict
	- other:0,85 to 1,15 of nominal voltage; - battery-operated vehicles: 0,7 to 1,2 of nom. volt. - from converting equipment: 0,9 to 1,1 of nom. volt.		
	Voltage interruption: - other: not exceeding 5 ms - converting equipment: not exceeding 20 ms Ripple (peak-to-peak): not exceed. 0,15 of nom. volt.		N N
4.3.4	Special supply systems; e.g. on board generators limits acc. 4.3.2 /.3 exceeded, but equipment designed acc. exceeded limits.		N
4.4	Physical environment and operating conditions		P
4.4.1	Electrical equipment suitable for the physical environment and operating conditions of its intended use.		P
4.4.2	Electromagnetic compatibility (EMC): Equipment shall not generate electromagnetic disturbances above levels that are appropriate for its intended operating environment and shall have a level of immunity to electromagnetic disturbances so that it can function in its intended environment (IEC 61000-6-1 or IEC 61000-6-2 and CISPR 61000-6-3 or IEC 61000-6-4 give general EMC emission and immunity limits.)		P
	Are there sufficient measures to limit the generation of electromagnetic disturbances, i.e. conducted and radiated provided? (E.g. power supply filtering; cable shielding; enclosures designed to minimize RF radiation; RF suppression techniques; design of functional bonding system, using conductors with low RF impedance and as short as practicable.		P
4.4.3	Electrical equipment shall be capable of operating correctly in the intended ambient air temperature. (Minimum requirement: air temperatures of +5 °C and +40 °C)		P
4.4.4	Electrical equipment shall be capable of operating		P

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	correctly when the relative humidity is up to 50 % at a maximum temperature of +40 °C		
4.4.5	Electrical equipment shall be capable of operating correctly at altitudes up to 1 000 m above mean sea level.		P
4.4.6	Electrical equipment shall be adequately protected against the ingress of solids and liquids (see 11.3)		P
4.4.7	Electrical equipment shall withstand ionizing and non-ionizing radiation.		P
4.4.8	Electrical equipment shall withstand vibration, shock and bump.		P
4.5	Electrical equipment designed to withstand the effects of transportation and storage within a temperature range of - 25 to + 55 °C.		P
4.6	Heavy or bulky electrical equipment of the machine provided with suitable means for handling.		P
4.7	Electrical equipment is installed and operated in accordance with the supplier's instruction.		P
5	**INCOMING SUPPLY CONDUCTOR TERMINATIONS AND DEVICES FOR DISCONNECTING AND SWITCHING OFF**		-
5.1	Incoming supply conductor terminal		P
5.1	Electrical equipment of a machine connected to one single power supply (For large complex machinery comprising a number of widely-spaced machines working together in a coordinated manner, there can be a need for more than one incoming supply depending upon the site supply arrangements)		P
	Power supply conductors terminated to main disconnecting device of electrical equipment (unless a plug is provided for disconnection)		P
	Neutral conductor clearly indicated in technical documentation with "N" (see cl. 16.1)		P
	No connection between neutral conductor and		P

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	protective bonding circuit nor combined PEN-terminals. Exception: a connection may be made between the neutral terminal and the PE terminal at the point of the connection of the power supply to the machine for TN-C systems.		
	All terminals of incoming supply clearly marked in ac. with cl. 16.1 (symbols acc. to EN 60445)		P
5.2	Terminal for connection to external protective earthing system		P
	For each incoming supply, a terminal shall be provided in the vicinity of the associated phase conductor terminals for connection of the machine to the external protective earthing system or to the external protective conductor, depending upon the supply distribution system.		P
	Cross section of incoming PE conductor acc. to cl. 5.2, table 1. (Where an external protective conductor of a material other than copper is used, the terminal size shall be selected accordingly. See also 8.2.2).	1,5 mm^2	P
	Protective earth identified either by graphic symbol, letters “PE”, or bicolour combination GREEN / YELLOW		P
5.3	Supply disconnecting device		-
5.3.1	A supply disconnecting device shall be provided: – for each incoming source of supply to a machine – for each on-board power supply.		P
5.3.2	Type of power supply disconnecting device:		-
	a) Switch-disconnector, acc. to EN 60947-3 for appliance category AC-23 B or DC-23 B		P
	b) Disconnector with or without fuses, with aux. contact (acc. to EN 60947-3		P
	c) Power circuit breaker suitable for isolation (acc. to EN 60947-2)		P
	d) any other switching device in accordance with an		P

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Clause	Requirement – Test	Result - Remark	Verdict
	IEC product standard for that device and which meets the isolation requirements of IEC 60947-1as well as a utilization category		
	e) Plug/socket combination for electrical load (requirements see cl. 5.3.3)	No such construction	N
5.3.3	Disconnection device has to fulfil all of the following requirements		-
	- isolate the electrical equipment from the supply and have only one OFF (isolated) and only one ON position marked with "O" and "I"		P
	- visible contact gap or a position indicator which cannot indicate OFF (isolated) until all contacts are actually open and the requirements for the isolating function have been satisfied		P
	- have an external operating means e.g.a handle (except power operated CB's)		P
	- coloured black or grey recommended (If used as an emergency stop, red/yellow combination selected)		P
	- be provided with a means permitting it to be locked in the OFF position (padlocks). When so locked, remote as well as local closing shall be prevented		P
	- disconnect all live conductors of its power supply circuit (For TN supply systems, the neutral conductor may or may not be disconnected except in countries where disconnection of the neutral conductor (when used) is compulsory.)		p
	Requirements for plug/socket combination as a disconnection device: - Breaking capacity of the plug/socket combination: sufficient to interrupt the current of the largest motor when stalled together with the sum of the normal running currents of all other motors and/or loads. - further see. cl. 13.4.5 a) to f)		N

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5.3.4	The operating means are easily accessible and located between 0,6 m and 1,9 m above the servicing level.	1,25m	P
5.3.5	Only the following circuits need not be disconnected by the supply disconnecting device: - lighting circuits for lighting needed during maintenance or repair; – plug and socket outlets for the exclusive connection of repair or maintenance tools and equipment;		N
	– under voltage protection circuits that are only provided for automatic tripping in the event of supply failure;		
	– circuits supplying equipment that should normally remain energized for correct operation		
	– control circuits for interlocking		
	Such circuits are provided with their own disconnecting device.		
	Circuits not disconnected by the supply disconnecting device have: - permanent warning labels in accordance with cl. 16.1		N
	- a statement is included in the maintenance manual		N
	- additionally one or more of the following is applied; - a permanent warning label in accordance with 16.1 is affixed in proximity to each excepted circuit, or - the circuit is separated from other circuits, or - the conductors are identified by colour taking into account the recommendation of Cl.13.2.4.		N
5.4	Disconnecting devices to prevent of unexpected start-up:		-
	- Devices for the prevention of unexpected start-up are provided These devices are appropriate and convenient for the intended use, are suitably placed, and readily identifiable as to their function and purpose (for example by a durable marking in accordance with cl.		P

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Clause	Requirement – Test	Result - Remark	Verdict
	16.1).		
	- Means are provided to prevent inadvertent and/or mistaken closure of these devices either at the controller or from other locations		P
	- Devices that do not fulfil the isolation function (e.g. a contactor switched off by a control circuit) are only used for situations that include: – inspections; – adjustments; – no hazardous work on the electrical equipment (for example replacement of plug-in devices without disturbing existing wiring)		P
5.5	Devices for disconnecting electrical equipment		-
	- Requirements to devices for disconnecting electrical equipment to enable work to be carried out when it is de-energised and isolated: – appropriate and convenient for the intended use; – suitably placed; – readily identifiable as to which part or circuit of the equipment is served (for example by durable marking in accordance with 16.1 where necessary). - Additional means are provided to prevent of inadvertent and/or mistaken closure of these devices either at the controller or from other locations		P
	- Where it is necessary to work on individual parts of the electrical equipment of a machine, or on one of a number of machines fed by a common conductor bar, conductor wire or inductive power supply system, a disconnecting device is provided for each part, or for each machine, requiring separate isolation. In addition to the mentioned supply disconnecting device, the following devices that fulfil the isolation function may be provided for this purpose: – devices described in 5.3.2; – disconnectors, withdrawable fuse links and		P

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	withdrawable links only if located in an electrical operating area (see 3.15) and relevant information is provided with the electrical equipment (see 17.2 b)9) and b)12)).		
5.6	Protection against unauthorized, inadvertent and/or mistaken connection		-
	For devices acc. to cl. 5.4(disconnecting electrical equipment) and 5.5 (prevention of unexpected start-up) locking means in OFF position are provided and no remote reconnection is possible.		P
	Where a non-lockable disconnecting device is provided (for example withdrawable fuse-links, withdrawable links), other means of protection against unintended energising are used.		P
	Where plug/socket combinations according to 5.3.2 e) are used for the purpose of prevention of unexpected start-up the are so positioned that they can be kept under the immediate supervision of the person carrying out the work.		P
6	**PROTECTION AGAINST ELECTRIC SHOCK**		-
6.2.2	Protection against direct contact		-
	Live parts that are located inside enclosures have to bee conform to the relevant requirements of Clauses 4, 11, and 14 and have to have a protection against direct contact of at least IP2X or IPXXB.		P
	Where the top surfaces of the enclosure are readily accessible, the minimum degree of protection against direct contact provided by the top surfaces shall be IP4X or IPXXD.	IP54	P
6.2.2 a	Opening an enclosure (i.e. opening doors, lids, covers, and the like) is possible only when: a) Either the use of a key or tool is necessary for access and: - all live parts, that are likely to be touched when resetting or adjusting devices intended for such		P

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Clause	Requirement – Test	Result - Remark	Verdict
	operations while the equipment is still connected are protected against direct contact to at least IP2X or IPXXB - live parts on the inside of doors are protected against direct contact to at least IP1X or IPXXA.		
6.2.2 b	b) Or the opening of an enclosure (i.e. opening doors, lids, covers, and the like) is possible only if disconnection is provided for all live parts inside the enclosure before it can be opened. Exception: If a special device or tool (intended for use only by skilled or instructed persons) as prescribed by the supplier is provided that can be used to defeat the interlock and that intends that: - it is possible at all times while the interlock is defeated to open the disconnecting device and lock the disconnecting device in the OFF position or otherwise prevent unauthorised closure of the disconnecting device; - upon closing the door, the interlock is automatically restored - all live parts, that are likely to be touched when resetting or adjusting devices intended for such operations while the equipment is still connected are protected against direct contact to at least IP2X or IPXXB - live parts on the inside of doors shall be protected against direct contact to at least IP1X or IPXXA - relevant information is provided with the electrical equipment like instructions on the procedures for securing the machine for safe maintenance and information on the residual risks. - means are provided to restrict access to live parts behind doors not directly interlocked with the disconnecting means to skilled or instructed persons. - parts still alive after switching off are protected at least		P

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Clause	Requirement – Test	Result - Remark	Verdict
	IP 2X or IP XXB and marked with a warning sign in accordance with 16.2.1  Excepted from this marking are: - parts that can be live only because of connection to interlocking circuits and that are distinguished by colour as potentially live in accordance with 13.2.4 - the supply terminals of the supply disconnecting device when the latter is mounted alone in a separate enclosure.		
6.2.2 c	c) Or the opening without the use of a key or a tool and without disconnection of live parts shall be possible only when all live parts are protected against direct contact to at least IP2X or IPXXB. Where barriers provide this protection, either they shall require a tool for their removal or all live parts protected by them shall be automatically disconnected when the barrier is removed.		P
6.2.3	Protection by insulation of live parts:		-
	Live parts are completely covered with insulation that can only be removed by destruction and that is capable of withstanding the mechanical, chemical, electrical, and thermal stresses to which it can be subjected under normal operating conditions.		
	Paint, varnish lacquer etc. not used as the unique insulation layer.		P
6.2.4	Protection against residual voltages		-
	Live parts with residual voltage greater than 60 V after a time period of 5 s after disconnection of the supply shall be discharged until this interferes with the proper functioning of the equipment. Except are components with charges of ≤ 60 µC (- equivalent to capacitor with less then 1µF @ 60V).		P P
	Where pins of plugs or similar devices after withdrawal are exposed, discharge time is ≤ 1s. Otherwise such	No such construction	N

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Clause	Requirement – Test	Result - Remark	Verdict
	conductors are protected against direct contact to at least IP2X or IPXXB.		
	If above requirements cannot be achieved, additional disconnecting devices or appropriate warning devices shall be applied (e.g. warning acc. cl. 16.1).		P
6.2.5	For protection by barriers, 412.2 of IEC 60364-4-41 is applied.		N
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 is applied.		P
6.3	Protection against indirect contact		-
6.3.2	Prevention of the occurrence of a touch voltage		-
6.3.2.2	Protection by provision of:		P
	- class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation in accordance with IEC 61140) or - switchgear and control gear assemblies having total insulation in accordance with IEC 60439-1or - supplementary or reinforced insulation in accordance with 413.2 of IEC 60364-4-41.		
6.3.2.3	Protection by electrical separation. For this type of protection, the requirements of 413.5 of IEC 60364-4-41 apply.		P
6.3.3	Protection by automatic disconnection of supply.		
6.3.3 a)	Use of overcurrent protective device for automatic cut-off in the event of an insulation failure in a TN-System. Where disconnection within the time specified in Clause A.1 cannot be assured, supplementary bonding is provided as necessary to meet the requirements of Clause A.3.		P
6.3.3 b)	Use of residual current protective devices (RCD) for automatic cut-off in the event of an insulation failure in a TN - or TT -System.		P

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Clause	Requirement – Test	Result - Remark	Verdict
6.3.3 c)	Use of earth fault detection device to initiate automatic disconnection in a IT-System.		P
6.4	Protection by the use of PELV		P
6.4.1 a)	PELV circuits shall satisfy all of the following conditions: -the nominal voltage does not exceed: • 25 V a.c. r.m.s. or 60 V ripple-free d.c. when the equipment is normally used in dry locations and when large area contact of live parts with the human body is not expected; or • 6 V a.c. r.m.s. or 15 V ripple-free d.c. in all other cases;		P
6.4.1 b)	one side of the circuit or one point of the source of the supply of that circuit is connected to the protective bonding circuit;		P
6.4.1 c)	live parts of PELV circuits is electrically separated from other live circuits		P
6.4.1 d)	Conductors of each PELV circuit are physically separated from those of any other circuit. If this requirement is impracticable, the insulation provisions of 13.1.3 are fulfilled;		P
6.4.1 e)	plugs and socket-outlets for a PELV circuit are conform to the following: 1) plugs do not to enter socket-outlets of other voltage systems; 2) socket-outlets do not admit plugs of other voltage systems.	No PELV plug and socket provided	N
6.4.2	Sources for PELV		-
	The source for PELV shall be one of the following: - safety isolating transformer in accordance with IEC 61558-1 and IEC 61558-2-6 or - a source of current with a degree of safety equi-valent to that of the safety isolating transformer or - an source independent of circuit with higher voltage - electronic power supply conforming to appropriate		P

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Clause	Requirement – Test	Result - Remark	Verdict
	standards		
6.1	Other measures from IEC 60364-4-41 are used. (Description!)		P
7.	**PROTECTION OF EQUIPMENT**		-
7.2.	Overcurrent protection Unless otherwise specified by the user, the supplier of the electrical equipment is not responsible for providing the overcurrent protective device for the supply conductors to the electrical equipment (see Annex B).		P
7.2.2.	On the installation diagram data necessary for selecting the overcurrent protective device are stated for each incoming feeder. (see 7.2.10 and 17.4)		P
7.2.3	Power circuits:		-
	Devices for detection and interruption of overcurrent, selected in accordance with 7.2.10, are applied to each live conductor.		P
	And, none of the following conductors, as applicable, is disconnected without disconnecting all associated live conductors:		
	– the neutral conductor of a.c. power circuits;		
	– the earthed conductor of d.c. power circuits;		
	– d.c. power conductors bonded to exposed conductive parts of mobile machines.		
	Cross section area of neutral conductor is at least equal to the phase conductor. No overcurrent protective/ disconnecting device is required. (For a neutral conductor with a cross sectional area smaller than that of the associated phase conductors, the measures detailed in 524 of IEC 60364-5-52 shall apply.)		P
	IT-Systems:, no neutral conductor is used. Or, when it is used, the measures detailed in 431.2.2 of IEC 60364-4-43 are applied.		P
7.2.4	Control circuits		-
	Conductors of control circuits directly connected to the		P

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Clause	Requirement – Test	Result - Remark	Verdict
	supply voltage and of circuits supplying control circuit transformers are protected against overcurrent in accordance with 7.2.3.		
	Conductors of control circuits supplied by a control circuit transformer or d.c. supply: see 9.4.3.1		-
7.2.5	Socket outlets and their associated conductors		-
	Overcurrent protection is provided for the circuits feeding the general purpose socket.		P
7.2.6	Lighting circuits		-
	Lighting circuits are protected separate from other circuits.		P
7.2.7	Transformers		-
	Transformers are protected in accordance with the manufacturer's instructions and includes: - avoiding tripping due to transformer magnetizing inrush currents - avoiding a winding temperature rise in excess of the permitted value for the insulation class when there is a short circuit at the secondary terminals. - type and setting of the overcurrent protective device in accordance with the recommendations of the transformer supplier.		P
7.2.8	Location of overcurrent protective devices:		-
	- located at the point where a reduction in the cross sectional area of the conductors or another change reduces the current-carrying capacity of the conductors.		P
	<u>Exceptions:</u> - current carrying capacity of the conductors is at least equal to that of the load and - conductors between the point of reduction of current-carrying capacity and the position of the overcurrent protective device is ≤ 3 m and - the conductor is protected e.g. by an enclosure or duct.		P

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Clause	Requirement – Test	Result - Remark	Verdict
7.2.9	Selection of overcurrent protective devices		-
	The rated short-circuit breaking capacity Icn is at least equal to the prospective fault current at the point of installation. Additional currents other than from the supply (e.g. from motors, from power factor correction capacitors) shall be taken into consideration.		P
	Reduced breaking capacity is permitted, where another protective device is installed at supply side with the necessary breaking capacity. (In that case, the characteristics of the two devices shall be co-ordinated so that the let-through energy (I^2t) of the two devices in series does not exceed that which can be withstood without damage to the overcurrent protective device on the load side and to the conductors protected by that device. See Annex A of IEC 60947-2).		N
	Where fuses are provided as overcurrent protective devices, a type readily available in the country of use shall be selected, or arrangements shall be made for the supply of spare parts.		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
	The rated current of overcurrent protective device is determined by the current carrying capacity of the conductors to be protected in accordance with Cl. 12.4, D.2 and the maximum allowable interrupting time *t* in accordance with Clause D.3, taking into account the needs of coordination with other electrical devices in the protected circuit.		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

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Clause	Requirement – Test	Result - Remark	Verdict
	Protective device may be omitted for motors, which cannot be overloaded.		P
	Exceptions: In applications where an automatic interruption of the motor operation is unacceptable (for example fire pumps), the means of detection shall give a warning signal to which the operator can respond.		P
7.3.2	Protection achieved by overload protection device: - detection in each live conductor - switching off of all live conductors (not necessary to switch of neutral conductor)		P
	For special duty motors, appropriate protective devices are recommended		P
7.3.3	Protection achieved by over-temperature protection device: Is recommended in situations where the cooling can be impaired (for example dusty environments)		P
7.3.4	Protection achieved by current limiting protection: 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.		P
7.4	Abnormal temperature protection: Resistance heating or other circuits that are capable of attaining or causing abnormal temperatures and can cause a hazardous situation are provided with suitable detection to initiate an appropriate control response.		P
7.5	Protection against supply interruption or voltage reduction and subsequent restoration: Where a supply interruption or a voltage reduction can cause a hazardous situation, damage to the machine, or to the work in progress, undervoltage protection is provided.		P
	Upon restoration of supply voltage, automatic or unexpected restarting of machine prevented.		P

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Clause	Requirement – Test	Result - Remark	Verdict
	Undervoltage protection does initiate appropriate control responses to ensure necessary coordination of groups of machines working together		P
7.6	Motor overspeed protection: Overspeed protection is provided where overspeeding can occur and could possibly cause a hazardous situation.		P
7.8	Phase sequence protection: Where an incorrect phase sequence of the supply voltage can cause a hazardous situation or damage to the machine, protection shall be provided.		P
7.9	Protection against overvoltage due to lightning and to switching surges: - Devices are connected to the incoming terminals of the supply disconnecting device.		P
8	**EQUIPOTENTIAL BONDING**		-
8.2	Protective bonding circuit		P
8.2.1	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 is provided.		P
	In IT distribution systems, the machine structure is part of the protective bonding circuit and insulation monitoring is provided.		P
	Exposed conductive parts of equipment in accordance with 6.3.2.3 (Protection by electrical separation) are not connected to the protective bonding circuit. (For this type of protection, the requirements of 413.5 of IEC 60364-4-41 apply.)		P
8.2.2	Protective conductors		-
	Protective conductors shall be identified in accordance with 13.2.2.		P
	Copper conductors are preferred.		P
	Where other material is used, its electrical resistance	No other material used for	N

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Clause	Requirement – Test	Result - Remark	Verdict
	per unit length shall not exceed that of the allowable copper conductor and such conductors shall be not less than 16 mm^2 in cross-sectional area.	conductor	
	The cross-sectional area of protective conductors shall be determined in accordance with the requirements of: – 543 of IEC 60364-5-54; or – 7.4.3.1.7 of IEC 60439-1, as appropriate. This requirement is met in most cases if it is in accordance with Table 1 of this standard (see 5.2).		P
8.2.3	Continuity of the protective bonding circuit		P
	All exposed conductive parts are connected to the protective bonding circuit in accordance with 8.2.1. Parts that are mounted so that they do not constitute a hazard because cannot be touched on large surfaces or grasped with the hand and they are small in size (less than approximately 50 mm × 50 mm) or they are located so that either contact with live parts, or an insulation failure is unlikely need not be connected to the protective bonding circuit		
	Where a part is removed the protective bonding circuit for the remaining parts isn't interrupted.		P
	Current-carrying capacity of connection and bonding points cannot impaired by mechanical, chemical, or electrochemical influences (e.g. electrolytic corrosion on aluminium parts)		P
	Metal ducts of flexible or rigid construction and metallic cable sheaths are not used as protective conductors. Nevertheless they are connected to the protective bonding circuit.		P
	Where the electrical equipment is mounted on lids, doors, or cover plates, continuity of the protective bonding circuit shall be ensured. The use of a protective conductor (see 8.2.2) is recommended.		P
	For cables that are exposed to damage (for example		P

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Clause	Requirement – Test	Result - Remark	Verdict
	flexible trailing cables) the continuity of the protective conductors are ensured by appropriate measures (for example monitoring).		
8.2.4	No means of interruption of the protective bonding conductor are provided. 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.		P
	As well the protective bonding circuit does not incorporate a switching device or an over current protective device (for example switch, fuse).		P
	Removable current collectors, plug/socket combinations or withdrawable plug-in units: The protective bonding circuit is interrupted by a first make last break contact. (see also 13.4.5)		P
8.2.6	Protective conductor connecting points: have no other function and are not intended to attach or connect appliances or parts.		P
	Each protective conductor connecting point is marked or labelled as such using the symbol IEC 60417-5019 or the letters PE or by use of bicolour GREEN / YELLOW		P
8.2.7	Mobile machines with on-board power supplies: The protective bonding system is connected to a single protective bonding terminal. This protective bonding terminal is the connection point for a possible additional external incoming power supply.		N
8.2.8	Electrical equipment having earth leakage currents higher than 10 mA a.c. or d.c.: Additional protective bonding requirements: - Cross section of protective conductor ≥ 10 mm^2 CU or 16 mm^2 AL - OR Second protective conductor of at least the same cross sectional area if above cross section is impracticable		P

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Clause	Requirement – Test	Result - Remark	Verdict
	- OR monitoring of continuity of protective conductor with automatic disconnection function. Additionally a warning label is provided adjacent to the PE terminal.		P
9	**CONTROL CIRCUITS AND CONTROL FUNCTIONS**		-
9.1.	Control circuit		P
9.1.1	Control circuit supply: Control transformers mandatory only when more then one motor starter or two control devices are used.		P
	Control transformers with separate windings are used for supplying the control circuits.		P
	Where several transformers are used, the secondary voltages are in phase.		P
	Separate windings on transformer for DC supplies connected to PE.		P
	Switch-mode units fitted with transformers in accordance with IEC 61558-2-17		P
9.1.2	The nominal voltage of control supply does not exceed 277 V when supplied from a transformer.		P
9.1.3	Control circuits are provided with overcurrent protection in accordance with 7.2.4 and 7.2.10.		P
9.2.	Control functions		P
	Safety related control functions in accordance with ISO 13849-1 (2006), ISO 13849-2 (2003) and /or IEC 62061 (see 9.4.1)		-
9.2.1	Start functions operating by energizing the relevant circuit (see 9.2.5.2).		P
9.2.3	Operating modes		-
	Suitable means are prevented for unauthorized or inadvertent mode selection if hazardous situations can result.		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 is provided		P

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Clause	Requirement – Test	Result - Remark	Verdict
	(e.g. the position of a mode selector, the provision of an indicating light, a visual display indication).		
9.2.4	Where it is necessary to suspend safety functions and/or protective measures (for example for setting or maintenance purposes), protection is ensured.		P
9.2.5	Operation		-
	Prevention of movement of the machine in an unintended or unexpected manner is taken after any stopping of the machine. (e.g. due to locked-off condition, power supply fault, battery replacement, lost signal condition with cableless control)		P
	When a machine has more than one control station, measures are provided to ensure that initiation of commands from different control stations do not lead to a hazardous situation.		P
9.2.5.2	Start of an operation is 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 are met - and all start control devices are in the released (off) position - then all start control devices have to be actuated concurrently (see 3.6).		P
9.2.5.3	Stop category 0 and/or stop category 1 and/or stop category 2 stop functions are provided as indicated by the risk assessment and the functional requirements of		P

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Clause	Requirement – Test	Result - Remark	Verdict
	the machine (see 4.1).		
	Stop functions override related start functions		P
	Facilities to connect protective devices and interlocks are provided, where required. If such a protective device or interlock causes a stop of the machine, it may be necessary for that condition to be signalled to the logic of the control system. The reset of the stop function does not initiate any hazardous situation.		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.		P
9.2.5.4	Emergency operations (emergency stop, emergency switching off)		-
	Emergency stop or emergency switching off commands are sustained until it is reset.		P
	This reset is possible only by a manual action at that location where the command has been initiated.		P
	The reset of the command does not restart the machinery but only permit restarting.		P
	It is not be possible to restart the machinery until all emergency stop commands are reset.		P
	It is not be possible to reenergize the machinery until all emergency switching off commands are reset.		P
9.2.5.4.2	The emergency stop does function either as a stop category 0 or as a stop category 1.		P
	- it overrides all other functions and operations in all modes;		P
9.2.5.4.3	Emergency switching off is provided where: -Protection against direct contact is achieved only by placing out of reach or by obstacles (see 6.2.6) - or there is the possibility of other hazards or damage caused by electricity.		P
	Emergency switching off is accomplished by electromechanical switching devices, effecting a stop		P

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Clause	Requirement – Test	Result - Remark	Verdict
	category 0 of machine actuators connected to this incoming supply.		
9.2.5.5	Movement or action that can result in a hazardous situation are monitored by providing, for example, overtravel limiters, motor overspeed detection, mechanical overload detection or anti-collision devices.		P
9.2.6	Other control functions		-
9.2.6.2	No type 1 two-hand control device is used for the initiation of hazardous operation. It need type 2 or type 3 two-hand control devices for such operations.		P
9.2.6.3	Enabling control: Enabling control are arranged in the way to minimize the possibility of defeating, e. g. by requiring the de-activation of the enabling control device before machine operation may be reinitiated. It is not possible to defeat the enabling function by simple means.		P
9.2.6.4	Combined start and stop controls: Push-buttons etc. that alternately initiate and stop motion are provided only for functions, which cannot result in a hazardous situation.		P
9.2.7	Cableless control station		N
9.2.7.1	Means shall be provided to readily remove or disconnect the power supply of the operator control station (see also 9.2.7.3).		N
	Means (for example key operated switch, access code) are provided, as necessary, to prevent unauthorized use of the operator control station.		N
	Each operator control station carries an unambiguous indication of which machine(s) is (are) intended to be controlled by that operator control station.		N
9.2.7.2	Measures shall be taken to ensure that control commands: – affect only the intended machine; – affect only the intended functions.		N
	Measures are taken to prevent the machine from		N

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Clause	Requirement – Test	Result - Remark	Verdict
	responding to signals other than those from the intended operator control station(s).		
	Where necessary, means are provided so that the machine can only be controlled from operator control stations in one or more predetermined zones or locations.		N
9.2.7.3	Operator control stations include a separate and clearly identifiable means to initiate the stop function of the machine or of all the operations that can cause a hazardous situation. The actuating means to initiate this stop function are not marked or labelled as an emergency stop device, even though the stop function initiated on the machine can fulfil an emergency stop function.		N
	Stopping of the machine and preventing a potentially hazardous operation is automatically initiated in the following situations: – when a stop signal is received; – when a fault is detected in the cableless control system; – when a valid signal (which includes a signal that communication is established and maintained) has not been detected within a specified period of time (see Annex B), except when a machine is executing a pre-programmed task taking it outside the range of the cableless control where no hazardous situation can occur.		N
9.2.7.4	Machines having more than one operator control station, including one or more cableless control stations, have measures provided to ensure that only one of the control stations can be enabled at a given time.		N
	An indication of which operator control station is in control of the machine is provided at suitable locations as determined by the risk assessment of the machine.		N

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Clause	Requirement – Test	Result - Remark	Verdict
	Exception: a stop command from any one of the control stations are effective when required by the risk assessment of the machine.		
9.2.7.5	Battery-powered cableless operator control stations: A variation in the battery voltage does not cause a hazardous situation.		N
	A clear warning is given to the operator when a variation in battery voltage exceeds specified limits.		N
	Under those circumstances, the cableless operator control station remains functional long enough for the operator to put the machine into a non- hazardous situation.		N
9.3	Protective interlocks		P
9.3.1	The reclosing or resetting of an interlocking safeguard does not initiate hazardous machine operation.		P
9.3.2	Where overtraveling an operating limit (for example speed, pressure, position) can lead to a hazardous situation, means are provided to detect when a predetermined limit(s) is exceeded and initiate an appropriate control action.		P
9.3.3	The correct operation of auxiliary functions is checked by appropriate devices.		P
	Appropriate interlocking is provided, when non-operation of an auxiliary function (for example lubrication, supply of coolant, swarf removal) can cause a hazardous situation, or cause damage to the machine or to the work in progress.		P
9.3.4	Interlocks between different operations and for contrary motions are provided if this operations lead to hazardous situations.		P
9.3.5	Reverse current braking: Where braking of a motor is accomplished by current reversal, measures prevent the motor starting in the opposite direction at the end of braking where that reversal can cause a hazardous situation or damage to		P

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Clause	Requirement – Test	Result - Remark	Verdict
	the machine or to the work in progress.		
	For this purpose, a device operating exclusively as a function of time is not permitted.		P
	Control circuits are arranged that rotation of a motor shaft, for example manually, does not result in a hazardous situation.		P
9.4	Control functions in the event of failure		P
9.4.1	The safety related electrical control circuits have an appropriate level of safety performance that has been determined from the risk assessment at the machine. The requirements of IEC 62061 and/or ISO 13849-1, ISO 13849-2 are met.		P
	Where memory retention is achieved for example, by battery power, measures are taken to prevent hazardous situations arising from failure or removal of the battery.		P
	Means are provided to prevent unauthorized or inadvertent memory alteration by, e.g. requiring the use of a key, access code or tool.		P
9.4.2	Measures are taken to minimize risk in the event of failure:		-
9.4.2.1	- Use of proven circuit techniques and components		P
9.4.2.2	- Provisions of partial or complete redundancy		P
9.4.2.3	- Provision of diversity		P
9.4.2.4	- Provision for functional tests		P
9.4.3	Protection against mal-operation due to earth faults, voltage interruptions and loss of circuit continuity		-
9.4.3.1	Earth faults on any control circuit don't cause unintentional starting, potentially hazardous motions, or prevent stopping of the machine. Methods to meet these requirements include but are not limited to the following:		-
	a) 1) Control circuits, fed by control transformers and connected to the protective bonding circuit at the point of supply. (PELV) (see Figure 3 of this standard)		P

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Clause	Requirement – Test	Result - Remark	Verdict
	a) 2) Control circuits, fed by control transformers without connection to the protective bonding circuit at the point of supply in the arrangement according to figure 3 and having a device that interrupts the circuit automatically in the event of an earth fault		P
	b) Control circuits fed by a control transformer with a centre-tapped winding, this centre tap connected to the protective bonding circuit, arranged as shown in Figure 4 of this standard with the overcurrent protective device having switching elements in all control circuit supply conductors.		P
	c) Where the control circuit is not fed from a control transformer and is either: 1) directly connected between the phase conductors of an earthed supply, or; 2) directly connected between the phase conductors or between a phase conductor and a neutral conductor of a supply that is not earthed or is earthed through a high impedance, multpole switch that switch all live conductors are used for those functions that can cause hazardous situations or damage to the machine.		P
	Or in case of c) 2), a device is provided that interrupts the circuit automatically in the event of an earth fault.		P
9.4.3.2	For control systems using a memory device(s), proper functioning in the event of power failure is ensured (e.g. by using a non-volatile memory) to prevent any loss of memory that can result in a hazardous situation.		P
9.4.3.3	Upon sliding contacts the loss of continuity of safety-related control circuits depending on, can result in a hazardous situation. Appropriate measures are taken (for example by duplication of the sliding contacts).		P
10	**OPERATOR INTERFACE AND MACHINE-MOUNTED CONTROL DEVICES**		-

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Clause	Requirement – Test	Result - Remark	Verdict
10.1.1	As far as is practicable, those devices are selected, mounted, and identified or coded in accordance with relevant parts of IEC 61310.		P
10.1.2	As far as is practicable, machine-mounted control devices are: – readily accessible for service and maintenance;		P
	– mounted in such a manner as to minimize the possibility of damage from activities such as material handling.		P
	The actuators of hand-operated control devices are selected and installed so that: – they are not less than 0,6 m above the servicing level and		P
	– are within easy reach of the normal working position of the operator;		P
	– the operator is not placed in a hazardous situation when operating them.		P
	The actuators of foot-operated control devices are selected and installed so that: – they are within easy reach of the normal working position of the operator;		P
	– the operator is not placed in a hazardous situation when operating them.		P
10.1.3	The degree of protection (see IEC 60529) together with other appropriate measures does afford protection against:		P
	– the effects of aggressive liquids, vapours, or gases found in the physical environment or used on the machine;		P
	– the ingress of contaminants (for example swarf, dust, particulate matter).		P
	The operator interface control devices has a minimum degree of protection against direct contact of IPXXD (see IEC 60529).		P
10.1.4	Position sensors (for example position switches,		P

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Clause	Requirement – Test	Result - Remark	Verdict
	proximity switches) are so arranged that they will not be damaged in the event of overtravel.		
	Position sensors in circuits with safety-related control functions shall have direct opening action (see IEC 60947-5-1) or shall provide similar reliability (see 9.4.2).		P
10.1.5	Portable and pendant operator control stations and their control devices are so selected and arranged as to minimize the possibility of inadvertent machine operations caused by shocks and vibrations		P
10.2	Push-buttons		P
10.2.1	Mandatory: The colour RED is used only for emergency stop and emergency switching off actuators.		P
	The recommend colours of push-buttons are as shown in table 2 of this standard.		P
10.2.2	The recommend markings on push-buttons are as shown in table 3 of this standard.		P
10.3	Indicator lights and displays		-
10.3.1	Indicator lights and displays are selected and installed in such a manner as to be visible from the normal position of the operator (see also IEC 61310-1).		P
	Indicator light circuits used for warning lights are fitted with facilities to check the operability of these lights.		P
	The recommend colours on Indicator light are as shown in table 4 of this standard.		P
	Indicating towers on machines have the applicable colours in the following order from the top down; RED, YELLOW, BLUE, GREEN and WHITE.		P
	Where flashing lights or displays are used to provide higher priority information, audible warning devices should also be provided.		P
10.4	illuminated push-button actuators are colour-coded in accordance with Tables 2 and 4. Where there is difficulty in assigning an appropriate colour, WHITE is		P

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Clause	Requirement – Test	Result - Remark	Verdict
	used.		
	The colour RED for the emergency stop actuator shall not depend on the illumination of its light.		P
10.5	Devices having a rotational member, such as potentiometers and selector switches, have means of prevention of rotation of the stationary member. Friction alone isn't considered sufficient.		P
10.6	Actuators used to initiate a start function or the movement of machine elements (for example slides, spindles, carriers) are constructed and mounted so as to minimize inadvertent operation.		P
	However, mushroom-type actuators are used for two-hand control only. (see also ISO 13851).		P
10.7	Emergency stop devices		-
10.7.1	Devices for emergency stop are readily accessible.		P
	They are located at each operator control station and at other locations where the initiation of an emergency stop can be required (exception: see 9.2.7.3).		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	Allowed types of device for emergency stop: – a push-button operated switch with a palm or mushroom head type; – a pull-cord operated switch; – a pedal-operated switch without mechanical guard. The devices are direct opening operation (see IEC 60947-5-1, Annex K).		P P
10.7.3	Actuators are coloured RED. If a background exists immediately around the actuator, then this background is coloured YELLOW. See also ISO 13850.		P
10.7.4	The supply disconnecting device may be locally operated to serve the function of emergency stop		P

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Clause	Requirement – Test	Result - Remark	Verdict
	when: – it is readily accessible to the operator; and – it is of the type described in 5.3.2 a), b), c), or d). When also intended for this use, the supply disconnecting device meets the colours RED/YELLOW.		
10.8	Emergency switing off device		P
10.8.1	Means are provided, where necessary, to avoid confusion between these devices.		P
10.8.2	The types of device for emergency switching off include: – a push-button operated switch with a palm or mushroom head type of actuator; – a pull-cord operated switch. The devices are direct opening action (see IEC 60947-5-1, Annex K). The push-button operated switch may be in a break-glass enclosure.		P
10.8.3	Actuators are coloured RED. If a background exists immediately around the actuator, then this background is coloured YELLOW. See also ISO 13850.		P
10.8.4	Where the supply disconnecting device is to be locally operated for emergency switching off, it is be readily accessible and meets the colours RED/YELLOW.		P
10.9	Enabling control device		P
	An enabling control device as a part of a system, does allow operation when actuated in one position only. In any other position, operation is stopped or prevented.		P
	Functions of two-position types: position 1: off-function of the switch (actuator is not operated); position 2: enabling function (actuator is operated)		P
	Functions of three-position types: position 1: off-function of the switch (actuator is not operated);		P

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Clause	Requirement – Test	Result - Remark	Verdict
	position 2: enabling function (actuator is operated in its mid position); position 3: off-function (actuator is operated past its mid position); when returning from position 3 to position 2, the enabling function is not activated.		
11	**CONTROLGEAR: LOCATION, MOUNTING AND ENCLOSURES**		
11.2.1	All items of controlgear (inclusively terminals that are not part of controlgear components or devices) are placed and oriented so that they can be identified without moving them or the wiring.		P
	For items that require checking for correct operation or that are liable to need replacement, those actions should be possible without dismantling other equipment or parts of the machine (except opening doors or removing covers, barriers or obstacles).		P
	All controlgear are mounted so as to facilitate its operation and maintenance from the front.		P
	Necessary tools to adjust, maintain, or remove a device are supplied.		P
	Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0,4 m and 2,0 m above the servicing level.		P
	Terminals are least 0,2 m above the servicing level and so placed that conductors and cables can be easily connected to them.		P
	Only operating, indicating, measuring, and cooling devices are mounted on doors or on normally removable access covers of enclosures.		P
	Plug-in arrangements of control devices and plug-in-devices:		-
	The connection is clearly identified by shape, marking or reference designation, singly or in combination.		P
	When they have to bee handled during normal		P

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Clause	Requirement – Test	Result - Remark	Verdict
	operation means are provided with non-interchangeable features where the lack of such a facility can result in malfunctioning.		
	Plug/socket combinations that are handled during normal operation are unobstructedly accessible.		P
	Test points for connection of test equipment are: – unobstructedly accessible; – clearly identified to correspond with the documentation; – adequately insulated; – sufficiently spaced.		P
11.2.2	Non-electrical parts and devices, not directly associated with the electrical equipment, are not located within enclosures containing controlgear.		P
	Devices such as solenoid valves are separated from the other electrical equipment (for example in a separate compartment).		P
	Control devices mounted in the same location and connected to the supply voltage, or to both supply and control voltages, are grouped separately from those connected only to the control voltages.		P
	Terminals shall be separated into groups for: – power circuits; – associated control circuits; – other control circuits, fed from external sources (for example for interlocking).		P
	The clearances and creepage distances specified by the supplier are maintained, taking into account the external influences or conditions of the physical environment.		P
11.2.3	Heat generating components (for example heat sinks, power resistors) are located so, that the temperature of each component in the vicinity remains within the permitted limit.		P
	Controlgears are sufficiently protected against:		P

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Clause	Requirement – Test	Result - Remark	Verdict
	- ingress of solid foreign objects - liquids - dust, coolants, and swarf, taking into account the external influences under which the machine is intended to operate (i.e. the location and the physical environmental conditions).		
	Enclosures of controlgear provide a degree of protection of at least IP22 (see IEC 60529). Exceptions: a) specific electrical operating area b) When with removable collectors on conductor wire or conductor bar systems do not achieve IP22 measures of 6.2.5 are applied.		P
11.4	Enclosures, doors and openings		P
	Enclosures (inclusively screens of windows (windows: toughened glass or polycarbonate sheet of not less than 3 mm thickness), joints, gaskets of doors and lids) do withstand the foreseeable mechanical, electrical and thermal stresses and other environmental factors and of the aggressive liquids, vapours, or gases used on the machine.		P
	Fasteners used to secure doors and covers are of the captive type.		P
	Enclosure doors are not wider than 0,9 m and have vertical hinges, with an angle of opening > 95°.		P
	Openings in enclosures (for example, for cable access), including those towards the floor or foundation or to other parts of the machine are equipped with means to ensure the degree of protection specified for the equipment. A suitable opening may be provided in the base of enclosures within the machine so that moisture due to condensation can drain away.		P
	Openings for cable entries shall be easily re-opened on site.		P

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Clause	Requirement – Test	Result - Remark	Verdict
	No openings between enclosures containing electrical equipment and compartments containing coolant, lubricating or hydraulic fluids, or those into which oil, other liquids, or dust can penetrate.		P
	Holes in an enclosure for mounting do not impair the required protection.		P
	Equipment that, in normal or abnormal operation, can attain a surface temperature sufficient to cause a risk of fire or harmful effect to an enclosure material is: – located within an enclosure that will withstand, such temperatures; and – is located at a sufficient distance from adjacent equipment allowing safe dissipation of heat (see also 11.2.3); or – is otherwise screened by material that can withstand to the harmful effect.		P
11.5	Access to control gear		N
	Doors in gangways for access to electrical operating areas: – are at least 0,7 m wide and 2,1 m high; – do open outwards; – have a means (for example panic bolts) to allow opening from the inside without the use of a key or tool.		N
	Enclosures which readily allow a person to fully enter are be provided with means to allow escape, e.g. panic bolts on the inside of doors.		N
	Enclosures intended for such access, for example for resetting, adjusting, maintenance, shall have a clear width of at least 0,7 m and a clear height of at least 2,1 m When equipment is likely to be live during access with > 1,0m and when on both side with > 1.5m.		N
12	**CONDUCTORS AND CABLES**		P
	IMPORTANT: The following requirements do not apply to the integral wiring of assemblies, subassemblies,		-

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Clause	Requirement – Test	Result - Remark	Verdict
	and devices that are manufactured and tested in accordance with their relevant IEC standard (for example IEC 60439-1).		
12.2	In general, conductors are of copper. Where aluminium conductors are used, the cross-sectional area is at least 16 mm^2.		P
	The cross-sectional areas of conductors are according to Table 5 and its notes.		P
	All conductors that are often in movement (> one movement per hour of machine operation) have flexible stranding of class 5 or class 6.		P
	Where the insulation of conductors and cables (for example PVC) can constitute hazards due to the propagation of a fire or the emission of toxic or corrosive fumes adequate means are provided. Special attention is given to the integrity of a circuit having a safety-related function		P
	Minimum insulation test voltages for used cables are: – ≥ 2 000 V a.c. for a duration of 5 min for operation at voltages higher than 50 V a.c. or 120 V d.c., or – ≥ 500 V a.c. for a duration of 5 min for PELV circuits (see IEC 60364-4-41, class III equipment).		P
	Insulation strong enough to withstand damage due to operation or during laying, especially for cables pulled into ducts.		P
12.4	Current-carrying capacity in normal service in accordance with table 6. Or in accordance with suppliers recommendation.		P
12.6	Flexible cables		P
12.6.1	All flexible cables have Class 5 or Class 6 conductors. Cables under severe duties are adequately protected against: - abrasion due to mechanical handling and dragging across rough surfaces; - kinking due to operation without guides;		P

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Clause	Requirement – Test	Result - Remark	Verdict
	- stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums.		P
12.6.2	The tensile stress applied to copper conductors does not exceed 15 N/mm2 of cross-sectional area. Or special measures are taken to withstand the applied stress. For material other than copper the applied stress is within the cable manufacturer's specification.		P
12.6.3	For cables installed on drums, the maximum current-carrying capacity in free air is derated in accordance with Table 7.		P
12.7	Conductor wires, conductor bars and slip-ring assemblies		P
12.7.1	During normal access to the machine, protection against direct contact to conductor wires, conductor bars and slip-ring assemblies is achieved by the application of one of the following protective measures: – protection by partial insulation of live parts, or where this is not practicable; – protection by enclosures or barriers of at least IP2X.		P
	Horizontal top surfaces of barriers or enclosures that are readily accessible provide a degree of protection of at least IP4X.		P
	Where the required degree of protection is not achieved, protection by placing live parts out of reach in combination with emergency switching off in accordance with 9.2.5.4.3 is applied.		P
	Conductor wires and conductor bars are so placed / protected as to: – prevent contact with conductive items such as the cords of pull-cord switches, strain-relief devices and drive chains; – prevent damage from a swinging load.		P
12.7.2	Protective conductor circuit (PE) and the neutral conductor (N) each use a separate conductor		P

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Clause	Requirement – Test	Result - Remark	Verdict
	wire, conductor bar or slip-ring.		
	The continuity of the protective conductor circuit using sliding contacts is ensured by taking appropriate measures (for example, duplication of the current collector, continuity monitoring)		P
12.7.3	Protective conductor current collectors have a shape or construction so that they are not interchangeable with the other current collectors. Such current collectors shall be of the sliding contact type.		P
12.7.4	Removable current collectors (e.g. swivelingable) with disconnector function: The protective conductor circuit interrupts after and reconnects before any live conductor.		P
12.7.5	Clearances in air between conductors and adjacent systems are suitable at least a rated impulse voltage of an overvoltage category III in accordance with IEC 60664-1 (For example 4 kV for 230/400 V systems → clearances 3mm)		P
12.7.6	Creepage distances between conductors and adjacent systems are suitable suitable for operation in the intended environment, e.g. open air (IEC 60664-1), inside buildings, protected by enclosures. In abnormally dusty, moist or corrosive environments, the following creepage distance requirements apply: – unprotected conductor etc.: minimum creepage dist. of 60 mm – enclosed conductor etc.: minimum creepage distance of 30 mm		P
12.7.7	Conductor system divided into isolated sections: suitable design measures are employed to prevent the energization of adjacent sections by the current collectors themselves.		P
12.7.8	Construction of conductor wires etc.:		P

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Clause	Requirement – Test	Result - Remark	Verdict
	- power circuits are grouped separately from those in control circuits. - do withstand the foreseeable mechanical forces and thermal effects of short-circuit current. - covers can not be opened without the use of a tool - all conductive parts of accompanying enclosures are connected to the protective bonding circuit - underground and underfloor conductor bar ducts have drainage facilities		
13	**WIRING PRACTICES**		P
13.1	Connections and routing		P
13.1.1	All connections are secured against accidental loosening.		P
	The means of connection are suitable for the cross-sectional areas and nature of the conductors being terminated.		P
	No connection of two or more conductors to one terminal, unless the terminal is designed for it.		P
	No soldered connections to terminals unless they are suitable for it.		P
	Terminals on terminal blocks are plainly marked or labelled corresponding with the diagrams.		P
	Installations of flexible conduits and cables are such that liquids drain away from the fittings.		P
	Retaining means for conductor strand and shields provided (no soldering for that purpose)		P
	Indentification tags legible, permanent, and appropriate for the physical environment.		P
	Terminal blocks mounted and wired so that the internal and external wiring does not cross over the terminals (see IEC 60947-7-1).		P
13.1.2	Conductors and cables run from terminal to terminal without splices or joints. Connections using plug/socket combinations with		P

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Clause	Requirement – Test	Result - Remark	Verdict
	suitable protection against accidental disconnection are not considered to be joints for the purpose of this subclause.		
	Terminations of cables are adequately supported to prevent mechanical stresses at the terminations of the conductors.		P
	Protective conductor placed close to the associated live conductors in order to decrease the impedance of the loop.		P
13.1.3	Conductors for circuits that operate at different voltages are separated by suitable barriers, or are insulated for the highest voltage that occurs within the same duct.		P
13.1	Connections and routing		P
13.2.1	Each conductor is identifiable at each termination in accordance with the technical documentation.		P
13.2.2	The protective conductor has the bicolour combination GREEN-AND-YELLOW Where the protective conductor can be easily identified colour coding throughout its length is not necessary, but the ends or accessible locations are clearly identified by the graphical symbol or by the bicolour combination GREEN-AND-YELLOW.		P
13.2.3	Neutral conductors are identified by the colour LIGHT BLUE. That colour is not used for identifying any other conductor where confusion is possible.		P
	Bare conductors used as neutral conductors have at minimum a stripe in LIGHT BLUE 15 mm to 100 mm wide in each compartment or unit and at each accessible location.		P
	Identification by colour for other conductors: Colours GREEN or YELLOW are not used. (Details to colour coding see this norm Cl. 13.2.3)		P
13.3	Wiring inside enclosures		P
	Conductors inside enclosures are supported where necessary.		P

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Clause	Requirement – Test	Result - Remark	Verdict
	Conductors and cables that do not run in ducts are adequately supported.		
	Non-metallic supports are made with a flame-retardant insulating material (see IEC 60332 series)		P
	Connections to devices mounted on doors or to other movable parts are using flexible conductors in accordance with 12.2 and 12.6.		P
13.4	Wiring outside enclosures		P
13.4.2	Conductors and their connections external to the electrical equipment are 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
13.4.3	Connection to moving elements of the machine		N
	Connections to moving elements of the machine are made of flexible cable in accordance with 12.2 and 12.6.		N
	Bending radius of the cable are of at least 10 times the diameter of the cable		N
	Cables close to moving parts, maintain a space of at least 25 mm between the moving parts and the cables or barriers are provided.		N
	Cable handling systems: Lateral cable angles do not exceeding 5°, at being wound on and off cable drums or approaching and leaving cable guidance devices. The bending radius is in accordance with table 8.		N
	Flexible conduit: - is not used for connections to rapidly or frequently moving parts, except when specifically designed for that purpose. - is supported when adjacent to moving parts		N
13.4.4	Interconnection of devices on the machine is made		P

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Clause	Requirement – Test	Result - Remark	Verdict
	through adequate terminals.		
13.4.5	Requirements to plug/socket combinations outside of enclosures: Exceptions: components connected to a bus system by a plug/socket combination a) Prevention for unintentional contact with live parts at any time. At least IPXXB. (PELV circuits are excepted from this requirement.) b) First make last break protective bonding contact if used in TN- or TT-systems. c) Sufficient load-breaking capacity, when intended to be disconnected under running conditions. When rated at ≥ 30 A interlocked with a switching device d) When rated at ≥ 16 A having a retaining means to prevent unintended or accidental disconnection. e) when unintended or accidental disconnection +can cause a hazardous situation, having a retaining means. f) Component remaining live after disconnection having at least IP2X or IPXXB, taking into account the required clearance and creepage distances.(PELV circuits are excepted from this requirement.) g) Metallic housings of plug/socket combinations being connected to the protective bonding circuit. (PELV circuits are excepted from this requirement.) h) Having retaining means to prevent unintended or accidental disconnection and being marked that they are not intended to be disconnected under load. i) Clearly identifiable if more then one plug / socket per device. It is recommended that mechanical coding being used. j) When used in control circuits fulfilling the applicable requirements of IEC 61984. Exception: see item k). k) No plug/socket combinations intended for household	No such construction	N

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Clause	Requirement – Test	Result - Remark	Verdict
	and similar general purposes used for control circuits. In plug/socket combinations in accordance with IEC 60309-1, only those contacts shall be used for control circuits which are intended for those purposes. Exception: The requirements of item k) do not apply to control functions using high frequency signals on the power supply.		
13.4.6	Protection of Plug / socket from the physical environment during transportation and storage.		P
13.5	Ducts, connection boxes and other boxes		P
	Provided with a degree of protection suitable for the application.		P
	No sharp edges, flash, burrs, rough surfaces, or threads with which the insulation of the conductors can come into contact.		P
	Where human passage is required, least 2 m above the working surface.		P
	Not used as connection for protective bonding circuit.		P
	Where cable trays are a.s.o. are only partially covered, the cables used are of a suitable type.		P
13.5.2	Filling the percentage of ducts adapted to the straightness and length of the duct and the flexibility of the conductors.		P
13.5.3	Rigid metal conduit and fittings shall galvanized steel or of a corrosion-resistant material		P
	Fittings compatible with the conduit.		P
	Conduit bends properly made		P
13.5.4	Flexible metal tubing or woven wire armour suitable for the expected physical environment.		P
13.5.5	Flexible non-metallic conduit resistant to kinking and suitable for the expected physical environment.		P
13.5.6	Requirements to cable trunking systems: - Rigidly supported and clear of all moving or contaminating portions of the machine - Covers overlapping the sides and attached.		P

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Clause	Requirement – Test	Result - Remark	Verdict
13.5.7	The compartments of machine used as cable trunking systems are isolated from coolant or oil reservoirs and are entirely enclosed, and the conductors are secured.		P
13.5.8	Connection boxes and other boxes used for wiring: - Are accessible for maintenance. - Provide protection against the ingress of solid bodies and liquids, taking into account the external influences under which the machine is intended to operate (see 11.3). - Do not have unused knockouts etc.		P
13.5.9	Motor connection boxes: Encloses only connections to the motor and motor-mounted devices (e.g brakes, temperature sensors)		P
14	**ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT**		P
14.1	Electric motors are conform to the relevant parts of IEC 60034 series.		P
	There protection is conform to the requirements given in 7.2 for overcurrent protection, in 7.3 for overload protection, and in 7.6 for overspeed protection.		P
	Motor control equipment is located and mounted in accordance with Clause 11.		P
14.2	Minimal IP23 protection for all motors. More stringent requirements depending on the application and the physical environment.		P
14.4	Motors incorporated as an integral part of the machine are adequately protected from mechanical damage.		P
	motors and its associated parts (inclusively motor connection box) are easily accessible for inspection and maintenance etc		P
	Cooling is ensured and the temperature rise remains within the limits of the insulation class (see IEC 60034-1)		P
	No opening between the motor compartment and any		P

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Clause	Requirement – Test	Result - Remark	Verdict
	other compartment that does not meet the motor compartment requirements.		
14.5	The characteristics of motors and associated equipment are selected in accordance with the anticipated service and physical environmental conditions (see 4.4). Detailed criteria see 14.5 of this norm.		P
14.6	Overload and overcurrent protective devices for mechanical brake actuators initiate simultaneously the deenergization (release) of the associated motors.		P
15	**ACCESSORIES AND LIGHTING**		P
15.1	Requirements for socket-outlets for accessory equipment:		P
	– conform to IEC 60309-1 (Where that is not practicable, they are clearly marked with voltage and current ratings);		P
	–continuity of the protective bonding circuit to the socket-outlet is ensured, except where protected by PELV;		P
	– unearthed conductors connected to the socket-outlet are overcurrent- and if required overload-protected		P
	– protection is separately from other circuits;		P
	– power supply to the socket-outlet is not disconnected by the supply disconnecting device for the machine or the section of the machine, the requirements of 5.3.5 apply.		P
15.2.1	Requirements for local lighting of the machine and equipment: - protective bonding circuit in accordance with 8.2.2. - ON/OFF switch incorporated in the lamp-holder or in the flexible connecting cords. - Stroboscopic effects avoided. - Where fixed lighting electromagnetic compatibility is taken into account.		P
15.2.2	Requirements to the power supply for local lighting:		P

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Clause	Requirement – Test	Result - Remark	Verdict
	– Nominal voltage not exceeding 250 V between conductors – isolating transformer connected to the load side of the supply with overcurrent protection in the secondary circuit; or – isolating transformer connected to the line side of the supply disconnecting device with overcurrent protection in the secondary circuit. That source is permitted for maintenance lighting circuits in control enclosures only; or – from a machine circuit with dedicated overcurrent protection; or – from an isolating transformer connected to the line side of the supply disconnecting device, provided with a dedicated primary disconnecting means and secondary overcurrent protection, and mounted within the control enclosure adjacent to the supply disconnecting device; or – from an externally supplied lighting circuit (for example factory lighting supply). This shall be permitted in control enclosures only, and for the machine work light(s) where their total power rating is not more than 3 kW. Exception: Where fixed lighting is out of reach of operators during normal operations, the provisions of this subclause do not apply.		
15.2.3	All unearthed conductors of circuits supplying lighting have their own overcurrent protecting devices.		P
15.2.4	Requirements to the fittings for local lighting: – Adjustable lighting fittings are suitable for the physical environment. – lamp holders are in accordance with the relevant IEC standard; – lamp holders are constructed with an insulating material protecting the lamp cap		P

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Clause	Requirement – Test	Result - Remark	Verdict
	– Reflectors are supported by a bracket and not by the lamp holder. Exception: where fixed lighting is out of reach of operators during normal operation, the provisions of this subclause do not apply.		
16	**MARKING, WARNING SIGNS AND REFERENCE DESIGNATIONS**		
16.1	Warning signs, nameplates, markings, and identification plates are of sufficient durability to withstand the physical environment.		P
16.2.1	Enclosures that do not clearly show that they contain electrical equipment that has a risk of electric shock are marked with the graphical symbol  plainly visible on the enclosure door or cover. Exception: – enclosure equipped with a supply disconnecting device; – operator-machine interface or control station; – a single device with its own enclosure (for example position sensor).		P
16.2.2	Hazardous hot surfaces of the electrical equipment, are equipped with the graphical warning symbol 	No such construction	N
16.2.3	Control devices, visual indicators, and displays are clearly and durably marked to their functions.		P
16.2.4	Equipment (e.g. controlgear assemblies) is legibly and durably marked. A nameplate is attached to the enclosure adjacent to each incoming supply with: – name or trade mark of supplier; – certification mark, when required; – serial number, where applicable; – rated voltage, number of phases and frequency (if a.c.),		P

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Clause	Requirement – Test	Result - Remark	Verdict
	– full-load current for each supply; – short-circuit rating of the equipment; – main document number (see IEC 62023).		
16.2.5	All enclosures, assemblies, control devices, and components are plainly identified with the same reference designation as shown in the technical documentation.		P
17	**TECHNICAL DOCUMENTATION**		-
17.1	Documentation in agreed language provided.	Documentation in English	P
17.2	Information provided with the electrical equipment include: a) A main document (parts list or list of documents); b) Complementary documents including: 1) a clear, comprehensive description of the equipment, installation and mounting, and the connection to the electrical supply(ies); 2) electrical supply(ies) requirements; 3) information on the physical environment (for example lighting, vibration, noise levels, atmospheric contaminants) where appropriate; 4) overview (block) diagram(s) where appropriate; 5) circuit diagram(s); 6) information (as applicable) on: - programming, as necessary for use of the equipment; - sequence of operation(s); - frequency of inspection; - frequency and method of functional testing; - guidance on the adjustment, maintenance, and repair, particularly of the protective devices and circuits; -recommended spare parts list; - list of tools supplied. 7) a description (including interconnection diagrams) of the safeguards, interlocking functions, and interlocking		P

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Clause	Requirement – Test	Result - Remark	Verdict
	of guards against hazards, particularly for machines operating in a co-ordinated manner; 8) a description of the safeguarding and of the means provided where it is necessary to suspend the safeguarding (for example for setting or maintenance), (see 9.2.4); 9) instructions on the procedures for securing the machine for safe maintenance; (see also 17.8); 10) information on handling, transportation and storage; 11) information regarding load currents, peak starting currents and permitted voltage drops, as applicable; 12) information on the residual risks due to the protection measures adopted, indication of whether any particular training is required and specification of any necessary personal protective equipment.		
17.3	Unless otherwise agreed between manufacturer and user: – the documentation is in accordance with relevant parts of IEC 61082; – reference designations are in accordance with relevant parts of IEC 61346; - instructions / manuals are in accordance with IEC 62079. - parts lists where provided are in accordance with IEC 62027, class B.		P
17.4	Installation documents giving all information necessary for the preliminary work of setting up the machine (including commissioning) are provided. (In complex cases, it may be necessary to refer to the assembly drawings for details.)		P
	The recommended position, type, and cross-sectional areas of the supply cables to be installed on are clearly indicated.		P
	Data necessary for choosing the type, characteristics,		P

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Clause	Requirement – Test	Result - Remark	Verdict
	rated currents, and setting of the overcurrent protective device for the supply conductors to the electrical equipment of the machine is stated (see 7.2.2).		
	The size, purpose, and location of any ducts in the foundation that are to be provided by the user are detailed (see Annex B).		P
	The size, type, and purpose of ducts, cable trays, or cable supports between the machine and the associated equipment that are to be provided by the user are detailed (see Annex B).		P
	A diagram indicates where space is required for the removal or servicing of the electrical equipment.		P
	An interconnection diagram or table is provided, where it is appropriate. They give full information about all external connections.		P
	Where the electrical equipment is intended to be operated from more than one source of electrical supply, the interconnection diagram or table does indicate the modifications or interconnections required for the use of each supply.		P
17.5	Where it is necessary to facilitate the understanding of the principles of operation, an overview diagram is provided.		P
17.6	The circuit diagram shows the electrical circuits on the machine and its associated electrical equipment.		P
	Any graphical symbol not shown in IEC 60617-DB:2001 are separately described on the diagrams or supporting documents.		P
	The symbols and identification of components and devices are consistent throughout all documents and on the machine.		P
	Switch symbols on the electromechanical diagrams are shown with all supplies turned off (for example electricity, air, water, lubricant) and with the machine and its electrical equipment ready for a normal start.		P

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Clause	Requirement – Test	Result - Remark	Verdict
	Conductors are identified in accordance with 13.2.		P
	Characteristics relating to the function of the control devices and components which are not evident from their symbolic representation are included on the diagrams adjacent to the symbol or referenced to a footnote.		P
17.7	An operating manual detailing proper procedures for set-up and use of the electrical equipment is provided.		P
	Particular attention is given to the safety measures.		P
	Where the operation of the equipment can be programmed, detailed information on methods of programming, equipment required, program verification, and additional safety procedures (where required) is given.		P
17.8	A maintenance manual detailing proper procedures for adjustment, servicing and preventive inspection, and repair is provided. Recommendations on maintenance/service intervals and records are part of that manual. Where methods for the verification of proper operation are provided (for example software testing programs), the use of those methods is detailed		P
17.9	The parts list, where provided, comprises, as a minimum, information necessary for ordering spare or replacement parts (for example components, devices, software, test equipment, technical documentation) required for preventive or corrective maintenance including those that are recommended to be carried in stock by the user of the equipment.		P
18	**VERFICATION**		P
18.1	The extent of verification will be given in the dedicated product standard for a particular machine. Where there is no dedicated product standard for the machine, the verifications shall always include the items a), b) and f) and may include one or more of the items c) to e):		-

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Clause	Requirement – Test	Result - Remark	Verdict
	a) verification that the electrical equipment complies with its technical documentation; b) in case of protection against indirect contact by automatic disconnection, conditions for protection by automatic disconnection shall be verified according to 18.2; c) insulation resistance test (see 18.3); d) voltage test (see 18.4); e) protection against residual voltage (see 18.5); f) functional tests (see 18.6).		
18.2	Verification of conditions for protection by automatic disconnection of supply		
18.2.2	Test 1: Verification of the continuity of the protective bonding circuit		-
	The resistance of each protective bonding circuit between the PE terminal and relevant points that are part of each protective bonding circuit is measured with a current between at least 0,2 A. And the resistance measured is in the expected range according to the length, the cross sectional area and the material of the related protective bonding conductor.		P
	Test 2: Fault loop impedance verification and suitability of the associated overcurrent protective device.		P
	The connections of the power supply and of the incoming external protective conductor to the PE terminal of the machine are verified by inspection.		P
	The conditions for the protection by automatic disconnection of supply in accordance with 6.3.3 and Annex A a verified by both: 1) A verification of the fault loop impedance by calculation, or - measurement in accordance with A.4, and		P
	2) A confirmation that the setting and characteristics of the associated overcurrent protective device are in		P

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Clause	Requirement – Test	Result - Remark	Verdict
	accordance with the requirements of Annex A or table 10		
18.3	Insulation resistance tests (facultative) The insulation resistance measured at 500 V d.c. between the power circuit conductors and the protective bonding circuit are not less than 1 MΩ.		P
18.4	Voltage test (facultative) Testing voltage; twice the rated supply voltage of the equipment or 1 000 V whichever is the greater With test voltage applied between the power circuit conductors and the protective bonding circuit for a period of approximately 1 s. there is no disruptive discharge occurred.		P
18.5	Protection against residual voltages (facultative) Compliance with 6.2.4. is ensured		P
18.6	Functional tests The function of circuits for electrical safety (for example earth fault detection) is insured.		P

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Clause	Requirement – Test	Result - Remark	Verdict

(ATTACHMENT TO TEST REPORT IEC 60204-1, European Group Differences and National Differences **)**

ATTACHMENT TO TEST REPORT IEC 60204-1 **EUROPEAN GROUP DIFFERENCES AND NATIONAL DIFFERENCES** Safety of machinery - Electrical equipment of machines Part 1: General requirements
Differences according to .....: EN 60204-1:2006 + A1:2009
Attachment Form No.....: EU_GD_IEC60204_1A **Attachment Originator .....**: Electrosuisse **Master Attachment**.....: 2018-11

	CENELEC COMMON MODIFICATIONS (EN)		
1.	Scope		—
	– are sewing machines, units, and systems; NOTE 7 For sewing machines, see EN 60204-31. – are hoisting machines. NOTE 8 For hoisting machines, see EN 60204-32.		—
3.	Terms and definitions		-
3.56	Uncontrolled stop NOTE This definition does not imply any particular state of other (for example, non-electrical) stopping devices, for example, mechanical or hydraulic brakes that are outside the scope of this standard.		-
4.2	Section of equipment		P
4.2.2	The electrical equipment of the machine shall satisfy the safety requirements identified by the risk assessment of the machine. Depending upon the machine, its intended use and its electrical equipment, the designer may select parts of the electrical equipment of the machine that are in compliance with EN 60439-1 and, as necessary, other relevant parts of the EN 60439 series (see also Annex F).		P
4.4	Physical environment and operating conditions		P
4.4.1	The electrical equipment shall be suitable for the physical environment and operating conditions of its		P

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Clause	Requirement – Test	Result - Remark	Verdict
	intended use. The requirements of 4.4.2 to 4.4.8 cover the physical environment and operating conditions of the majority of machines covered by this part of EN 60204. When special conditions apply or the limits specified are exceeded, an agreement between user and supplier (see 4.1) is recommended (see Annex B).		
4.4.3	Electrical equipment shall be capable of operating correctly in the intended ambient air temperature. The minimum requirement for all electrical equipment is correct operation between air temperatures of +5 °C and +40 °C. For very hot environments (for example hot climates, steel mills, paper mills) and for cold environments, additional measures are recommended (see Annex B).		P
4.4.7	When equipment is subject to radiation (for example microwave, ultraviolet, lasers, X-rays), additional measures shall be taken to avoid malfunctioning of the equipment and accelerated deterioration of the insulation. A special agreement is recommended between the supplier and the user (see Annex B).	No radiation subjected.	N
4.4.8	Undesirable effects of vibration, shock and bump (including those generated by the machine and its associated equipment and those created by the physical environment) shall be avoided by the selection of suitable equipment, by mounting it away from the machine, or by provision of anti-vibration mountings. A special agreement is recommended between the supplier and the user (see Annex B).		P
5.	Incoming supply conductor terminations and devices for disconnecting and switching off		P
5.1	Add:		—

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Clause	Requirement – Test	Result - Remark	Verdict
	See 17.8 for the provision of instructions for maintenance.		
5.4	NOTE 2 Further information on the location and actuation of devices such as those used for the prevention of unexpected start-up is provided in EN 60447. After the fifth paragraph, replace note 2 with: NOTE 3 The selection of a device should take into account, for example, information derived from the risk assessment, intended use and foreseeable misuse of the device. For example, the use of disconnectors, withdrawable fuse links		—
9.	Control circuits and control functions		P
9.2.6.3	Enabling control (see also 10.9) is a manually activated control function interlock that:		—
	a) when activated allows a machine operation to be initiated by a separate start control		N
	b) when de-activated – initiates a stop function in accordance with 9.2.5.3, and – prevents initiation of machine operation.		N
	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. It should not be possible to defeat the enabling function by simple means.		N
9.2.7.3	Stop:		—
	Cableless control stations shall include a separate and clearly identifiable means to initiate the stop function of the machine or of all the operations that can cause a hazardous situation. The actuating means to initiate this stop function shall not be marked or labelled as an emergency stop device (see10.7).		P

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Clause	Requirement – Test	Result - Remark	Verdict
10.	Operator interface and machine-mounted control devices		P
	Replace table 2 with **Table 2 – Colour coding for push-button actuators and their meanings** Colour / Meaning / Explanation / Examples of application RED / Emergency / Actuate in the event of a hazardous situation or emergency / Emergency stop; Initiation of emergency function (see also 10.2.1) YELLOW / Abnormal / Actuate in the event of an abnormal condition / Intervention to suppress abnormal condition; Intervention to restart an interrupted automatic cycle BLUE / Mandatory / Actuate for a condition requiring mandatory action / Reset function GREEN / Normal / Actuate to initiate normal conditions / (See 10.2.1) WHITE / No specific meaning assigned / For general initiation of functions except for emergency stop / START/ON (preferred) STOP/OFF GREY / No specific meaning assigned / For general initiation of functions except for emergency stop / START/ON STOP/OFF BLACK / No specific meaning assigned / For general initiation of functions except for emergency stop / START/ON STOP/OFF (preferred)		P
12.	Conductors and cables		P
12.7.8	Construction and installation of conductor wire, conductor bar systems and slip-ring assemblies		—
	The protective bonding circuit shall include the covers or cover plates of metal enclosures or underfloor ducts. Where metal hinges form a part of the bonding circuit, their continuity shall be verified (see Clause 18).		P
17.	Technical documentation		P
17.2	Information to be provided 3) information on the physical environment (for example lighting, vibration, atmospheric contaminants) where appropriate;		P
18.	Verification		P
18.1	General (5th paragraph) For tests in accordance with 18.2 and 18.3, measuring equipment in accordance with the EN 61557 series is applicable. NOTE For other tests as required by this standard measuring equipment in accordance with relevant IEC or European Standards should be used.		P
ZA	**ANNEX ZA, Normative references to IEC standards (normative)**		P
	Normative references to international publications with their corresponding European		-

IEC 60204-1 / EN 60204 -1			
Clause	Requirement – Test	Result - Remark	Verdict
	publications The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.		
ZZ	**ANNEX ZZ, Essential requirements EC directives (informative)**		P
	Coverage of Essential Requirements of EC Directives This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers only the following essential requirements out of those given in Annex I of the EC Directive 98/37/EC: – 1.1.2 – 1.2 – 1.5.1 – 1.5.4 – 1.6.3 (for isolation of electrical supplies of machinery) – 1.6.4 (for access to electrical equipment) – 1.7.0 – 1.7.1 – 1.7.2 (for residual risks of an electrical nature) – 1.7.4(c) Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive concerned. WARNING: Other requirements and other EC		-

IEC 60204-1 / EN 60204 -1			
Clause	Requirement – Test	Result - Remark	Verdict
	Directives may be applicable to the products falling within the scope of this standard.		

1. Continuity of the protective bonding circuit

Test Points	Requirement	Test Result	Test Current(A)	Voltage Drop(V)	Verdict
PE-Control Panel	100 mΩ	68 mΩ	100	0,68	P
PE-Electrical Box	100 mΩ	58 mΩ	100	0,58	P
PE-Accessible metal	100 mΩ	58 mΩ	100	0,58	P

2. Insulation Resistance

Test Points	Requirement	Test Result(MΩ)	Verdict
L-Control Panel	4 MΩ	230	P
L-Electrical Box	4 MΩ	260	P

Test voltage: 500V DC

3. Withstanding Voltage

Test Points	Test voltage	Breakdown	Verdict
L-Control Panel	1830V 60s 5mA	No	P
L-Electrical Box	1830V 60s 5mA	No	P

- End of Test Report -