APPLICATION FOR CE LVD TEST REPORT

On Behalf of

Prepared For	:	Yangzhou Zhitong Machinery Co., Ltd
Address	:	No.95, Xingqu Road, Chengnan New Area, Gaoyou, Yangzhou City, Jiangsu Province, China
Product Name	:	Filling machine
Trade Name	:	志同 ZHITONG
Model	:	GZJ-150A, ZT-2T, ZT-4T, ZT-6T, ZT-8T, ZT-12T, ZT-2F, ZT-6F, ZT-8F, ZT-Z, ZT-P-2, ZT-P-4, GZJ-50A, GZJ-100A, GZJ-50B, GZJ-100B, GZJ-150B, ZTM-125, ZT-H, ZT-15, ZT-25, ZT-50, ZT-100, ZT-250, DF-A, DF-B, ZT-C-2, ZT-C-4, GLF-1-1, GLF-1-2, GLF-2-1, GLF-2-2, ZT-16L, ZT-30L, ZT-50L, MT-50, MT-50A, MT-60, MT-60A, MT-220, MT-300, MT-550, MT-500A, MT-500B, HT-280, ZT-QGBS, ZT-QGBC, ZT-Q-500, XC-100, XG-200, TD-SGJ, XLSGJ-6100, KFJ-1035, DK-50, XG-2, DY-80, DY-60, DY-60F, DY-60Y, DY-60Y-1, BY-6, BY-60F, BY-60Y, BY-60YJ, BY-80P, BY-60P, BY-280, BY-420K, BY-420F, DX DL-500B
Prepared By	:	SHENZHEN POCE TECHNOLOGY CO., LTD.
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Test Date	:	Sep. 21, 2020 to Sep. 30, 2020
Date of Report	:	Sep. 30, 2020
Report No.	:	POCE200923002RRS

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TEST REPORT

EN 60204-1:2018
Safety of machine- Electrical equipment of machines, Part 1: General requirements

Report Reference No.....:	POCE200923002RRS
Date of issue.....:	Sep. 30, 2020
Compiled by (+ signature).....:	Eva
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Testing Laboratory.....:	Shenzhen POCE Technology Co., Ltd
Address.....:	H Building, Hongfa Science And Technology Park, Tangtou, Shiyan, Bao'an District, Shenzhen, China
Applicant's name.....:	Yangzhou Zhitong Machinery Co., Ltd
Address.....:	No.95, Xingqu Road, Chengnan New Area, Gaoyou, Yangzhou City, Jiangsu Province, China
Test specification:	
Directive/ standard.....:	EN 60204-1:2018
Test procedure.....:	CE-LVD
Test item description.....:	Filling machine
Trademark.....:	志同 ZHITONG
Model/Type reference.....:	Yangzhou Zhitong Machinery Co., Ltd
Manufacturer.....:	No.95, Xingqu Road, Chengnan New Area, Gaoyou, Yangzhou City, Jiangsu Province, China
Address.....:	GZJ-150A, ZT-2T, ZT-4T, ZT-6T, ZT-8T, ZT-12T, ZT-2F, ZT-6F, ZT-8F, ZT-Z, ZT-P-2, ZT-P-4, GZJ-50A, GZJ-100A, GZJ-50B, GZJ-100B, GZJ-150B, ZTM-125, ZT-H, ZT-15, ZT-25, ZT-50, ZT-100, ZT-250, DF-A, DF-B, ZT-C-2, ZT-C-4, GLF-1-1, GLF-1-2, GLF-2-1, GLF-2-2, ZT-16L, ZT-30L, ZT-50L, MT-50, MT-50A, MT-60, MT-60A, MT-220, MT-300, MT-550, MT-500A, MT-500B, HT-280, ZT-QGBS, ZT-QGBC, ZT-Q-500, XC-100, XG-200, TD-SGJ, XLSGJ-6100, KFJ-1035, DK-50, XG-2, DY-80, DY-60, DY-60F, DY-60Y, DY-60Y-1, BY-6, BY-60F, BY-60Y, BY-60YJ, BY-80P, BY-60P, BY-280, BY-420K, BY-420F, DXDL-500B
Rating(s).....:	220V~, 50/60Hz, 0.75KW

Test case verdicts	
Test case does not apply to the test object .....:	N(/A)
Test item does meet the requirement ..... :	P(ass)
Test item does not meet the requirement ..... :	F(ail)
Testing	
Date of receipt of test item ..... :	Sep. 21, 2020
Date(s) of performance of test ..... :	Sep. 21, 2020 to Sep. 30, 2020

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:

The all models are same except their model number, and all tests are based on GZJ-150A

Copy of marking plate:

Filling Machine
Model: GZJ-150A
Input:220V~, 50/60Hz, 0.75KW

CE

Manufacturer: Yangzhou ZhiTong Machinery Co., Ltd.
Address: No.95 , Xingqu Road, Chengnan New Area, Gaoyou, Jiangsu Province,China
Made in china

EN 60204-1 Electrical equipment of machines–Part 1: General requirments			
4	**General requirments**		
4.1	**General considerations**		
	This part of IEC 60204 is intended to apply to electrical equipment used with a wide variety of machines and with a group of machines working together in a co-coordinated manner. The risks associated with the hazards relevant to the electrical equipment shall be assessed as part of the overall requirements for risk assessment of the machine. This will determine the adequate risk reduction and the necessary protective measures for persons who can be exposed to those hazards, while still maintaining an acceptable level of performance of the machine and its equipment.		P
4.2	**Selection of equipment**		
4.2.1	**General**		
	Electrical components and devices shall: —be suitable for their intended use; and —conform to relevant IEC standards where such exist; and —be applied in accordance with the supplier's instructions risk assessment of the machine.	Be suitable for their intended use and conform to relevant IEC/EN standards.	P
4.2.2	**Electrical equipment in compliance with the EN 60439 series**		
	Depending upon the machine, its intended use and its electrical equipment, the designer may select parts of the electrical equipment of the machine that are in compliance with EN 60439-1 and, as necessary, other relevant parts of the EN 60439 series (see also Annex F).		P
4.3	**Electrical supply**		
4.3.1	**General**		
	The electrical equipment shall be designed to operate correctly with the conditions of the supply: —as specified in 4.3.2 or 4.3.3, or —as otherwise specified by the user (see Annex B), or as specified by the supplier in the case of a special source of supply such as an on-board generator.	Comply with clause 4.3.2.	P
4.3.2	**AC supplies**		
	Voltag: Steady state voltage: 0,9 to 1,1 of nominal voltage. Frequency: 0,99 to 1,01 of nominal frequency continuously; 0,98 to 1,02 short time. Harmonics: Harmonic distortion not exceeding 10 % of the total r.m.s. voltage between live conductors for the sum of the 2nd through to the 5th harmonic. An additional 2 % of the total r.m.s. voltage between live conductors for the sum of the 6th through to the 30th harmonic is permissible. Voltage unbalance: Neither the voltage of the negative sequence component nor the voltage of the zero sequence components in three-phase supplies exceeding 2 % of the positive sequence component. Voltage interruption: Supply interrupted or at zero voltage for not more than 3 ms at any random time in the supply cycle with more than 1 s between successive interruptions		P

	Voltage dips: Voltage dips not exceeding 20 % of the peak voltage of the supply for more than one cycle with more than 1 s between successive dips		P
4.3.3	**DC supplies**		
	From batteries, Voltage 0,85 to 1,15 of nominal voltage 0,7 to 1,2 of nominal voltage in the case of battery-operated vehicles . Voltage interruption: Not exceeding 5 ms From converting equipment: Voltage: 0,9 to 1,1 of nominal voltage. Voltage interruption: Not exceeding 20 ms with more than 1 s between successive interruptions. Ripple (peak-to-peak): Not exceeding 0,15 of nominal voltage.		N
4.3.4	**Special supply systems**		
	For special supply systems such as on-board generators, the limits given in 4.3.2 and 4.3.3 may be exceeded provided that the equipment is designed to operate correctly with those conditions.		N
4.4	**Physical environment and operating conditions**		
4.4.1	**General**		
	The electrical equipment shall be suitable for the physical environment and operating conditions of its intended use. The requirements of 4.4.2 to 4.4.8 cover the physical environment and operating conditions of the majority of machines covered by this part of EN 60204. When special conditions apply or the limits specified are exceeded, an agreement between user and supplier (see 4.1) is recommended (see Annex B).		P
4.4.2	**Electromagnetic compatibility (EMC)**		
	The electrical equipment shall not generate electromagnetic disturbances above levels that are appropriate for its intended operating environment. In addition, the electrical equipment shall have a sufficient level of immunity to electromagnetic disturbances so that it can function in its intended environment.		P
4.4.3	**Ambient air temperature**		
	Electrical equipment shall be capable of operating correctly in the intended ambient air temperature. The minimum requirement for all electrical equipment is correct operation between air temperatures of +5 °C and +40 °C.		P
4.4.4	**Humidity**		
	The electrical equipment shall be capable of operating correctly when the relative humidity does not exceed 50 % at a maximum temperature of +40 °C. Higher relative humilities are permitted at lower temperatures (for example 90 % at 20 °C). Harmful effects of occasional condensation shall be avoided by design of the equipment or where necessary, by additional measures (for example built-in heaters, air conditioners, drain holes).		P
4.4.5	**Altitude**		
	Electrical equipment shall be capable of operating correctly at altitudes up to 1 000 m above mean sea level.	<1000m.	P
4.4.6	**Contaminants**		
	Electrical equipment shall be adequately protected against the ingress of solids and liquids. The electrical equipment shall be adequately protected against contaminants (for example dust, acids, corrosive gases, salts) that can be present in the physical environment in which the electrical	For electrical equipment, IP2X.	P

	equipment is to be installed (see Annex B).		
4.4.7	**Ionizing and non-ionizing radiation**		
	When equipment is subject to radiation (for example microwave, ultraviolet, lasers, X-rays), additional measures shall be taken to avoid malfunctioning of the equipment and accelerated deterioration of the insulation.	No ionizing and non-ionizing radiation outside this equipment.	P
4.4.8	**Vibration, shock, and bump**		
	Undesirable effects of vibration, shock and bump (including those generated by the machine and its associated equipment and those created by the physical environment) shall be avoided by the selection of suitable equipment, by mounting it away from the machine, or by provision of anti-vibration mountings.	Undesirable effects be avoided by the selection of suitable equipment.	P
4.5	**Transportation and storage**		
	Electrical equipment shall be designed to withstand, or suitable precautions shall be taken to protect against, the effects of transportation and storage temperatures within a range of –25 °C to +55 °C and for short periods not exceeding 24 h at up to +70°C. Suitable means shall be provided to prevent damage from humidity, vibration, and shock	Within the SMPS during approval	P
4.6	**Provisions for handling**		
	Heavy and bulky electrical equipment that has to be removed from the machine for transport or that is independent of the machine, shall be provided with suitable means for handling by cranes or similar equipment.		P
4.7	**Installation**		
	Electrical equipment shall be installed in accordance with the electrical equipment supplier's Instructions.		P
5 Incoming supply conductor terminations and devices for disconnecting and switching off			
5.1	**Incoming supply conductor terminations**		
	It is recommended that, where practicable, the electrical equipment of a machine is connected to a single incoming supply. Where another supply is necessary for certain parts of the equipment (for example, electronic equipment that operates at a different voltage), that supply should be derived, as far as is practicable, from devices (for example, transformers, converters) forming part of the electrical equipment of the machine. For large complex machinery comprising a number of widely-spaced machines working together in a coordinated manner, there can be a need for more than one incoming supply depending upon the site supply arrangements (see 5.3.1) . Unless a plug is provided with the machine for the connection to the supply (see 5.3.2 e), it is recommended that the supply conductors are terminated at the supply disconnecting device. where a neutral conductor is used it shall be clearly indicated in the technical documentation of the machine, such as in the installation diagram and in the circuit diagram, and a separate insulated terminal, labeled N in accordance with 16.1, shall be provided for the neutral conductor. There shall be no connection between the neutral conductor and the protective bonding circuit inside the electrical .		P
5.2	**Terminal for connection of the external protective conductor**		
	At each incoming supply point, the terminal for connection of external protective conductor shall be marked or labelled with the letters PE (see IEC 60445).		P
5.3	**Supply disconnecting (isolating) device**		
5.3.1	**General**		
	supply disconnecting device shall be provided:		P

	—for each incoming source of supply to a machine(s); —for each on-board power supply. The supply disconnecting device shall disconnect (isolate) the electrical equipment of the machine from the supply when required (for example for work on the machine, including the electrical equipment). When two or more supply disconnecting devices are provided, protective interlocks for their correct operation shall also be provided in order to prevent a hazardous situation, including damage to the machine or to the work in progress.		
5.3.2	**Type**		
	The supply disconnecting device shall be one of the following types: a) switch-disconnect or, with or without fuses, in accordance with IEC 60947-3, utilization category AC-23B or DC-23B; b) control and protective switching device suitable for isolation, in accordance with IEC 60947-6-2; c) a circuit-breaker suitable for isolation in accordance with IEC 60947-2; 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 defined in the product standard; e) a plug/socket combination for a flexible cable supply.		P
5.3.3	**Requirements**		
	When the supply disconnecting device is one of the types specified in 5.3.2 a) to d) it shall fulfill all of the following requirements:		P
	—isolate the electrical equipment from the supply and have one OFF (isolated) and one ON position marked with "O" and "I" (symbols IEC 60417-5008 (DB:2002-10) and IEC 60417-5007 (DB:2002-10), see 10.2.2);		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;		P
	— ave an external operating means		P
	—be provided with a means permitting it to be locked in the OFF (isolated) position (for example by padlocks). When so locked, remote as well as local closing shall be prevented;		N
	—disconnect all live conductors of its power supply circuit. However, 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 breaking capacity sufficient to interrupt the current of the largest motor when stalled together with the sum of the normal running currents of all other motors and other loads. The calculated breaking capacity may be reduced by the use of a proven diversity factor. Where motor(s) are supplied by converter(s) or similar devices, the calculation should take into account the possible effect on the required breaking capacity		N
5.3.4	**Operating means of the supply disconnecting device**		
	The operating means (for example, a handle) of the supply disconnecting device shall be external to the enclosure of the electrical equipment.		P
5.3.5	**Excepted circuits**		

	The following circuits need not be disconnected by the supply disconnecting device:		N
	—lighting circuits for lighting needed during maintenance or repair;		N
	—socket outlets for the exclusive connection of repair or maintenance tools and equipment		N
	—under voltage protection circuits that are only provided for automatic tripping in the event of supply failure;		N
	—circuits supplying equipment that should normally remain energized for correct operation (for example emperature controlled measuring devices, product (work in rogress) heaters, program storage devices)		N
	Where such a circuit is not disconnected by the supply disconnecting device:		N
	—permanent warning label(s) shall be appropriately placed in proximity to the operating means of the supply disconnecting device to draw attention to the hazard;		N
	—a corresponding statement shall be included in the maintenance manual, and one or more of the following shall apply:		N
	.the conductors are identified by colour taking into account the recommendation of 13.2.4.		N
	.the excepted circuit is separated from other circuits,		N
	.excepted circuits are identified by permanent warning label(s).		N
5.4	**Devices for switching off for prevention of unexpected start-up**		
	Devices for removal of power for the prevention of unexpected start-up shall be provided where a start-up of the machine or part of the machine can create a hazard (for example during maintenance). Such devices shall be appropriate and convenient for the intended use, be suitably placed, and readily identifiable as to their function and purpose. Where their function and purpose is not otherwise obvious (e.g. by their location) these devices shall be marked to indicate the extent of removal of power		N
5.5	**Devices for disconnecting electrical equipment**		
	be carried out when it is de-energized and isolated. Such devices shall be: —appropriate and convenient for the intended use; —suitably placed; —readily identifiable as to which part(s) or circuit(s) of the equipment is served. Where their function and purpose is not otherwise obvious (e.g. by their location) these devices shall be marked to indicate the extent of the equipment that they isolate.		N
5.6	**Protection against unauthorized, inadvertent and/or mistaken connection**		
	Where the devices described in 5.4 and 5.5 are located outside an enclosed electrical operating area they shall be equipped with means to secure them in the OFF position (disconnected state), (for example by provisions for padlocking, trapped key interlocking).		N
	When so secured, remote as well as local reconnection shall be prevented.		N
6 Protection against electric shock			
6.1	**General**		
	The electrical equipment shall provide protection of persons against electric shock from: —basic protection (see 6.2 and 6.4); —fault protection (see 6.3 and 6.4). The measures for protection given in 6.2, 6.3, and, for PELV, in 6.4, are a selection from IEC 60364-4-41. Where those measures are not practicable, for example due to the physical or operational conditions, other measures from IEC 60364-4-41 may be used.	See below	P

6.2	**Protection against direct contact**		
6.2.1	**General**		
	For each circuit or part of the electrical equipment, the measures of either 6.2.2 or 6.2.3 and where applicable, 6.2.4 shall be applied.	IP2X.	P
6.2.2	**Protection by enclosures**		
	Live parts shall be located inside enclosures that provide protection against contact with live parts of at least IP2X or IPXXB (see IEC 60529).	IP2X, protected by earthed metal enclosure.	P
6.2.3	**Protection by insulation of live parts**		
	Live parts protected by insulation shall be completely covered with insulation that can only be removed by destruction. Such insulation shall be capable of withstanding the mechanical, chemical, electrical, and thermal stresses to which it can be subjected under normal operating conditions.		P
6.2.4	**Protection against residual voltages**		
	Live parts having a residual voltage greater than 60 V after the supply has been disconnected shall be discharged to 60 V or less within a time period of 5 s after disconnection of the supply voltage provided that this rate of discharge does not interfere with the proper functioning of the equipment. Exempted from this requirement are components having a stored charge of 60 µC or less. Where this specified rate of discharge would interfere with the proper functioning of the equipment, a durable warning notice drawing attention to the hazard and stating the delay required before the enclosure may be opened shall be displayed at an easily visible location on or immediately adjacent to the enclosure containing the capacitances.	IP2X, residual voltage less than 60V after 1s.	P
	In the case of plugs or similar devices, the withdrawal of which results in the exposure of conductors (for example pins), the discharge time shall not exceed 1 s, otherwise such conductors shall be protected against direct contact to at least IP2X or IPXXB. If neither a discharge time of 1 s nor a protection of at least IP2X or IPXXB can be achieved (for example in the case of removable collectors on conductor wires, conductor bars, or slip-ring assemblies, see 12.7.4), additional switching devices or an appropriate warning device (for example a warning notice in accordance with 16.1) shall be applied		
6.2.5	**Protection by barriers**		
	For protection by barriers, 412.2 of IEC 60364-4-41 shall apply.		P
6.2.6	**Protection by placing out of reach or protection by obstacles**		
	For protection by placing out of reach, 412.4 of IEC 60364-4-41 shall apply. For protection by obstacles, 412.3 of IEC 60364-4-41 shall apply. For conductor wire systems or conductor bar systems with a degree of protection less than IP2X, see 12.7.1.		P
6.3	**Fault protection**		
6.3.1	**General**		
	Fault protection (3.31) is intended to prevent hazardous situations due to an insulation fault between live parts and exposed conductive parts.		P
	For each circuit or part of the electrical equipment, at least one of the measures in accordance with 6.3.2 to 6.3.3 shall be applied:		P
	– measures to prevent the occurrence of a touch voltage (6.3.2); or		P
	– automatic disconnection of the supply before the time of contact with a touch voltage can become hazardous (6.3.3).		P
6.3.2	**Prevention of the occurrence of a touch voltage**		
6.3.2.1	**General**		
	Measures to prevent the occurrence of a touch voltage include the following:		P

	—provision of class II equipment or by equivalent insulation; —electrical separation.		
6.3.2.2	**Protection by provision of class II equipment or by equivalent insulation**		
	This measure is intended to prevent the occurrence of touch voltages on the accessible parts through a fault in the basic insulation. This protection is provided by 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); —switchgear and control gear assemblies having total insulation in accordance with IEC 60439-1; —supplementary or reinforced insulation in accordance with 413.2 of IEC 60364-4-41.		N
6.3.2.3	**Protection by electrical separation**		
	Electrical separation of an individual circuit is intended to prevent a touch voltage through contact with exposed conductive parts that can be energized by a fault in the basic insulation of the live parts of that circuit. For this type of protection, the requirements of 413.5 of IEC 60364-4-41 apply.		N
6.3.3	**Protection by automatic disconnection of supply**		
	Automatic disconnection of the supply of any circuit affected by an insulation fault is intended to prevent a hazardous situation resulting from a touch voltage.		N
6.4	**Protection by the use of PELV**		
6.4.1	**General requirements**		
	The use of PELV (Protective Extra-Low Voltage) is to protect persons against electric shock from indirect contact and limited area direct contact (see 8.2.1).		P
	PELV circuits shall satisfy all of the following conditions: a) the nominal voltage shall not exceed: • 25 V AC r.m.s. or 60 V ripple-free DC 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;		P
	b) one side of the circuit or one point of the source of the supply of that circuit shall be connected to the protective bonding circuit;		P
	c) live parts of PELV circuits shall be electrically separated from other live circuits. Electrical separation shall be not less than that required between the primary and secondary circuits of a safety isolating transformer		P
	d) conductors of each PELV circuit shall be physically separated from those of any other circuit. When this requirement is impracticable, the insulation provisions of 13.1.3 shall apply;		P
	e) plugs and socket-outlets for a PELV circuit shall conform to the following: • plugs shall not be able to enter socket-outlets of other voltage systems; • socket-outlets shall not admit plugs of other voltage systems		P
6.4.2	**Sources for PELV**		
	The source for PELV shall be one of the following: —a safety isolating transformer in accordance with IEC 61558-1 and IEC 61558-2-6; —a source of current providing a degree of safety equivalent to that of the safety isolating transformer (for example a motor generator with winding providing equivalent isolation); —an electrochemical source (for example a battery) or another		N

	source independent of a higher voltage circuit (for example a diesel-driven generator); —an electronic power supply conforming to appropriate standards specifying measures to be –taken to ensure that, even in the case of an internal fault, the voltage at the outgoing terminals cannot exceed the values specified in 6.4.1.		
7 Protection of equipment			
7.1	**General**		
	This Clause details the measures to be taken to protect equipment against the effects of: —overcurrent arising from a short circuit; —overload and/or loss of cooling of motors; —abnormal temperature; —loss of or reduction in the supply voltage; —overspeed of machines/machine elements; —earth fault/residual current; —incorrect phase sequence; —overvoltage due to lightning and switching surges.		P
7.2	**Overcurrent protection**		
7.2.1	**General**		
	Overcurrent protection shall be provided where the current in a machine circuit can exceed either the rating of any component or the current carrying capacity of the conductors whichever is the lesser value. The ratings or settings to be selected are detailed in 7.2.10.		P
7.2.2	**Supply conductors**		
	Unless otherwise specified by the user, the supplier of the electrical equipment is not responsible for providing the overcurrent protective device for the supply conductors to the electrical equipment.		P
	The supplier of the electrical equipment shall state in the installation documents the data necessary for conductor dimensioning (including the maximum cross-sectional area of the supply conductor that can be connected to the terminals of the electrical equipment) and for selecting the overcurrent protective device (see 7.2.10 and 17).		P
7.2.3	**Power circuits**		
	evices for detection and interruption of overcurrent, selected in accordance with 7.2.10 shall be applied to each live conductor. The following conductors, as applicable, shall not be disconnected without disconnecting all associated live conductors: —the neutral conductor of a.c. power circuits; —the earthed conductor of d.c. power circuits; —d.c. power conductors bonded to exposed conductive parts of mobile machines. Where the cross-sectional area of the neutral conductor is at least equal to or equivalent to that of the phase conductors, it is not necessary to provide over current detection for the neutral conductor nor a disconnecting device for that conductor. For a neutral conductor with a cross-sectional area smaller than that of the associated phase conductors, the measures detailed in 524 of IEC 60364-5-52 shall apply. In IT systems, it is recommended that the neutral conductor is not used. However, where a neutral conductor is used, the measures detailed in 431.2.2 of IEC 60364-4-43 shall apply.		N
7.2.4	**Control circuits**		
	Conductors of control circuits directly connected to the supply voltage and of circuits supplying control circuit transformers shall be protected against over current in accordance with 7.2.3. Conductors of control circuits supplied by a control circuit	Switch provided.	P

	transformer or d.c. supply shall be protected against over current (see also 9.4.3.1.1): —in control circuits connected to the protective bonding circuit, by inserting an over current protective device into the switched conductor; —in control circuits not connected to the protective bonding circuit; where all control circuits of the equipment have the same current carrying capacity, by inserting an overcurrent protective device into the switched conductor, or; where different control circuits of the equipment have different current carrying capacity, by inserting an overcurrent protective device into both switched and common conductors of each control circuit.		
7.2.5	**Socket outlets and their associated conductors**		
	Overcurrent protection shall be provided for the circuits feeding the general purpose socket outlets intended primarily for supplying power to maintenance equipment. Overcurrent protective devices shall be provided in the unearthed live conductors of each circuit feeding such socket outlets.		N
7.2.6	**Lighting circuits**		
	All unearthed conductors of circuits supplying lighting shall be protected against the effects of short circuits by the provision of over current devices separate from those protecting other circuits.	No provided.	N
7.2.7	**Transformers**		
	Transformers shall be protected against over current in accordance with the manufacturer's instructions. Such protection shall (see also 7.2.10): —avoid nuisance tripping due to transformer magnetizing inrush currents; —avoid a winding temperature rise in excess of the permitted value for the insulation class of transformer when it is subjected to the effects of a short circuit at its secondary terminals.	No provided.	N
7.2.8	**Location of over current protective devices**		
	An over current protective device 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 where all the following conditions are satisfied: —the current carrying capacity of the conductors is at least equal to that of the load; —the part of the conductor between the point of reduction of current-carrying capacity and the position of the over current protective device is no longer than 3 m; —the conductor is installed in such a manner as to reduce the possibility of a short-circuit for example, protected by an enclosure or duct.		P
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. Where the short-circuit current to an over current protective device can include additional currents other than from the supply (for example from motors from power factor correction capacitors), those currents shall be taken into consideration. Where fuses are provided as over current protective devices, a type readily available in the country of use shall be selected, or arrangements shall be made for the supply of spare parts.		P
7.2.10	**Rating and setting of overcurrent protective devices**		
	The rated current of fuses or the setting current of other over current protective devices shall be selected as low as possible but		P

	adequate for the anticipated over currents (for example during starting of motors or energizing of transformers). When selecting those protective devices, consideration shall be given to the protection of switching devices against damage due to over currents The rated current or setting of an over current protective device is determined by the current carrying capacity of the conductors to be protected in accordance with 12.4, D.2 and the maximum allowable interrupting time *t* in accordance with Clause D.3, taking into account the needs of co-ordination with other electrical devices in the protected circuit.		
7.3	**Protection of motors against overheating**		
7.3.1	**General**		
	Protection of motors against overheating shall be provided for each motor rated at more than 0,5 kW. Protection of motors against overheating can be achieved by: —overload protection (7.3.2), —over-temperature protection (7.3.3), or —current-limiting protection (7.3.4). Automatic restarting of any motor after the operation of protection against overheating shall be prevented where this can cause a hazardous situation or damage to the machine or to the work in progress.	current-limiting protection (7.3.4)	P
7.3.2	**Overload protection**		
	Where overload protection is provided, detection of overload(s) shall be provided in each live conductor except for the neutral conductor. However, where the motor overload detection is not used for cable overload protection (see also Clause D.2), the number of overload detection devices may be reduced at the request of the user (see also Annex B). For motors having single- phase or d.c. power supplies,detection in only one unearthed live conductor is permitted. For motors that cannot be overloaded (for example torque motors, motion drives that either are protected by mechanical overload protection devices or are adequately dimensioned) overload protection is not required.		P
7.3.3	**Over-temperature protection**		
	The provision of motors with over-temperature protection (see IEC 60034-11) is recommended in situations where the cooling can be impaired (for example dusty environments). Depending upon the type of motor, protection under stalled rotor or loss of phase conditions is not always ensured by over-temperature protection, and additional protection should then be provided. Over-temperature protection is also recommended for motors that cannot be overloaded (for example torque motors, motion drives that are either protected by mechanical overload protection devices or are adequately dimensioned), where the possibility of over-temperature exists (for example due to reduced cooling).		N
7.4	**Protection against abnormal temperature**		
	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 shall be provided by, for example, switching off the machine at a predetermined voltage		N

	level. Where the operation of the machine can allow for an interruption or a reduction of the voltage for a short time period, delayed undervoltage protection may be provided. The operation of the undervoltage device shall not impair the operation of any stopping control of the machine.		
7.6	**Motor overspeed protection**		
	Overspeed protection shall be provided where overspeeding can occur and could possibly cause a hazardous situation taking into account measures in accordance with 9.3.2. Overspeed protection shall initiate appropriate control responses and shall prevent automatic restarting. The overspeed protection should operate in such a manner that the mechanical speed limit of the motor or its load is not exceeded		P
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		P
7.8	**Phase sequence protection**		
	Where an incorrect phase sequence of the supply voltage can cause a hazardous situation or damage to the machine, protection shall be provided.		P
7.9	**Protection against over voltages due to lightning and to switching surges**		
	Surge protective devices (SPDs) can be provided to protect against the effects of overvoltages due to lightning or to switching surges. Where provided: —SPDs for the suppression of overvoltages due to lightning shall be connected to the incoming terminals of the supply disconnecting device. —SPDs for the suppression of overvoltages due to switching surges shall be connected as necessary for equipment requiring such protection.		P
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			
8.1	**General**		
	This Clause 8 provides requirements for protective bonding and functional bonding. Figure 4 illustrates those concepts.		P
8.2	**Protective bonding circuit**		
8.2.1	**General**		
	The protective bonding circuit consists of: —PE terminal(s) (see 5.2); —the protective conductors (see 3.1.51) in the equipment of the machine including sliding contacts where they are part of the circuit; —the conductive structural parts and exposed conductive parts of the electrical equipment; —conductive structural parts of the machine. All parts of the protective bonding circuit shall be so designed that they are capable of withstanding the highest thermal and mechanical stresses that can be caused by earth-fault currents that could flow in that part of the protective bonding circuit.		P

8.2.2	**Protective conductors**		
	Protective conductors shall be identified in accordance with 13.2.2. Copper conductors are preferred. Where a conductor material other than copper 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 for reasons of mechanical durability.		P
8.2.3	**Continuity of the protective bonding circuit**		
	Where a part is removed for any reason (for example routine maintenance), the protective bonding circuit for the remaining parts shall not be interrupted. Connection and bonding points shall be so designed that their current-carrying capacity is not impaired by mechanical, chemical, or electrochemical influences. Where enclosures and conductors of aluminium or aluminium alloys are used, particular consideration should be given to the possibility of electrolytic corrosion.		P
8.2.4	**Protective conductor connecting points**		
	All protective conductors shall be terminated in accordance with 13.1.1. The protective conductor connecting points are not intended, for example, to attach appliances or parts.		P
8.2.5	**Mobile machines**		
	On mobile machines with on-board power supplies, the protective conductors, the conductive structural parts of the electrical equipment, and those extraneous-conductive-parts which form the structure of the machine shall all be connected to a protective bonding terminal to provide protection against electric shock. Where a mobile machine is also capable of being connected to an external incoming power supply, this protective bonding terminal shall be the connection point for the external protective conductor		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 that is greater than 10 mA AC or DC in any protective conductor, one or more of the following conditions for the integrity of each section of the associated protective bonding circuit that carries the earth leakage current shall be satisfied:		N
	a) the protective conductor is completely enclosed within electrical equipment enclosures or otherwise protected throughout its length against mechanical damage;		N
	b) the protective conductor has a cross-sectional area of at least 10 mm 2 Cu or 16 mm 2 Al;		N
	c) where the protective conductor has a cross-sectional area of less than 10 mm 2 Cu or 16 mm 2 Al, a second protective conductor of at least the same cross-sectional area is provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm 2 Cu or 16 mm 2 Al. This can require that the electrical equipment has a separate terminal for a second protective conductor		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, with adequate strain relief and a minimum protective earthing conductor cross-section of 2,5 mm 2 as part of a multi-conductor power cable is provided.		N
8.3	**Functional bonding**		

	Protection against maloperation as a result of insulation failures can be achieved by connecting to a common conductor in accordance with 9.4.3.1.1. For recommendations regarding functional bonding to avoid maloperation due to electromagnetic disturbances, see 4.4.2 and Annex H.		N
9 Control circuits and control functions			
9.1	**Control circuits**		
9.1.1	**Control circuit supply**		
	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
9.1.2	**Control circuit voltages**		
	The nominal value of the control voltage shall be consistent with the correct operation of the control circuit.		P
	The nominal voltage of AC control circuits should preferably not exceed – 230 V for circuits with 50 Hz nominal frequency, – 277 V for circuits with 60 Hz nominal frequency		P
	The nominal voltage of DC control circuits should preferably not exceed 220 V.		N
9.1.3	**Protection**		
	Control circuits shall be provided with over current protection in accordance with 7.2.4 and 7.2.10.		P
9.2	**Control functions**		
9.2.2	**Categories of stop functions**		
	There are three categories of stop functions as follows:		P
	stop category 0: stopping by immediate removal of power to the machine actuators (i.e.an uncontrolled stop – see 3.1.64);		P
	stop category 1: a controlled stop (see 3.1.14) with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved;		N
	stop category 2: a controlled stop with power remaining available to the machine actuators		N
9.2.3	**Operation**		
9.2.3.1	**General**		P
	Safety functions and/or protective measures (for example interlocks (see 9.3)) shall be provided where required to reduce the possibility of hazardous situations.		P
9.2.3.2	**Start**		
	Start functions shall operate by energizing the relevant circuit.		P
9.2.3.3	**Stop**		
	Stop category 0 and/or stop category 1 and/or stop category 2 stop functions shall be provided as indicated by the risk assessment and the functional requirements of the machine		P
9.2.3.4	**Emergency operations (emergency stop, emergency switching off)**		
9.2.3.4.1	**General**		
	Emergency stop and emergency switching off are complementary protective measures that are not primary means of risk reduction for hazards (for example trapping, entanglement, electric shock or burn) at a machine (see ISO 12100).		P
9.2.3.4.2	**Emergency stop**		
	Requirements for functional aspects of emergency stop equipment are given in ISO 13850.		P
9.2.3.4.3	**Emergency switching off**		P
9.2.3.5	**Operating modes**		N
9.2.3.6	**Monitoring of command actions**		N
9.2.3.7	**Hold-to-run controls**		N
9.2.3.8	**Two-hand control**		N

9.2.3.9	**Enabling control**		N
9.2.3.10	**Combined start and stop controls**		N
9.2.4	**Cableless control system (CCS)**		
9.2.4.1	**General requirements**		
	Subclause 9.2.4 deals with the functional requirements of control systems employing cableless (for example radio, infra-red) techniques for transmitting control signals and data between operator control station(s) and other parts of the control system(s).		N
9.2.4.2	**Monitoring the ability of a cableless control system to control a machine**		
	The ability of a cableless control system (CCS) to control a machine shall be automatically monitored, either ontinuously or at suitable intervals. The status of this ability shall be clearly indicated		N
9.2.4.3	**Control limitation**		
	Measures shall be taken (e.g. coded transmission) to prevent the machine from responding to signals other than those from the intended cableless operator control station(s)		N
9.2.4.4	**Use of multiple cableless operator control stations**		
	When more than one cableless operator control station is used to control a machine: • only one cableless operator control station shall be enabled at a time except as necessary for the operation of the machine; • transfer of control from one cableless operator control station to another shall require a deliberate manual action at the control station that has control; • during machine operation, transfer of control shall only be possible when both cableless operator control stations are set to the same mode of machine operation and/or function(s) of the machine; • transfer of control shall not change the selected mode of machine operation and/or function(s) of the machine; • each cableless operator control station that has control of the machine shall be provided with an indication that it has control (by for example, the provision of an indicating light, a visual display indication).		N
9.2.4.5	**Portable cableless operator control stations**		
	Portable cableless operator control stations shall be provided with means (for example key operated switch, access code) to prevent unauthorized use.		N
9.2.4.6	**Deliberate disabling of cableless operator control stations**		
	Where a cableless operator control station is disabled when under control, the associated machine shall meet the requirements for loss of ability of a CCS to control a machine in 9.2.4.2		N
9.2.4.7	**Emergency stop devices on portable cableless operator control stations**		
	Emergency stop devices on portable cableless operator control stations shall not be the sole means of initiating the emergency stop function of a machine.		N
9.2.4.8	**Emergency stop reset**		
	Restarting of cableless control after power loss, disabling and re-enabling, loss of communication, or failure of parts of the CCS shall not result in a reset of an emergency stop condition.		N
9.3	**Protective interlocks**		
9.3.1	**Reclosing or resetting of an interlocking safeguard**		

	The reclosing or resetting of an interlocking safeguard shall not initiate hazardous machine operation		P
9.3.2	**Exceeding operating limits**		
	Where an operating limits (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		P
9.3.3	**Operation of auxiliary functions**		P
	The correct operation of auxiliary functions shall be checked by appropriate devices (for example pressure sensors). Where the non-operation of a motor or device for an auxiliary function (for example lubrication, supply of coolant, swarf removal) can cause a hazardous situation, or cause damage to the machine or to the work in progress, appropriate interlocking shall be provided.		P
9.3.4	**Interlocks between different operations and for contrary motions**		
	All contactors, relays, and other control devices that control elements of the machine and that can cause a hazardous situation when actuated at the same time (for example those which initiate contrary motion), shall be interlocked against incorrect operation. Reversing contactors (for example those controlling the direction of rotation of a motor) shall be interlocked in such a way that in normal service no short circuit can occur when switching. Where, for safety or for continuous operation, certain functions on the machine are required to be interrelated, proper co-ordination shall be ensured by suitable interlocks. For a group of machines working together in a co-coordinated manner and having more than one controller provision shall be made to co-ordinate the operations of the controllers as necessary. Where a failure of a mechanical brake actuator can result in the brake being applied when the associated machine actuator is energized and a hazardous situation can result, interlocks shall be provided to switch off the machine actuator.		P
9.3.5	**Reverse current braking**		
	Where braking of a motor is accomplished by current reversal, measures shall be provided to 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. For this purpose, a device operating exclusively as a function of time is not permitted. Control circuits shall be so arranged that rotation of a motor shaft, for example manually shall not result in a hazardous situation.		P
9.3.6	**Suspension of safety functions and/or protective measures**		

	Where it is necessary to suspend safety functions and/or protective measures (for example for setting or maintenance purposes), the control or operating mode selector shall simultaneously: • disable all other operating (control) modes; • 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; • permit operation of the hazardous elements only in reduced risk conditions (e.g. reduced speed, reduced power / force, step-by-step operation, e.g. with a limited movement control device); • prevent any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.		P
9.4	**Control functions in the event of failure**		
9.4.1	**General requirements**		
	Where failures or disturbances in the electrical equipment can cause a hazardous situation or damage to the machine or to the work in progress, appropriate measures shall be taken to minimize the probability of the occurrence of such failures or disturbances. The required measures and the extent to which they are implemented, either individually or in combination depend on the level of risk associated with the respective application (see 4.1).		P
9.4.2	**Measures to minimize risk in the event of failure**		
9.4.2.1	**General**		
	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.	(See appended table)	P
9.4.2.2	**Use of proven circuit techniques and components**		
	These measures include but are not limited to: • bonding of control circuits to the protective bonding circuit for functional purposes (see 9.4.3.1.1 and Figure 4); • connection of control devices in accordance with 9.4.3.1.1; • stopping by de-energizing; • the switching of all control circuit conductors (for example both sides of a coil) of the device being controlled; • switching devices having direct opening action (see IEC 60947-5-1);		N
	• monitoring by: – use of mechanically linked contacts (see IEC 60947-5-1); – use of mirror contacts (see IEC 60947-4-1); • circuit design to reduce the possibility of failures causing undesirable operations		N
9.4.2.3	**Provisions of partial or complete redundancy**		
	By providing partial or complete redundancy, it is possible to minimize the probability that one single failure in the electrical circuit can result in a hazardous situation. Redundancy can be effective in normal operation (on-line redundancy) or designed as special circuits that take over the protective function (off-line redundancy) only where the operating function fails.		N
9.4.2.4	**Provision of diversity**		

	Functional tests may be carried out automatically by the control system, or manually by inspection or tests at start-up and at predetermined intervals or a combination as appropriate (see also 17.2 and 18.6).		P
9.4.2.5	**Provision for functional tests**		
	Functional tests may be carried out automatically by the control system, or manually by inspection or tests at start-up and at predetermined intervals, or a combination as appropriate (see also 17.2 and 18.6)		P
9.4.3	**Protection against malfunction of control circuits**		
9.4.3.1	**Insulation faults**		
9.4.3.1.1	**General**		
	The measures to meet the requirements include but are not limited to the following methods: – method a) Earthed control circuits fed by transformers; – method b) Non-earthed control circuits fed by transformers; – method c) Control circuits fed by transformer with an earthed centre-tap winding; – method d) Control circuits not fed by a transformer.	method d)	P
9.4.3.1.2	**Method a) – Earthed control circuits fed by transformers**		N
	The common conductor shall be connected to the protective bonding circuit at the point of supply		N
9.4.3.1.3	**Method b) – Non-earthed control circuits fed by transformers**		
	Control circuits fed from a control transformer that is not connected to the protective bonding circuit		N
9.4.3.1.4	**Method c) – Control circuits fed by transformer with an earthed centre-tap winding**		
	Control circuits fed from a control transformer with its centre-tap winding connected to the protective bonding circuit shall have overcurrent protective devices that break both the conductors.		N
9.4.3.2	**Voltage interruptions**		
	Where the control system uses a memory device(s), proper functioning in the event of power failure shall be ensured (for example by using a non-volatile memory) to prevent any loss of memory that can result in a hazardous situation.	No such risk.	P

9.4.3.3	**Loss of circuit continuity**		
	Where the loss of continuity of safety-related control circuits depending upon sliding contacts can result in a hazardous situation, appropriate measures shall be taken (for example by duplication of the sliding contacts).		N
10 Operator interface and machine-mounted control devices			
10.1	**General**		
10.1.1	**General device requirements**		

	This Clause contains requirements for devices mounted outside or partially outside control enclosures. As far as is practicable, those devices shall be selected, mounted, and identified or coded in accordance with relevant parts of IEC 61310. The possibility of inadvertent operation shall be minimized by, for example, positioning of devices, suitable design, and provision of additional protective measures. Particular consideration shall be given to the selection, arrangement, programming and use of operator input devices such as touch screens, keypads and keyboards, for the control of hazardous machine operations. See IEC 60447.		P
10.1.2	**Location and mounting**		
	As far as is practicable, machine-mounted control devices shall be: —readily accessible for service and maintenance; —mounted in such a manner as to minimize the possibility of damage from activities such as material handling. The actuators of hand-operated control devices shall be 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; —the operator is not placed in a hazardous situation when operating them. The actuators of foot-operated control devices shall be selected and installed so that: —they are within easy reach of the normal working position of the operator; —the operator is not placed in a hazardous situation when operating them.	Easily reach and control.	P
10.1.3	**Protection**		
	The degree of protection (see IEC 60529) together with other appropriate measures shall afford protection against: —the effects of aggressive liquids, vapours, or gases found in the physical environment or used on the machine; —the ingress of contaminants (for example swarf, dust, particulate matter). In addition, the operator interface control devices shall have a minimum degree of protection against direct contact of IPXXD (see IEC 60529).		P
10.1.4	**Position sensors**		
	Position sensors (for example position switches, proximity switches) shall be so arranged that they will not be damaged in the event of over travel. Position sensors in circuits with safety-related control functions shall have direct opening action (see IEC 60947-5-1) or shall provide similar reliability (see 9.4.2).		P

10.1.5	**Portable and pendant control stations**		
	Portable and pendant operator control stations and their control devices shall be so selected and arranged as to minimize the possibility of inadvertent machine operations caused by shocks and vibrations (for example if the operator control station is dropped or strikes an obstruction) (see also 4.4.8).		N
10.2	**Actuators**		
10.2.1	**Colors**		

	The colors for START/ON actuators should be WHITE, GREY, BLACK or GREEN with a preference for WHITE. RED shall not be used. The color RED shall be used for emergency stop and emergency switching off actuators. The colors for STOP/OFF actuators should be BLACK, GREY, or WHITE with a preference for BLACK. GREEN shall not be used. RED is permitted, but it is recommended that RED is not used near an emergency operation device. WHITE, GREY, or BLACK are the preferred colors for push-button actuators that alternately act as START/ON and STOP/OFF push-buttons. The colors RED, YELLOW, or GREEN shall not be used (see also 9.2.6). WHITE, GREY, or BLACK is the preferred colors for push-button actuators that cause operation while they are actuated and cease the operation when they are released (for example hold-to-run). The colors RED, YELLOW, or GREEN shall not be used. Reset push-buttons shall be BLUE, WHITE, GREY, or BLACK. Where they also act as a STOP/OFF button, the colors WHITE, GREY, or BLACK are preferred with the main preference being for BLACK. GREEN shall not be used. Where the same color WHITE, GREY, or BLACK is used for various functions (for example WHITE for START/ON and for STOP/OFF actuators) a supplementary means of coding (for example shape, position, symbol) shall be used for the identification of push-button actuators.		N
10.2.2	**Markings**		
	In addition to the functional identification as described in 16.3, recommended symbols to be placed near to or preferably directly on certain actuators are given in Table 2 or 3.		P
10.3	**Indicator lights and displays**		
10.3.1	**General**		
	Indicator lights and displays serve to give the following types of information: —Indication: to attract the operator's attention or to indicate that a certain task should be performed. The colors RED, YELLOW, BLUE, and GREEN are normally used in this mode; for flashing indicator lights and displays, see 10.3.3. —confirmation: to confirm a command, or a condition, or to confirm the termination of a change or transition period. The colors BLUE and WHITE are normally used in this mode and GREEN may be used in some cases. Indicator lights and displays shall be selected and installed in such a manner as to be visible from the normal position of the operator. Indicator light circuits used for warning lights shall be fitted with facilities to check the operability of these devices.		P
10.3.2	**Colors**		
	Unless otherwise agreed between the supplier and the user。 Indicator lights shall be color-coded with respect to the condition (status) of the machine in accordance with Table 4. Indicating towers on machines should have the applicable colors in the following order from the top down; RED, YELLOW, BLUE, GREEN and WHITE.		P
10.3.3	**Flashing lights and displays**		

	For further distinction or information and especially to give additional emphasis, flashing lights and displays can be provided for the following purposes: —to attract attention; —to request immediate action; —to indicate a discrepancy between the command and actual state; —to indicate a change in process (flashing during transition). It is recommended that higher frequency flashing lights or display be used for higher priority information (see IEC 60073 for recommended flashing rates and pulse/pause ratios). Where flashing lights or displays are used to provide higher priority information, audible warning devices should also be provided		P
10.4	**Illuminated push-buttons**		
	Illuminated push-button actuators shall be colour-coded in accordance with 10.2.1. Where there is difficulty in assigning an appropriate colour, WHITE shall be used. The colour of active emergency stop actuators shall remain RED regardless of the state of the illumination.		P
10.5	**Rotary control devices**		
	Devices having a rotational member, such as potentiometers and selector switches, shall have means of prevention of rotation of the stationary member. Friction alone shall not be considered sufficient.		P
10.6	**Start devices**		
	Actuators used to initiate a start function or the movement of machine elements (for example slides, spindles, carriers) shall be constructed and mounted so as to minimize inadvertent operation		P
10.7	**Emergency stop devices**		
10.7.1	**Location of emergency stop devices**		
	Devices for emergency stop shall be readily accessible. Emergency stop devices shall be located at each operator control station and at other locations where the initiation of an emergency stop can be required. There can be circumstances where confusion can occur between active and inactive emergency stop devices caused by disabling the operator control station. In such cases means (for example, information for use) shall be provided to minimize confusion		P
10.7.2	**Types of emergency stop device**		
	The types of device for emergency stop include: —a push-button device for actuation by the palm or the fist —a pull-cord operated switch; —a pedal-operated switch without a mechanical guard. The devices shall be in accordance with IEC 60947-5-5.		P
10.7.3	**Operation of the supply disconnecting device to effect emergency stop**		
	Where a stop category 0 is suitable, the supply disconnecting device may serve the functionof 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
10.8	**Emergency switching off devices**		
10.8.1	**Location of emergency switching off devices**		
	Emergency switching off devices shall be located as necessary for the given application. Normally, those devices will be located separate from operator control stations. Where confusion can occur between emergency stop and emergency switching off devices, means shall be provided to minimise confusion		P

10.8.2	**Types of emergency switching off device**		
	The types of device for emergency switching off include: —a push-button operated switch with a palm or mushroom head type of actuator; —a pull-cord operated switch.		N
10.8.3	**Local operation of the supply disconnecting device to effect emergency switching off**		
	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. Enabling control devices shall be selected that have the following features: —designed in accordance with ergonomic principles; —for a two-position type: —position 1: off-function of the switch (actuator is not operated); —position 2: enabling function (actuator is operated). —for a three-position type: —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 Control gear: location, mounting, and enclosures			
11.1	**General requirements**		
	All control gear shall be located and mounted so as to facilitate: —its accessibility and maintenance; —its protection against the external influences or conditions under which it is intended to operate; —operation and maintenance of the machine and its associated equipment.		P
11.2	**Location and mounting**		

11.2.1	**Accessibility and maintenance**

	All items of control gear shall be placed and oriented so that they can be identified without moving them or the wiring. 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). Terminals not part of control gear components or devices shall also conform to these requirements. All control gear shall be mounted so as to facilitate its operation and maintenance from the front. Where a special tool is necessary to adjust, maintain, or remove a device, such a tool shall be supplied. 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. It is recommended that terminals be at least 0,2 m above the servicing level and be so placed that conductors and cables can be easily connected to them. No devices except devices for operating, indicating, measuring, and cooling shall be mounted on doors or on normally removable access covers of enclosures. Where control devices are connected through plug-in arrangements, their association shall be made clear by type (shape), marking or reference designation, singly or in combination (see 13.4.5). Plug-in devices that are handled during normal operation shall be provided with no interchangeable features where the lack of such a facility can result in malfunctioning. Plug/socket combinations that are handled during normal operation shall be located and mounted so as to provide unobstructed access. Test points for connection of test equipment, where provided, shall be: —mounted so as to provide unobstructed access; —clearly identified to correspond with the documentation (see 17.3); —adequately insulated; —Sufficiently spaced.		P
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 control gear. Devices such as solenoid valves should be separated from the other electrical equipment (for example in a separate compartment). Control devices mounted in the same location and connected to the supply voltage, or to both supply and control voltages, shall be grouped separately from those connected only to the control voltages. Terminals shall be separated into groups for: —power circuits; —associated control circuits; —other control circuits, fed from external sources (for example for interlocking). The groups may be mounted adjacently, provided that each group can be readily identified (for example by markings, by use of different sizes, by use of barriers or by colors). When arranging the location of devices (including interconnections), the clearances and creep age distances specified for them by the supplier shall be maintained, taking into account the external influences or conditions of the physical environment.		P
11.2.3	**Heating effects**		
	Heat generating components (for example heat sinks, power resistors) shall be so located that the temperature of each component in the vicinity remains within the permitted limit.		N

11.3	**Degrees of protection**		
	The protection of control gear 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 (i.e. the location and the physical environmental conditions) and shall be sufficient against dust, coolants, and swarf. Enclosures of control gear shall provide a degree of protection of at least IP22 (see IEC 60529). Exceptions: a) an electrical operating area provides an appropriate degree of protection against ingress of solids and liquids, or: b) removable collectors on conductor wire or conductor bar systems are used and the measures of 12.7.1 are applied.	Degrees of protection: IP22.	P
11.4	**Enclosures, doors and openings**		P
11.5	**Access to electrical equipment**		N
	Doors in gangways and 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	**General requirements**		
	Conductors and cables shall be selected so as to be suitable for the operating conditions (for example voltage, current, protection against electric shock, grouping of cables) and external influences (for example ambient temperature, presence of water or corrosive substances mechanical stresses (including stresses during installation), fire hazards) that can exist.		P

12.2	**Conductors**		
	conductors shall be of copper. Where aluminum conductors are used, the cross-sectional area shall be at least 16 mm^2. To ensure adequate mechanical strength, the cross-sectional area of conductors should not be less than as shown in Table 5. However, conductors with smaller cross-sectional areas or other constructions than shown in Table 5 may be used in equipment provided adequate mechanical strength is achieved by other means and proper functioning is not impaired.	Copper used, conform to relevant IEC/EN standards.	P
12.3	**Insulation**		
	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, guidance from the cable supplier sh be sought. It is important to give special attention to the integrity of a circuit having a safety-related function		N
12.4	**Current-carrying capacity in normal service**		
	The current-carrying capacity depends on several factors, for example insulation material number of conductors in a cable, design (sheath), methods of installation, grouping and ambient temperature.		N
12.5	**Conductor and cable voltage drop**		
	The voltage drop from the point of supply to the load shall not exceed 5 % of the nominal voltage under normal operating conditions. In order to conform to this requirement, it can be necessary to use conductors having a larger cross-sectional area than that derived from Table 6.		N

12.6	**Flexible cables**		
12.6.1	**General**		
	Flexible cables shall have Class 5 or Class 6 conductors.		P
12.6.2	**Mechanical rating**		
	The cable handling system of the machine shall be so designed to keep the tensile stress of the conductors as low as is practicable during machine operations. Where copper conductors are used, the tensile stress applied to the conductors shall not exceed 15 N/mm2 of the copper cross-sectional area. Where the demands of the application exceed the tensile stress limit of 15 N/mm2, cables with special construction features should be used and the allowed maximal tensile stress should be agreed with the cable manufacturer. The maximum stress applied to the conductors of flexible cables with material other than copper shall be within the cable manufacturer's specification.		P
12.6.3	**Current-carrying capacity of cables wound on drums**		
	Cables to be wound on drums shall be selected with conductors having a cross-sectional area such that, when fully wound on the drum and carrying the normal service load, the maximum allowable conductor temperature is not exceeded. For cables of circular cross-sectional area installed on drums, the maximum current-carrying capacity in free air should be derated in accordance with Table 7 (see also Clause 44 of IEC 60621-3).		P
12.7	**Conductor wires, conductor bars and slip-ring assemblies**		

12.7.1	**Basic protection**		
	Conductor wires, conductor bars and slip-ring assemblies shall be installed or enclosed in such a way that, during normal access to the machine, protection against direct contact is achieved by the application of one of the following protective measures:		P
12.7.2	**Protective conductor circuit**		
	Where conductor wires, conductor bars and slip-ring assemblies are installed as part of the protective bonding circuit, they shall not carry current in normal operation. Therefore, the protective conductor (PE) and the neutral conductor (N) shall each use a separate conductor wire, conductor bar or slip-ring..		P
12.7.3	**Protective conductor current collectors**		
	Movement or action of a machine or part of a machine that can result in a hazardous situation shall be monitored by providing, for example, over travel limiters, motor overspeed detection, mechanical overload detection or anti-collision devices.		P
12.7.4	**Removable current collectors with a disconnector function**		
	Removable current collectors having a disconnector function shall be so designed that the protective conductor circuit is interrupted only after the live conductors have been disconnected, and the continuity of the protective conductor circuit is re-established before any live conductor is reconnected (see also 8.2.3).		P
12.7.5	**Clearances in air**		
	Clearances between the respective conductors and between adjacent systems, of conductor wires, conductor bars, slip-ring assemblies and their current collectors 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**		

	Creepage distances between the respective conductors, between adjacent systems of conductor wires, conductor bars and slip-ring assemblies, and their current collectors shall be suitable for operation in the intended environment, for example open air (IEC 60664-1), inside buildings, protected by enclosures. In abnormally dusty, moist or corrosive environments, the following creepage distance requirements apply: —unprotected conductor wires, conductor bars, and slip-ring assemblies shall be equipped with insulators with a minimum creepage distance of 60 mm; —enclosed conductor wires, insulated multipole conductor bars and insulated individual conductor bars shall have a minimum creepage distance of 30 mm. The manufacturer's recommendations shall be followed regarding special measures to prevent a gradual reduction in the insulation values due to unfavorable ambient conditions (for example deposits of conductive dust, chemical attack).		N
12.7.7	**Conductor system sectioning**		
	Where conductor wires or conductor bars are arranged so that they can be divided into isolated sections, suitable design measures shall be employed to prevent the energization of adjacent sections by the current collectors themselves.		N

12.7.8	**Construction and installation of conductor wire, conductor bar systems and slip-ring assemblies**		
	Conductor wires, conductor bars and slip-ring assemblies in power circuits shall be grouped separately from those in control circuits. Conductor wires, conductor bars and slip-ring assemblies shall be capable of withstanding without damage, the mechanical forces and thermal effects of short-circuit currents. Removable covers for conductor wire and conductor bar systems laid underground or under floor shall be so designed that they cannot be opened by one person without the aid of a tool. Where conductor bars are installed in a common metal enclosure, the individual sections of the enclosure shall be bonded together and connected to a protective bonding conductor at several points depending upon their length. Metal covers of conductor bars laid underground or under floor shall also be bonded together and connected to a protective bonding conductor. The protective bonding circuit shall include the covers or cover plates of metal enclosures or under floor ducts. Where metal hinges form a part of the bonding circuit, their continuity shall be verified (see Clause 18). Underground and under floor conductor bar ducts shall have drainage facilities.		N
13 Wiring practices			
13.1	**Connections and routing**		
13.1.1	**General requirements**		
	All connections, especially those of the protective bonding circuit, shall be secured against accidental loosening.		P
13.1.2	**Conductor and cable runs**		

	Conductors and cables shall be run from terminal to terminal without splices or joints. Connections using plug/socket combinations with suitable protection against accidental disconnection are not considered to be joints for the purpose of this Sub clause. Exception: Where it is impracticable to provide terminals in a junction box (for example on mobile machines, on machines having long flexible cables; cable connections exceeding a length which is not practical to be supplied by the cable manufacturer on one cable drum; repair of cable due to mechanical stresses during installation and operation), splices or joints may be used. Where it is necessary to connect and disconnect cables and cable assemblies, a sufficient extra length shall be provided for that purpose. The terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors. Wherever practicable, the protective conductor shall be placed close to the associated live conductors in order to decrease the impedance of the loop.		P
13.1.3	**Conductors of different circuits**		
	Conductors of different circuits may be laid side by side, may occupy the same duct (for example conduit, cable trunking system), or may be in the same multiconductor cable provided that the arrangement does not impair the proper functioning of the respective circuits. Where those circuits operate at different voltages, the conductors shall be separated by suitable barriers or shall be insulated for the highest voltage to which any conductor within the same duct can be subjected, for example line to line voltage for unearthed systems and phase to earth voltage for earthed systems.		P
13.1.4	**AC circuits – Electromagnetic effects (prevention of eddy currents)**		
	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. Where such conductors enter a ferrous enclosure, they shall be arranged		P
13.1.5	**Connection between pick-up and pick-up converter of an inductive power supply system**		N
	The cable between the pick-up and the pick-up converter shall be: – as short as practicable; – adequately protected against mechanical damage		N
13.2	**Identification of conductors**		
13.2.1	**General requirements**		
	Each conductor shall be identifiable at each termination in accordance with the technical documentation. It is recommended (for example to facilitate maintenance) that conductors be identified by number, alphanumeric, color (either solid or with one or more stripes), or a combination of color and numbers or alphanumeric. When numbers are used, they shall be		P
13.2.2	**Identification of the protective conductor / protective bonding conductor**		

	The protective conductor shall be readily distinguishable by shape, location, marking, or color. When identification is by color alone, the bicolor combination GREEN-ANDYELLOW shall be used throughout the length of the conductor. This colour identification is strictly reserved for the protective conductor. For insulated conductors, the bicolor combination GREEN-AND-YELLOW shall be such that on any 15 mm length, one of the colors covers at least 30 % and not more than 70 % of the surface of the conductor, the other color covering the remainder of the surface. Where the protective conductor can be easily identified by its shape, position, or construction (for example a braided conductor, uninsulated stranded conductor), or where the insulated conductor is not readily accessible, color coding throughout its length is not necessary but the ends or accessible locations shall be clearly identified by the graphical symbol IEC 60417-5019 (DB: 2002-10) or by the bicolor combination GREEN-AND-YELLOW.		P

13.2.3	**Identification of the neutral conductor**		
	Where a circuit includes a neutral conductor that is identified by color alone, the color used for this conductor shall be BLUE. In order to avoid confusion with other colors, it is recommended that an unsaturated blue be used, called here “light blue” (see 6.2.2 of IEC 60445). Where the selected color is the sole identification of the neutral conductor, that color shall not be used for identifying any other conductor where confusion is possible. Where identification by color is used, bare conductors used as neutral conductors shall be either colored by a stripe, 15 mm to 100 mm wide in each compartment or unit and at each accessible location, or colored throughout their length.		P
13.2.4	**Identification by color**		
	Where color-coding is used for identification of conductors (other than the protective conductor (see 13.2.2) and the neutral conductor (see 13.2.3)), the following colors may be used: BLACK, BROWN, RED, ORANGE, YELLOW, GREEN, BLUE (including LIGHT BLUE), VIOLET, GREY, WHITE, PINK, TURQUOISE.		P
13.3	**Wiring inside enclosures**		
	Conductors inside enclosures shall be supported where necessary to keep them in place. Non-metallic ducts shall be permitted only when they are made with a flame-retardant insulating material (see the IEC 60332 series). It is recommended that electrical equipment mounted inside enclosures be designed and constructed in such a way as to permit modification of the wiring from the front of the enclosure (see also 11.2.1). Where that is not practicable and control devices are connected from the rear of the enclosure, access doors or swing out panels shall be provided.		P
13.4	**Wiring outside enclosures**		
13.4.1	**General requirements**		
	The means of introduction of cables or ducts with their individual glands, bushings, etc., into an enclosure shall ensure that the degree of protection is not reduced (see 11.3).		P

13.4.2	**External ducts**		
	Conductors and their connections external to the electrical equipment enclosure(s) shall be enclosed in suitable ducts (i.e. conduit or cable trunking systems) as described in 13.5except for suitably protected cables that may be installed without ducts and with or without the use of open cable trays or cable support means. Where devices such as position switches or proximity switches are supplied with a dedicated cable, their cable need not be enclosed in a duct when the cable is suitable for the purpose, sufficiently short, and so located or protected, that the risk of damage is minimized. Fittings used with ducts or multiconductor cable shall be suitable for the physical environment.		P
13.4.3	**Connection to moving elements of the machine**		
	Connections to frequently moving parts shall be made using conductors in accordance with 12.2 and 12.6. Flexible cable and flexible conduit shall be so installed as to avoid excessive flexing and straining, particularly at the fittings.		N

13.4.4	**Interconnection of devices on the machine**		
	Where several machine-mounted switching devices (for example position sensors, pushbuttons) are connected in series or in parallel, it is recommended that the connections between those devices be made through terminals forming intermediate test points. Such terminals shall be conveniently placed, adequately protected, and shown on the relevant diagrams.		N
13.4.5	**Plug/socket combinations**		
	Plug/socket combinations intended to be connected or disconnected during load conditions shall have sufficient load-breaking capacity. Where the plug/socket combination is rated at 30 A, or greater, it shall be interlocked with a switching device so that the connection and disconnection is possible only when the switching device is in the OFF position. Plug/socket combinations that are rated at more than 16 A shall have		N
13.4.6	**Dismantling for shipment**		
	Where it is necessary that wiring be disconnected for shipment, terminals or plug/socket combinations shall be provided at the sectional points. Such terminals shall be suitably enclosed and plug/socket combinations shall be protected from the physical environment during transportation and storage.		P
13.4.7	**Additional conductors**		
	Consideration should be given to providing additional conductors for maintenance or repair. When spare conductors are provided, they shall be connected to spare terminals or isolated in such a manner as to prevent contact with live parts.		P
13.5	**Ducts, connection boxes and other boxes**		
13.5.1	**General requirements**		
	Ducts shall provide a degree of protection suitable for the application (see IEC 60529). All sharp edges, flash, burrs, rough surfaces, or threads with which the insulation of the conductors can come in contact shall be removed from ducts and fittings. Where necessary additional protection consisting of a flame-retardant, oil-resistant insulating material shall be provided to protect conductor insulation. Drain holes of 6 mm diameter are permitted in cable trunking systems, connection boxes, and other boxes used for wiring purposes that can be subject to accumulations of oil or moisture.		N

13.5.2	**Rigid metal conduit and fittings**		
	Fittings shall be compatible with the conduit and appropriate for the application. Fittings should be threaded unless structural difficulties prevent assembly. Where threadless fittings are used, the conduit shall be securely fastened to the equipment		N
13.5.3	**Flexible metal conduit and fittings**		
	A flexible metal conduit shall consist of a flexible metal tubing or woven wire armour. It shall be suitable for the expected physical environment. Fittings shall be compatible with the conduit and appropriate for the application.		N
13.5.4	**Flexible non-metallic conduit and fittings**		
	Flexible non-metallic conduit shall be resistant to kinking and shall have physical characteristics similar to those of the sheath of multiconductor cables. The conduit shall be suitable for use in the expected physical environment. Fittings shall be compatible with the conduit and appropriate for the application.		N
13.5.5	**Cable trunking systems**		
	Cable trunking systems external to enclosures shall be rigidly supported and clear of all moving parts of the machine and of sources of contamination. Covers shall be shaped to overlap the sides; gaskets shall be permitted. Covers shall be attached to cable trunking systems by suitable means. On horizontal cable trunking systems, the cover shall not be on the bottom unless specifically designed for such installation. Where the cable trunking system is furnished in sections, the joints between sections shall fit tightly but need not be gasketed. The only openings permitted shall be those required for wiring or for drainage. Cable trunking systems shall not have opened but unused knockouts.		N
13.5.6	**Machine compartments and cable trunking systems**		
	The use of compartments or cable trunking systems within the column or base of a machine to enclose conductors is permitted provided the compartments or cable trunking systems are isolated from coolant or oil reservoirs and are entirely enclosed. Conductors run in enclosed compartments and cable trunking systems shall be so secured and arranged that they are not subject to damage.		N
13.5.7	**Connection boxes and other boxes**		
	Connection boxes and other boxes used for wiring purposes shall be accessible for maintenance. Those boxes shall provide protection against the ingress of solid bodies and liquids, taking into account the external influences under which the machine is intended to operate (see 11.3). Those boxes shall not have opened but unused knockouts nor any other openings and shall be so constructed as to exclude materials such as dust, flying, oil, and coolant.		N
13.5.9	**Motor connection boxes**		
	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices.		N
14 Electric motors and associated equipment			

14.1	**General requirements**		
	Electric motors should conform to the relevant parts of IEC 60034 series. The protection requirements for motors and associated equipment are given in 7.2 for over current protection, in 7.3 for overload protection, and in 7.6 for overspeed protection. As many controllers do not switch off the supply to a motor when it is at rest, care shall be taken to ensure compliance with the requirements of 5.3, 5.4, 5.5, 7.5, 7.6 and 9.4. Motor control equipment shall be located and mounted in accordance with Clause 11.		P
14.2	**Motor enclosures**		
	It is recommended that motor enclosures be chosen from those included in IEC 60034-5. The degree of protection shall be dependent on the application and the physical environment (see 4.4). All motors shall be adequately protected from mechanical damage		P
14.3	**Motor dimensions**		
	As far as is practicable, the dimensions of motors shall conform to those given in the IEC 60072 series.		P
14.4	**Motor mounting and compartments**		
	Each motor and its associated couplings, belts, pulleys, or chains, shall be so mounted that they are adequately protected and are easily accessible for inspection, maintenance, adjustment and alignment, lubrication, and replacement. The motor mounting arrangement shall be such that all motor hold-down means can be removed and all terminal boxes are accessible. Motors shall be so mounted that proper cooling is ensured and the temperature rise remains within the limits of the insulation class (see IEC 60034-1). Where practicable, motor compartments should be clean and dry, and when required, shall be ventilated directly to the exterior of the machine. The vents shall be such that ingress of swarf, dust, or water spray is at an acceptable level. There shall be no opening between the motor compartment and any other compartment that does not meet the motor compartment requirements. Where a conduit or pipe is run into the motor compartment from another compartment not meeting the motor compartment requirements, any clearance around the conduit or pipe shall be sealed.		P
14.5	**Criteria for motor selection**		
	The characteristics of motors and associated equipment shall be selected in accordance with the anticipated service and physical environmental conditions (see 4.4). In this respect, the points that shall be considered include: —type of motor; —type of duty cycle (see IEC 60034-1); —fixed speed or variable speed operation, (and the consequent variable influence of the ventilation); —mechanical vibration; —type of motor control; —influence of the harmonic spectrum of the voltage and/or current feeding the motor (particularly when it is supplied from a static convertor) on the temperature rise; —method of starting and the possible influence of the inrush current on the operation of other users of the same power supply, taking also into account possible special considerations		P

	stipulated by the supply authority; —variation of counter-torque load with time and speed; —influence of loads with large inertia; —influence of constant torque or constant power operation; —possible need of inductive reactors between motor and converter.		
14.6	**Protective devices for mechanical brakes**		
	Operation of the overload and over current protective devices for mechanical brake actuators shall initiate the simultaneous de-energization (release) of the associated machine actuators.		P
15 Accessories and lighting			
15.1	**Socket-outlets for accessories**		
	Where the machine or its associated equipment is provided with socket-outlets that are intended to be used for accessory equipment (for example hand-held power tools, test equipment), the following apply: – the socket-outlets should conform to IEC 60309-1. Where that is not practicable, they should be clearly marked with the voltage and current ratings; – the continuity of the protective bonding circuit to the socket-outlet shall be ensured; – all unearthed conductors connected to the socket-outlet shall be protected against overcurrent and, when required, against overload in accordance with 7.2 and 7.3 separately from the protection of other circuits; – where the power supply to the socket-outlet is not disconnected by the supply discon-necting device for the machine or the section of the machine, the requirements of 5.3.5apply; – 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; – circuits supplying socket-outlets with a current rating not exceeding 20 A shall be provided		N
15.2	**Local lighting of the machine and equipment**		
15.2.1	**General**		
	The ON/OFF switch shall not be incorporated in the lampholder or in the flexible connecting cords. Stroboscopic effects from lights shall be avoided by the selection of appropriate luminaries. Where fixed lighting is provided in an enclosure, electromagnetic compatibility should be taken into account using the principles outlined in 4.4.2.	No lamp used.	N
15.2.2	**Supply**		
	The nominal voltage of the local lighting circuit shall not exceed 250 V between conductors. A voltage not exceeding 50 V between conductors is recommended.		N
15.2.3	**Protection**		
	Local lighting circuits shall be protected in accordance with 7.2.6.		N
15.2.4	**Fittings**		
	Adjustable lighting fittings shall be suitable for the physical environment. The lamp holders shall be: —in accordance with the relevant IEC standard; —constructed with an insulating material protecting the lamp cap so as to prevent unintentional contact. Reflectors shall be supported by a bracket and not by the lamp		N

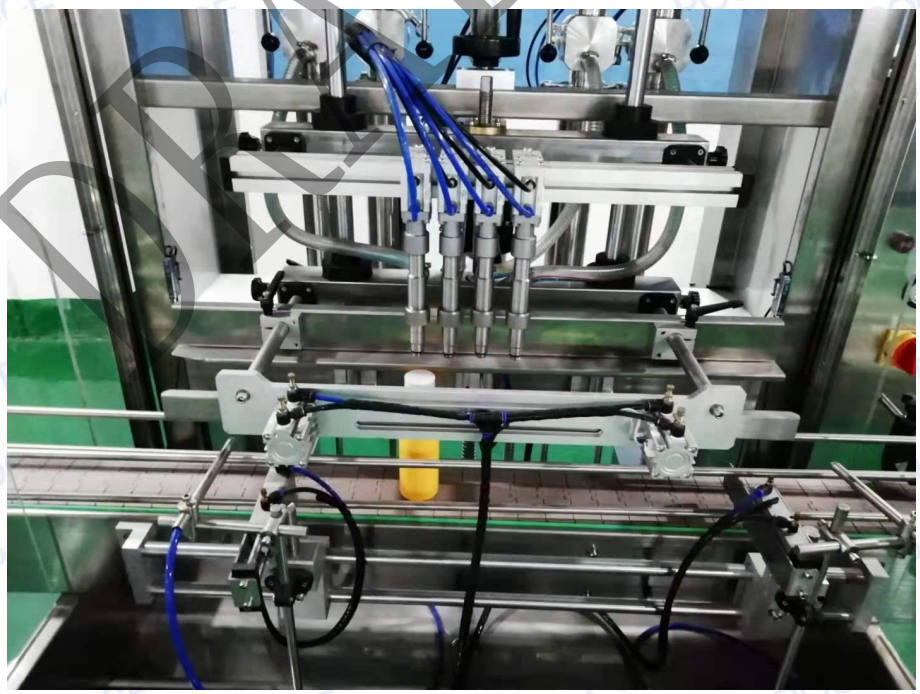
	holder.		
16 Marking, warning signs and reference designations			
16.1	**General**		
	Warning signs, nameplates, markings, and identification plates shall be of sufficient durability to withstand the physical environment involved.		P
16.2	**Warning signs**		
16.2.1	**Electric shock hazard**		
	Enclosures that do not otherwise clearly show that they contain electrical equipment that can give rise to a risk of electric shock shall be marked with the graphical symbol IEC 60417-5036 (DB:2002-10). The warning sign shall be plainly visible on the enclosure door or cover. The warning sign may be omitted (see also 6.2.2 b)) for: —an enclosure equipped with a supply disconnecting device; —an operator-machine interface or control station; —a single device with its own enclosure (for example position sensor).		P
16.2.2	**Hot surfaces hazard**		
	Where the risk assessment shows the need to warn against the possibility of hazardous surface temperatures of the electrical equipment, the graphical symbol IEC 60417-5041 (DB: 2002-10) shall be used.		N
16.3	**Functional identification**		
	Control devices and isual indicators shall be clearly and durably marked with regard to their functions either on or adjacent to the item. It is recommended that such markings are made in accordance with IEC 60417 and ISO 7000.		P
16.4	**Marking of enclosures of electrical equipment**		
	The following information shall be legibly and durably marked in a way that is plainly visible after the equipment is installed on enclosures that receive incoming power supplies: —name or trade mark of supplier; —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		P

16.5	**Reference designations**		
	All enclosures, assemblies, control devices, and components shall be plainly identified with the same reference designation as shown in the technical documentation.		P
17 Technical documentation			
17.1	**General**		
	The information necessary for identification, transport, installation, use, maintenance, decommissioning and disposal of the electrical equipment shall be supplied. Annex I should be considered as guidance for the preparation of information and documents		P
17.2	**Information related to the electrical equipment**		

18	**Verification**			
18.2	**TABLE: Earth bonding**			P
	Test Current (A)..... :	25		
	Ambient (℃)..... :	25℃		
Test locations (most unfavorable case)		Conductor diameter (mm^2)	Measure resistance (mΩ)	
	PE – enclosure outside	$10mm^2$	76	
18.3	**TABLE: Insulation resistance test**			P
	Test Voltage (V)..... :	500Va.c.		
	Ambient (℃)..... :	25		
Test locations (most unfavorable case)		Insulation resistance (MΩ)		
	Live part to enclsoure	>100		
18.4	**TABLE: Dielectric test**			P
	Test Voltage (V)..... :	1000Va.c.		
	Test Duration (s)..... :	1 min.		
Test locations (most unfavorable case)		Observation		
	Live part to enclsoure	No damage		
18.5	**Protection against residual voltages**			
	Where appropriate, tests shall be performed to ensure compliance with 6.2.4.	See clause 6.2.4.		P
18.6	**Functional tests**			
	The functions of electrical equipment shall be tested. The function of circuits for electrical safety (for example earth fault detection) shall be tested.			P

Table 4.2	List of Components					
Symbol	object/part No.	Manufacturer/ trademark	type/model	technical data	standard	mark(s) of conformity[1)]
---	low-voltage circuit breaker	Schneider	EA9AN4C40 4P 40A	40A	IEC/EN 60947-2	CE
---	low-voltage circuit breaker	Schneider	EA9AN4C25 4P 25A	25A	IEC/EN 60947-2	CE
---	low-voltage circuit breaker	Schneider	EA9AN4C20 4P 20A	20A	IEC/EN 60947-2	CE
---	low-voltage circuit breaker	Schneider	EA9AN2C16 2P 16A	16A	IEC/EN 60947-2	CE
---	low-voltage circuit breaker	Schneider	EA9AN2C6 2P 6A	6A	IEC/EN 60947-2	CE
---	alternating current contactor	Schneider	LC1D32AM7C AC220 50/60HZ	220V	IEC/EN 60947-2	CE
---	alternating current contactor	Schneider	LC1D12M7C 220V 50/60HZ	220V	IEC/EN 60947-2	CE
---	Switching power supply	Schneider	ABL2REM2404 5H DC24V 100W	DC24V	IEC/EN 60947-2	CE
---	Electronic transformer	vibang technology	WB-075	7.5KVA	/	CE
---	actuating motor	Schneider	BCH2LD0433 CA5C	400W	IEC 60364-4-41	CE
---	actuating motor	Schneider	BCH2LD0433 CF5C	400W	IEC 60364-4-41	CE
---	actuating motor	Schneider	BCH2MM152 3CA6C	1.5KW	IEC 60364-4-41	CE
---	servo driver	Schneider	LXM26DU04 M3X	400W	IEC 60364-4-41	CE
---	servo driver	Schneider	LXM26DU15 M3X	1.5KW	IEC 60364-4-41	CE
---	VGA Cable	Shenzhen Green Union Technology	VGA HD15M/M Cable 5M Black	5M	IEC 11801	CE
---	Push-button switch	Shanghai AIA	LA130-22C-10	24V	EN60947-7-1	CE
Note: N/A.						

PHOTO

Photo 1	
Photo 2	

*** THE END ***