TEST REPORT

For

Dongguan Huayu Automation Technology Co., Ltd.

Screen Printing Feeding Machine

Model: HY-767-1, HY-767, HY-767S, HY-767L, HY-230, HY-230ZP, HY-175, HY-320, HY-340, HY-R45, HY-T106, HY-324, HY-F12, HY-1000.

Test Report Number： WD21012020ES

Dongguan Wode Testing Co.,Ltd

Building B,No.6 Gongye North Road,Songshan Lake(SSL) High-tech Zone,Dongguan523808,P.R.China

Tel.：4008882955 0769-22891258 Fax：0769-22891235

Email：service.vip@worldtest.cn Web：www.worldtest.cn & www.robot-testing.com

TEST REPORT

EN 60204-1:2018

Safety of machine- Electrical equipment of machines,

Part 1: General requirements

Report Reference No. .....:	WD21012020ES
Tested by (+ signature) .....:	Dylan
Review by (+ signature) .....:	Daisy
Approved by (name + signature).....:	Alex
Date of issue .....:	Feb. 24, 2021
Contents.....:	53 pages
Testing Laboratory	
Name.....:	Dongguan Wode Testing Co.,Ltd.
Address.....:	Building B,No.6 Gongye North Road,Songshan Lake(SSL) High-tech Zone,Dongguan523808,P.R.China
Applicant	
Name.....:	Dongguan Huayu Automation Technology Co., Ltd.
Address.....:	A Building 168#, Changheng Road, Changping Town, Dongguan City, Guangdong Province, China
Test specification:	
Directive.....:	2006/42/EC
Standard.....:	EN 60204-1:2018
Test procedure .....:	CE- MD
Test item	
Description.....:	Screen Printing Feeding Machine
Model/Type reference .....:	HY-767-1, HY-767, HY-767S, HY-767L, HY-230, HY-230ZP, HY-175, HY-320, HY-340, HY-R45, HY-T106, HY-324, HY-F12, HY-1000.
Main test type.....:	HY-767-1
Trademark .....:	HYOO
Manufacturer.....:	Dongguan Huayu Automation Technology Co., Ltd.
Address .....:	A Building 168#, Changheng Road, Changping Town, Dongguan City, Guangdong Province, China
Rating(s).....:	380V AC, 50/60Hz

Copy of marking plate:

Remarks:
The Importer's name and address shall be marked on the label before shipment.
Other information may be included if no misuse or misunderstanding.

Summary of testing:

The product has been tested and found in compliance with EN60204-1:2018 for Safety of machine-Electrical equipment of machines, Part 1: General requirements

Test case verdicts

Test case does not apply to the test object : N(N/A)

Test item does meet the requirement : P(Pass)

Test item does not meet the requirement : F(Fail)

Testing

Date of receipt of test item :	Jan. 27, 2021
Date(s) of performance of test :	Jan. 28, 2021 to Feb. 22, 2021
Testing location / address:	A Building 168#,Changheng Road, Changping Town, Dongguan City, Gongdong Province

General remarks

This report shall not be reproduced except in full without the written approval of the testing laboratory.

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

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

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

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

General product information:

This machine is specially designed for 1 color automatic UV screen printer that is suitable for the printing for round, oval shaped plastic bottles. The equipment can handle the design and printing of mass mono-color and multi-color screen printing operations. Equipped with world famous PLC controller and convenient touch screen, therefore the whole operation becomes easy and simple. The screen printing machine is widely used by manufacturers in industries such as cosmetics, food, medicine, and other consumer goods. Automatic feeder (can save manpower and realize fully automatic production).

Model	Supply	Equipment size (mm)	Weight (KG)	Working Platform Size (mm)	Other differences
HY-767	380V/480V 3phase 50Hz/60Hz 5.4kW	2300x1800x1700mm	1600KG	2300x1800mm	
HY-767S	380V/480V 3phase 50Hz/60Hz 5kW	2300x1800x1700mm	1600KG	2300x1800mm	
HY-767L	380V/480V 3phase 50Hz/60Hz 5.4kW	2300x1800x1700mm	1600KG	2300x1800mm	
HY-230	380V/480V 3phase 50Hz/60Hz 4.5kW	2600x1700x1900mm	1500KG	2600x1700mm	
HY-230ZP	380V 3Phase 50Hz 4.5kW	2600x1700x1900mm	1400Kg	2600x1700mm	
HY-175	380V/480V 3phase 50Hz/60Hz 3.8KW/4.6kW	2500x1700x1900mm	1400KG	2500x1700mm	
HY-320	380V/480V 3phase 50Hz/60Hz 15kW	2300x2300x2350mm	3500KG	2300x2300mm	
HY-340	380V/480V 3phase 50Hz/60Hz 5.4kW	2300x1800x1700mm	1600KG	2300x1800mm	
HY-R45	380V/480V 3phase 50Hz/60Hz 7kW	1100x2500x1700 mm	2000KG	1100x2500mm	
HY-T106	380V/480V 3phase 50Hz/60Hz 3.2kW	3150x1250x1900mm	1000KG	3150x1250mm	
HY-324	380V/480V 3phase 50Hz/60Hz 3.8KW/4.6kW	4950x3150x2350mm	2500KG	4950x3150mm	
HY-F12	380V/480V 3phase 50Hz/60Hz 3.2kW	2400x1200x1700 mm	1000KG	2400x1200mm	
HY-1000	380V 3phase 50Hz 20kW	7000x2900x2000mm	2500KG	7000x2900mm	

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Clause	Requirement - Test	Result - Remark	Verdict
4	**GENERAL REQUIREMENTS**		—
4.1	**General**		**P**
	Hazards relevant to the electrical equipment are assessed as part of the overall risk assessment of the machine as described		P
4.2	**Selection of equipment**		P
4.2.1	Electrical components and devices shall be: - suitable for their intended use - conform to IEC standards where such exist - be applied in accordance with supplier's instructions	Suitable for their intended use	P
4.2.2	Where appropriate electrical equipment in compliance with IEC 61439 series	Comply with requirement.	P
4.3	**Electrical supply**		P
4.3.1	Electrical equipment to be designed for correct operation within the conditions of mains power supply		P
4.3.2	AC supplies		P
	Supply Voltage: Steady state voltage: 0.9 to 1.1 of nominal voltage	380-400 VAC, and the stable voltage comply with ±10% rated voltage.	P
	Frequency: 0.99 to 1.01 of nominal frequency continuously; 0.98 to 1.02 short time.	50/60Hz,comply with ±2% rated frequency.	P
	Harmonics: not exceeding 12 % of the total r.m.s. etc.		N
	Voltage unbalance: not exceeding 2% deviation		N
	Voltage interruption: interrupted or at zero voltage for not more than 3 ms at any random time in the supply cycle with more than 1 s between successive interruptions		N
	Voltage dips not exceeding 20 % of the rms voltage of the supply for more than one cycle with more than 1 s between successive dips		N
4.3.3	DC supplies		N
	Supply voltage: - batteries: 0.85 – 1.15 of nominal voltage - battery-operated vehicles: 0.7 – 1.2 of nom. volt. - from converting equipment: 0.9 – 1.1 of nom. volt.		N
	Voltage interruption: - batteries: not exceeding 5 ms - converting equipment: not exceeding 20 ms		N
	Ripple (peak-to-peak): not exceed. 0.15 of nom. volt.		N

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Clause	Requirement - Test	Result - Remark	Verdict
4.3.4	Special supply systems (e.g. on-board generators, DC bus) limits acc. 4.3.2 /.3 may be exceeded, provided equipment is designed accordingly		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.	Manufacturer is responsible for selecting suitable electric equipment acc. to IEC or EN standards.	P
4.4.2	Immunity and/or emission tests required unless		N
	- incorporated devices and components comply with the relevant product standard and		N
	- installation and wiring according supplier instructions or Annex H:		N
4.4.3	Electrical equipment shall be capable of operating correctly in the intended ambient air temperature. (Minimum requirement: air temperatures of +5 °C and +40 °C)		P
4.4.4	Electrical equipment shall be capable of operating correctly when the relative humidity is up to 50 % at a maximum temperature of +40 °C	35-90%RH	P
	Harmful effects of condensation shall be avoided		P
4.4.5	Electrical equipment shall be capable of operating correctly at altitudes up to 1 000 m above mean sea level	Altitude dose not exceed 1000 m	P
4.4.6	Electrical equipment shall be adequately protected against the ingress of solids and liquids (see 11.3)	For electrical equipment, IP43	P
4.4.7	When equipment is subjected to radiation, additional measures shall be taken	No ionizing and non-ionizing radiation outside this equipment	N
4.4.8	Undesirable effects of vibration, shock and bump avoided by suitable mans	Environmental vibration requirements are described in the specification	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	Wood package and transporting vehicle used Equipment provided hook for moving and handling	P
5	**INCOMING SUPPLY CONDUCTOR TERMINATIONS AND DEVICES FOR DISCONNECTING AND SWITCHING OFF**		—

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Clause	Requirement - Test	Result - Remark	Verdict
5.1	**Incoming supply conductor terminations**		P
	Recommendation that electrical equipment of a machine is connected to a single supply (For large complex machinery, there can be a need for more than one incoming supply)	Incoming supply conductor provided by user and detail specification refer to manual instruction	P
	Unless a plug is provided, supply conductors should be terminated at the supply disconnecting device		P
	Neutral conductor clearly indicated in technical documentation with "N" (see cl. 16.1)		P
	A separate terminal, labelled N provided (it may be part of the supply disconnecting device)		P
	No connection between neutral conductor and protective bonding circuit		P
	For machines supplied from parallel sources the requirements of IEC 60364-1 apply		N
	All terminals of incoming supply clearly marked in ac. with IEC 60445)	All terminals marked correct label	P
5.2	**Terminal for connection of external protective conductor (PE)**		—
	For each incoming supply, a terminal shall be provided in the same compartment as the line conductor terminals for connection to the external protective conductor		P
	Terminal size according to table 1 in relation to the line conductors	PE letter and grounding sign used	P
	Where an external protective conductor other than copper is used, the terminal size and type shall be selected accordingly		P
	At each incoming point this terminal shall be marked or labelled with the letters PE	Terminal is marked with the letters PE Green/Yellow color used	P
5.3	**Supply disconnecting device**		—
5.3.1	A supply disconnecting device shall be provided: – for each incoming supply to a machine – for each on-board power supply		P
	Where two or more such devices exist, interlocks shall be provided to prevent hazardous situations		N
5.3.2	The supply disconnecting device shall be one of the following:		P
	a) a switch-disconnector, acc. to IEC 60947-3 for at least appliance category AC-23 B or DC-23 B		N

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Clause	Requirement - Test	Result - Remark	Verdict
	b) a control and protective switching device suitable for insulation acc. to IEC 60947-6-2		N
	c) a circuit-breaker suitable for isolation (acc. to IEC 60947-2)		P
	d) any other switching device in accordance with an IEC product standard for that device and which meets the isolation requirements and the appropriate utilization category and/or specified endurance requirements		N
	e) a plug/socket combination for a flexible cable supply		N
5.3.3	A disconnection device acc. to 5.3.2 a) to d) has to fulfil all of the following requirements		—
	- isolate the electrical equipment from the supply and have one OFF (isolated) and one ON position marked with "O" and "I"		P
	- have a visible contact gap or a position indicator which cannot indicate OFF (isolated) until all contacts are actually open and the requirements for the isolating function have been satisfied	Comply with the requirement	P
	- have an operating means (see 5.3.4)		N
	- coloured black or grey recommended (If used as an emergency stop, red/yellow combination selected)		N
	- be provided with a means permitting it to be locked in the OFF position (padlocks). When so locked, remote as well as local closing shall be prevented		N
	- disconnect all live conductors of its power supply circuit For TN supply systems, the neutral conductor may or may not be disconnected except in countries where disconnection of the neutral conductor (when used) is compulsory		N
	- have a braking capacity to interrupt the system, when the largest motor is stalled		P
	A plug/socket combination used as a disconnection device shall: - comply with 13.4.5 - have a braking capacity to interrupt the system, when the largest motor is stalled		N
5.3.4	Operating means of supply disconnecting devices (e.g. a handle) shall be external to the enclosure		P
	The operating means shall be easily accessible and located between 0,6 m and 1,9 m above the servicing level (upper limit of 1,7 m is recommended)	Easy to access	P

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Clause	Requirement - Test	Result - Remark	Verdict
5.3.5	The following circuits need not be disconnected by the supply disconnecting device: - lighting circuits for lighting needed during maintenance or repair; - socket outlets for the exclusive connection of repair or maintenance tools and equipment; - undervoltage protection circuits that are only provided for automatic tripping in the event of supply failure; - circuits supplying equipment that should normally remain energized for correct operation Such circuits should be provided with their own disconnecting device.	Not such circuits	N
5.4	**Devices for removal of power for prevention of unexpected start-up**		—
	Devices for removal of power for the prevention of unexpected start-up shall be provided where this can create a hazard	Comply with the requirement	P
	They shall be appropriate and convenient for the intended use, suitably placed, and readily identifiable as to their function and purpose	Comply with the requirement	P
	Where not obvious, they shall be marked to indicate the extent of removal of power		P
	Devices in accordance with 5.3.2 may be used for this purpose		P
	Disconnectors, withdrawable fuse links and withdrawable links only used, if located in enclosed electrical operator area (see 3.1.23)		N
	Devices that do not fulfil the isolation function (e.g. a contactor switched off by a control circuit etc.) only used for tasks such as: – inspections; – adjustments; – work on the electrical equipment where there are only minor risks (as described)		N
5.5	**Devices for isolating electrical equipment**		—
	Devices shall be provided for isolating electrical equipment or parts of it to enable work	Disconnector	P
	Such devices shall be: - appropriate and convenient for the intended use; - suitably placed; - readily identifiable as to which part or circuit of the equipment is served. They shall be marked unless their function and purpose is obvious		P

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Clause	Requirement - Test	Result - Remark	Verdict
	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		N
	In addition, the following devices that fulfil the isolation function may be provided for this purpose: - devices described in 5.3.2; - disconnectors, withdrawable fuse links and withdrawable links only used, if located in enclosed electrical operator area (see 3.1.23) and information provided (see cl 17)		N
5.6	**Protection against unauthorized, inadvertent and/or mistaken connection**		—
	Where devices acc. to cl. 5.4 and 5. are located outside an enclosed electrical operator area, locking means in OFF position shall be provided When so secured, local and remote reconnection shall be prevented	The disconnector can be locked in the OFF position.	P
	Where these devices are located inside an enclosed electrical operator area, other means of protection against unintended reconnection can be sufficient		N
	Where a plug/socket combinations is so positioned that it can be kept under the immediate supervision of the person carrying out the work, means for securing in the disconnected state are not needed		N
6	**PROTECTION AGAINST ELECTRIC SHOCK**		—
6.1	The electrical equipment shall provide protection against electric shock by basic protection and fault protection		P
	Where the measures for protection as in 6.2, 6.3 and 6.4 are not practicable, other measures from IEC 60364-4-41 may be used (e.g. SELV)		P
6.2	**Basic protection**		—
6.2.1	For each circuit the measures of 6.2.2, 6.2.3 and, where applicable, 6.2.4 shall apply		P
	Where not appropriate, other measures as defined in IEC 60364-4-41 may be applied (see also 6.2.5 and 6.2.6)		N
	For equipment in places open to all persons including children, 6.2.2 with a minimum protection of IP4X or IPXXD, or 6.2.3 shall be applied		P

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Clause	Requirement - Test	Result - Remark	Verdict
6.2.2	Live parts shall be located inside enclosures that provide protection against contact with live parts of at least IP2X or IPXXB.	Protected by grounded metal enclosure, which only can be opened by using key and IP20 used	P
	Where the top surfaces of the enclosure are readily accessible, the minimum degree of protection against contact with live parts provided by the top surfaces shall be IP4X or IPXXD.	Ipossible to cause accessible hazard	P
	Opening an enclosure (i.e. opening doors, lids, covers, etc) shall be possible only under one of the following conditions:		—
	a) The use of a key or tool is necessary for access	All electric cabinet doors require a key or tool to open.	P
	b) The disconnection of live parts inside the enclosure before it can be opened (see explanation)		N
	c) Opening without the use of a key or a tool and without disconnection of live parts shall be possible only when all live parts are protected against contact to at least IP2X or IPXXB.		N
6.2.3	Live parts protected by insulation shall be completely covered with insulation that can only be removed by destruction and that is capable of withstanding the mechanical, chemical, electrical, and thermal stresses to which it can be subjected under normal operating conditions	Live wires are protected by an insulating layer and can only be removed using destructive methods.	P
6.2.4	Live parts having a residual voltage greater than 60 V when disconnected, shall be discharged to 60 V or less within 5 s, if this does not interfere with the proper functioning of the equipment		P
6.2.5	For protection by barriers, the requirements of IEC 60364-4-41 shall apply (412.2)		N
6.2.6	For protection by placing out of reach or protection by obstacles, the requirements of IEC 60364-4-41 shall apply (412.4 and 412.3)		N
6.3	**Fault protection**		—
6.3.1	For each circuit or part of el. equipment at least one of the measures of 6.3.2 to 6.3.3 shall be applied:		—
	- Prevention of the occurrence of a touch voltage		N
	- Protection by automatic disconnection of supply		P
6.3.2	Prevention of the occurrence of a touch voltage		--
6.3.2.2	Protection by provision of one or more of the following:		—
	- class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation in accordance with IEC 61140) or		N

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

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Clause	Requirement - Test	Result - Remark	Verdict
	Where protection of a PDS (power drive system) is not provided by the converter, the necessary protection shall be acc. to the converter manufacturer's instructions		N
6.4	**Protection by the use of PELV**		—
6.4.1	PELV circuits shall satisfy all of the following conditions:		—
	a) the nominal voltage does not exceed: - 25 V AC r.m.s. or 60 V ripple-free AC when the equipment is normally used in dry locations and when large area contact of live parts with the human body is not expected; or - 6 V AC r.m.s. or 15 V ripple-free DC in all other cases;		N
	b) one side of the circuit or one point of the source of the supply of that circuit is connected to the protective bonding circuit;		N
	c) live parts of PELV circuits shall be electrically separated from other live circuits (see IEC 61558)		N
	d) conductors of each PELV circuit shall be physically separated from those of any other circuit. If this requirement is impracticable, the insulation provisions of 13.1.3 shall apply		N
	e) plugs and socket-outlets for a PELV circuit shall conform to the following: - plugs shall not to enter socket-outlets of other voltage systems - socket-outlets shall not admit plugs of other voltage systems		N
6.4.2	The sources for PELV shall be one of the following:		—
	- a safety isolating transformer in accordance with IEC 61558-1 and IEC 61558-2-6 or		N
	- a source of current with a degree of safety equi-valent to that of the safety isolating transformer or		N
	- a source independent of circuit with higher voltage (e.g. battery or diesel –driven) or		N
	- electronic power supply conforming to appropriate standards		N

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Clause	Requirement - Test	Result - Remark	Verdict
7.	**PROTECTION OF EQUIPMENT**		—
7.2	**Overcurrent protection**		—
7.2.1	Overcurrent protection shall be provided where the current in any circuit can exceed the rating of a component or the capacity of a conductor	Power supply circuit breaker have overcurrent protection function	P
7.2.2	Supply conductors		P
	Unless otherwise specified by the user, the supplier of the electrical equipment is not responsible for providing the supply conductors or the overcurrent protective device for it		N
	In the installation documents, the data necessary for conductor dimensioning and selecting the overcurrent protective device are stated (see 7.2.10 and 17.4)	See instruction	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 including supplies to control circuit transformers.	Power supply circuit breaker have overcurrent protection function	P
	The following conductors shall not be disconnected without disconnecting all associated live conductors: - the neutral conductor of AC power circuits; - the earthed conductor of DC power circuits; - DC power conductors bonded to exposed conductive parts of mobile machines.		P
	Where the cross-section area of the neutral conductor is at least equal to the line conductor, no overcurrent detection nor disconnecting device is required for that conductor		N
	Otherwise the measures detailed in 524 of IEC 60364-5-52:2009 shall apply		N
	In IT-Systems, it is recommended that no neutral conductor is used. Where a neutral conductor is used, the measures detailed in 431.2.2 of IEC 60364-4-43:2008 shall apply		N
7.2.4	Control circuits		—
	Conductors of control circuits directly connected to the supply shall be protected against overcurrent in accordance with 7.2.3.		P
	Conductors of control circuits supplied by a transformer or DC supply shall be protected against overcurrent (see also 9.4.3.1.1):		—

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Clause	Requirement - Test	Result - Remark	Verdict
	- In control circuits, connected to the protective bonding circuit, by an overcurrent protective device in the switched conductor	Fuse used	P
	- In circuits, not connected to the protective bonding circuit: • Where all control circuits have the same current carrying capacity, by an overcurrent protective device in the switched conductor • Otherwise, by an overcurrent protective device in both, switched and common conductors of each control circuit		N
7.2.5	Overcurrent protection shall be provided for circuits feeding general purpose socket outlets		N
7.2.6	Unearthed conductors of lighting circuits shall be protected separately from other circuits.		P
7.2.7	Transformers shall be protected in accordance with the manufacturer's instructions and includes: - avoiding tripping due to transformer magnetizing inrush currents - avoiding a winding temperature rise in excess of the permitted value for the insulation class when there is a short circuit at the secondary terminals		P
7.2.8	Location of overcurrent protective devices		—
	It shall be located at the point where a reduction in the cross sectional area of the conductors or another change reduces the current-carrying capacity of the conductors except:	located at point where conductor is connected to the supply	P
	- current carrying capacity of the conductors is at least equal to that of the load and - conductors between the point of reduction of current-carrying capacity and the position of the overcurrent protective device is ≤ 3 m and - the conductor is protected e.g. by an enclosure or duct.		N
7.2.9	Overcurrent protective devices		—
	The rated short-circuit breaking capacity shall be at least equal to the prospective fault current at the point of installation. Additional currents other than from the supply (e.g. from motors, from power factor correction capacitors) shall be taken into consideration.	Comply with the requirement	P
	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.	Comply with the requirement	P
7.2.10	Rating and setting of overcurrent protective devices:		—

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Clause	Requirement - Test	Result - Remark	Verdict
	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 for conductors is determined by the current carrying capacity of the conductors to be protected in accordance with Cl. 12.4, D.2 and the maximum allowable interrupting time *t* in accordance with Clause D.3.	Comply with the requirement	P
7.3	**Protection of motors against overheating**		—
7.3.1	Protection shall be provided for each motor rated at more than 0.5 kW.		P
	Automatic restarting prevented where this can cause a hazard		N
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)	The driver system provided	P
	For special duty motors, appropriate protective devices are recommended		N
	For motors that cannot be overloaded, overload protection is not required.		N
7.3.3	Protection achieved by over-temperature protection device: Is recommended in situations where the cooling can be impaired (for example dusty environments)	Use a cooling fan to cool down	P
7.4	Equipment shall be protected against abnormal temperatures that can result in a hazardous situation.		P
7.5	**Protection against the effects of supply interruption or voltage reduction and subsequent restoration**		—
	Where a supply interruption or a voltage reduction can cause a hazardous situation, damage to the machine, or to the work in progress, undervoltage protection is provided.		N
	Upon restoration of supply voltage, automatic or unexpected restarting of machine prevented.		P
	Undervoltage protection does initiate appropriate control responses to ensure necessary coordination of groups of machines working together		P
7.6	Motor overspeed protection shall be provided where overspeeding can occur and could possibly cause a hazardous situation.	The driver system provides speed feedback monitoring	P

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Clause	Requirement - Test	Result - Remark	Verdict
7.7	Additional earth fault/residual current protection In addition to providing overcurrent protection for automatic disconnection as described in 6.3, earth fault/residual current protection can be provided to reduce damage to equipment due to earth fault currents less than the detection level of the overcurrent protection. The setting of the devices shall be as low as possible consistent with correct operation of the equipment.		N
7.8	Phase sequence protection shall be provided, where an incorrect phase sequence of the supply voltage can cause a hazardous situation or damage to the machine.		N
7.9	Surge protective devices (SPDs) can be provided to protect against the effects of overvoltages due to lightning or to switching surges.		N
7.10	Short-circuit current rating The short-circuit current rating of the electrical equipment shall be determined. This can be done by the application of design rules or by calculation or by test.		P
8	**EQUIPOTENTIAL BONDING**		—
8.2	**Protective bonding circuit**		—
8.2.1	All parts of the protective bonding circuit shall be so designed that they are capable of withstanding the highest thermal and mechanical stresses		P
	Protective conductors which does not form part of a cable shall not be less than:		—
	- 2.5 mm^2 Cu or 16 mm^2 Al if protection against mechanical damage is provided		P
	- 4 mm^2 Cu or 16 mm^2 Al if protection against mechanical damage is not provided		N
	Small parts and other conductive parts that do not constitute a hazard need not to be earthed	No such parts	N
8.2.2	Protective conductors		—
	Protective conductors shall be identified in accordance with 13.2.2.	The sign has the letter "PE"	P
	Copper conductors are preferred.	Copper conductors	P
	Where other material is used, its electrical resistance per unit length shall not exceed that of the allowable copper conductor and such conductors shall be not less than 16 mm^2 in cross-sectional area.	Copper conductors	N

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Clause	Requirement - Test	Result - Remark	Verdict
	Metal enclosures or frames or mounting plates may be used as protective conductors if they satisfy the following three requirements: - protection against mechanical, chemical or electrochemical deterioration - compliant with 543.1 of IEC 60364-5-54: - permit the connection of other protective conductors where foreseen	Comply with the requirement	P
	The cross-section of protective conductors shall be calculated according to 543.1.2 of IEC 60364-5-54, or selected in accordance with Table 1.	Comply with the requirement	P
	Each protective conductor shall: - be part of a multicore cable, or; - be in a common enclosure with the line conductor, or; - have a cross-sectional area of at least; • 2.5 mm^2 Cu or 16 mm^2 Al with protection against mechanical damage • 4 mm^2 Cu or 16 mm^2 Al without protection against mechanical damage	4 mm^2 Cu	P
	A protective conductor not forming part of a cable is considered to be mechanically protected if it is installed in a conduit, trunking or protected in a similar way.		P
	The following parts shall be connected to the protective bonding circuit but shall not be used as protective conductors: - conductive structural parts of the machine; - metal ducts of flexible or rigid construction; - metallic cable sheaths or armouring; - metallic pipes containing flammable materials such as gases, liquids, powder. - flexible or pliable metal conduits; - constructional parts subject to mechanical stress in normal service; - • flexible metal parts; support wires; cable trays and cable ladders.	No such parts	N
8.2.3	Continuity of the protective bonding circuit		—
	Where a part is removed the protective bonding circuit for the remaining parts isn't interrupted.		P
	Current-carrying capacity of connection and bonding points not impaired by mechanical, chemical, or electrochemical influences (e.g. electrolytic corrosion on aluminium parts)	Not impaired by mechanical, chemical or electrochemical influences	P

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Clause	Requirement - Test	Result - Remark	Verdict
	Where the electrical equipment is mounted on lids, doors, or cover plates, continuity of the protective bonding circuit shall be ensured. The use of a protective conductor (see 8.2.2) is recommended.		N
	For cables that are exposed to damage (for example flexible trailing cables) the continuity of the protective conductors are ensured by appropriate measures (for example monitoring).	No such parts	N
	Where the continuity can be interrupted, a first make last break contact is required.	Plug/socket combination, first make last break contact the protective conductors	P
8.2.4	Protective conductor connecting points are not intended to attach appliances or parts.		P
	Each connecting point shall be marked or labelled as such using the symbol IEC 60417-5019 or the letters PE or by use of bicolour GREEN / YELLOW 	Green/yellow are used, PE marking used	P
8.2.5	Mobile machines with on-board power supplies: The protective bonding system is connected to a single protective bonding terminal. This protective bonding terminal is the connection point for a possible additional external incoming power supply		N
8.2.6	**Additional requirements for electrical equipment having earth leakage currents higher than 10 mA**		—
	Where electrical equipment has an earth leakage current greater than 10 mA AC or DC the associated protective bonding circuit shall satisfy one of the following:	Earth leakage currents less than 10mA	N
	a) the protective conductor is completely enclosed or otherwise protected		N
	b) the protective conductor has a cross-sectional area of at least 10 mm^2 Cu or 16 mm^2 Al		N
	c) a second protective conductor of at least the same cross-sectional area is provided		N
	d) the supply is automatically disconnected in case of loss of continuity of the protective conductor		N
	e) where a plug-socket combination is used, an industrial connector in accordance with IEC 60309 series is provided		N
	A statement shall be given in the instructions for installation that the equipment shall be installed as described in this 8.2.6.		N

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Clause	Requirement - Test	Result - Remark	Verdict
8.3	Measures to restrict the effects of high leakage current can be taken as described		N
8.4	If functional bonding is used, the connecting points should be marked with symbol IEC 60417-5020 		N
9	**CONTROL CIRCUITS AND CONTROL FUNCTIONS**		—
9.1.	**Control circuit**		—
9.1.1	Where control circuits are supplied from an AC source, transformers having separate windings shall be used to separate the power supply from the control supply.		P
	Where several transformers are used, it is recommended that the secondary voltages are in phase.		N
	Where DC control circuits derived from an AC supply are connected to the protective bonding, they shall be supplied from a separate winding		N
9.1.2	The nominal voltage of control circuits should preferably not exceed - 230 V @ 50 Hz - 277 V @ 60 Hz - 220 V @ DC		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**		—
9.2.2	Categories of stop functions are stop category 0, 1, 2	Stop category 0	P
9.2.3	Operation		—
9.2.3.1	Where a machine has more than one control station, measures shall be provided to ensure that initiation of commands from different control stations do not lead to a hazardous situation.	Only one control station	P
9.2.3.2	Start functions shall operate by energizing the relevant circuit.	Start by pressing the start button	P
	Start of an operation shall be possible only when all of the relevant safety functions and/or protective measures are in place and are operational.		N
	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.	No such device	N

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Clause	Requirement - Test	Result - Remark	Verdict
	In the case of machines requiring the use of more than one control station to initiate a start, each of these control stations shall have a separate manually actuated start control device. The conditions to initiate a start are: - all required conditions for machine operation shall be met and - all start control devices shall be in the released (off) position, then - all start control devices have to be actuated concurrently (see 3.1.7).	Only one control station	N
9.2.3.3	Stop category 0 and/or stop category 1 and/or stop category 2 stop functions are provided as indicated by the risk assessment and the functional requirements of the machine (see 4.1).	Stop category 0	P
	Stop functions shall override related start functions	Comply with the requirement	P
	Where more than one control station is provided, stop commands from any control station is effective when required by the risk assessment of the machine.		N
9.2.3.4	Emergency operations (emergency stop, emergency switching off)		—
9.2.3.4.1	Emergency stop or emergency switching off commands shall be sustained until it is reset.	When emergency stop function starting, all power supply disconnected and other control function can not operate.	P
	This reset shall be possible only by a manual action at that location where the command has been initiated.		P
	The reset of the command shall not restart the machinery but only permit restarting.		P
	It shall not be possible to restart the machinery until all emergency stop commands are reset.		P
	It shall not be possible to reenergize the machinery until all emergency switching off commands are reset.		P
9.2.3.4.2	The emergency stop does function either as a stop category 0 or as a stop category 1.	Stop category 0	P
	- it shall override all other functions and operations in all modes - it shall stop the hazardous motion as quickly as practicable without creating other hazards - a reset shall not initiate a restart	Comply with the requirement	P
9.2.3.4.3	Emergency switching off should be provided where: - Protection against direct contact is achieved only by placing out of reach or by obstacles (see 6.2.6) or - there is the possibility of other hazards or damage caused by electricity		N

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Clause	Requirement - Test	Result - Remark	Verdict
	Emergency switching off is accomplished by electromechanical switching devices, effecting a stop category 0 of machine actuators connected to this incoming supply		N
9.2.3.5	Operating modes		—
	Where machinery uses several control or operating modes requiring different protective measures and having a different impact on safety, it shall be fitted with a mode selector which can be locked in each position		P
	Another selection method can be used (for example an access code)		N
	Mode selection by itself does not initiate machine operation. A separate actuation of the start control has to be stated by the operator.	by the start button	P
	Indication of the selected operating mode shall be provided (e.g. the position of a mode selector, the provision of an indicating light, a visual display indication)	Marked on key operated switch	P
9.2.3.6	Movement or action that can result in a hazardous situation shall be monitored by providing, for example, overtravel limiters, motor overspeed detection, mechanical overload detection or anti-collision devices	Motor overspeed detection；	P
9.2.3.7	Hold-to-run controls shall require continuous actuation of the control device(s) to achieve operation		N
9.2.3.8	Two-hand controls shall be one of the following types and have the following features		N
	Type I: this type requires: - the provision of two control devices and their concurrent actuation by both hands; - continuous concurrent actuation during the hazardous situation; - machine operation shall cease upon the release		N
	Type II: a Type I control requiring the release of both control devices before machine operation can be reinitiated		N

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Clause	Requirement - Test	Result - Remark	Verdict
	Type III: a Type II control requiring concurrent actuation of the control devices as follows: - it shall be necessary to actuate the control devices within a certain time limit of each other, not exceeding 0.5 s - where this time limit is exceeded, both control devices shall be released before machine operation can be initiated		N
9.2.3.9	Enabling control shall be so arranged as to minimize the possibility of defeating, for example by requiring the de-activation of the enabling control device before machine operation may be reinitiated		N
9.2.3.10	Combined start and stop controls: Push-buttons etc. that alternately initiate and stop motion shall only be provided for functions, which cannot result in a hazardous situation.		N
9.2.4	Cableless control system		—
9.2.4.1	The CCS shall have functionality and a response time suitable for the application based on the risk assessment.		N
9.2.4.2	The ability of a CCS to control a machine shall be automatically monitored, either continuously or at suitable intervals.		N
	If the communication signal has degraded (e.g., reduced signal level, low battery power) a warning shall be given		N
	When the ability to control a machine has been lost, an automatic stop of the machine shall be initiated.		N
	Its restoration shall not restart the machine.		N
9.2.4.3	Measures shall be taken to prevent the machine from responding to signals other than those from the intended operator control station(s).		N
	Cableless operator control station(s) shall only control the intended machine(s) and shall affect only the intended machine functions.		N
9.2.4.4	When more than one cableless operator control station is used, then:		—
	- only one control station shall be enabled at a time except as necessary for the operation		N
	- transfer of control shall require a deliberate manual action at the station having control		N
	- transfer shall only be possible if both stations are in the same mode		N

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Clause	Requirement - Test	Result - Remark	Verdict
	- a transfer shall not change the mode of operation or function		N
	- on the station that has control, a visual indication shall indicate this		N
9.2.4.5	Portable cableless operator control stations shall be provided with means to prevent unauthorized use		N
	Each machine should have an indication when it is under cableless control		N
	When possible to be connected to several machines, means shall be provided on the portable device to select		N
	Selecting a machine shall not initiate control commands.		N
9.2.4.6	A deliberate disabling shall meet the requirements of 9.2.4.2.		N
	Where disabling without interrupting machine operation is necessary, appropriate means shall be provided to transfer control		N
9.2.4.7	Emergency stop devices on portable cableless operator control stations shall not be the sole means of initiating an emergency stop		N
	Confusion between active and inactive emergency stop devices shall be avoided		N
9.2.4.8	Restarting of a cableless control shall not result in a reset of an emergency stop condition		N
	The instructions shall state that a reset shall only be performed when it can be seen that the reason has been cleared		N
9.3	**Protective interlocks**		—
9.3.1	The reclosing or resetting of an interlocking safeguard does not initiate hazardous machine operation		P
9.3.2	Where an operating limit (for example speed, pressure, position) can be exceeded leading to a hazardous situation, means shall be provided to detect when a predetermined limit(s) is exceeded and initiate an appropriate control action		N
9.3.3	The correct operation of auxiliary functions shall be checked by appropriate devices		N
	Where the non-operation of a device can cause a hazard, appropriate interlocking shall be provided		N
9.3.4	Interlocks between different operations and for contrary motions shall be provided, if these operations can lead to hazardous situations		N

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Clause	Requirement - Test	Result - Remark	Verdict
9.3.5	Where braking of a motor is accomplished by current reversal, measures shall prevent the motor starting in the opposite direction at the end of braking where that reversal can cause a hazardous situation or damage to the machine or to the work in progress		N
	For this purpose, a device operating exclusively as a function of time is not permitted		N
	Control circuits shall be so arranged that rotation of a motor shaft, for example manually, does not result in a hazardous situation		N
9.3.6	Where it is necessary to suspend safety functions and/or protective measures, the control or operating mode selector shall simultaneously:		—
	- disable all other operating (control) modes		N
	- permit operation only by the use of a hold-to-run device or by a similar control device positioned so as to permit sight of the hazardous elements		N
	- prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors		N
	If these four conditions cannot be fulfilled, the mode selector shall activate other protective measures to ensure a safe intervention zone. In addition, the operator shall be able to control operation of the parts he is working on from the adjustment point.		N
9.4	Control functions in the event of failure		—
9.4.1	The electrical control system(s) shall have an appropriate performance that has been determined from the risk assessment of the machine	Use of proven circuit techniques and components;	P
	The requirements for safety-related control functions of IEC 62061 and/or ISO 13849-1, ISO 13849-2 shall apply		P
	Where memory retention is achieved for example, by battery power, measures shall be taken to prevent hazardous situations arising from failure, undervoltage or removal of the battery		N
	Means shall be provided to prevent unauthorized or inadvertent memory alteration by, for example, requiring the use of a key, access code or tool		N
9.4.2	Measures to minimize risk in the event of failure		—

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Clause	Requirement - Test	Result - Remark	Verdict
9.4.2.1	Measures to minimize risk in the event of failure include but are not limited to: • use of proven circuit techniques and components; • provisions of partial or complete redundancy ; • provision of diversity; • provision for functional tests.	Comply with the requirement	P
9.4.2.2	Use of proven circuit techniques and components (see examples)		P
9.4.2.3	Provisions of partial or complete redundancy		N
9.4.2.4	Provision of diversity (see examples)		N
9.4.2.5	Provision for functional tests	Comply with the requirement	P
9.4.3	Protection against malfunction of control circuits		—
9.4.3.1.1	Measures shall be provided to reduce the probability that insulation faults on any control circuit can cause malfunction		P
9.4.3.1.2	Method a) – Earthed control circuits fed by transformers		P
	The common conductor shall be connected to the protective bonding circuit at the point of supply.		N
	All control elements are to be inserted on the other side of the components		N
9.4.3.1.3	Method b) – Non-earthed control circuits fed by transformers shall either		N
	1) have 2-pole control switches that operate on both conductors; or		N
	2) be provided with a device that interrupts the circuit automatically in the event of an earth fault; or		N
	3) where 2) above would increase the risk, it can be sufficient to provide an insulation monitoring device hat will initiate an acoustic and optical signal		N
9.4.3.1.4	Method c) – Control circuits fed by transformer with an earthed centre-tap winding shall have overcurrent protective devices that break both the conductors		N
	The control switches shall be 2-pole types that operate on both conductors		N
9.4.3.1.5	Method d) – Control circuits not fed by a transformer are only allowed for machines with a maximum of one motor starter and/or maximum of two control devices, in accordance with 9.1.1		N
	Possible cases are:		—

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Clause	Requirement - Test	Result - Remark	Verdict
	1) directly connected to an earthed supply system (TN- or TT-system)		N
	If powered between two lines, multi-pole control switches are required		N
	2) directly connected to a supply system that is not earthed or is earthed through a high impedance (IT-system)		N
	A device shall be provided that interrupts the circuit automatically in the event of an earth fault		N
9.4.3.2	Where the loss of memory due to a power failure can result in a hazardous situation, appropriate measures shall be taken		N
9.4.3.3	Where the loss of continuity of control circuits depending upon sliding contacts can result in a hazard, appropriate measures shall be taken		N
10	**OPERATOR INTERFACE AND MACHINE-MOUNTED CONTROL DEVICES**		—
10.1.1	Control devices for operator interface shall, as far as is practicable, be selected, mounted, and identified or coded in accordance with IEC 61310 series	Comply with IEC 61310 series	P
10.1.2	As far as is practicable, machine-mounted control devices shall be:		—
	- 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	The installation position of the control device is easy to access, the possibility of damage is minimized, and the operation is not in a dangerous position	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 are within easy reach of the normal working position of the operator	More than 0.6m service level and easy reach of normal working	P
	- the operator is not placed in a hazardous situation when operating them	Not place in the hazardous position	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		N
	- the operator is not placed in a hazardous situation when operating them		N

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Clause	Requirement - Test	Result - Remark	Verdict
10.1.3	The degree of protection (IP rating in accordance with IEC 60529) together with other appropriate measures shall provide protection against:	The protection level of operation panel is suitable for its working environment and meets the requirements of IP20	P
	– the effects of 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 shall have a minimum degree of protection against contact with live parts of IPXXD (see IEC 60529)		N
10.1.4	Position sensors (for example position switches, proximity switches) are so arranged that they will not be damaged in the event of overtravel		N
	Position sensors in circuits with safety-related control functions shall have direct opening action (see IEC 60947-5-1) or shall provide similar reliability (see 9.4.2)		N
10.1.5	Portable and pendant operator control stations and their control devices are so selected and arranged as to minimize the possibility of machine operations caused by inadvertent actuation, shocks and vibrations	No such device	N
10.2	**Actuators**		—
10.2.1	Actuators shall be colour-coded as follows:		P
	The colours for START/ON actuators should be WHITE, GREY, BLACK or GREEN with a preference for WHITE. RED shall not be used	The color of button operator conforms to the requirements in table 2	P
	The colour RED shall be used for emergency stop and emergency switching off actuators	RED	P
	If a background exists, it shall be coloured YELLOW	Background coloured YELLOW	P
	The colours for STOP/OFF actuators should be BLACK, GREY, or WHITE with a preference for BLACK. GREEN shall not be used. RED is permitted	RED	P
	WHITE, GREY, or BLACK are the preferred colours for actuators that alternately act as START/ON and STOP/OFF actuators. The colours RED, YELLOW, or GREEN shall not be used		P
	The same is applicable for “hold-to-run” actuators		P
	Reset actuators shall be BLUE, WHITE, GREY, or BLACK. Where they also act as a STOP/OFF actuator, the colours WHITE, GREY, or BLACK are preferred with the main preference being for BLACK. GREEN shall not be used.		P

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Clause	Requirement - Test	Result - Remark	Verdict
	The colour YELLOW is reserved for use in abnormal conditions		N
	Where the same colours are used for various functions, a supplementary means of coding shall be used for the identification		P
10.2.2	Recommended markings for actuators are given in table 2 and 3		P
10.3	**Indicator lights and displays**		—
10.3.1	Indicator lights and displays shall be selected and installed in such a manner as to be visible from the normal position of the operator (see also IEC 61310-1).	Equipped with indicator light and alarm light Emergency–red Abnomal- yellow Normal -green	P
	Circuits used for visual or audible devices used to warn persons of an impending hazardous event shall be fitted with facilities to check the operability of these devices	Comply with the requirement	P
10.3.2	Indicator lights should be colour-coded with respect to the condition (status) of the machine in accordance with Table 4.		N
	Indicating towers on machines have the applicable colours in the following order from the top down; RED, YELLOW, BLUE, GREEN and WHITE.		N
10.3.3	For further distinction or information and especially to give additional emphasis, flashing lights and displays can be provided		P
	Where flashing lights or displays are used to provide higher priority information, additional acoustic warnings should be considered		P
10.4	illuminated push-button actuators shall be colour-coded in accordance with Tables 2 and 4. Where there is difficulty in assigning an appropriate colour, WHITE is used.		P
	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, shall 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 shall be constructed and mounted so as to minimize inadvertent operation		P
10.7	**Emergency stop devices**		—

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Clause	Requirement - Test	Result - Remark	Verdict
10.7.1	Devices for emergency stop are readily accessible		P
	Emergency stop devices shall be provided at each location where the initiation of an emergency stop can be required	Comply with the requirement	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.	Comply with the requirement	P
10.7.2	The types of device for emergency stop include, but are not limited to: – a push-button device for actuation by the palm or the fist (e.g. mushroom) – a pull-cord operated switch – a pedal-operated switch without mechanical guard	Red mushroom head type button switch, with direct disconnect operation	P
	The devices shall be in accordance with IEC 60947-5-5.		P
10.7.3	Where a stop category 0 is suitable, the supply disconnecting device may serve the function of emergency stop where: – it is readily accessible to the operator; and – it is of the type described in 5.3.2 a), b), c), or d)		P
	Where intended for emergency use, the supply disconnecting device shall meet the colour requirements of 10.2.1		P
10.8	**Emergency switching off devices**		—
10.8.1	Such devices shall be located as necessary for the given application.		P
	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		P
	The devices shall have direct opening action		P
10.8.3	Where the supply disconnecting device is to be locally operated for emergency switching off, it shall be readily accessible and shall meet the colour requirements of 10.2.1		N
10.9	**Enabling control device**		—
	Enabling control devices shall be selected and arranged so as to minimize the possibility of defeating		N

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Clause	Requirement - Test	Result - Remark	Verdict
	They shall be designed in accordance with ergonomic principles		N
	Functions of two-position types: - position 1: off-function of the switch (actuator is not operated); - position 2: enabling function (actuator is operated)		N
	Functions of three-position types: - position 1: off-function of the switch (actuator is not operated) - position 2: enabling function (actuator is operated in its mid position) - position 3: off-function (actuator is operated past its mid position) - when returning from position 3 to position 2, the enabling function is not activated		N
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	All the components of the control equipment can be clearly identified, and easy to replace, easy to operate and repair from the front, plug with anti-misplug design, plug socket easy to plug	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)	Easy accessible	P
	All controlgear are mounted so as to facilitate its operation and maintenance		P
	Necessary tools to adjust, maintain, or remove a device are supplied		N
	Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0.4 m and 2.0 m above the servicing level		P
	Recommendation, that terminals be least 0.2 m above the servicing level and so placed that conductors and cables can be easily connected		P
	Only operating, indicating, measuring, and cooling devices are mounted on doors or on normally removable access covers of enclosures		P
	Where connected through plug-in arrangements, their association shall be made clear by type (shape), marking or reference designation		P

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Clause	Requirement - Test	Result - Remark	Verdict
	Plug-in devices that are handled during normal operation shall be provided with non-interchangeable features		N
	Plug/socket combinations that are handled during normal operation are unobstructedly accessible.		N
	Test points for connection of test equipment shall be: – mounted to provide unobstructed access – clearly identified to correspond with the documentation – adequately insulated – sufficiently spaced		N
11.2.2	Physical separation or grouping		—
	Non-electrical parts and devices, not directly associated with the electrical equipment, shall not be located within enclosures containing controlgear		P
	Devices such as solenoid valves should be separated from the other electrical equipment (for example in a separate compartment)		N
	Control devices mounted in the same location and connected to the supply voltage, or to both supply and control voltages, should be grouped separately from those connected only to the control voltages		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 shall be maintained, taking into account the external influences or conditions of the physical environment.		P
11.2.3	The temperature rise inside electrical equipment enclosures shall not exceed the ambient temperature specified by the component manufacturers		P
	Heat generating components (for example heat sinks, power resistors) are located so, that the temperature of each component in the vicinity remains within the permitted limit		P
11.3	**Degrees of protection**		—
	The protection of controlgear against ingress of solid foreign objects and of liquids shall be adequate taking into account the external influences under which the machine is intended to operate and shall be sufficient against dust, coolants, lubricants and swarf		P

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Clause	Requirement - Test	Result - Remark	Verdict
	Enclosures of controlgear provide a degree of protection of at least IP22 (see IEC 60529)		P
11.4	**Enclosures, doors and openings**		—
	Enclosures shall be constructed using materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity and other environmental factors that are likely to be encountered in normal service		P
	Fasteners used to secure doors and covers should be of the captive type	Comply with the requirement	P
	Windows of enclosures shall be of a material suitable to withstand expected mechanical stress and chemical attack		N
	It is recommended that enclosure doors having vertical hinges be not wider than 0,9 m, with an angle of opening of at least 95°	Comply with the requirement	P
	Joints or gaskets of doors, lids, etc. shall withstand the chemical effects of the aggressive liquids, vapours, or gases used on the machine.		N
	They shall: - be securely attached - not deteriorate due to removal or replacement of the door		N
	Openings in enclosures (for example, for cable access), including those towards the floor or foundation or to other parts of the machine shall be equipped with means to ensure the degree of protection specified for the equipment.		N
	A suitable opening may be provided in the base of enclosures within the machine so that moisture due to condensation can drain away		N
	Openings for cable entries shall be easily re-opened on site		N
	There shall be no opening between enclosures containing electrical equipment and compartments containing coolant, lubricating or hydraulic fluids, or those into which oil, other liquids, or dust can penetrate.		N
	Holes in an enclosure for mounting shall not impair the required protection.		N

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Clause	Requirement - Test	Result - Remark	Verdict
	Equipment that, in normal or abnormal operation, can attain a surface temperature sufficient to cause a risk of fire or harmful effect to an enclosure material shall: – be located within an enclosure that will withstand, such temperatures; and – be located at a sufficient distance from adjacent equipment allowing safe dissipation of heat (see also 11.2.3); or – be otherwise screened by material that can withstand to the harmful effect.		N
11.5	**Access to electrical equipment**		—
	Doors in gangways for access to electrical operating areas shall: - be at least 0.7 m wide and 2.0 m high - open outwards - have a means (for example panic bolts) to allow opening from the inside without the use of a key or tool		N
12	**CONDUCTORS AND CABLES**		—
12.1	Conductors and cables shall be selected so as to be suitable for the operating conditions and external Influences that can exist	Comply with the requirement	P
	These requirements do not apply to the integral wiring of assemblies, subassemblies, and devices that are manufactured and tested in accordance with their relevant IEC standard (for example IEC 61800 series).		—
12.2	Conductors should be of copper. Where aluminium conductors are used, the cross-sectional area shall be at least 16 mm^2.	Copper used	P
	The cross-sectional area of conductors should not be less than as shown in Table 5	Comply with the requirement	P
	Smaller cross-sectional areas or other constructions than shown in Table 5 may be used, provided adequate mechanical strength is achieved by other means		N
	Class 1 and class 2 conductors are primarily intended for use between rigid, non-moving parts where vibration is not likely to cause damage		P
	All conductors that are subject to frequent movement should have flexible stranding of class 5 or class 6.		P
12.3	Where the insulation of conductors and cables can constitute hazards due for example to the propagation of a fire or the emission of toxic or corrosive fumes adequate means are provided. Special attention is given to the integrity of a circuit having a safety-related function	Comply with the requirement	P

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Clause	Requirement - Test	Result - Remark	Verdict
	The insulation of cables and conductors used, shall be suitable for a test voltage:		—
	- not less than 2 000 V AC for a duration of 5 min for operation at voltages higher than 50 V AC or 120 V DC, or		P
	- not less than 500 V AC for a duration of 5 min for PELV circuits (see IEC 60364-4-41, class III equipment).		N
	The insulation shall be such that it cannot be damaged in operation or during laying, especially for cables pulled into ducts.	Comply with the requirement	P
12.4	Current-carrying capacity in normal service in accordance with table 6. Or in accordance with suppliers recommendation.		P
12.5	The voltage drop from the point of supply to the load in any power circuit cable shall not exceed 5 % of the nominal voltage under normal operating conditions.		P
	In control circuits, the voltage drop shall not reduce the voltage at any device below the manufacturer's specification for that device, taking into account inrush currents.	Comply with the requirement	P
12.6	**Flexible cables**		—
12.6.1	Flexible cables shall have Class 5 or Class 6 conductors		P
	Cables that are subjected to severe duties shall be of adequate construction to protect against: - abrasion due to mechanical handling and dragging across rough surfaces - kinking due to operation without guides - stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums		N
12.6.2	The tensile stress applied to copper conductors shall not exceed 15 N/mm^2 of cross-sectional area Or special measures are taken to withstand the applied stress		P
	For material other than copper the applied stress shall be within the cable manufacturer's specification		P
12.6.3	For cables of circular cross-sectional area installed on drums, the maximum current should be derated in accordance with Table 7		N
12.7	**Conductor wires, conductor bars and slip-ring assemblies**		—

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Clause	Requirement - Test	Result - Remark	Verdict
12.7.1	During normal access to the machine, protection to conductor wires, conductor bars and slip-ring assemblies shall be achieved by the application of one of the following protective measures:		P
	- protection by partial insulation of live parts, or where this is not practicable		P
	- protection by enclosures or barriers of at least IP2X or IPXXB		P
	Horizontal top surfaces of barriers or enclosures that are readily accessible shall provide a degree of protection of at least IP4X or IPXXD		N
	Where the required degree of protection is not achieved, protection by placing live parts out of reach in combination with emergency switching off in accordance with 9.2.5.4.3 shall be applied		N
	Conductor wires and conductor bars shall be so placed and/or protected as to:		—
	- prevent contact, especially for unprotected conductor wires and conductor bars, with conductive items such as the cords of pull-cord switches, strain-relief devices and drive chains		N
	- prevent damage from a swinging load		N
12.7.2	Protective conductor circuit (PE) and the neutral conductor (N) each use a separate conductor wire, conductor bar or slip-ring		P
	The continuity of the protective conductor circuit using sliding contacts shall be ensured by taking appropriate measures (for example, duplication of the current collector, continuity monitoring)		P
12.7.3	Protective conductor current collectors shall have a shape or construction so that they are not interchangeable with the other current collectors. Such current collectors shall be of the sliding contact type		N
12.7.4	Removable current collectors with disconnector function: The protective conductor circuit interrupts after and reconnects before any live conductor		N
12.7.5	Clearances in air between conductors and adjacent systems shall be suitable for at least a rated impulse voltage of an overvoltage category III in accordance with IEC 60664-1		P
12.7.6	Creepage distances between conductors and adjacent systems shall be suitable suitable for operation in the intended environment, e.g. open air, inside buildings, protected by enclosures		P

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Clause	Requirement - Test	Result - Remark	Verdict
	In abnormally dusty, moist or corrosive environments, the following creepage distance requirements apply:		N
	- unprotected conductor wires, conductor bars, and slip-ring assemblies: 60 mm		N
	- enclosed conductor wires, insulated multipole conductor bars and insulated individual conductor bars: 30 mm		N
12.7.7	Conductor system divided into isolated sections: suitable design measures shall be employed to prevent the energization of adjacent sections by the current collectors themselves		P
12.7.8	Conductor wires, conductor bars and slip-ring assemblies in power circuits shall be grouped separately from those in control circuits		P
	They shall be capable of withstanding, without damage, the mechanical forces and thermal effects of short-circuit currents		P
	Removable covers cannot be opened by one person without the aid of a tool		N
	Where common metal enclosures are used, the individual sections shall be bonded together and connected to the protective bonding circuit		N
	Conductor bar ducts that can be subject to accumulation of liquid shall have drainage facilities		N
13	**WIRING PRACTICES**		—
13.1	Connections and routing		—
13.1.1	All connections shall be secured against accidental loosening	Terminal and bonding used for fixing	P
	The means of connection shall be suitable for the cross-sectional areas and nature of the conductors being terminated	Comply with the requirement	P
	No connection of two or more conductors to one terminal, unless the terminal is designed for it		N
	No soldered connections to terminals unless they are suitable for it	No soldered used	N
	Terminals on terminal blocks are plainly marked or labelled corresponding with the diagrams	Marking intended for using	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

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Clause	Requirement - Test	Result - Remark	Verdict
	Indentification tags shall be legible, permanent, and appropriate for the physical environment	Marking legible and permanent	P
	Terminal blocks mounted and wired so that the wiring does not cross over the terminals	No cross	P
13.1.2	Conductors and cables shall be run from terminal to terminal without splices or joints	Without splices or joints	P
	Connections using plug/socket combinations with suitable protection against accidental disconnection are not considered to be splices or joints for the purpose of this subclause		P
	Exceptions are possible as described		P
	Terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors	Adequately supported	P
	Protective conductor shall be placed close to the associated live conductors in order to decrease the impedance of the loop	Placed protective conductor closely	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	Conductor for different circuits laid side by side or occupy the same duct	P
13.1.4	Conductors of AC circuits installed in ferromagnetic enclosures shall be arranged so that all conductors of each circuit, including the protective conductor of each circuit, are contained in the same enclosure		N
	Single-core cables armoured with steel wire or steel tape should not be used for AC circuits		N
13.1.5	The cable between the pick-up and the pick-up converter of an inductive power supply system shall be: --as short as practicable --adequately protected against mechanical damage		N
13.2	Identification of conductors		--
13.2.1	Each conductor shall be identifiable at each termination in accordance with the technical documentation	Meet the requirements, use color and letter, number identification	P
13.2.2	When identification of the protective conductor is by colour alone, the bicolour combination GREEN-AND-YELLOW shall be used throughout the length of the conductor	Bicolour combination GREEN-AND- YELLOW used throughout the length of the conductor	P
	Where the protective conductor can be easily identified colour coding throughout its length is not necessary, but the ends or accessible locations are clearly identified by the graphical symbol or by the bicolour combination GREEN-AND-YELLOW		N

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Clause	Requirement - Test	Result - Remark	Verdict
	Exception: Protective bonding conductors may be marked with the letters PB and/or the symbol IEC 60417-5021		N
13.2.3	Where a neutral conductor is identified by colour alone, the colour shall be BLUE (preferably light blue)		P
	In this case that colour shall not be used for identifying any other conductor where confusion is possible		P
	Bare conductors used as neutral conductors shall have at minimum a stripe in LIGHT BLUE 15 mm to 100 mm wide in each compartment or unit and at each accessible location		P
13.2.4	Where colour-coding is used, BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE (including LIGHT BLUE), VIOLET, GREY, WHITE, PINK, TURQUOISE may be used		P
	GREEN and YELLOW should not be used where there is a possibility of confusion with the bicolour combination GREEN-AND-YELLOW		N
13.3	**Wiring inside enclosures**		—
	Conductors inside enclosures shall be supported where necessary		P
	Non-metallic supports shall be made with a flame-retardant insulating material (see IEC 60332 series)		P
	Connections to devices mounted on doors or to other movable parts shall be made using flexible conductors in accordance with 12.2 and 12.6.		N
	Conductors and cables that do not run in ducts shall be adequately supported	Keep in suitable place	P
13.4	**Wiring outside enclosures**		—
13.4.1	Conductors of a circuit shall not be distributed over different multi-core cables, conduits, etc.		P
13.4.2	Conductors and their connections external to the electrical equipment shall be placed in suitable ducts (see cl.13.5)	Comply with the requirement	P
13.4.3	Connections to moving parts shall take into account the foreseeable frequency of movement and shall be made using conductors in accordance with 12.2 and 12.6		N
	The bending radius of the cable shall be at least 10 times the diameter of the cable		N

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

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Clause	Requirement - Test	Result - Remark	Verdict
	Ducts shall provide a degree of protection (see IEC 60529) 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
	Where cable trays are only partially covered, the cables used shall be of a type suitable for installation on open cable trays.		N
13.5.2	Rigid metal conduit and fittings shall be of galvanized steel or of a corrosion-resistant material		N
	Fittings shall be compatible with the conduit and should be threaded		N
	Conduit bends shall be properly made		N
13.5.3	A flexible metal conduit shall consist of a flexible metal tubing or woven wire armour		N
13.5.4	Flexible non-metallic conduit shall be resistant to kinking		N
13.5.5	Cable trunking systems external to enclosures shall be rigidly supported and clear of all moving and of sources of contamination		N
	Where furnished in sections, the joints shall fit tightly but need not be gasketed		N
	The only openings permitted shall be those required for wiring or for drainage		N
13.5.6	The use of compartments or cable trunking systems within the column or base of a machine to enclose conductors is permitted provided they are isolated from coolant or oil reservoirs and are entirely enclosed		N
	Conductors shall be so secured		N
13.5.7	Connection boxes and other boxes used for wiring purposes shall be accessible for maintenance.		N
	Those boxes shall provide protection against the ingress of solid bodies and liquids		N
	They shall not have opened but unused knockouts nor any other openings		N
13.5.8	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices (e.g. brakes, temperature sensors		P

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Clause	Requirement - Test	Result - Remark	Verdict
14	**ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT**		—
14.1	Electric motors should conform to the relevant parts of IEC 60034 series	Conform to EN60034-1	P
14.2	Enclosures for motors should be in accordance with IEC 60034-5	Conform to EN60034-5	P
	The degree of protection shall be dependent on the application and the physical environment		P
14.3	The dimensions of motors shall conform to those given in the IEC 60072 series	Comply with the requirement	P
14.4	Motors and its accessories shall be so mounted that they are adequately protected and are easily accessible for inspection, maintenance, etc.	Comply with the requirement	P
	Proper cooling shall be ensured and the temperature rise shall remain within the limits of the insulation class (see IEC 60034-1)		P
	There shall be no opening between the motor compartment and any other compartment that does not meet the motor compartment requirements		N
14.5	The characteristics of motors and associated equipment shall be selected in accordance with the anticipated service and physical environmental conditions	Comply with the requirement	P
14.6	Operation of the overload and overcurrent protective devices for mechanical brake actuators shall initiate the simultaneous de-energization (release) of the associated machine actuators		N
15	**SOCKET-OUTLETS AND LIGHTING**		—
15.1	For socket-outlets intended for accessory equipment, the following apply:		N
	- they should conform to IEC 60309-1. Where not practicable, they should be clearly marked with the voltage and current ratings		N
	- the continuity of the protective bonding circuit to the socket-outlet shall be ensured		N
	- all unearthed conductors connected to the socket-outlet shall be protected against overcurrent and, when required, overload		N
	– where the power supply to the socket-outlet is not disconnected by the supply disconnecting device for the machine or the section of the machine, the requirements of 5.3.5 apply		N

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Clause	Requirement - Test	Result - Remark	Verdict
	– where fault protection is provided by automatic disconnection of supply, the disconnection time shall be in accordance with Table A.1 for TN systems or Table A.2 for TT systems		N
	–socket-outlets with a rating not exceeding 20 A shall be provided with an RCD not exceeding 30 mA		N
15.2	**Local lighting of the machine and of the equipment**		—
15.2.1	The ON/OFF switch shall not be incorporated in the lampholder or in the flexible connecting cord		P
	Stroboscopic effects from lights shall be avoided		N
15.2.2	The nominal voltage of the local lighting circuit shall not exceed 250 V between conductors. A voltage not exceeding 50 V is recommended		P
	Lighting circuits shall be supplied from one of the following sources:		—
	– a dedicated isolating transformer connected to the supply disconnecting device. Overcurrent protection shall be provided in the secondary circuit		N
	– a dedicated isolating transformer connected before the supply disconnecting device. This is permitted for maintenance lighting in control enclosures only. Overcurrent protection shall be provided in the secondary circuit		N
	– a circuit of the electrical equipment of the machine for lighting, with dedicated overcurrent protection		P
	– an isolating transformer connected before the supply disconnecting device, provided with a dedicated primary disconnecting means (see 5.3.5) and secondary overcurrent protection, and mounted within the control enclosure adjacent to the supply disconnecting device		N
	– an externally supplied lighting circuit (for example factory lighting supply). This shall be permitted in control enclosures only, and for the machine work light(s) where their total power rating is not more than 3 kW		N
	– power supply units, for DC supply to LED light sources, fitted with isolating transformers		N
	Exception: where fixed lighting is out of reach of operators during normal operations, the provisions of this 15.2.2 do not apply		N
15.2.3	Local lighting circuits shall be protected in accordance with 7.2.6		P
15.2.4	Adjustable lighting fittings shall be suitable for the physical environment		P

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Clause	Requirement - Test	Result - Remark	Verdict
	The lampholders shall be:		P
	– in accordance with the relevant IEC standard		P
	– constructed with an insulating material protecting the lamp cap so as to prevent unintentional contact		P
	Reflectors shall be supported by a bracket and not by the lampholder		P
	Exception: where fixed lighting is out of reach of operators during normal operations, the provisions of this 15.2.4 do not apply		P
16	**MARKING, WARNING SIGNS AND REFERENCE DESIGNATIONS**		—
16.1	Warning signs, nameplates, markings, labels and identification plates shall be of sufficient durability	Marking clear and durable.	P
16.2.1	Enclosures that do not otherwise clearly show that they contain electrical shall be marked with the graphical symbol ISO 7010-W012 		P
	It may be omitted (see also 6.2.2 b)) for: – an enclosure equipped with a supply disconnecting device – an operator-machine interface or control station – a single device with its own enclosure (for example position sensor)		N
16.2.2	Where the risk assessment shows the need to warn against the possibility of hazardous surface temperatures, the graphical symbol ISO 7010-W017 shall be used 		P
16.3	Control devices and visual indicators, shall be clearly and durably marked with regard to their functions	Marking clear and durable.	P
16.4	The following information shall be legibly and durably marked - plainly visible after installation on enclosures that receive incoming power supplies: • name or trade mark of supplier • certification mark or other marking where applicable • type designation or model, where applicable • serial number where applicable • main document number (see IEC 62023) where applicable • rated voltage, number of phases and frequency (if AC), and full-load current for each incoming supply It is recommended that this information is provided adjacent to the main incoming supply(ies)	See Information identification plate	P

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Clause	Requirement - Test	Result - Remark	Verdict
16.5	All enclosures, assemblies, control devices, and components shall be plainly identified with the same reference designation as shown in the technical documentation	See component layout diagram.	P
17	**TECHNICAL DOCUMENTATION**		—
17.1	The information necessary for identification, transport, installation, use, maintenance, decommissioning and disposal of the electrical equipment shall be supplied	See instruction.	P
	Annex I should be considered as guidance for the preparation of information and documents		P
17.2	**Information related to the electrical equipment**		--
	The following shall be supplied:	See instruction.	P
	a) where more than one document is provided, a main document for the electrical equipment as a whole, listing the complementary documents	See instruction.	P
	b) identification of the electrical equipment	See instruction.	P
	c) information on installation and mounting including: • a description of installation and mounting, and its connection to the electrical and other supplies • short-circuit current rating for each incoming power supply • rated voltage, number of phases and frequency (if AC.), type of distribution system (TT, TN, IT) and full-load current for each incoming supply • any additional electrical supply(ies) requirements (for example maximum supply source impedance, leakage current) for each incoming supply • space required for servicing • installation requirements regarding cooling • environmental limitations (for example lighting, vibration, EMC environment, atmospheric contaminants) • functional limitations (for example peak starting currents and permitted voltage drops) • precautions to be taken for the installation regarding electromagnetic compatibility	See instruction.	P
	d) an instruction for the connection of conductive-parts in the vicinity of the machine to the protective bonding circuit: • metallic pipes • fences • ladders • handrails		N

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Clause	Requirement - Test	Result - Remark	Verdict
	e) information on the functioning and operation as applicable: • an overview of the structure of the electrical equipment • procedures for programming or configuring • procedures for restarting after an unexpected stop • a sequence of operation	See instruction.	P
	f) information on maintenance, as appropriate: • frequency and method of functional testing • instructions for safe maintenance and where necessary suspend a safety function and/or protective measure (see 9.3.6) • guidance on the adjustment, repair, and frequency and method of preventive maintenance • details of the interconnections subject to replacement • required special devices or tools; • spare parts; • possible residual risks, indication of particular training and specification of personal protective equipment • instructions to restrict availability of keys or too(s to skilled or instructed persons • settings (DIP-switches, programmable parameter values, etc); • information for validation of safety related control functions after repair or modification, and for periodic testing where necessary;	See instruction.	P
	g) information on handling, transportation and storage	See instruction.	P
	h) information for proper disassembly and handling of components	See instruction.	P
18	**VERFICATION**		—
18.1	The extent of verification will be given in the dedicated product standard for a particular machine. Where there is no such standard, the verifications shall always include the items a), b), c) and h) and may include one or more of the items d) to g): a) verification that the electrical equipment complies with its technical documentation b) verification of continuity of the protective bonding circuit (Test 1 of 18.2.2) c) in case of fault protection by automatic disconnection of supply, conditions shall be verified according to 18.2; d) insulation resistance test (see 18.3) e) voltage test (see 18.4) f) protection against residual voltage (see 18.5) g) verification that the relevant requirements of 8.2.6 are met h) functional tests (see 18.6)		—
	The results of the verification shall be documented		P

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Clause	Requirement - Test	Result - Remark	Verdict
18.2	Verification of conditions for protection by automatic disconnection of supply		—
18.2.1	Test 1 verifies the continuity of the protective bonding circuit. Test 2 verifies the conditions for protection by automatic disconnection of the supply in TN systems For TN-systems, those test methods are described in 18.2.2 and 18.2.3; their application for different conditions of supply are specified in 18.2.4 For TT systems, see Clause A.2 For IT systems, see IEC 60364-6		P
	Where RCDs are used in the electrical equipment, their function shall be verified in accordance with the manufacturer's instructions. The test procedure and test interval shall be specified in the maintenance instructions		N
18.2.2	Test 1: Verification of the continuity of the protective bonding circuit		—
	The resistance between the PE terminal (see 5.2 and Figure 4) and relevant points that are part of the protective bonding circuit shall be measured with a current between 0.2 A and approximately 10 A derived from an electrically separated supply source having a maximum no-load voltage of 24 V	See appended table	P
	The resistance measured shall be in the expected range		P
18.2.3	Test 2: Fault loop impedance verification and suitability of the associated overcurrent protective device		—
	The connections of each power supply including the connection of the associated protective conductor to the PE terminal of the machine, shall be verified by inspection		P
	The conditions for the protection by automatic disconnection of supply in accordance with 6.3.3 and Annex A shall be verified by both		P
	a) verification of the fault loop impedance by - calculation, or - measurement in accordance with A.4, and		P
	b) confirmation that the setting and characteristics of the associated overcurrent protective device are in accordance with the requirements of Annex A, and		P

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

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Clause	Requirement - Test	Result - Remark	Verdict
	Where a portion of the machine or its associated equipment is changed or modified, the need for re-verification and testing of the electrical equipment shall be considered	No portion of the machine or its associated equipment is changed or modified.	N

Appendix_1 ： Conformity of Relevant Components

No.	Name	Model	Spec.	MFR	Approval
1	Cable of power cord	VARIOUS	PVC, 3X4.0mm2	VARIOUS	CE,VDE
2	Motor	MU75	750W	SITI	CE
3	Motor	M91X40GDW2	40W	PANASONIC	CE
4	Motor driver	DVUS940W2	40W for M91X40GDW2	PANASONIC	CE
5	Fan motor	CY150	220V~, 50/60Hz, 370W	---	CE
6	Switching mode power supply	S8JC-10024C	Input: 220-240V~, 50/60Hz, Output: DC24V	OMRON	CE
7	Contactor	SC-N1	26A, 220V	---	CE
8	Contactor	SC-03	11A, 220V	---	CE
9	Circuit breaker	EA53C	40A, 400V, 3-poles	---	CE
10	Circuit breaker	BH-D6	16A, 250V, 1-pole	---	CE
11	Circuit breaker	BH-D6	40A, 400V, 2-poles	---	CE
12	Circuit breaker	BH-D6	6A, 400V, 3-poles	---	CE
13	Opto-switch	WTB8-N1131	---	SICK	CE
14	PLC	CP1L-M60DT-D	---	OMRON	CE
15	PLC	CP1W-16ET	---	OMRON	CE
16	Monitor	NB7W-TOOB	---	OMRON	CE
17	Frequency inverter	3G3JZ-A4007	---	OMRON	CE
18	Coder	E6B2-CWZ6C 360P/R2M	---	OMRON	CE
19	Relay	MY2J 24VDC	---	OMRON	CE
20	Socket of relay	PYF08A	---	OMRON	CE
21	Relay	MY4J 24VDC	---	OMRON	CE
22	Socket of relay	PYF14A	---	OMRON	CE
23	Emergency stop switch	YW1B-V4E01R	---	JANPAN HEQUAN	CE
24	Select switch	YW1S-2E10	---	JANPAN HEQUAN	CE
25	Push button	YW1B-M1E10B	---	JANPAN HEQUAN	CE
26	Push button	YW1B-M1E10G	---	JANPAN HEQUAN	CE
27	Push button	YW1B-M1E01R	---	JANPAN HEQUAN	CE
28	Indicator	YW1P-2EQ4G	---	JANPAN HEQUAN	CE
29	Indicator	YW1P-2EQ4R	---	JANPAN HEQUAN	CE
30	Current meter	DP3AA20	---	---	CE
31	Fuse holder	TFBR0321N	---	TAIWAN TIANDE	CE
32	Ventilation fan	4”, 6”	220V	---	CE
33	Lighting	18W, 20W	220V	---	CE
34	Air cylinder	ACPS50-40-B	---	AIRTAC	CE
35	Air cylinder	CRB2BW30-180S	---	SMC	CE
36	Air regulator	AR20-01-A	---	SMC	CE

37	Air meter	G46-10-01M-C	---	SMC	CE
38	Air meter	G36-10-01	---	SMC	CE
39	Electromagnetic valve	VX212BZ1B	---	SMC	CE
40	Electromagnetic valve	SY5120-5LD-01	---	SMC	CE

Appendix_2: Datasheet of test

18.2	**TABLE: Continuity of the protective bonding circuit**		**P**
Location	Current(A)	Frequency(Hz)	Measured resistance(mΩ)
Between incoming PE terminal and relevant points that are part of the protective bonding circuit	10	--	41.3
Note:			

18.3	**TABLE: insulation resistance tests**			**P**
Location	Voltage(V)d.c	Frequency(Hz)	Time(s)	Measured insulation resistance(MΩ)
Between power circuit conductors L_1 and protective bonding circuit	500	--	60	77.68
Between power circuit conductors L_2 and protective bonding circuit	500	--	60	424.3
Between power circuit conductors L_3 and protective bonding circuit	500	--	60	412.1
Note:				

18.4	**TABLE: voltage tests**	**P**
test voltage applied between:	test voltage (V) a.c. / d.c.	breakdown Yes / No
Between power circuit conductors L_1 and protective bonding circuit	1000Va.c.	No
Between power circuit conductors L_2 and protective bonding circuit	1000Va.c.	No
Between power circuit conductors L_3 and protective bonding circuit	1000Va.c.	No
supplementary information:		

Photos

Photo 1 Front view

Photo 2 Rear view

Photo 3 Control panel

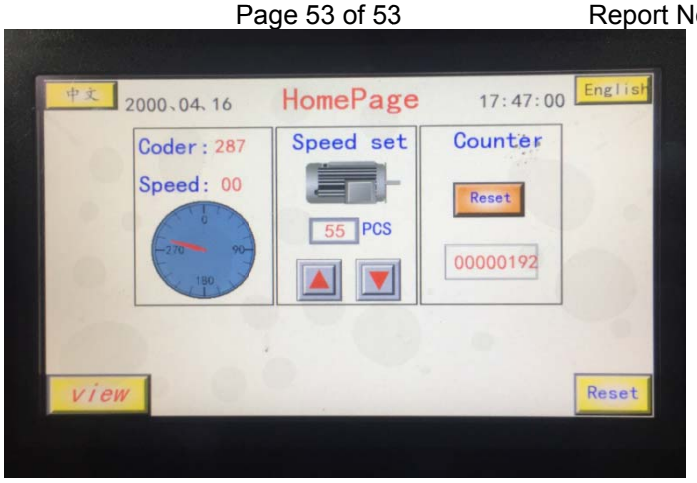

Photo 4 System setting interface

Photo 5 Control box-1

Photo 6 warning mark

The photos are limited to the use of the original report.

* END *