

TEST REPORT EN 60204-1:2018 Safety of machine- Electrical equipment of machines, Part 1: General requirements	
Report Reference No	STL2026S0302061C-Y1
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Date of issue	Mar .16,2026
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Address	Unit C, 4F, Building A, ShengHengji Industrial Park, No. 137 FuYuan 1 Road, Heping Community, Fuyong Street, Baoan District, Shenzhen, China
Testing location / address	As above
Applicant's name	HUIZHOU XING QI SHI SPORTING GOODS CO., LTD.
Address	THE LOCATION OF THE EAST DISTRICT OF BOLUO INTELLIGENT EQUIPMENT INDUSTRIAL PARK, YUANZHOU TOWN, BOLUO COUNTY (NO. 2, GREENING NORTH ROAD)
Test specification:	
Directive/ standard	EN 60204-1:2018 EN ISO 12100:2010; 2006/42/EC Annex I
Test procedure	MD test report
Test item description	Electric Bicycle
Manufacturer	HUIZHOU XING QI SHI SPORTING GOODS CO., LTD.
Address:	THE LOCATION OF THE EAST DISTRICT OF BOLUO INTELLIGENT EQUIPMENT INDUSTRIAL PARK, YUANZHOU TOWN, BOLUO COUNTY (NO. 2, GREENING NORTH ROAD)
Trademark	N/A
Model/Type reference	Q20-X,Q20MINI-X,Q20PLUS-X,Q20,Q20MIN,Q20-PLUS,K20, K20Lite,K20MAX,C20,C20Lite,C20Max,C26MAX,E26PRO, E26PRO-x,H26-X,H26,H26PRO,H26PRO-X,H20-ZD-X, H20PRO-X,DC26-X,MN20-X,MN26-X,CR20,CR20-X, Q20-Luxe-X,S29PLUS-X,S29PRO-X,FM-001,Q8,Q8MINI, Q8Lite,Q8PRO,M2000,Q31,Q21,Q22,Q23,L20,L20 Min, L20 Pro,L20 Max,R20,R20 Pro,R20 Max,L26,L26 Min, L26 Pro,L26 Max,L8,L8 Pro,L8 Max,L31,L31 Pro,L31 Max,X1, X1 Pro,X1 Max,X3,X3 Pro,X3 Max,L28,L28 Min,L28 Pro, L28 Max,U4-260203,Q8-16,Q8MAX,C16,Q16,E26RPO-X



Rating(s).....:	Power Adapter:Input:220-240V~,50/60Hz,1.6A Max Output:54.6V ---3.0A Li-ion Battery : 48V--- 20Ah,960Wh
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Summary of testing:**Tests performed (name of test and test clause):**

EN 60204-1:2018
EN ISO 12100:2010;
2006/42/EC Annex I

Testing location:

Unit C, 4F, Building A, ShengHengji Industrial
Park, No. 137 FuYuan 1 Road, Heping
Community, Fuyong Street, Baoan District,
Shenzhen, China

The submitted samples were found to comply with
the requirements of above specification.

Copy of marking plate:**Electric Bicycle**

Model: Q20-X

Power Adapter: Input: 220-240V~, 50/60Hz, 1.6A Max

Output: 54.6V --- 3.0A

Li-ion Battery : 48V--- 20Ah, 960Wh

HUIZHOU XING QI SHI SPORTING GOODS CO., LTD.
THE LOCATION OF THE EAST DISTRICT OF BOLUO
INTELLIGENT EQUIPMENT INDUSTRIAL PARK, YUANZHOU
TOWN, BOLUO COUNTY (NO. 2, GREENING NORTH ROAD)
S/N:xxxxx Made in China

Test items particulars:

Modifications allowed?:	No
Size of equipment:	/
Mass of equipment:	<50kg
Ambient temperature range (°C) :	-10~ +40°C
Humidity range :	30%-95%
Altitude :	< 2000m above mean sea level
Environmental requirements :	Suitability for use indoors/outdoors
Radiation:	No hazard
Vibration, shock :	No hazard
Special installation and operation requirements:	See installation and operation manual
Anticipated voltage fluctuations (if more than $\pm 10\%$):	Class III equipment
Anticipated frequency fluctuations (if more than in cl. 4.3.2):	N/A.
- specification of short-term value:	N/A.
Indicate of possible future changes in electrical equipment:	N/A.
Indicate for each source of electrical supply the requirements:	N/A.
- nominal voltage (V):	DC 48V
- number of phases:	N/A.
- frequency(Hz):	N/A.
- prospective short-circuit current at point of supply to machine:	N/A
- fluctuations outside to values given in cl. 4.3.2:	N/A
Type of power supply earthing:	Class III equipment
Electrical equipment to be connected to neutral (N):	N/A.
User or supplier provide overcurrent protection of the supply conductors:	Circuit-breakers,
- type and rating of overcurrent protective device :	N/A
- settings of protective device:	N/A.
Supply disconnecting device:	N/A

- disconnection of neutral (N) conductor required :	N/A
- link for neutral (N) permissible:	N/A
- type of disconnecting device to be provided:	Yes
Limit of power up to which three-phase AC-motors may be started directly across the incoming supply lines:	N.A.
Number of motor overload detection devices	Two
Where machine is equipped with local lighting:	N/A.
- highest permissible voltage:	N/A.
- if lighting circuit voltage is not obtained directly from the power supply, state preferred voltage :	N/A.
Functional identification:	See installation and operation manual
Inscriptions / special markings:	Yes
- mark of certification:	N/A.
- on electrical equipment:	English
- language :	Provided by English
Technical documentation (media, language):	Yes
Size, location and purpose of ducts, open cable trays or cable-supports to be provided by the user:	Instructed person
For which of following classes of persons is access to the interior of the switchgear cabinets required during normal operation of the equipment:	Protected by enclosure.
Locks with removable keys provided for fastening doors or covers :	N/A
Type of two-hand control to be provided:	N/A
- where it is type III, time limit (max. 0,5 s) within which each pair of push-buttons are to be operated :	N/A
Indicate special limitations on size or weight which affect the transport of a particular machine or control gear assemblies to the installation site:	N/A
- maximum dimensions:	See instruction and marking
- maximum weight:	See instruction and marking
Repetition of manual controlled cycles of operation:	N/A

- length of time expected that machine will be operated at this rate without subsequent pause: N/A

Certificate for operating tests P

- with the loaded machine to be supplied (specially built machines): N/A

- on a loaded prototype machine to be supplied (normal machines): P

Time delay for cableless control systems: N/A

Specific method of conductor identification to be used : Color and code used

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 : Mar .02,2026

Date(s) of performance of test : Mar .02-16,2026

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.

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
4.	GENERAL REQUIREMENTS		P
4.1	General considerations		P
	Hazard and risk assessment	Risk assessments as well as the evaluation on corresponding measures are carried out. And the result of which is found to be suitable.	P
4.2	Selection of equipment		P
4.2.1	Electrical components and devices shall:		P
	– be suitable for their intended use; and	Suitable for their intended use	P
	– conform to relevant IEC standards where such exist; and		P
	– be applied in accordance with the supplier's instructions.		P
4.2.2	Electrical equipment in compliance with the IEC/EN 60439 series		P
	The electrical equipment of the machine shall satisfy the safety requirements identified by the risk assessment of the machine. Depending upon the machine, its intended use and its electrical equipment, the designer may select parts of the electrical equipment of the machine that are in compliance with IEC/EN 60439-1 and, as necessary, other relevant parts of the IEC/EN 60439 series (see also Annex F).	Comply with requirement	P
4.3	Electrical supply		P
4.3.1	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		P
	– as otherwise specified by the user (see Annex B), or		P
	– as specified by the supplier in the case of a special source of supply such as an on-board generator.		P
4.3.2	AC Supplies	Class III equipment	N
	Voltage Steady state voltage: 0,9 to 1,1 of nominal voltage.		N
	Frequency 0,99 to 1,01 of nominal frequency continuously; 0,98 to 1,02 short time.		N
	Harmonics		N
	Voltage unbalance		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Voltage interruption		N
	Voltage dips		N
4.3.3	DC Supplies		P
	From batteries:		P
	Voltage 0,85 to 1,15 of nominal voltage; 0,7 to 1,2 of nominal voltage in the case of battery-operated vehicles.		P
	Voltage interruption Not exceeding 5 ms.		P
	From converting equipment:		N
	Voltage 0,9 to 1,1 of nominal voltage.		NP
	Voltage interruption Not exceeding 20 ms with more than 1 s between successive interruptions.		N
	Ripple (peak-to-peak) Not exceeding 0,15 of nominal voltage.		N
4.3.4	Special supply systems		N
	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		P
4.4.1	Electrical equipment to be suitable for use in physical environment and operating conditions	Manufacturer is responsible for selecting suitable electric equipment acc. to IEC or EN standards.	P
4.4.2	Electromagnetic compatibility (EMC)		N
	Equipment not to generate electromagnetic disturbances above harmful levels: (applicable EMC-standard: EN 50081-2)		N
	Equipment has adequate level of immunity to EMC: (applicable EMC-standards: EN 50082-2)		N
4.4.3	Electrical equipment to be capable for correct operation at intended ambient air temperature	-10°C ~ +40°C	P
4.4.4	Electrical equipment to be capable for correct operation at specified relative humidity:	35% ~ 90%	P
4.4.5	Electrical equipment capable of operating correctly at altitudes up to 1000 m above m.s.l.		P

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
4.4.6	Electrical equipment shall be adequately protected against ingress of solid properties and liquids		P
4.4.7	Ionizing and non-ionizing radiation Electrical equipment subject to radiation, additional measures to be taken to avoid equipment malfunction	No ionizing and non-ionizing radiation outside this equipment	P
4.4.8	Undesirable effects of vibration, shock and bump avoided	The use of equipment should be free of vibration	P
4.5	Transportation and storage	Manufacturer is responsible for this design	P
4.6	Provisions for handling		P
4.7	Installation and operation	Installed and operated in accordance with supplier's instructions and take into account ergonomic principles	P
5.	INCOMING SUPPLY CONDUCTOR TERMINATIONS AND DEVICES FOR DISCONNECTING AND SWITCHING OFF		P
5.1	Incoming supply conductor terminal	Class III equipment, not connection to mains supply	N
	Electrical equipment of a machine connected to a single power supply		N
	Power supply conductors terminated to main disconnecting device of electrical equipment		N
	Neutral conductor "N" clearly indicated in technical documentation.		N
	No connection between neutral conductor and protective bonding circuit, nor combined PEN-terminals.		N
	All terminals of incoming supply clearly marked (symbols acc. to EN 60445)		N
5.2	Terminal for connection to external protective earthing system.	Class III equipment	N
	Terminal for connection of external protective conductor provided and marked with "PE"		N
	Cross section of incoming PE conductor acc. to cl. 5.2, table 1		N
	other protective earth identified either by graphic symbol, letters "PE", or bicolour combination green / yellow		n
5.3	Supply disconnecting device		N
5.3.1	Power supply disconnecting device provided for electrical equipment	Comply not connection to mains supply with requirement	N
5.3.2	Type of power supply disconnecting device:		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	a) Switch-disconnector, acc. to EN 60947-3 for appliance category AC-23 B or DC-23 B		N
	b) Disconnector with or without fuses, with aux. contact (acc. to EN 60947-3)		N
	c) Power Circuit Breaker suitable for isolation (acc. to EN 60947-2)		N
	d) Plug/socket combination for electrical load=3kW or 16A		N
	e) plug and socket outlets or appliance couplers for flexible cable supply under following conditions:		N
	- not possible to connect or disconnect while load is connected		N
	- wired such with equipment, that IP-Protection degree is at least IP2X or IPXXB		N
	Plug/socket-outlet combination as supply disconnecting device have sufficient breaking capacity		N
	Plug/socket-outlet combination as overload connecting device have sufficient overload capacity		N
	Equipment has a switching device		N
5.3.3	When supply disconnecting device is a switch-disconnector or a circuit-breaker		N
	Isolate electrical equipment from supply (acc. to EN 60947-2)		N
	One OFF (isolated) and one ON position only		N
	Clearly marked with "0" and "1"		N
	CB's with additional reset position between "0" and "1"		N
	visible isolating distance or		N
	Position indication which cannot indicate the OFF-position until all contacts are actually open		N
	External operating device provided (except power operated CB's)		N
	Colour black or grey preferred.		N
	If used as an emergency stop, red/yellow combination selected		N
	Locking means provided to lock in OFF-position		N
	In locked position an unintended closing for local or remote operation mode possible		N
	Disconnection of all live conductors (Exception: TN-supply systems, neutral conductor)		N
	Sufficient breaking capacity		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
5.3.4	Handle of disconnecting device to be easily accessible	Easy to access	N
	Handle located between 0.6m and 1.9m above service level, an upper limit of 1.7m is recommended.		N
5.3.5	Following circuits not disconnect by supply disconnecting device:		N
	Lighting circuits during maintenance or repair		N
	Plug/socket outlets exclusively used for maintenance or repair		N
	Undervoltage protection circuits used for automatic tripping only at power supply failures		N
5.4	Devices for switching off for prevention of unexpected start-up:		N
	Means shall be provided to prevent inadvertent and/or mistaken closure of the disconnecting device		N
	Such devices appropriate and convenient for intended use		N
	Suitable placed		N
	Readily identifiable		N
	Disconnecting devices acc. to cl. 5.3.2 used:		N
	Other disconnecting devices for the following situations only:		---
	- no significant dismantling of the machine		N
	- adjustments requiring a relatively short time		N
	No work at the electrical equipment of the machine except:		---
	- no hazard arising of electric shock or burn		N
	- switched-off status cannot be released due to maintenance work		N
	- work of minor nature		N
5.5	Devices for disconnecting electrical equipment	Device in 5.3 applied	N
	Supply-disconnecting device used		N
	Disconnecting device provided for each separated part of the machine or partial machine where necessary		N
	Disconnectors, fuse links etc. used only in enclosed electrical operating areas		N
	Such disconnecting devices appropriate and convenient for intended use and		N
	Suitably located and		N
	Readily identifiable to which part it serves and		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
5.6	Provided with adequate means to prevent unauthorised, inadvertent and/or mistaken closing	Marking used	N
6	PROTECTION AGAINST ELECTRIC SHOCK		P
6.2	Protection against direct contact:	Class III equipment, not connection to mains supply	N
6.2.1	- By means of protection by enclosure	Enclosure used	P
	- by means of insulation of live parts		N
	- by means of protection against residual voltages		N
6.2.2	Protection by enclosure:		P
	Live parts located inside enclosures conform to relevant requirements of clauses 4, 12 and 15 Protection against direct contact at least IP2X or IPXXB		N
	Where top surfaces of enclosures are readily accessible, degree of protection against direct contact is IP4X or IPXXD.	Impossible to cause accessible hazard	P
	Opening of enclosure possible only under following conditions:		---
	a) use of a key or a tool. Special requirements for enclosed electrical operating areas may apply	Using a special tool	P
	Live parts inside of doors with protection degree of IP1X or IPXXA		N
	Live parts likely to be touched during resetting or adjustment with protection degree IP2X or IPXXB		N
	b) disconnection of live parts inside enclosure prior to opening of enclosure		N
	At door interlocking safety circuit, door will open only when main isolator is in open position		N
	For skilled persons a special device provided, to defeat interlocking circuit under following conditions:		---
	Special device or tool provided to permit skilled persons to defeat the interlock provided that:		N
	- opening of disconnector possible at all times while interlock is defeated		N
	- upon closing the door, interlock is automatically restored		N
	Excepted from this requirement for marking are:		---
	- Parts that can be live only because of connection to interlocking circuits and that are distinguished by colour as potentially live in accordance with 14.2.4		N
	- the supply terminals of the supply disconnecting device when the latter is mounted alone in a separate enclosure		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	c) Opening without the use of a key or a tool and without disconnection of live parts shall be possible only when all live parts are protected against direct contact to at least IP2X or IPXXB.		N
6.2.3	Protection by insulation of live parts	Class III equipment, not connection to mains supply	N
	Live parts completely covered with insulation		N
	Insulation can be removed only by destruction		N
	Insulation capable to withstand mechanical, chemical, electrical and thermal stress occurring under normal service conditions		N
	Paint, varnish lacquer etc. not used as insulation	Not used.	N
6.2.4	Protection of residual voltage		N
	Live parts with residual voltage=60V after disconnection, to be discharged to =60V within 5s after disconnection except are components with charges of = 60 μ C or less.		N
	If above requirements cannot be achieved, additional disconnecting devices or appropriate warning devices shall be applied. (see cl. 13.8.4)		N
6.2.6	Protection by placing out of reach or protection by obstacles acc. to EN 60364-4-41, cl. 412.4 and 412.3)		N
6.3	Protection against indirect contact		N
6.3.2	Measures to prevent the occurrence of a hazardous touch voltage		N
6.3.2.2	Use of class II electrical devices or apparatus (double insulation, reinforced insulation or by equivalent insulation acc. to EN 61140)		N
	Use of switchgear and control gear assemblies with total insulation acc. to EN 60439-1		N
	Application of supplementary or reinforced insulation acc. to EN 60364-4-41, cl. 413.2		N
6.3.2.3	Electrical separation of an individual circuit to prevent hazardous touch voltage acc. to EN 60364-41, cl. 413.5		N
6.3.3	Protection by automatic disconnection of supply:		N
	This protective measure comprises both:		---
	—protective bonding of exposed conductive parts (see 8.2.3)		N
	—and either:		---
	a) overcurrent protective devices for the automatic disconnection of the supply on detection of an insulation fault in TN systems,		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	b) residual current protective devices to initiate the automatic disconnection of the supply on detection of an insulation fault from a live part to exposed conductive parts or to earth in TT systems,		N
	c) insulation monitoring or residual current protective devices to initiate automatic disconnection of IT systems. Except where a protective device is provided to interrupt the supply in the case of the first earth fault, an insulation monitoring device shall be provided to indicate the occurrence of a first fault from a live part to exposed conductive parts or to earth. This insulation monitoring device shall initiate an audible and/or visual signal which shall continue as long as the fault persists.		N
6.4	Protection by application of PELV circuit which have to fulfil following requirements:		P
6.4.1	a) nominal voltage not to exceed 25 VAC (r.m.s.) or 60 VDC (ripple-free) or		P
	6VAC or 15VDC for all other cases		N
	b) one side of PELV – circuit or one point of source of supply to be connected to PE-circuit		N
	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		N
	d) conductors of each PELV circuit shall be physically separated from those of any other circuits.		N
	e) plugs and socket-outlets for a PELV circuit shall conform to the following:		---
	1) plugs shall not be able to enter socket-outlets of other voltage systems		N
	2) socket-outlets shall not admit plugs of other voltage systems		N
6.4.2	Sources for PELV – circuits to be one of the following:		N
	Safety isolating transformers		N
	Source of current providing a degree of safety, equivalent to safety isolating transformers		N
	Electrochemical or other source, independent of circuit with higher voltage		N
	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.		N
7	PROTECTION OF EQUIPMENT		P
7.2	Overcurrent protection:		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
7.2.1	Overcurrent protection device provided	Class III equipment, not connection to mains supply	N
7.2.2	Overcurrent protective device at incoming feeder to the electrical equipment (see Annex B)		N
	Electrical equipment supplier state data for overcurrent protective device		N
7.2.3	Power circuits:		N
	Overcurrent protective devices applied to each live conductors except for neutral earth conductor		N
	Cross section area of neutral conductor to be at least equal to phase conductor, no overcurrent protective/ disconnecting device required		N
	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.		N
	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		N
	Conductors of control circuits directly connected to the supply voltage and of circuits supplying control circuit transformers shall be protected against overcurrent in accordance with 7.2.3.		N
	Conductors of control circuits supplied by a control circuit transformer or d.c. supply shall be protected against overcurrent (see also 9.4.3.1):		---
	–in control circuits connected to the protective bonding circuit, by inserting an overcurrent protective device into the switched conductor;		N
	–in control circuits not connected to the protective bonding circuit;		N
	- where the same cross sectional area conductors are used in all control circuits, by inserting an overcurrent protective device into the switched conductor, and;		N
	- where different cross sectional areas conductors are used in different sub-circuits, by inserting an overcurrent protective device into both switched and common conductors of each sub-circuit.		N
7.2.5	Socket outlets and their associated conductors:		N
	Overcurrent protection devices for socket outlets provided for non-earthed live conductors of each circuit feeding such socket outlets	No socket outlets.	N
7.2.6	Lighting circuits		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	All unearthed conductors of circuits supplying lighting shall be protected against the effects of short circuits by the provision of overcurrent devices separate from those protecting other circuits	No lighting circuits.	N
7.2.7	Transformers:		N
	Transformers shall be protected against overcurrent in accordance with the manufacturer's instructions.		N
	Avoid unnecessary tripping due to overcurrent caused by magnetizing inrush currents		N
	Avoid temperature rise of transformer winding in excess of its permitted of its insulation class of transformer in case of short circuit at secondary terminals		N
	Type and setting of overcurrent protective device acc. to recommendations of transformer manufacturer		N
7.2.8	Location of protective devices:		N
	Overcurrent protective device located at point where conductor is connected to the supply		N
	the current carrying capacity of the conductors is at least equal to that of the load;		N
	the part of the conductor between the point of reduction of current-carrying capacity and the position of the overcurrent protective device is no longer than 3 m		N
	the conductor is installed in such a manner as to reduce the possibility of a short-circuit,		N
7.2.9	Overcurrent protective devices:		N
	Rated short-circuit breaking capacity at least equal to prospective fault current at point of installation		N
	Current other than those coming from supply side taken into account		N
	Reduced breaking capacity is permitted, where another protective device is installed at supply side with the necessary breaking capacity		N
	Back-up protection carefully checked, no destruction of conductor or overcurrent protective device may result		N
	Co-ordination with other protective devices in circuit required		N
	Overcurrent protective devices in power circuits include fuses and circuit breakers. Electronic current limiting devices may also be used in protected circuits		N
7.2.10	Rating and setting of overcurrent protective devices:		N
	Rated current of fuses or overcurrent setting of other protective devices selected as low as possible, but adequate for anticipated overcurrents.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Settings of overcurrent protective devices appropriately listed in technical documentation		P
7.3	Overload protection of motors:		P
7.3.1	General	Rating of motor not more than 500W	P
	Protection of motors against overheating shall be provided for each motor rated at more than 0,5 kW.		N
	In applications where an automatic interruption of the motor operation is unacceptable the means of detection shall give a warning signal to which the operator can respond.		N
	Protection of motors against overheating can be achieved by:		---
	–overload protection (7.3.2),		N
	–over-temperature protection (7.3.3)		N
	–current-limiting protection (7.3.4).		N
	Automatic restarting of any motor after the operation of protection against overheating shall be prevented where this can cause a hazardous situation or damage to the machine or to the work in progress.		N
7.3.2	Overload protection		N
	Where overload protection is provided, detection of overload(s) shall be provided in each live conductor except for the neutral conductor.		N
	For motors having single-phase or d.c. power supplies, detection in only one unearthed live conductor is permitted		N
	Where overload protection is achieved by switching off, the switching device shall switch off all live conductors. The switching of the neutral conductor is not necessary for overload protection.		N
	Appropriate protective devices designed to accommodate special duty motors or over-temperature protection (see 7.3.3) can be necessary		N
	For motors that cannot be overloaded, overload protection is not required.		N
7.3.3	Over-temperature protection		N
	The provision of motors with over-temperature protection (see IEC 60034-11) is recommended in situations where the cooling can be impaired		N
	Over-temperature protection is also recommended for motors that cannot be overloaded, where the possibility of over-temperature exists.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
7.3.4	Current limiting protection		N
	Where protection against the effects of overheating in three phase motors is achieved by current limitation, the number of current limitation devices may be reduced from 3 to 2 (see 7.3.2)		N
	For motors having single phase a.c or d.c. power supplies, current limitation in only one unearthed live conductor is permitted.		N
7.4	Abnormal temperature protection:		P
	Resistance heating or similar devices which cause excessive heat, equipped with suitable over temperature detection		P
7.5	Protection against supply interruption or voltage reduction and subsequent restoration		N
	Undervoltage protection provided for applications where loss of supply or undervoltage causes a hazardous condition		N
	If interruption or reduction of supply voltage is allowed for a short period of time, delayed undervoltage protection provided.	No such device	N
	Undervoltage protection not impair any stopping control of the machine	No abnormality	N
	Upon restoration of supply voltage, automatic or unexpected restarting of machine prevented		N
	Undervoltage protection to initiate appropriate control responses to ensure co-ordination the groups of machines working together		N
7.6	Motor overspeed protection:		P
	Overspeed protection provided where overspeeding causes a hazardous condition		P
	Overspeed protection initiates appropriate control response and prevents automatic restarting		P
7.7	Earth fault / residual current protection:		N
	To reduce damage to equipment due to earth fault currents below detection level, earth fault/residual protect used		N
	Detection level for earth fault protection set as low as possible		N
7.8	Phase sequence protection:		N
	Protection from incorrect phase sequence of supply voltage provided		N
7.9	Protection against overvoltages due to lightning strike or switching action:		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Protective devices for the suppression of overvoltages caused by lightning strikes or switching surges provided		N
8	EQUIPOTENTIAL BONDING		N
8.2	Protective bonding circuit		N
8.2.1	General:		N
	All parts of protective bonding circuit capable to withstand max. thermal and mechanical stress, caused by earth-fault currents		N
	Where the conductance of structural parts of the electrical equipment or of the machine is less than that of the smallest protective conductor connected to the exposed conductive parts, a supplementary bonding conductor shall be provided. This supplementary bonding conductor shall have a cross-sectional area not less than half that of the corresponding protective conductor.		N
	If an IT distribution system is used, the machine structure shall be part of the protective bonding circuit and insulation monitoring shall be provided. See 6.3.3 c).	Not for IT power system.	N
	Conductive structural parts of equipment in accordance with 6.3.2.2 need not be connected to the protective bonding circuit. Extraneous conductive parts which form the structure of the machine need not be connected to the protective bonding circuit where all the equipment provided is in accordance with 6.3.2.2.		N
	Exposed conductive parts of equipment in accordance with 6.3.2.3 shall not be connected to the protective bonding circuit.		N
8.2.2	Protective conductors:		N
	Identification and marking of protective conductors acc. to cl. 13.2.2		N
	Copper conductors used as protective conductors		N
	Other conductor materials allowed, if cross section of such conductors is not less than 16 mm ²		N
	Cross-sectional area of protective conductors determined acc. to IEC 60364-5-54, cl. 543 or EN 60439-1, cl. 7.4.3.1.7, table 4		N
	Relationship between cross-section area of phase conductor and PE acc. to table 1		N
8.2.3	Continuity of protective bonding circuit:		N
	All exposed conductive parts of electrical equipment and machine(s) connected to protective bonding circuit.		N
	In case of removal of parts of PE system, remaining parts not to be interrupted		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Current-carrying capacity of connections and bonding points not impaired by mechanical, chemical or electrochemical influences		N
	Particular consideration should be given if enclosure consists of aluminium and its alloys		N
	Metal ducts and cable armouring not used as protective conductors and not connected to protective bonding circuit		N
	If electrical equipment is mounted on lids, doors or cover plates, continuity of protective bonding circuit ensured		N
	The continuity of the protective conductor in cables that are exposed to damage (for example flexible trailing cables) shall be ensured by appropriate measures		N
	For requirements for the continuity of the protective conductor using conductor wires, conductor bars and slip-ring assemblies, see 12.7.2.		N
8.2.4	Exclusions of switching devices from protective bonding circuit:		N
	Protective bonding circuit not incorporate a switching-/overcurrent protective device nor a means for current detection	Comply with requirement	N
	No means of interruption of the protective bonding conductor shall be provided.		N
	Interruption of protective conductors permitted by links, intended to be opened by instructed/skilled persons for test or measurement purposes by using a tool		N
8.2.5	Equipment parts that need not to be connected to protective bonding circuit:		N
	Parts which cannot be touched on large surfaces or grasped by hand due to its small size (less than approx. 50×50mm), small parts such as screws, rivets, nameplates or		N
	Part are located in such way, that either contact with live parts or an insulation failure is unlikely		N
8.2.6	Interruption of the protective bonding circuit:		N
	All protective conductors shall be terminated in accordance with 13.1.1. The protective conductor connecting points shall have no other function and are not intended, for example, to attach or connect appliances or parts.		N
	Each protective conductor connecting point shall be marked or labelled as such using the symbol IEC 60417-5019 (DB:2002-10):		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	with the letters PE, the graphical symbol being preferred, or by use of the bicolour combination GREEN-AND-YELLOW, or by any combination of these.		N
8.2.7	Mobile machines		N
	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		N
	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
8.2.8	Additional protective bonding requirements for electrical equipment having earth leakage currents higher than 10 mA a.c. or d.c.		N
	One or more of the following conditions for the associated protective bonding circuit shall be satisfied:		---
	a) the protective conductor shall have a cross-sectional area of at least 10 mm ² Cu or 16 mm ² Al, through its total run;		N
	b) where the protective conductor has a cross-sectional area of less than 10 mm ² Cu or 16 mm ² Al, a second protective conductor of at least the same cross-sectional area shall be provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm ² Cu or 16 mm ² Al.		N
	c) automatic disconnection of the supply in case of loss of continuity of the protective conductor.		N
	To prevent difficulties associated with electromagnetic disturbances, the requirements of 4.4.2 also apply to the installation of duplicate protective conductors.		N
	In addition, a warning label shall be provided adjacent to the PE terminal, and where necessary on the nameplate of the electrical equipment. The information provided under 17.2 b)1) shall include information about the leakage current and the minimum cross-sectional area of the external protective conductor.		N
8.3	Functional bonding		N
	Protection against maloperation as a result of insulation failures can be achieved by connecting to a common conductor in accordance with 9.4.3.1.		N
	For recommendations regarding functional bonding to avoid maloperation due to electromagnetic disturbances, see 4.4.2.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
8.4	Measures to limit the effects of high leakage current		N
	The protective bonding circuit shall be connected to exposed conductive parts of the equipment and, in addition, to the secondary winding of the transformer.		N
	The protective conductor(s) between the equipment and the secondary winding of the transformer shall comply with one or more of the arrangements described in 8.2.8.		N
9	CONTROL CIRCUITS AND CONTROL FUNCTIONS		P
9.1	Control circuits		P
9.1.1	Control circuit supply		P
	control circuits supplied by transformers have separate windings		N
	If several transformers are used, secondary voltages are in phase.		N
	Where d.c. control circuits derived from an a.c. supply are connected to the protective bonding circuit (see 8.2.1), they shall be supplied from a separate winding of the a.c. control circuit transformer or by another control circuit transformer.		N
	Transformers are not mandatory for machines with a single motor starter and/or a maximum of two control devices.		N
9.1.2	Control circuit voltages		N
	The nominal voltage shall not exceed 277 V when supplied from a transformer.		N
9.1.3	Protection		N
	Control circuits shall be provided with overcurrent protection in accordance with 7.2.4 and 7.2.10.	See cl.7.2.4	N
9.2	Control function		N
9.2.1	Start functions		P
	Start functions shall operate by energizing the relevant circuit (see 9.2.5.2).		P
9.2.2	Stop functions		P
	Category 0: Stopping by immediate removal of power to machine actuators		N
	Category 1: A controlled stop with power available to machine actuators. Then removal of power when stop condition has been achieved.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Category 2: A controlled stop with power left available to machine actuators		P
9.2.3	Operating modes		N
	Hazardous condition, resulting from a mode selection, prevented by suitable means		N
	Mode selection by itself shall not initiate machine operation. A separate actuation of the start control shall be required.		N
	For each specific operating mode, the relevant safety functions and/or protective measures shall be implemented.		N
	Indication of the selected operating mode shall be provided (for example the position of a mode selector, the provision of an indicating light, a visual display indication).		N
9.2.4	Suspension of safety functions and/or protective measures		N
	Where it is necessary to suspend safety functions and/or protective measures protection shall be ensured by: disabling all other operating (control) modes		N
	Other relevant means (see 4.11.9 of ISO 12100-2:2003), that can include, for example, one or more of the following:		---
	Initiation of operation by a hold-to-run device or by a similar control device;		N
	A portable control station with an emergency stop device and, where appropriate, an enabling device.		N
	A cableless control station with a device to initiate stop functions in accordance with 9.2.7.3 and, where appropriate, an enabling device. Where a cableless control station is in use, initiation of motion shall only be possible from that control station		N
	limitation of the speed or the power of motion;		N
	limitation of the range of motion.		N
9.2.5	Operation		P
9.2.5.1	General		P
	The necessary interlocks (see 9.3) shall be provided for safe operation		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Measures shall be taken to prevent movement of the machine in an unintended manner after any stopping of the machine		P
	Where a machine has more than one control station, measures shall be provided to ensure that initiation of commands from different control stations do not lead to a hazardous situation.		P
9.2.5.2	Start		P
	The start of an operation shall be possible only when all the safeguards are in place and functional (except described in 9.2.4)		P
	Hold-to-run control shall be used for the others machines, as appropriate		N
	Suitable interlocks shall be provided to secure correct sequential starting.		N
	The use of more than one control station to initiate a start		---
	—all required conditions for machine operation shall be met		N
	—all start control devices shall be in the released (off) position,		N
	—all start control devices shall be actuated concurrently (see 3.6).		N
9.2.5.3	Stop		P
	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	category 2 used	P
	Stop functions shall override related start functions		P
	Where more than one control station is provided, stop commands from any control station shall be effective when required by the risk assessment of the machine.		N
9.2.5.4	Emergency operations		N
9.2.5.4.2	Emergency stop		N
	Principles for the design of emergency stop equipment, including functional aspects, are given in ISO 13850.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	The emergency stop shall function either as a stop category 0 or as a stop category 1 (see 9.2.2). The choice of the stop category of the emergency stop depends on the results of a risk assessment of the machine.		N
	In addition to the requirements for stop (see 9.2.5.3), the emergency stop function has the following requirements:		---
	It shall override all other functions and operations in all modes		N
	Power to the machine actuators that can cause a hazardous situation(s) shall be either removed immediately (stop category 0) or shall be controlled in such a way to stop the hazardous motion as quickly as possible (stop category 1) without creating other hazards;		N
	Reset shall not initiate a restart.		N
9.2.5.4.3	Emergency switching off		N
	The functional aspects of emergency switching off are given in 536.4 of IEC 60364-5-53.		N
	Emergency switching off should be provided where:		---
	protection against direct contact is achieved only by placing out of reach or by obstacles (see 6.2.6)		N
	there is the possibility of other hazards or damage caused by electricity.		N
	Emergency switching off is accomplished by switching off the relevant incoming supply by electromechanical switching devices, effecting a stop category 0 of machine actuators connected to this incoming supply		N
	When a machine cannot tolerate this stop category 0 stop, it may be necessary to provide other measures, for example protection against direct contact, so that emergency switching off is not necessary.		N
9.2.5.5	Monitoring of command actions		P
	Movement or action of a machine or part of a machine that can result in a hazardous situation shall be monitored by providing		P
9.2.6	Other control functions		N
9.2.6.1	Hold-to-run controls		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Hold-to-run controls shall require continuous actuation of the control device(s) to achieve operation.		N
9.2.6.2	Two-hand control		N
	Type I:		---
	—the provision of two control devices and their concurrent actuation by both hands;		N
	—continuous concurrent actuation during the hazardous situation;		N
	—machine operation shall cease upon the release of either one or both of the control devices when hazardous situations are still present.		N
	Type II:		---
	a type I control requiring the release of both control devices before machine operation can be reinitiated.		N
	Type III:		---
	—it shall be necessary to actuate the control devices within a certain time limit of each other, not exceeding 0,5 s;		N
	—where this time limit is exceeded, both control devices shall be released before machine operation can be initiated.		N
9.2.6.3	Enabling control		N
	Enabling control (see also 10.9) is a manually activated control function interlock that:		---
	a) when activated allows a machine operation to be initiated by a separate start control,		N
	b) when de-activated —initiates a stop function in accordance with 9.2.5.3, —prevents initiation of machine operation.		N
	Enabling control shall be so arranged as to minimize the possibility of defeating. It should not be possible to defeat the enabling function by simple means.		N
9.2.6.4	Combined start and stop controls		N
	Push-buttons and similar control devices that, when operated, alternately initiate and stop motion shall only be provided for functions which cannot result in a hazardous situation.		N
9.2.7	Cableless control		N
9.2.7.1	General		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Means shall be provided to readily remove or disconnect the power supply of the operator control station		N
	Means shall be provided, as necessary, to prevent unauthorized use of the operator control station		N
	Each operator control station shall carry an unambiguous indication of which machine is intended to be controlled by that operator control station		N
9.2.7.2	Control limitation		N
	Measures shall be taken to ensure that control commands:		---
	–affect only the intended machine;		N
	–affect only the intended functions.		N
	Measures shall be taken to prevent the machine from responding to signals other than those from the intended operator control station(s).		N
	Where necessary, means shall be provided so that the machine can only be controlled from operator control station in one or more predetermined zones or locations		N
9.2.7.3	Stop		N
	Cableless control stations shall include a separate and clearly identifiable means to initiate the stop function of the machine or of all the operations that can cause a hazardous situation		N
	The actuating means to initiate this stop function shall not be marked or labeled as an emergency stop device		N
	A machine which is equipped with cableless control shall have a means of automatically initiating the stopping of the machine and of preventing a potentially hazardous operation, in the following situations		---
	–when a stop signal is received;		N
	–when a fault is detected in the cableless control system;		N
	–when a valid signal has not been detected within a specified period of time (see Annex B),		N
9.2.7.4	Use of more than one operator control station		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	In a machine where the control of safety-related functions relies on series data transfer, correct communications shall be ensured by using an error detection method that is able to cope with up to three error bits in any command sequence		N
	Where a machine has more than one operator control station, An indication of which operator control station is in control of the machine shall be provided at suitable locations as determined by the risk assessment of the machine.		N
9.2.7.5	Battery-powered operator control station		N
	A variation in the battery voltage shall not cause a hazardous condition		N
	If one or more potentially hazardous motions are controlled using a battery-powered operator control station, a clear warning shall be given to the operator when a variation in battery voltage exceeds specified limits		N
9.3	Protective interlocks		N
9.3.1	Reclosing or resetting of an interlocking safeguard		N
	The reclosing or resetting of an interlocking safeguard shall not initiate hazardous machine operation.		N
9.3.2	Exceeding operating limits		N
	Where an operating limit can be exceeded leading to a hazardous situation, means shall be provided to detect when a predetermined limit(s) is exceeded and initiate an appropriate control action.		N
9.3.3	Operation of auxiliary functions		N
	The correct operation of auxiliary functions shall be checked by appropriate devices		N
	Where the non-operation of a motor or device for an auxiliary function can cause a hazardous situation, or cause damage to the machine or to the work in progress, appropriate interlocking shall be provided.		N
9.3.4	Interlocks between different operations and for contrary motions		N
	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 shall be interlocked against incorrect operation.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Reversing contactors shall be interlocked in such a way that in normal service no short circuit can occur when switching.		N
	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.		N
	For a group of machines working together in a co-ordinated manner and having more than one controller, provision shall be made to co-ordinate the operations of the controllers as necessary		N
	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.		N
9.3.5	Reverse current braking		N
	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		N
	Control circuits shall be so arranged that rotation of a motor shaft, for example manually, shall not result in a hazardous situation.		N
9.4	Control functions in the event of failure		P
9.4.1	General requirements		P
	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
	The electrical control circuits shall have an appropriate level of safety performance that has been determined from the risk assessment at the machine. The requirements of IEC 62061 and/or ISO 13849-1, ISO 13849-2 shall apply.	Comply with requirement	P
	Measures to reduce those risks include but are not limited to:		---
	–protective devices on the machine (for example interlocking guards, trip devices);		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	–protective interlocking of the electrical circuit;		N
	–use of proven circuit techniques and components (see 9.4.2.1);		N
	–provision of partial or complete redundancy (see 9.4.2.2) or diversity (see 9.4.2.3);		N
	–provision for functional tests (see 9.4.2.4).		N
	Where memory retention is achieved for example, by battery power, measures shall be taken to prevent hazardous situations arising from failure or removal of the battery.		N
	Means shall be provided to prevent unauthorized or inadvertent memory alteration by, for example, requiring the use of a key, access code or tool.		N
9.4.2	Measures to minimize risk in the event of failure:		P
9.4.2.1	Use of proven circuit techniques and components		P
	These measures include but are not limited to:		---
	–bonding of control circuits to the protective bonding circuit for functional purposes		P
	–connection of control devices in accordance with 9.4.3.1;		P
	– stopping by de-energizing (see 9.2.2);		P
	–the switching of all control circuit conductors to the device being controlled		P
	– switching devices having direct opening action (see IEC 60947-5-1)		P
	– circuit design to reduce the possibility of failures causing undesirable operations		P
9.4.2.2	Provisions of partial or complete redundancy		N
	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.		N
	Where off-line redundancy which is not active during normal operation is provided, suitable measures shall be taken to ensure that those control circuits are available when required.		N
9.4.2.3	Provision of diversity		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	The use of control circuits having different principles of operation, or using different types of components or devices can reduce the probability of hazards resulting from faults and/or failures. Examples include:		---
	–the combination of normally open and normally closed contacts operated by interlocking guards;		N
	–the use of different types of control circuit components in the circuit;		N
	–the combination of electromechanical and electronic equipment in redundant configurations.		N
	The combination of electrical and non-electrical systems may perform the redundant function and provide the diversity.		N
9.4.2.4	Provision for functional tests		P
	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).	Comply with requirement	P
9.4.3	Protection against maloperation due to earth faults, voltage interruptions and loss of circuit continuity	Class II equipment	N
9.4.3.1	Earth faults		N
	Earth faults on any control circuit shall not cause unintentional starting, potentially hazardous motions, or prevent stopping of the machine.		N
	Control circuits, fed by control transformers:		N
	Control circuits fed from a control transformer with a centre-tapped winding, this centre tap connected to the protective bonding circuit, arranged as shown in Figure 4 with the overcurrent protective device having switching elements in all control circuit supply conductors.		N
	Multi-pole control switches that switch all live conductors are used for START or STOP of those machine functions that can cause a hazardous situation or damage to the machine in the event of unintentional starting or failure to stop, or in the case of c) 2), a device shall be provided that interrupts the circuit automatically in the event of an earth fault.		N
9.4.3.2	Voltage interruptions		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Where the control system uses a memory device(s), proper functioning in the event of power failure shall be ensured to prevent any loss of memory that can result in a hazardous situation.		N
9.4.3.3	Loss of circuit continuity		N
	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		N
10	Operator interface and machine-mounted control devices		P
10.1.1	Devices to be selected, mounted and identified or coded acc. to EN 60073 and EN 60447		N
10.1.2	Location and mounting		N
	As far as is practicable, machine-mounted control devices shall be:		---
	–readily accessible for service and maintenance;		N
	– mounted in such a manner as to minimize the possibility of damage from activities such as material handling.		N
	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;		N
	–the operator is not placed in a hazardous situation when operating them.		N
	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;		N
	–the operator is not placed in a hazardous situation when operating them.		N
10.1.3	Protection		P
	The degree of protection (see IEC 60529) together with other appropriate measures shall afford protection against:		P
	–the effects of aggressive liquids, vapours, or gases found in the physical environment or used on the machine;		P
	–the ingress of contaminants (for example swarf, dust, particulate matter).		P

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	In addition, the operator interface control devices shall have a minimum degree of protection against direct contact of IPXXD (see IEC 60529).		N
10.1.4	Position sensors		P
	Position sensors shall be so arranged that they will not be damaged in the event of overtravel.		PN
	Position sensors in circuits with safety-related control functions shall have direct opening action (see IEC 60947-5-1) or shall provide similar reliability (see 9.4.2).		N
10.1.5	Portable and pendant operator control stations and their control devices shall be so selected and arranged as to minimize the possibility of inadvertent machine operations caused by shocks and vibrations		P
10.2.1	Push-button actuators shall be colour-coded in accordance with Table 2 (see also 9.2 and Annex B).		N
10.2.2	In addition to the functional identification as described in 16.3, it is recommended that push-buttons be marked, near to or preferably directly on the actuators, with the symbols given in Table 3.		N
10.3.1	Colours for indication lights: RED, YELLOW, GREEN, BLUE Colours for confirmation: GREEN and WHITE		P
	Indicator lights and displays shall be selected and installed in such a manner as to be visible from the normal position of the operator (see also IEC 61310-1).		N
	Indicator light circuits used for warning lights shall be fitted with facilities to check the operability of these lights.		P
10.3.2	Unless otherwise agreed between the supplier and the user (see Annex B), indicator lights shall be colour-coded with respect to the condition (status) of the machine in accordance with Table 4.		N
	Indicating towers on machines should have the applicable colours in the following order from the top down; RED, YELLOW, BLUE, GREEN and WHITE.		N
10.3.3	Flashing lights and displays		N
	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;		N
	–to request immediate action;		N
	–to indicate a discrepancy between the command and actual state;		N
	–to indicate a change in process (flashing during transition).		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	It is recommended that higher frequency flashing lights or display be used for higher priority information		N
	Where flashing lights or displays are used to provide higher priority information, audible warning devices should also be provided.		N
10.4	Illuminated push-buttons		N
	Illuminated push-button actuators shall be colour-coded in accordance with Tables 2 and 4.		N
	Where there is difficulty in assigning an appropriate colour, WHITE shall be used.		N
	The colour RED for the emergency stop actuator shall not depend on the illumination of its light		N
10.5	Rotary control devices		N
	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.		N
10.6	Start devices		N
	Actuators used to initiate a start function or the movement of machine elements shall be constructed and mounted so as to minimize inadvertent operation.		N
	mushroom-type actuators may be used for two-hand control		N
10.7	Devices for emergency stop:		N
10.7.1	Location of emergency stop devices		N
	Devices for emergency stop shall be readily accessible.		N
	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		N
10.7.2	Types of emergency stop device		N
	The types of device for emergency stop include:		---
	–a push-button operated switch with a palm or mushroom head type;		N
	–a pull-cord operated switch;		N
	–a pedal-operated switch without a mechanical guard.		N
	The devices shall have direct opening operation		N
10.7.3	Colour of actuators		N
	Actuators of emergency stop devices shall be coloured RED. If a background exists immediately around the actuator, then this background shall be coloured YELLOW. See also ISO 13850.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
10.7.4	Local operation of the supply disconnecting device to effect emergency stop		N
	The supply disconnecting device may be locally operated to serve the function of emergency stop when:		---
	it is readily accessible to the operator		N
	it is of the type described in 5.3.2 a), b), c), or d)		N
	When also intended for such use, the supply disconnecting device shall meet the colour requirements of 10.7.3.		N
10.8	Emergency switching off devices		N
10.8.1	Location of emergency switching off devices		N
	Emergency switching off devices shall be located as necessary for the given application. Normally, those devices will be located separate from operator control stations.		N
	Where it is necessary to provide a control station with an emergency stop device and an emergency switching off device, means shall be provided to avoid confusion between these devices.		N
10.8.2	Types of emergency switching off device		N
	The types of device for emergency switching off include:		---
	–a push-button operated switch with a palm or mushroom head type of actuator;		N
	–a pull-cord operated switch.		N
	The devices shall have direct opening action (see IEC 60947-5-1, Annex K).		N
	The push-button operated switch may be in a break-glass enclosure.		N
10.8.3	Colour of actuators		N
	Actuators of emergency switching off devices shall be coloured RED		N
	If a background exists immediately around the actuator, then this background shall be coloured YELLOW.		N
	Where confusion can occur between emergency stop and emergency switching off devices, means shall be provided to minimise confusion.		N
10.8.4	Local operation of the supply disconnecting device to effect emergency switching off		N
	Where the supply disconnecting device is to be locally operated for emergency switching off, it shall be readily accessible and should meet the colour requirements of 10.8.3.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
10.9	Enabling control device		N
	In any other position, operation shall be stopped or prevented		N
	Enabling control devices shall be selected and arranged so as to minimize the possibility of defeating.		N
11	Controlgear : location, mounting, and enclosures		N
11.2	Location and mounting		N
11.2.1	Accessibility and maintenance		N
	All items of controlgear shall be placed and oriented so that they can be identified without moving them or the wiring		N
	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		N
	Terminals not part of controlgear components or devices shall also conform to these requirements.		N
	All controlgear shall be mounted so as to facilitate its operation and maintenance from the front		N
	Where a special tool is necessary to adjust, maintain, or remove a device, such a tool shall be supplied.		N
	Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0,4 m and 2,0 m above the servicing level.		N
	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		N
	No devices except devices for operating, indicating, measuring, and cooling shall be mounted on doors or on normally removable access covers of enclosures		N
	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).		N
	Plug-in devices that are handled during normal operation shall be provided with non-interchangeable features where the lack of such a facility can result in malfunctioning.		N
	Plug/socket combinations that are handled during normal operation shall be located and mounted so as to provide unobstructed access.		N
	Test points for connection of test equipment, where provided, shall be:		---
	–mounted so as to provide unobstructed access;		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	–clearly identified to correspond with the documentation (see 17.3);		N
	–adequately insulated;		N
	–sufficiently spaced.		N
11.2.2	Physical separation or grouping		N
	Non-electrical parts and devices, not directly associated with the electrical equipment, shall not be located within enclosures containing controlgear.		N
	Devices such as solenoid valves should be separated from the other electrical equipment		N
	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.		N
	Terminals shall be separated into groups for:		---
	– power circuits;		N
	–associated control circuits;		N
	–other control circuits, fed from external sources		N
	The groups may be mounted adjacently, provided that each group can be readily identified		N
	When arranging the location of devices (including interconnections), the clearances and creepage distances specified for them by the supplier shall be maintained, taking into account the external influences or conditions of the physical environment.		N
11.2.3	Heating effects		N
	Heat generating components shall be so located that the temperature of each component in the vicinity remains within the permitted limit.	Considered	N
11.3	Degrees of protection		N
	The protection of controlgear against ingress of solid foreign objects and of liquids shall be adequate taking into account the external influences under which the machine is intended to operate and shall be sufficient against dust, coolants, and swarf.		N
	Enclosures of controlgear shall provide a degree of protection of at least IP22 (see IEC 60529).		N
	Exceptions:		N
	a) Where an electrical operating area is used as a protective enclosure for an appropriate degree of protection against the ingress of solid bodies and liquids.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	b) Where removable collectors on conductor wire or conductor bar systems are used and IP22 is not achieved, but the measures of 6.2.5 are applied.		N
11.4	Enclosures, doors and openings		N
	Enclosures shall be constructed using materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effects of humidity and other environmental factors that are likely to be encountered in normal service.		N
	Fasteners used to secure doors and covers should be of the captive type.		N
	Windows provided for viewing internally mounted indicating devices shall be of a material suitable to withstand mechanical stress and chemical attack		N
	It is recommended that enclosure doors be not wider than 0,9 m and have vertical hinges, with an angle of opening of at least 95°.		N
	The joints or gaskets of doors, lids, covers and enclosures shall withstand the chemical effects of the aggressive liquids, vapours, or gases used on the machine.		N
	be securely attached to either the door/cover or the enclosure;		N
	not deteriorate due to removal or replacement of the door or the cover, and so impair the degree of protection		N
	openings in enclosures closed by supplier, ensuring degree of protection specified for the equipment		N
	Openings for cable entries shall be easily re-opened on site.		N
	A suitable opening may be provided in the base of enclosures within the machine so that moisture due to condensation can drain away		N
	no opening between enclosures containing electrical equipment and compartments containing coolant, lubricating or hydraulic fluids		N
	holes in an enclosure for mounting purposes not impair the required protection		N
	Equipment that, in normal or abnormal operation, can attain a surface temperature sufficient to cause a risk of fire or harmful effect to an enclosure material shall:		---
	–be located within an enclosure that will withstand, without risk of fire or harmful effect, such temperatures as can be generated;		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	–be mounted and located at a sufficient distance from adjacent equipment so as to allow safe dissipation of heat (see also 11.2.3);		N
	–be otherwise screened by material that can withstand, without risk of fire or harmful effect, the heat emitted by the equipment.		N
11.5	Access to controlgear		N
	Doors in gangways and for access to electrical operating areas shall be at least 0,7 m wide and 2,1 m high;		N
	open outwards;		N
	have a means to allow opening from the inside without the use of a key or tool		N
	Enclosures which readily allow a person to fully enter shall be provided with means to allow escape, for example panic bolts on the inside of doors. Enclosures intended for such access,		N
12	CONDUCTORS AND CABLES		N
12.1	Conductors and cables shall be selected so as to be suitable for the operating conditions and external influences that can exist.		N
	These requirements do not apply to the integral wiring of assemblies, subassemblies, and devices that are manufactured and tested in accordance with their relevant IEC standard		N
12.2	Conductors		N
	In general, conductors shall be of copper. Where aluminium conductors are used, the cross-sectional area shall be at least 16 mm ² .		N
	To ensure adequate mechanical strength, the cross-sectional area of conductors should not be less than as shown in Table 5.		N
	All conductors that are subject to frequent movement shall have flexible stranding of class 5 or class 6.		N
12.3	Insulation		N
	The types of insulation include (but are not limited to):		---
	–polyvinyl chloride (PVC);		N
	–rubber, natural and synthetic;		N
	–silicone rubber (SiR);		N
	–mineral;		N
	–cross-linked polyethylene (XLPE);		N
	–ethylene propylene compound (EPR).		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Where the insulation of conductors and cables can constitute hazards due to the propagation of a fire or the emission of toxic or corrosive fumes, guidance from the cable supplier should be sought.		N
	The insulation of cables and conductors used, shall be suitable for a test voltage:		---
	–not less than 2 000 V a.c. for a duration of 5 min for operation at voltages higher than 50 V a.c. or 120 V d.c., or		N
	–not less than 500 V a.c. for a duration of 5 min for PELV circuits (see IEC 60364-4-41, class III equipment).		N
	The mechanical strength and thickness of the insulation shall be such that the insulation cannot be damaged in operation or during laying, especially for cables pulled into ducts.		N
12.4	Current-carrying capacity in normal service		N
	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
	One typical example of the current-carrying capacities for PVC insulated wiring between enclosures and individual items of equipment under steady-state conditions is given in Table 6.		N
12.5	Conductor and cable voltage drop		N
	The voltage drop from the point of supply to the load shall not exceed 5 % of the nominal voltage under normal operating conditions.		N
12.6	Flexible cables		N
12.6.1	General		N
	Flexible cables shall have Class 5 or Class 6 conductors.		N
	Cables that are subjected to severe duties shall be of adequate construction to protect against:		---
	–abrasion due to mechanical handling and dragging across rough surfaces;		N
	–kinking due to operation without guides;		N
	–stress resulting from guide rollers and forced guiding, being wound and re-wound on cable drums.		N
12.6.2	Mechanical rating		N
	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.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	the tensile stress applied to the conductors shall not exceed 15N/mm ² of the copper cross-sectional area.		N
	Where tensile stress of conductors is exceeding 15N/mm ² , cables of special design are used.		N
	The maximum stress applied to the conductors of flexible cables with material other than copper shall be within the cable manufacturer's specification.		N
12.6.3	Current-carrying capacity of cables wound on drums		N
	Cables to be wound on drums selected such, as the maximum allowable conductor temperature is not exceeded		N
	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		N
12.7	Conductor wires, conductor bars and slip-ring assemblies		N
12.7.1	Protection against direct contact		N
	during normal access to the machine, protection against direct contact is achieved by the application of one of the following protective measures:		---
	–protection by partial insulation of live parts, or where this is not practicable;		N
	–protection by enclosures or barriers of at least IP2X		N
	Horizontal top surfaces of barriers or enclosures that are readily accessible shall provide a degree of protection of at least IP4X		N
	Where the required degree of protection is not achieved, protection by placing live parts out of reach in combination with emergency switching off in accordance with 9.2.5.4.3 shall be applied.		N
	Conductor wires and conductor bars shall be so placed and/or protected as to:		---
	–prevent contact, especially for unprotected conductor wires and conductor bars, with conductive items such as the cords of pull-cord switches, strain-relief devices and drive chains;		N
	–prevent damage from a swinging load.		N
12.7.2	Protective conductor circuit		N
	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.		N
12.7.3	Protective conductor current collectors		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Protective conductor current collectors shall have a shape or construction so that they are not interchangeable with the other current collectors. Such current collectors shall be of the sliding contact type.		N
12.7.4	Removable current collectors with a disconnect function		N
	Removable current collectors having a disconnect 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		N
12.7.5	Clearances in air		N
	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.		N
12.7.6	Creepage distances		N
	Creepage distance suitable for operation in the intended environment, for example open air (IEC 60664-1), inside buildings, protected by enclosures		N
	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;		N
	–enclosed conductor wires, insulated multipole conductor bars and insulated individual conductor bars shall have a minimum creepage distance of 30 mm.		N
	gradual reduction in the insulation values due to unfavourable ambient conditions		N
12.7.7	Conductor system sectioning		N
	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		N
	Conductor wires, conductor bars and slip-ring assemblies in power circuits shall be grouped separately from those in control circuits.		N
	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.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Removable covers for conductor wire and conductor bar systems laid underground or underfloor shall be so designed that they cannot be opened by one person without the aid of a tool.		N
	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.		N
	Metal covers of conductor bars laid underground or underfloor shall also be bonded together and connected to a protective bonding conductor.		N
	Underground and underfloor conductor bar ducts shall have drainage facilities.		N
13	Wiring practices		N
13.1	Connections and routing		N
13.1.1	General requirements		N
	All connections, especially those of the protective bonding circuit, shall be secured against accidental loosening.	Comply with requirement	N
	The means of connection shall be suitable for the cross-sectional areas and nature of the conductors being terminated.		N
	The connection of two or more conductors to one terminal is permitted only in those cases where the terminal is designed for that purpose.		N
	Only one protective conductor shall be connected to one terminal connecting point.		N
	Soldered connections shall only be permitted where terminals are provided that are suitable for soldering.		N
	Terminals on terminal blocks shall be plainly marked or labelled to correspond with markings on the diagrams.		NP
	Where an incorrect electrical connection (for example, arising from replacement of devices) can be a source of risk and it is not practicable to reduce the possibility of incorrect connection by design measures, the conductors and/or terminations shall be identified in accordance with 13.2.1.		N
	The installation of flexible conduits and cables shall be such that liquids shall drain away from the fittings.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Means of retaining conductor strands shall be provided when terminating conductors at devices or terminals that are not equipped with this facility. Solder shall not be used for that purpose.		N
	Shielded conductors shall be so terminated as to prevent fraying of strands and to permit easy disconnection.		N
	Identification tags shall be legible, permanent, and appropriate for the physical environment.		N
	Terminal blocks shall be mounted and wired so that the internal and external wiring does not cross over the terminals (see IEC 60947-7-1).		N
13.1.2	Conductor and cable runs		N
	Conductors and cables shall be run from terminal to terminal without splices or joints.	No splices or joints.	N
	Where it is impracticable to provide terminals in a junction box splices or joints may be used.	Not applicable	N
	Where it is necessary to connect and disconnect cables and cable assemblies, a sufficient extra length shall be provided for that purpose.		N
	The terminations of cables shall be adequately supported to prevent mechanical stresses at the terminations of the conductors.		N
	Wherever practicable, the protective conductor shall be placed close to the associated live conductors in order to decrease the impedance of the loop.		N
13.1.3	Conductors of different circuits		N
	Conductors of different circuits may be laid side by side, may occupy the same duct or may be in the same multiconductor cable provided that the arrangement does not impair the proper functioning of the respective circuits.		N
	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		N
13.1.4	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 as specified by the manufacturer of the inductive power supply shall be:		---
	– as short as practicable;		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	- adequately protected against mechanical damage.		N
13.2	Identification of conductors		N
13.2.1	General requirements		N
	Each conductor shall be identifiable at each termination in accordance with the technical documentation (see Clause 17).		N
	It is recommended (for example to facilitate maintenance) that conductors be identified by number, alphanumeric, colour (either solid or with one or more stripes), or a combination of colour and numbers or alphanumeric.		N
	When numbers are used, they shall be Arabic; letters shall be Roman (either upper or lower case)		N
13.2.2	Identification of the protective conductor		N
	The protective conductor shall be readily distinguishable by shape, location, marking, or colour.		N
	When identification is by colour alone, the bicolour combination GREEN-AND-YELLOW shall be used throughout the length of the conductor.		N
	the bicolour combination GREEN-AND-YELLOW shall be such that on any 15 mm length, one of the colours covers at least 30 % and not more than 70 % of the surface of the conductor		N
13.2.3	Identification of the neutral conductor		N
	Where a circuit includes a neutral conductor that is identified by colour alone, the colour used for this conductor shall be BLUE.		N
	Where the selected colour is the sole identification of the neutral conductor, that colour shall not be used for identifying any other conductor where confusion is possible.		N
	Where identification by colour is used, bare conductors used as neutral conductors shall be either coloured by a stripe, 15 mm to 100 mm wide in each compartment or unit and at each accessible location, or coloured throughout their length.		N
13.2.4	Identification by colour		N
	Where colour-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 colours may be used:		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	It is recommended that, where colour is used for identification, the colour be used throughout the length of the conductor either by the colour of the insulation or by colour markers at regular intervals and at the ends or accessible location.		N
	For safety reasons, the colour GREEN or the colour YELLOW should not be used where there is a possibility of confusion with the bicolour combination GREEN-AND-YELLOW (see 13.2.2).		N
	Colour identification using combinations of those colours listed above may be used provided there can be no confusion and that GREEN or YELLOW is not used except in the bicolour combination GREEN-AND-YELLOW.		N
	Where colour-coding is used for identification of conductors, it is recommended that they be colour-coded as follows:		---
	– BLACK: a.c. and d.c. power circuits;		N
	– RED: a.c. control circuits;		N
	– BLUE: d.c. control circuits;		N
	– ORANGE: excepted circuits in accordance with 5.3.5.		N
	Exceptions: to the above are permitted where:		---
	– insulation is used that is not available in the colours recommended; or		N
	- multiconductor cable is used, but not the bicolour combination GREEN-AND-YELLOW.		N
13.3	Wiring inside enclosures		N
	Conductors inside enclosures shall be supported where necessary to keep them in place.		N
	Non-metallic ducts shall be permitted only when they are made with a flame-retardant insulating material (see the IEC 60332 series).		N
	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		N
	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.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Connections to devices mounted on doors or to other movable parts shall be made using flexible conductors in accordance with 12.2 and 12.6 to allow for the frequent movement of the part.		N
	The conductors shall be anchored to the fixed part and to the movable part independently of the electrical connection		N
	Conductors and cables that do not run in ducts shall be adequately supported.		N
	Terminal blocks or plug/socket combinations shall be used for control wiring that extends beyond the enclosure. For plug/socket combinations, see also 13.4.5 and 13.4.6.		N
	Power cables and cables of measuring circuits may be directly connected to the terminals of the devices for which the connections were intended.		N
13.4	Wiring outside enclosures		N
13.4.1	General requirements		N
	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).		N
13.4.2	External ducts		N
	Conductors and their connections external to the electrical equipment enclosure(s) shall be enclosed in suitable ducts as described in 13.5		N
	Fittings used with ducts or multiconductor cable shall be suitable for the physical environment.		N
	Flexible conduit or flexible multiconductor cable shall be used where it is necessary to employ flexible connections to pendant push-button stations.		N
	The weight of the pendant stations shall be supported by means other than the flexible conduit or the flexible multiconductor cable,		N
	the conduit or cable is specifically designed for that purpose.		N
13.4.3	Connection to moving elements of the machine		N
	Connections to frequently moving parts shall be made using conductors in accordance with 12.2 and 12.6.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Flexible cable and flexible conduit shall be so installed as to avoid excessive flexing and straining, particularly at the fittings.		N
	Cables subject to movement shall be supported in such a way that there is no mechanical strain on the connection points nor any sharp flexing.		N
	When this is achieved by the provision of a loop, it shall have sufficient length to provide for a bending radius of the cable of at least 10 times the diameter of the cable.		N
	Flexible cables of machines shall be so installed or protected as to minimize the possibility of external damage due to factors that include the following cable use or potential abuse:		N
	–being run over by the machine itself;		N
	–being run over by vehicles or other machines;		N
	–coming into contact with the machine structure during movements;		N
	–running in and out of cable baskets, or on or off cable drums;		N
	–acceleration forces and wind forces on festoon systems or suspended cables;		N
	–excessive rubbing by cable collector;		N
	–exposure to excessive radiated heat.		N
	The cable sheath shall be resistant to the normal wear that can be expected from movement and to the effects of environmental contaminants		N
	Where cables subject to movement are close to moving parts, precautions shall be taken to maintain a space of at least 25 mm between the moving parts and the cables.		N
	Where that distance is not practicable, fixed barriers shall be provided between the cables and the moving parts.		N
	The cable handling system shall be so designed that lateral cable angles do not exceed 5° , avoiding torsion in the cable when:		---
	–being wound on and off cable drums; and		N
	–approaching and leaving cable guidance devices.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Measures shall be taken to ensure that at least two turns of flexible cables always remain on a drum.		N
	Devices serving to guide and carry a flexible cable shall be so designed that the inner bending radius at all points where the cable is bent is not less than the values given in Table 8		N
	The straight section between two bends shall be at least 20 times the diameter of the cable.		N
	Where flexible conduit is adjacent to moving parts, the construction and supporting means shall prevent damage to the flexible conduit under all conditions of operation.		N
	Flexible conduit shall not be used for connections subject to rapid or frequent movements except when specifically designed for that purpose.		N
13.4.4	Interconnection of devices on the machine		N
	Where several machine-mounted switching devices are connected in series or in parallel, it is recommended that the connections between those devices be made through terminals forming intermediate test points.		N
	Such terminals shall be conveniently placed, adequately protected, and shown on the relevant diagrams.		N
13.4.5	Plug/socket combinations		N
	Where plug/socket combinations are provided, they shall fulfil one or more of the following requirements as applicable:		---
	a) When installed correctly in accordance with f), plug/socket combinations shall be of such a type as to prevent unintentional contact with live parts at any time, including during insertion or removal of the connectors. The degree of protection shall be at least IPXXB. PELV circuits are excepted from this requirement.		N
	b) Have a first make last break protective bonding contact (earthing contact) (see also 6.3, 8.2.4) if used in TN- or TT-systems.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	c) 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.		N
	d) Plug/socket combinations that are rated at more than 16 A shall have a retaining means to prevent unintended or accidental disconnection.		N
	e) Where an unintended or accidental disconnection of plug/socket combinations can cause a hazardous situation, they shall have a retaining means.		N
	The installation of plug/socket combinations shall fulfil the following requirements as applicable:		---
	f) The component which remains live after disconnection shall have a degree of protection of at least IP2X or IPXXB, taking into account the required clearance and creepage distances. PELV circuits are excepted from this requirement.		N
	g) Metallic housings of plug/socket combinations shall be connected to the protective bonding circuit. PELV circuits are excepted from this requirement.		N
	h) Plug/socket combinations intended to carry power loads but not to be disconnected during load conditions shall have a retaining means to prevent unintended or accidental disconnection and shall be clearly marked that they are not intended to be disconnected under load.		N
	i) Where more than one plug/socket combination is provided in the same electrical equipment, the associated combinations shall be clearly identifiable. It is recommended that mechanical coding be used to prevent incorrect insertion.		N
	j) Plug/socket combinations used in control circuits shall fulfil the applicable requirements of IEC 61984. Exception: see item k).		N
	k) Plug/socket combinations intended for household and similar general purposes shall not be used for control circuits. In plug/socket combinations in accordance with IEC 60309-1, only those contacts shall be used for control circuits which are intended for those purposes.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
13.4.6	Dismantling for shipment		N
	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.		N
13.4.7	Additional conductors		N
	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.		N
13.5	Ducts, connection boxes and other boxes		N
13.5.1	General requirements		N
	Ducts shall provide a degree of protection suitable for the application (see IEC 60529).		N
	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.		N
	In order to prevent confusion of conduits with oil, air, or water piping, it is recommended that the conduits be either physically separated or suitably identified.		N
	Ducts and cable trays shall be rigidly supported and positioned at a sufficient distance from moving parts and in such a manner so as to minimize the possibility of damage or wear.		N
	Ducts shall be provided only for mechanical protection		N
	Cable trays that are partially covered should not be considered to be ducts or cable trunking systems (see 13.5.6), and the cables used shall be of a type suitable for installation with or without the use of open cable trays or cable support means.		N
13.5.2	Percentage fill of ducts		N
	Consideration of the percentage fill of ducts should be based on the straightness and length of the duct and the flexibility of the conductors. It is recommended that the dimensions and arrangement of the ducts be such as to facilitate the insertion of the conductors and cables.		N
13.5.3	Rigid metal conduit and fittings		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Rigid metal conduit and fittings shall be of galvanized steel or of a corrosion-resistant material suitable for the conditions.		N
	The use of dissimilar metals in contact that can cause galvanic action should be avoided.		N
	Conduits shall be securely held in place and supported at each end.		N
	Fittings shall be compatible with the conduit and appropriate for the application. Fittings shall be threaded unless structural difficulties prevent assembly. Where threadless fittings are used, the conduit shall be securely fastened to the equipment.		N
	Conduit bends shall be made in such a manner that the conduit shall not be damaged and the internal diameter of the conduit shall not be effectively reduced.		N
13.5.4	Flexible metal conduit and fittings		N
	A flexible metal conduit shall consist of a flexible metal tubing or woven wire armour. It shall be suitable for the expected physical environment.		N
	Fittings shall be compatible with the conduit and appropriate for the application.		N
13.5.5	Flexible non-metallic conduit and fittings		N
	Flexible non-metallic conduit shall be resistant to kinking and shall have physical characteristics similar to those of the sheath of multiconductor cables.		N
	The conduit shall be suitable for use in the expected physical environment.		N
	Fittings shall be compatible with the conduit and appropriate for the application.		N
13.5.6	Cable trunking systems		N
	Cable trunking systems external to enclosures shall be rigidly supported and clear of all moving or contaminating portions of the machine.		N
	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.		N
	Where the cable trunking system is furnished in sections, the joints between sections shall fit tightly but need not be gasketed.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	The only openings permitted shall be those required for wiring or for drainage. Cable trunking systems shall not have opened but unused knockouts.		N
13.5.7	Machine compartments and cable trunking systems		N
	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.		N
	Conductors run in enclosed compartments and cable trunking systems shall be so secured and arranged that they are not subject to damage.		N
13.5.8	Connection boxes and other boxes		N
	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).		N
	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, flyings, oil, and coolant.		N
13.5.9	Motor connection boxes		N
	Motor connection boxes shall enclose only connections to the motor and motor-mounted devices		N
14	ELECTRIC MOTORS AND ASSOCIATED EQUIPMENT		P
14.1	Electric motors should conform to the relevant parts of IEC 60034 series.		P
	The protection requirements for motors and associated equipment are given in 7.2 for overcurrent protection, in 7.3 for overload protection, and in 7.6 for overspeed protection.		N
	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.		N
14.2	Motor enclosures		P
	It is recommended that motor enclosures be chosen from those included in IEC 60034-5.		P

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	The degree of protection shall be at least IP23 (see IEC 60529) for all motors		P
	Motors incorporated as an integral part of the machine shall be so mounted that they are adequately protected from mechanical damage.		P
14.3	Motor dimensions		P
	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		N
	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).		N
	Where practicable, motor compartments should be clean and dry, and when required, shall be ventilated directly to the exterior of the machine.		N
	Temperature rise within limits of relevant insulation class		N
	There shall be no opening between the motor compartment and any other compartment that does not meet the motor compartment requirements.		N
	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.		N
14.5	Criteria for motor selection		P
	In this respect, the points that shall be considered include:		---
	–type of motor;		P
	–type of duty cycle (see IEC 60034-1);		P
	–fixed speed or variable speed operation, (and the consequent variable influence of the ventilation);		P
	–mechanical vibration;		P
	–type of motor control;		P
	–influence of the harmonic spectrum of the voltage and/or current feeding the motor on the temperature rise;		P
	–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 stipulated by the supply authority;		N
	–variation of counter-torque load with time and speed;		P
	–influence of loads with large inertia;		P
	–influence of constant torque or constant power operation;		P

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	–possible need of inductive reactors between motor and converter.		N
14.6	Protective devices for mechanical brakes		N
	Operation of the overload and overcurrent protective devices for mechanical brake actuators shall initiate the simultaneous de-energization (release) of the associated machine actuators.		N
15	ACCESSORIES AND LIGHTING		N
15.1	Accessories		N
	Where the machine or its associated equipment is provided with socket-outlets that are intended to be used for accessory 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;		N
	–the continuity of the protective bonding circuit to the socket-outlet shall be ensured except where protection is provided by PELV;		N
	–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;		N
	–where the power supply to the socket-outlet is not disconnected by the supply disconnecting device for the machine or the section of the machine, the requirements of 5.3.5 apply.		N
15.2	Local lighting of the machine and equipment		N
15.2.1	General		N
	Connections to the protective bonding circuit shall be in accordance with 8.2.2.		N
	The ON/OFF switch shall not be incorporated in the lampholder or in the flexible connecting cords.		N
	Stroboscopic effects from lights shall be avoided by the selection of appropriate luminaires.		N
	Where fixed lighting is provided in an enclosure, electromagnetic compatibility should be taken into account using the principles outlined in 4.4.2.		N
15.2.2	Supply		N
	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
	Lighting circuits shall be supplied from one of the following sources (see also 7.2.6):		---

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	–a dedicated isolating transformer connected to the load side of the supply disconnecting device. Overcurrent protection shall be provided in the secondary circuit;		N
	–a dedicated isolating transformer connected to the line side of the supply disconnecting device. That source shall be permitted for maintenance lighting circuits in control enclosures only. Overcurrent protection shall be provided in the secondary circuit		N
	–a machine circuit with dedicated overcurrent protection;		N
	–an isolating transformer connected to the line side of the supply disconnecting device, provided with a dedicated primary disconnecting means (see 5.3.5) and secondary overcurrent protection, and mounted within the control enclosure adjacent to the supply disconnecting device		N
	–an externally supplied lighting circuit (for example factory lighting supply). This shall be permitted in control enclosures only, and for the machine work light(s) where their total power rating is not more than 3 kW.		N
15.2.3	Protection		N
	Local lighting circuits shall be protected in accordance with 7.2.6.		N
15.2.4	Fittings		N
	Adjustable lighting fittings shall be suitable for the physical environment.		N
	The lampholders shall be:		---
	–in accordance with the relevant IEC standard;		N
	–constructed with an insulating material protecting the lamp cap so as to prevent unintentional contact.		N
	Reflectors shall be supported by a bracket and not by the lampholder.		N
16	Marking, warning signs and reference designations		P
16.1	General		P
	Warning signs, nameplates, markings, and identification plates shall be of sufficient durability to withstand the physical environment involved.	Marked clearly and visible	P
16.2	Warning signs		N
16.2.1	Electric shock hazard		N
	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).		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	The warning sign shall be plainly visible on the enclosure door or cover.		N
	The warning sign may be omitted (see also 6.2.2 b) for:		---
	–an enclosure equipped with a supply disconnecting device;		N
	–an operator-machine interface or control station;		N
	–a single device with its own enclosure		N
16.2.2	Hot surfaces hazard		N
	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		N
	Control devices, visual indicators, and displays (particularly those related to safety) shall be clearly and durably marked with regard to their functions either on or adjacent to the item.		N
	Such markings may be as agreed between the user and the supplier of the equipment (see Annex B). Preference should be given to the use of standard symbols given in IEC 60417-DB: 2002 and ISO 7000.		N
16.4	Marking of equipment		N
	Equipment shall be legibly and durably marked in a way that is plainly visible after the equipment is installed.		N
	A nameplate giving the following information shall be attached to the enclosure adjacent to each incoming supply:		---
	–name or trade mark of supplier;		N
	–certification mark, when required;		N
	–serial number, where applicable;		N
	–rated voltage, number of phases and frequency (if a.c.), and full-load current for each supply;		N
	–short-circuit rating of the equipment;		N
	–main document number (see IEC 62023).		N
	The full-load current shown on the nameplate shall be not less than the running currents for all motors and other equipment that can be in operation at the same time under normal conditions.		N
	Where only a single motor controller is used, that information may instead be provided on the machine nameplate where it is plainly visible.		N
16.5	Reference designations		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	All enclosures, assemblies, control devices, and components shall be plainly identified with the same reference designation as shown in the technical documentation.		N
17	Technical documentation		P
17.1	General		P
	The information necessary for installation, operation, and maintenance of the electrical equipment of a machine shall be supplied in the appropriate forms, for example, drawings, diagrams, charts, tables, instructions.		P
	The information shall be in an agreed language (see also Annex B).	English language	P
	The information provided may vary with the complexity of the electrical equipment. For very simple equipment, the relevant information may be contained in one document, provided that the document shows all the devices of the electrical equipment and enables the connections to the supply network to be made		P
17.2	Information to be provided		P
	The information provided with the electrical equipment shall include:		---
	a) A main document (parts list or list of documents);		P
	b) Complementary documents including:		---
	1) a clear, comprehensive description of the equipment, installation and mounting, and the connection to the electrical supply(ies);		P
	2) electrical supply(ies) requirements;		P
	3) information on the physical environment where appropriate;		P
	4) overview (block) diagram(s) where appropriate;		P
	5) circuit diagram(s);		P
	6) information (as applicable) on:		---
	• programming, as necessary for use of the equipment;		N
	• sequence of operation(s);		N
	• frequency of inspection;		N
	• frequency and method of functional testing;		N
	• guidance on the adjustment, maintenance, and repair, particularly of the protective devices and circuits;		N
	• recommended spare parts list;		N
	• list of tools supplied.		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	7) a description of the safeguards, interlocking functions, and interlocking of guards against hazards, particularly for machines operating in a co-ordinated manner;		P
	8) a description of the safeguarding and of the means provided where it is necessary to suspend the safeguarding (see 9.2.4);		P
	9) instructions on the procedures for securing the machine for safe maintenance;		P
	10) information on handling, transportation and storage;		P
	11) information regarding load currents, peak starting currents and permitted voltage drops, as applicable;		N
	12) information on the residual risks due to the protection measures adopted, indication of whether any particular training is required and specification of any necessary personal protective equipment.		P
17.3	Requirements applicable to all documentation		P
	Unless otherwise agreed between manufacturer and user:		---
	–the documentation shall be in accordance with relevant parts of IEC 61082;	Comply with IEC 61082	P
	–reference designations shall be in accordance with relevant parts of IEC 61346;	Comply with IEC 61346	P
	–instructions/manuals shall be in accordance with IEC 62079.	Comply with IEC 62079	P
	–parts lists where provided shall be in accordance with IEC 62027, class B.	Comply with IEC 62027, class B	P
	For referencing of the different documents, the supplier shall select one of the following methods:		---
	–where the documentation consists of a small number of documents each of the documents shall carry as a cross-reference the document numbers of all other documents belonging to the electrical equipment; or		N
	–for single level main documents only (see IEC 62023), all documents shall be listed with document numbers and titles in a drawing or document list; or		N
	–all documents of a certain level (see IEC 62023) of the document structure shall be listed, with document numbers and titles, in a parts list belonging to the same level.		N
17.4	Installation documents		N
	The installation documents shall give all information necessary for the preliminary work of setting up the machine. In complex cases, it may be necessary to refer to the assembly drawings for details.	See instruction	N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	The recommended position, type, and cross-sectional areas of the supply cables to be installed on site shall be clearly indicated.	Clearly indicated.	N
	The data necessary for choosing the type, characteristics, rated currents, and setting of the overcurrent protective device(s) for the supply conductors to the electrical equipment of the machine shall be stated (see 7.2.2).		N
	Where necessary, the size, purpose, and location of any ducts in the foundation that are to be provided by the user shall be detailed (see Annex B).		N
	The size, type, and purpose of ducts, cable trays, or cable supports between the machine and the associated equipment that are to be provided by the user shall be detailed (see Annex B).		N
	Where necessary, the diagram shall indicate where space is required for the removal or servicing of the electrical equipment.		N
	In addition, where it is appropriate, an interconnection diagram or table shall be provided.		N
17.5	Overview diagrams and function diagrams		N
	Where it is necessary to facilitate the understanding of the principles of operation, an overview diagram shall be provided.		N
	An overview diagram symbolically represents the electrical equipment together with its functional interrelationships without necessarily showing all of the interconnections.		N
	Function diagrams may be provided as either part of, or in addition to, the overview diagram.		N
17.6	Circuit diagrams		P
	A circuit diagram(s) shall be provided. This diagram(s) shall show the electrical circuits on the machine and its associated electrical equipment.		P
	Any graphical symbol not shown in IEC 60617-DB: 2001 shall be separately shown and described on the diagrams or supporting documents.		P
	The symbols and identification of components and devices shall be consistent throughout all documents and on the machine.		P
	Where appropriate, a diagram showing the terminals for interface connections shall be provided. That diagram may be used in conjunction with the circuit diagram(s) for simplification. The diagram should contain a reference to the detailed circuit diagram of each unit shown.		P

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	Switch symbols shall be shown on the electromechanical diagrams with all supplies turned off and with the machine and its electrical equipment ready for a normal start.		P
	Conductors shall be identified in accordance with 13.2.		P
	Characteristics relating to the function of the control devices and components which are not evident from their symbolic representation shall be included on the diagrams adjacent to the symbol or referenced to a footnote.		P
17.7	Operating manual		P
	The technical documentation shall contain an operating manual detailing proper procedures for set-up and use of the electrical equipment. Particular attention should be given to the safety measures provided.		P
	Where the operation of the equipment can be programmed, detailed information on methods of programming, equipment required, program verification, and additional safety procedures (where required) shall be provided.		P
17.8	Maintenance manual		P
	The technical documentation shall contain a maintenance manual detailing proper procedures for adjustment, servicing and preventive inspection, and repair.		P
	Recommendations on maintenance/service intervals and records should be part of that manual.		P
	Where methods for the verification of proper operation are provided (for example software testing programs), the use of those methods shall be detailed.		P
17.9	Parts list		P
	The parts list, where provided, shall comprise, as a minimum, information necessary for ordering spare or replacement parts required for preventive or corrective maintenance including those that are recommended to be carried in stock by the user of the equipment.	See instruction manual	P
18	Verification		P
18.1	General		P
	Where there is no dedicated product standard for the machine, the verifications shall always include the items a), b) and f) and may include one or more of the items c) to e):		---
	a) verification that the electrical equipment complies with its technical documentation;		P

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	b) in case of protection against indirect contact by automatic disconnection, conditions for protection by automatic disconnection shall be verified according to 18.2;		P
	c) insulation resistance test (see 18.3);		P
	d) voltage test (see 18.4);		P
	e) protection against residual voltage (see 18.5);		P
	f) functional tests (see 18.6).		P
	For tests in accordance with 18.2 and 18.3, measuring equipment in accordance with the EN 61557 series is applicable.	Comply with EN 61557	P
18.2	Verification of conditions for protection by automatic disconnection of supply		N
18.2.1	General		N
	The conditions for automatic disconnection of supply (see 6.3.3) shall be verified by tests.		N
	For TN-systems, those test methods are described in 18.2.2; their application for different conditions of supply are specified in 18.2.3.		N
	For TT and IT systems, see IEC 60364-6-61.		N
18.2.2	Test methods in TN-systems		N
	Test 1 – Verification of the continuity of the protective bonding circuit		N
	Test 2 – Fault loop impedance verification and suitability of the associated overcurrent protective device		N
18.2.3	Application of the test methods for TN-systems		N
	Test 1 of 18.2.2 shall be carried out on each protective bonding circuit of a machine.		N
	When Test 2 of 18.2.2 is carried out by measurement, it shall always be preceded by Test 1.		N
18.3	Insulation resistance tests		N
	The insulation resistance measured at 500 V d.c. between the power circuit conductors and the protective bonding circuit shall be not less than 1 MΩ		N
	The test may be made on individual sections of the complete electrical installation.		P
	for certain parts of electrical equipment, a lower minimum value is permitted, but that value shall not be less than 50 kΩ		P
	If the electrical equipment of the machine contains surge protection devices which are likely to operate during the test, it is permitted to either:		---

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict
	–disconnect these devices,		N
	–reduce the test voltage to a value lower than the voltage protection level of the surge protection devices, but not lower than the peak value of the upper limit of the supply (phase to neutral) voltage.		N
18.4	Voltage tests		P
	When voltage tests are performed, test equipment in accordance with IEC 61180-2 should be used.	Comply with IEC 61180-2	P
	Test conditions		---
	- at least 1 second - test voltage is twice the rated supply voltage of the equipment or 1000 V, whichever is greater - frequency of 50/60 Hz - supplied from a transformer with a min rating of 500 VA		P
	Components and devices that are not rated to withstand the test voltage shall be disconnected during testing.		P
	Components and devices that have been voltage tested in accordance with their product standards may be disconnected during testing.		P
18.5	Protection against residual voltages		P
	Where appropriate, tests shall be performed to ensure compliance with 6.2.4.		P
18.6	Functional tests		P
	The functions of electrical equipment shall be tested.		P
	The function of circuits for electrical safety (for example earth fault detection) shall be tested.		P
18.7	Retesting		P
	Where a portion of the machine and its associated equipment is changed or modified, that portion shall be reverified and retested, as appropriate (see 18.1).		N
	Particular attention should be given to the possible adverse effects that retesting can have on the equipment		N

EN 60204-1:2018			
Clause	Requirement – Test	Result - Remark	Verdict

Appendix_1: Datasheet of test

18.2	TABLE: Continuity of the protective bonding circuit			N
Location	Current(A)	Frequency(Hz)	Measured resistance(Ω)	
Between incoming PE terminal and relevant points that are part of the protective bonding circuit	---	---	---	
Note: Class III equipment				

18.3	TABLE: insulation resistance tests				P
Location	Voltage(V)d.c	Frequency(Hz)	Time(s)	Measured insulation resistance(MΩ)	
Between power circuit conductors L and protective bonding circuit	500	---	60	>100MΩ	
Between power circuit conductors N and protective bonding circuit	500	---	60	>100MΩ	
Note: Test under charging					

18.4	TABLE: voltage tests		P
test voltage applied between:		test voltage (V) a.c. / d.c.	breakdown Yes / No
Between power circuit conductors L and protective bonding circuit		1000 a.c., 50Hz, 1min	No
Between power circuit conductors N and protective bonding circuit		1000 a.c., 50Hz, 1min	No
supplementary information: Test under charging			

2006/42/EC Annex I			
Clause	Requirement – Test	Result - Remark	Verdict
1	Essential health and safety requirement		P
1.1	General remarks		P
1.1.1	Definitions		P
1.1.2	Principles of safety integration	Considered	P
1.1.3	Materials and products		P
1.1.4	Lighting		P
1.1.5	Design of machinery to facilitate its handling	Handled safely and stored safely and without damage.	P
1.1.6	Ergonomics	Taking into account ergonomic principles.	P
1.1.7	Operating positions	Designed and constructed in such a way as to avoid any risk due to lack of electrical.	P
1.1.8.	Seating		N
1.2	Controls	See EN60204-1 safety report.	P
1.2.1	Safety and reliability of control systems		P
1.2.2	Control devices		P
1.2.3	Starting		P
1.2.4	Stopping devices		P
1.2.4.1	Normal stopping		P
1.2.4.2	Operational stop		P
1.2.4.3	Emergency stop		P
1.2.4.4	Assembly of machinery		P
1.2.5	Model selection		P
1.2.6	Failure of the power supply		P
1.3	Protection against mechanical hazards		P
1.3.1	Risk of loss of stability	Square construction and low center of gravity, bottom fixture and ensure stability, no overturn drop and movement.	P
1.3.2	Risk of break-up during operation	The various parts of machinery and their linkages be able to with stand the stresses.	P
1.3.3	Risks due to falling or ejected objects	No ejected or failing object.	P
1.3.4.	Risks due to surfaces, edges or angles	Smooth surface and edges.	P
1.3.5	Risks related to combined machinery	Integrative structure.	N
1.3.6	Risks relating to variations in the rotational speed of tools		N

2006/42/EC Annex I			
Clause	Requirement – Test	Result - Remark	Verdict
1.3.7	Prevention of risks related to moving parts		P
1.3.8	Choice of protection against risks related to moving parts		P
1.3.8.1.	Moving transmission parts		P
1.3.8.2.	Moving parts involved in the process		P
1.3.9.	Risks of uncontrolled movements		N
1.4	Required characteristics of guards and protection devices		P
1.4.1	General requirement	Robust construction.	P
1.4.2	Special requirements for guards		P
1.4.2.1	Fixed guards	Fixed on properties position.	P
1.4.2.2	Movable guards		N
	A. Type A movable guards		N
	B. Type B movable guards		N
1.4.2.3	Adjustable guards restricting access		N
1.4.3	Special requirements for protective devices		P
1.5	Protection against other hazards		P
1.5.1	Electricity supply	All electrical parts, protecting by enclosure and protective earthing. No residual voltage hazard. No electric shock hazard. All connection complies with requirements of EN 60204-1.	P
1.5.2	Static electricity	Protective earthing circuits used.	P
1.5.3	Energy supply other than electricity		P
1.5.4	Errors of fitting	Machine design to avoid assembly errors. Only assembled by manufacturer. Relevant identification provided.	P
1.5.5	Extreme temperature	No extreme temperature.	P
1.5.6	Fire	No fire hazard.	P
1.5.7	Explosion	See instruction for environment required. Other location have not explosion source.	P
1.5.8	Noise	No risk of hazard.	N
1.5.9	Vibration	No risk of hazard.	P
1.5.10	Radiation	No hazard.	N
1.5.11	External radiation	No affect.	N
1.5.12	Laser equipment	No laser devices.	N

2006/42/EC Annex I			
Clause	Requirement – Test	Result - Remark	Verdict
1.5.13	Emission of dust, gases, etc.	No emission of dust, gases, etc.	P
1.5.14	Risk of being trapped in a machine	No risk of trapped hazard.	P
1.5.15	Risk of slipping, tripping or falling	No risk of such hazard.	P
1.5.16	Lightning		N
1.6	Maintenance		P
1.6.1	Machinery maintenance	Requirements in instruction regard for: adjustment, lubricate and maintenance under disconnecting power and no hazard to person.	P
1.6.2	Access to operating position and servicing points	Access easily.	P
1.6.3	Isolation of energy sources		N
1.6.4	Operator intervention		P
1.6.5	Cleaning of internal parts		P
1.7	Information		P
1.7.1	Information and warnings on the machinery		P
1.7.1.1	Information and information devices	Easy to understand.	P
1.7.1.2	Warning devices	Easy to understand.	P
1.7.2	Warning of residual risks	No residual hazards.	P
1.7.3	Marking of machinery	Comply with requirement	P
1.7.4	Instructions	Comply with requirement, see instructions.	P
1.7.4.1.	General principles for the drafting of instructions		P
1.7.4.2.	Contents of the instructions		P
1.7.4.3.	Sales literature		P
2	Essential Health and Safety Requirements for Certain Categories of Machinery		N
2.1	Agri-foodstuffs machinery	The machine is not used in food processing industry	N
2.2	Portable hand-held and/or hand-guided machinery		N
	It must have a supporting surface of sufficient size		N
	Have a sufficient number of handles		N
	Supports of an appropriate size and arranged		N
	i independent control, must be fitted with start and stop controls arranged in such a way that the operator can operate them without releasing the handles,		N

2006/42/EC Annex I			
Clause	Requirement – Test	Result - Remark	Verdict
	Portable hand-held machinery must be designed and constructed to allow, where necessary, a visual check of the contact of the tool with the material being processed.		N
2.3	Machinery for working wood and analogous materials	The machine is not used in the wood working industry	N
3	Essential Health and Safety Requirements to Offset due to the Mobility of Machinery		N
3.1	General	The machine is not intended for mobility application	N
3.1.1	Definition		N
3.2	Work stations		N
3.2.1	Driving position		N
3.2.2	Seating		N
3.2.3	Other places		N
3.3	Controls		N
3.3.1	Control devices		N
3.3.2	Starting/moving		N
3.3.3	Travelling function		N
3.3.4	Movement of pedestrian-controlled machinery		N
3.3.5	Control circuit failure		N
3.4	Protection against mechanical hazards		N
3.4.1	Uncontrolled movements		N
3.4.2	Risk of break-up during operation		N
3.4.3	Rollover		N
3.4.4	Falling objects		N
3.4.5	Means of access		N
3.4.6	Towing devices		N
3.4.7	Transmission of power between self-propelled machinery(or tractor)and recipient machinery		N
3.5	Protection against other hazards		N
3.5.1	Batteries		N
3.5.2	Fire		N
3.5.3	Emissions of dust, gases, etc.		N
3.6	Indications		N
3.6.1	Signs and warning		N
3.6.2	Marking		N
3.6.3	Instruction		N
3.6.3.1	Vibrations		N

2006/42/EC Annex I			
Clause	Requirement – Test	Result - Remark	Verdict
3.6.3.2	Multiple uses		N
4	Essential Health and Safety Requirements to Offset the Particular Hazards due to a Lifting Operation		N
4.1	General remarks	The machine is not intended for any lifting operations	N
4.1.1	Definition		N
4.1.2	Protection against mechanical hazards		N
4.1.2.1	Risk due to lack of stability		N
4.1.2.2	Machinery running on guide rails and rail tracks		N
4.1.2.3	Mechanical strength		N
4.1.2.4	Pulleys, drums, wheels, ropes and chains		N
4.1.2.5	Lifting accessories and their components		N
4.1.2.6	Control of movements		N
4.1.2.7	Movements of loads during handling		N
4.1.2.8	Machinery serving fixed landings		N
4.1.2.8.1	Movements of the carrier		N
4.1.2.8.2	Access to the carrier		N
4.1.2.8.3	Risks due to contact with the moving carrier		N
4.1.2.8.4	Risk due to the load falling off the carrier		N
4.1.2.8.5	Landings		N
4.1.3	Fitness for purpose		N
4.2	Special requirements for machinery whose power source is other than manual effort		N
4.2.1	Controls of movements		N
4.2.2	Loading control		N
4.2.3	Installations guided by ropes		N
4.3	Information and marking		N
4.3.1	Chain, ropes and webbing		N
4.3.2	Lifting accessories		N
4.3.3	Lifting machinery		N
4.4	Instruction		N
4.4.1	Lifting accessories		N
4.4.2	Lifting machinery		N
5	Essential Health and Safety Requirements for Machinery intended for Underground Work		N
5.1	Risks due to lack of stability	The machine is not intended for underground Work	N
5.2	Movement		N
5.3	Control devices		N

2006/42/EC Annex I			
Clause	Requirement – Test	Result - Remark	Verdict
5.4	Stopping		N
5.5	Fire		N
5.6	Exhaust emissions		N
6.	Supplementary essential health and safety requirements for machinery presenting particular hazards due to the lifting of persons		N
6.1	General	The machine is not intended for lifting of persons.	N
6.1.1	Mechanical strength		N
6.1.2	Loading control for machinery moved by power other than human strength		N
6.2	Control devices		N
6.3	Risks too persons in or on the carrier		N
6.3.1	Risks due to movements of the carrier		N
6.3.2	Risk of persons falling from the carrier		N
6.3.3	Risk due to objects falling on the carrier		N
6.4	Machinery serving fixed landings		N
6.4.1	Risks to persons in or on the carrier		N
6.4.2	Controls at landings		N
6.4.3	Access to the carrier		N
6.5	Markings		N

EN ISO 12100: 2010						
No.	Hazard	Place of hazard	Severity	Probability of occurrence	Risk	Methods adopted to eliminate hazards

Risk Assessment

Safety of machinery –Principle of Risk assessment

1	Mechanical Hazards due to:	---	---	---	---	See below
	- machine part or workpieces, e.g.:	---	---	---	---	---
	a. shape	---	---	---	---	---
	b. relative location	---	---	---	---	---
	c. mass and stability	---	---	---	---	---
	d. mass and velocity	---	---	---	---	---
	e. inadequacy of mechanical strength	---	---	---	---	---
	- accumulation of energy inside the machinery, e.g.	---	---	---	---	---
	f. elastic elements	---	---	---	---	---
	g. liquids and gases under pressure	---	---	---	---	---
	h. the effect of vacuum	---	---	---	---	---
1.1	Crushing hazard	N/A	Minor	Unlikely	No	No Crushing hazard
1.2	Shearing hazard	N/A	Minor	Unlikely	No	No Shearing hazard
1.3	Cutting or severing hazard	N/A	Minor	Unlikely	No	No Cutting or severing hazard
1.4	Entanglement hazard	N/A	Minor	Unlikely	No	No Entanglement hazard
1.5	Drawing-in or trapping hazard	N/A	Minor	Unlikely	No	No Drawing-in or trapping hazard
1.6	Impact hazard	N/A	Minor	Unlikely	No	No Impact hazard
1.7	Stabbing or puncture hazard	N/A	Minor	Unlikely	No	No Stabbing or puncture hazard
1.8	Friction or abrasion hazard	N/A	Minor	Unlikely	No	No Friction or abrasion hazard
1.9	High pressure fluid injection or ejection hazard	N/A	Slight	Unlikely	No	No high pressure fluid injection or ejection hazard
2.	Electrical hazards due to:	---	---	---	---	See below
2.1	Contact of persons with live parts (direct contact)	Live parts	Slight	Unlikely	Yes	Live parts protected by enclosure; affixing warning signs for related electrical parts; periodic check according to the instruction manual.
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)	Electrical control cabinet and external electrical part	Slight	Unlikely	Yes	Protected by insulation and earthing protective circuits. Periodic check according to the instruction manual

EN ISO 12100: 2010						
No.	Hazard	Place of hazard	Severity	Probability of occurrence	Risk	Methods adopted to eliminate hazards
2.3	Approach to live parts under high voltage	Live parts	Slight	Unlikely	No	Protected by enclosure and insulation, earthing protective circuits.
2.4	Electrostatic phenomena	Outside surface	Slight	Unlikely	No	Protected by earthing protective circuits
2.5	Thermal radiation of other phenomena such as the projection of molten particles, and chemical effects from short-circuits, overloads; etc.	N/A	Minor	Unlikely	No	No related hazard
3	Thermal hazards resulting in:	---	---	---	---	See below
3.1	Burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by the radiation of heat sources	Hot Air Gun and Work plate of heating	Slight	Unlikely	Yes	Protected by insulation. Warning signs affixed to the parts. Periodic check according to the instruction manual.
3.2	Damage to health by hot or cold work environment	Hot Air Gun and Work plate of heating	Slight	Unlikely	Yes	Protected by insulation. Warning signs affixed to the parts. Periodic check according to the instruction manual.
4	Hazard generated by noise, resulting in:	---	---	---	---	See below
4.1	Hearing loss (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	N/A	Minor	Unlikely	No	No related hazard
4.2	Interference with speech communication, acoustic signals, etc.	N/A	Minor	Unlikely	No	No related hazard
5	Hazards generated by vibration	---	---	---	---	See below
5.1	Use of hand-held machines resulting in a variety of neurological and vascular disorders	N/A	Minor	Unlikely	No	No related hazard
5.2	Whole body vibration, particularly when combined with poor postures	N/A	Minor	Unlikely	No	No related hazard
6	Hazard generated by radiation	---	---	---	---	See below
6.1	Low frequency, radio frequency radiation, microwaves	N/A	Minor	Unlikely	No	No related hazard

EN ISO 12100: 2010						
No.	Hazard	Place of hazard	Severity	Probability of occurrence	Risk	Methods adopted to eliminate hazards
6.2	Infrared, visible and ultraviolet	N/A	Minor	Unlikely	No	No related hazard
6.3	X and gamma rays	N/A	Minor	Unlikely	No	No related hazard
6.4	Alpha, beta rays, electron or ion beams, neutrons	N/A	Minor	Unlikely	No	No related hazard
6.5	Lasers	N/A	Minor	Unlikely	No	No related hazard
7	Hazards generated by materials and substances (and their constituent elements) processed or used by the machinery	---	---	---	---	See below
7.1	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	N/A	Minor	Unlikely	No	No related hazard
7.2	Fire or explosion hazard	N/A	Minor	Unlikely	No	No related hazard
7.3	Biological and microbiological (viral or bacterial) hazards	N/A	Minor	Unlikely	No	No related hazard
8	Hazards generated by neglecting ergonomic principals in machinery design as, e.g. hazards from:	---	---	---	---	See below
8.1	Unhealthy postures or excessive effort	N/A	Minor	Unlikely	No	Easy operation procedures, not needing excessive effort
8.2	Inadequate consideration of hand-arm or foot-leg anatomy	N/A	Minor	Unlikely	No	Not necessary to use hand or stand too long
8.3	Neglected use of personal protection equipment	N/A	Minor	Unlikely	No	No related hazard
8.4	Inadequate local lighting	N/A	Minor	Unlikely	No	Not necessary
8.5	Mental overload or underload, stress	N/A	Minor	Unlikely	No	No related hazard
8.6	Human error, human behavior	Whole machine	Minor	Unlikely	No	Only authorized person can use the machine; training before using this machine; refer to the instruction manual before using the machine
8.7	Inadequate design, location or identification of manual controls	Control panel	Minor	Unlikely	No	Adequate identification of machine provided clearly, visibly, enduringly control sign used

EN ISO 12100: 2010						
No.	Hazard	Place of hazard	Severity	Probability of occurrence	Risk	Methods adopted to eliminate hazards
8.8	Inadequate design or location of visual display units	N/A	Minor	Unlikely	No	No related hazards
9	Combination of hazards	N/A	Minor	Unlikely	No	No related hazards
10	Unexpected start-up, unexpected overrun/overspeed (or any similar malfunction) from:	---	---	---	---	See below
10.1	Failure/disorder of the control system	Control circuits	Minor	Unlikely	No	Using approved electrical parts; Using advanced safety design technologies; Using emergency stop devices
10.2	Restoration of energy supply after an interruption	Power switch	Minor	Unlikely	No	Only press power switch to start machine.
10.3	External influences on electrical equipment	Electrical equipments	Minor	Unlikely	No	Connection of protective earthing; Excellent electrical shielded housing
10.4	Other external influences (gravity, wind, etc.)	Electrical equipments	Minor	Unlikely	No	Connection of protective earthing; Excellent electrical shielded housing.
10.5	Errors in the software	Whole machine	Minor	Unlikely	No	No related hazard
10.6	Errors made by the operator (due to mismatch of machinery with human characteristics and abilities, see 8.6)	Whole machine	Minor	Unlikely	No	No related hazard
11	Impossibility of stopping the machine in the best possible conditions	N/A	Minor	Unlikely	No	Press the switch to stop the machine
12	Variations in the rotational speed of tools	N/A	Minor	Unlikely	No	Press the switch stop the machine
13	Failure of the power supply	Power source, power switches and wirings etc.	Minor	Unlikely	Yes	Using approval electrical parts; using advanced safety design technologies; Using emergency stop devices; Daily check
14	Failure of the control circuits	Control circuits	Minor	Unlikely	Yes	Using approval electrical parts; using advanced safety design technologies; Using emergency stop devices; Daily check
15	Errors of fitting	Whole machine	Minor	Unlikely	No	No hazard produced

EN ISO 12100: 2010						
No.	Hazard	Place of hazard	Severity	Probability of occurrence	Risk	Methods adopted to eliminate hazards
16	Break-up during operation	Whole machine	Minor	Unlikely	No	No related hazard, protected by metal enclosure
17	Falling or ejected objects or fluids	Whole machine	Minor	Unlikely	No	No related hazard
18	Loss of stability / overturning of machinery	Whole machine	Minor	Unlikely	No	No related hazard
19	Slip, trip and fall of persons (related to machinery)	Whole machine	Minor	Unlikely	No	No related hazard
Additional hazards, hazardous situations and hazardous events due to mobility						
20	Relating to the traveling function	N/A	Minor	Unlikely	No	No traveling function
20.1	Movement when starting the engine	N/A	Minor	Unlikely	Yes	No hazard
20.2	Movement without a driver at the driving position	N/A	Minor	Unlikely	No	No hazard
20.3	Movement without all parts in a safe position	N/A	Minor	Unlikely	No	No hazard
20.4	Excessive speed of pedestrian controlled machinery	N/A	Minor	Unlikely	No	No hazard
20.5	Excessive oscillations when moving	N/A	Minor	Unlikely	No	No hazard
20.6	Insufficient ability of machinery to be slowed down, stopped and immobilized	N/A	Minor	Unlikely	No	No hazard
21	Linked to the work position (including driving station) on the machine	N/A	Minor	Unlikely	No	See below
21.1	Fall of persons during access to (or at/from) the work position	N/A	Minor	Unlikely	No	No this hazard
21.2	Exhaust gases/lack of oxygen at the work position	N/A	Minor	Unlikely	No	No exhaust gases/lack of oxygen hazard
21.3	Fire (flammability of the cab, lack of extinguishing means)	N/A	Minor	Unlikely	No	No related hazard
21.4	Mechanical hazards at the work position:	N/A	Minor	Unlikely	No	No related hazard
	a. contact with the wheels;	N/A	Minor	Unlikely	No	No related hazard
	b. rollover;	N/A	Minor	Unlikely	No	No related hazard
	c. fall of objects, penetration by objects;	N/A	Minor	Unlikely	No	No related hazard
	d. break-up of parts rotating at high speed;	N/A	Minor	Unlikely	No	No related hazard
	e. contact of persons with machine parts or tools (pedestrian controlled machines)	N/A	Minor	Unlikely	No	No related hazard

EN ISO 12100: 2010						
No.	Hazard	Place of hazard	Severity	Probability of occurrence	Risk	Methods adopted to eliminate hazards
21.5	Insufficient visibility from the work positions	N/A	Minor	Unlikely	No	No related hazard
21.6	Inadequate lighting	N/A	Minor	Unlikely	No	No related hazard
21.7	Inadequate seating	N/A	Minor	Unlikely	No	No related hazard
21.8	Noise at the work position	N/A	Minor	Unlikely	Yes	No related hazard
21.9	Vibration at the work position	N/A	Minor	Unlikely	No	No related hazard
21.10	Insufficient means for evacuation/emergency exit	N/A	Minor	Unlikely	No	No related hazard
22	Due to the control system	---	---	---	---	See below
22.1	Inadequate location of manual controls	Adequate control system	Minor	Unlikely	No	No related hazard
22.2	Inadequate design of manual controls and their mode of operation	Adequate control system	Minor	Unlikely	No	No related hazard
23	From handling the machine (lack of stability)	N/A	Minor	Unlikely	No	Stationary machine
24	Due to the power source and to the transmission of power	---	---	---	---	See below
24.1	Hazards from the engine and the batteries	N/A	Minor	Unlikely	No	No related hazard
24.2	Hazards from transmission of power between machines	N/A	Minor	Unlikely	No	No related hazard
24.3	Hazards from coupling and towing	N/A	Minor	Unlikely	No	No related hazard
25	From / to third persons	---	---	---	---	See below
25.1	Unauthorized start-up / use	Whole machine	Minor	Unlikely	No	Skilled person use only
25.2	Drift of a part away from its stopping position	N/A	Minor	Unlikely	No	No drift of part
25.3	Lack or inadequacy of visual or acoustic warning means	Whole machine	Minor	Unlikely	No	Adequate warning label
26	Insufficient instructions for the driver / operator	Whole machine	Minor	Unlikely	No	Edit the instruction manual in conformity with those Requirements of Machinery Directive; Each machine accompanied with a complete Instruction manual
Additional hazards, hazardous situations events due to lifting						
27	Mechanical hazards and hazardous events	---	---	---	---	See below
27.1	From load falls, collisions, machine tipping caused by:	---	---	---	---	See below

EN ISO 12100: 2010						
No.	Hazard	Place of hazard	Severity	Probability of occurrence	Risk	Methods adopted to eliminate hazards
27.1.1	Lack of stability	N/A	Minor	Unlikely	No	Standing steady
27.1.2	Uncontrolled loading – overloading – overturning moments exceeded	N/A	Minor	Unlikely	No	No related hazard
27.1.3	Uncontrolled amplitude of movements	N/A	Minor	Unlikely	No	No related hazard
27.1.4	Unexpected / unintended movement of loads	N/A	Minor	Unlikely	No	No related hazard
27.1.5	Inadequate holding devices / accessories	N/A	Minor	Unlikely	No	No related hazard
27.1.6	Collision of more than one machine	N/A	Minor	Unlikely	No	No related hazard
27.2	From access of persons to load support	N/A	Minor	Unlikely	No	No related hazard
27.3	From derailment	N/A	Minor	Unlikely	No	No related hazard
27.4	From insufficient mechanical strength of parts	N/A	Minor	Unlikely	No	Sufficient mechanical strength
27.5	From inadequate design of pulleys, drums	N/A	Minor	Unlikely	No	No related hazard
27.6	From inadequate selection of chains, ropes, lifting and accessories and their inadequate integration into the machine	N/A	Minor	Unlikely	No	No related hazard
27.7	From lowering of the load under the control of friction brake	N/A	Minor	Unlikely	No	No related hazard
27.8	From lowering of the load under the control of friction brake	N/A	Minor	Unlikely	No	No related hazard
27.8	From abnormal conditions of assembly / testing / use / maintenance	N/A	Minor	Unlikely	No	No related hazard
27.9	From the effect of load on persons (impact by load or counterweight)	N/A	Minor	Unlikely	No	No related hazard
28	Electrical hazards	---	---	---	---	See below
28.1	From lightning	N/A	Minor	Unlikely	No	No related hazard
29	Hazards generated by neglecting ergonomic principles	---	---	---	---	See below
29.1	Insufficient visibility from the driving position	N/A	Minor	Unlikely	No	No related hazard
Additional hazards, hazardous situations and hazardous events due to underground work						
30	Mechanical hazards and hazardous events due to:	---	---	---	---	Not for underground work
30.1	Lack of stability of powered roof supports	N/A	Minor	Unlikely	No	No related hazard

EN ISO 12100: 2010						
No.	Hazard	Place of hazard	Severity	Probability of occurrence	Risk	Methods adopted to eliminate hazards
30.2	Failing accelerator or break control of machinery running on rails	N/A	Minor	Unlikely	No	No related hazard
30.3	Failing or lack of deadman's control of machinery running on rails	N/A	Minor	Unlikely	No	No related hazard
31	Restricted movement of persons	N/A	Minor	Unlikely	No	No related hazard
32	Fire and explosion	N/A	Minor	Unlikely	No	No related hazard
33	Emission of dust, gases etc.	N/A	Minor	Unlikely	No	No related hazard
Additional hazards, hazardous situations and hazardous events due to the lifting or moving of persons						
34	Mechanical hazards and hazardous events due to:	---	---	---	---	See below
34.1	Inadequate mechanical strength – inadequate working coefficients	N/A	Minor	Unlikely	No	Not for lifting or moving of persons
34.2	Failing of loading control	N/A	Minor	Unlikely	No	No related hazard
34.3	Failing of controls in person carrier (function, priority)	N/A	Minor	Unlikely	No	No related hazard
34.4	Overspeed of person carrier	N/A	Minor	Unlikely	No	No related hazard
35	Falling of person from person carrier	N/A	Minor	Unlikely	No	No related hazard
36	Falling or overturning of person carrier	N/A	Minor	Unlikely	No	No related hazard
37	Human error, human behaviour	N/A	Minor	Unlikely	No	No related hazard

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark

EN ISO12100: 2010 Test Report

4	Strategy for risk assessment and risk reduction	Pass
	To implement risk assessment and risk reduction the designer shall take the following actions, in the order given (see Figure 1):	---
	a) determine the limits of the machinery, which include the intended use and any reasonably foreseeable misuse thereof;	Pass
	b) identify the hazards and associated hazardous situations;	Pass
	c) estimate the risk for each identified hazard and hazardous situation;	Pass
	d) evaluate the risk and take decisions about the need for risk reduction;	Pass
	e) eliminate the hazard or reduce the risk associated with the hazard by means of protective measures.	Pass
	Risk assessment is a series of logical steps to enable, in a systematic way, the analysis and evaluation of the risks associated with machinery.	Pass
	Risk assessment is followed whenever necessary by risk reduction. Iteration of this process can be necessary to eliminate hazards as far as practicable and to adequately reduce risks by the implementation of protective measures.	Pass
5	Risk assessment	Pass
5.1	General	Pass
	Risk analysis provides information required for the risk evaluation, which in turn allows judgments to be made about whether or not risk reduction is required.	Pass
5.2	Information for risk assessment	Pass
	a) Related to machinery description:	---
	1) user specifications;	Pass
	2) anticipated machinery specifications , including	---
	i) a description of the various phases of the whole life cycle of the machinery,	Pass
	ii) design drawings or other means of establishing the nature of the machinery, and	Pass
	iii) required energy sources and how they are supplied;	Pass
	3) documentation on previous designs of similar machinery, if relevant;	Pass
	4) information for use of the machinery, as available.	Pass
	b) Related to regulations, standards and other applicable documents:	---
	1) applicable regulations;	Pass
	2) relevant standards;	Pass
	3) relevant technical specifications;	Pass
	4) relevant safety data sheets.	Pass
	c) Related to experience of use:	---

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	1) any accident, incident or malfunction history of the actual or similar machinery;	Pass
	2) the history of damage to health resulting, for example, from emissions (noise, vibration, dust, fumes, etc.), chemicals used or materials processed by the machinery;	Pass
	3) the experience of users of similar machines and, whenever practicable, an exchange of information with the potential users.	Pass
	d) Relevant ergonomic principles.	Pass
5.3	Determination of limits of machinery	Pass
5.3.1	General	Pass
	Risk assessment begins with the determination of the limits of the machinery, taking into account all the phases of the machinery life.	Pass
5.3.2	Use limits	Pass
	Use limits include the intended use and the reasonably foreseeable misuse. Aspects to be taken into account include the following:	---
	a) the different machine operating modes and different intervention procedures for the users, including interventions required by malfunctions of the machine;	Pass
	b) the use of the machinery (for example, industrial, non-industrial and domestic) by persons identified by sex, age, dominant hand usage, or limiting physical abilities (visual or hearing impairment, size, strength, etc.);	Pass
	c) the anticipated levels of training, experience or ability of users including	---
	1) operators,	Pass
	2) maintenance personnel or technicians,	Pass
	3) trainees and apprentices, and	Pass
	4) the general public;	Pass
	d) exposure of other persons to the hazards associated with the machinery where it can be reasonably foreseen:	---
	1) persons likely to have a good awareness of the specific hazards, such as operators of adjacent machinery;	Pass
	2) persons with little awareness of the specific hazards but likely to have a good awareness of site safety procedures, authorized routes, etc., such as administration staff;	Pass
	3) persons likely to have very little awareness of the machine hazards or the site safety procedures, such as visitors or members of the general public, including children.	Pass
5.3.3	Space limits	Pass
	Aspects of space limits to be taken into account include	---
	a) the range of movement,	Pass
	b) space requirements for persons interacting with the machine, such as during operation and maintenance,	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	c) human interaction such as the operator–machine interface, and	Pass
	d) the machine–power supply interface.	Pass
5.3.4	Time limits	Pass
	Aspects of time limits to be taken into account include	---
	a) the life limit of the machinery and/or of some of its components (tooling, parts that can wear, electromechanical components, etc.), taking into account its intended use and reasonably foreseeable misuse, and	Pass
	b) recommended service intervals.	Pass
5.3.5	Other limits	Pass
	Examples of other limits include	---
	a) properties of the material(s) to be processed,	Pass
	b) housekeeping — the level of cleanliness required, and	Pass
	c) environmental — the recommended minimum and maximum temperatures, whether the machine can be operated indoors or outdoors, in dry or wet weather, in direct sunlight, tolerance to dust and wet, etc.	Pass
5.4	Hazard identification	Pass
	The designer shall identify hazards taking into account the following.	---
	a) Human interaction during the whole life cycle of the machine	Pass
	b) Possible states of the machine	Pass
	c) Unintended behaviour of the operator or reasonably foreseeable misuse of the machine	Pass
5.5	Risk estimation	Pass
5.5.1	General	Pass
	After hazard identification, risk estimation shall be carried out for each hazardous situation by determining the elements of risk given in 5.5.2. When determining these elements, it is necessary to take into account the aspects given in 5.5.3.	Pass
5.5.2	Elements of risk	Pass
5.5.2.1	General	Pass
	The risk associated with a particular hazardous situation depends on the following elements:	---
	a) the severity of harm;	Pass
	b) the probability of occurrence of that harm, which is a function of	---
	1) the exposure of person(s) to the hazard,	Pass
	2) the occurrence of a hazardous event, and	Pass
	3) the technical and human possibilities to avoid or limit the harm.	Pass
5.5.2.2	Severity of harm	Pass
	The severity can be estimated by taking into account the following:	---

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	a) the severity of injuries or damage to health	Pass
	b) the extent of harm	Pass
5.5.2.3	Probability of occurrence of harm	Pass
5.5.2.3.1	Exposure of persons to the hazard	Pass
	The exposure of a person to the hazard influences the probability of the occurrence of harm. Factors to be taken into account when estimating the exposure are, among others,	---
	a) the need for access to the hazard zone (for normal operation, correction of malfunction, maintenance or repair, etc.)	Pass
	b) the nature of access (for example, manual feeding of materials),	Pass
	c) the time spent in the hazard zone,	Pass
	d) the number of persons requiring access, and	Pass
	e) the frequency of access.	Pass
5.5.2.3.2	Occurrence of a hazardous event	Pass
	The occurrence of a hazardous event influences the probability of occurrence of harm. Factors to be taken into account when estimating the occurrence of a hazardous event are, among others,	---
	a) reliability and other statistical data,	Pass
	b) accident history,	Pass
	c) history of damage to health, and	Pass
	d) comparison of risks (see 5.6.3).	Pass
5.5.2.3.3	Possibility of avoiding or limiting harm	Pass
	The possibility of avoiding or limiting harm influences the probability of occurrence of harm. Factors to be taken into account when estimating the possibility of avoiding or limiting harm are, among others, the following:	---
	a) different persons who can be exposed to the hazard(s), for example,	Pass
	b) how quickly the hazardous situation could lead to harm	Pass
	c) any awareness of risk,	Pass
	d) the human ability to avoid or limit harm (for example, reflex, agility, possibility of escape);	Pass
	e) practical experience and knowledge	Pass
5.5.3	Aspects to be considered during risk estimation	Pass
5.5.3.1	Persons exposed	Pass
	Risk estimation shall take into account all persons (operators and others) for whom exposure to the hazard is reasonably foreseeable.	Pass
5.5.3.2	Type, frequency and duration of exposure	Pass
	The estimation of the exposure to the hazard under consideration (including long-term damage to health) requires analysis of, and shall account for, all modes of operation of the machinery and methods of working.	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
5.5.3.3	Relationship between exposure and effects	Pass
	The relationship between an exposure to a hazard and its effects shall be taken into account for each hazardous situation considered. The effects of accumulated exposure and combinations of hazards shall also be considered. When considering these effects, risk estimation shall, as far as practicable, be based on appropriate recognized data.	Pass
5.5.3.4	Human factors	Pass
	Human factors can affect risk and shall be taken into account in the risk estimation, including, for example,	---
	a) the interaction of person(s) with the machinery, including correction of malfunction,	Pass
	b) interaction between persons,	Pass
	c) stress-related aspects,	Pass
	d) ergonomic aspects,	Pass
	e) the capacity of persons to be aware of risks in a given situation depending on their training, experience and ability,	Pass
	f) fatigue aspects, and	Pass
	g) aspects of limited abilities (due to disability, age, etc.).	Pass
5.5.3.5	Suitability of protective measures	Pass
	Risk estimation shall take into account the suitability of protective measures and shall	---
	a) identify the circumstances which can result in harm,	Pass
	b) whenever appropriate, be carried out using quantitative methods to compare alternative protective measures (see ISO/TR 14121-2), and	Pass
	c) provide information that can assist with the selection of appropriate protective measures.	Pass
5.5.3.6	Possibility of defeating or circumventing protective measures	Pass
	Risk estimation shall take account of the possibility of defeating or circumventing protective measures. It shall also take account of the incentive to defeat or circumvent protective measures when, for example,	---
	a) the protective measure slows down production or interferes with another activity or preference of the user,	Pass
	b) the protective measure is difficult to use,	Pass
	c) persons other than the operator are involved, or	Pass
	d) the protective measure is not recognized by the user or not accepted as being suitable for its function.	Pass
5.5.3.7	Ability to maintain protective measures	Pass
	Risk estimation shall consider whether the protective measures can be maintained in the condition necessary to provide the required level of protection.	Pass
5.5.3.8	Information for use	Pass
	Risk estimation shall take into account the information for use, as available. See also 6.4.	Pass
5.6	Risk evaluation	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
5.6.1	General	Pass
	After risk estimation has been completed, risk evaluation shall be carried out to determine if risk reduction is required.	Pass
5.6.2	Adequate risk reduction	Pass
	Application of the three-step method described in 6.1 is essential in achieving adequate risk reduction.	Pass
5.6.3	Comparison of risks	Pass
	As part of the process of risk evaluation, the risks associated with the machinery or parts of machinery can be compared with those of similar machinery or parts of machinery	Pass
6	Risk reduction	Pass
6.1	General	Pass
	The objective of risk reduction can be achieved by the elimination of hazards, or by separately or simultaneously reducing each of the two elements that determine the associated risk:	---
	- severity of harm from the hazard under consideration;	Pass
	- probability of occurrence of that harm.	Pass
	All protective measures intended for reaching this objective shall be applied in the following sequence, referred to as the three-step method (see also Figures 1 and 2).	Pass
	Step 1: Inherently safe design measures	Pass
	Step 2: Safeguarding and/or complementary protective measures	Pass
	Step 3: Information for use	Pass
6.2	Inherently safe design measures	Pass
6.2.1	General	Pass
6.2.2	Consideration of geometrical factors and physical aspects	Pass
6.2.2.1	Geometrical factors	Pass
	a) The form of machinery is designed to maximize direct visibility of the working areas and hazard zones from the control position — reducing blind spots, for example — and choosing and locating means of indirect vision where necessary (mirrors, etc.) so as to take into account the characteristics of human vision, particularly when safe operation requires permanent direct control by the operator, for example:	Pass
	b) The form and the relative location of the mechanical components parts: for instance, crushing and shearing hazards are avoided by increasing the minimum gap between the moving parts, such that the part of the body under consideration can enter the gap safely, or by reducing the gap so that no part of the body can enter it (see ISO 13854 and ISO 13857).	Pass
	c) Avoiding sharp edges and corners, protruding parts: in so far as their purpose allows, accessible parts of the machinery shall have no sharp edges, no sharp angles, no rough surfaces, no protruding parts likely to cause injury, and no	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	openings which can “trap” parts of the body or clothing. In particular, sheet metal edges shall be deburred, flanged or trimmed, and open ends of tubes which can cause a “trap” shall be capped.	
	d) The form of the machine is designed so as to achieve a suitable working position and provide accessible manual controls (actuators).	Pass
6.2.2.2	Physical aspects	Pass
	a) limiting the actuating force to a sufficiently low value	Pass
	b) limiting the mass and/or velocity of the movable elements, and hence their kinetic energy;	Pass
	c) limiting the emissions by acting on the characteristics of the source using measures for reducing	---
	1) noise emission at source (see ISO/TR 11688-1),	Pass
	2) the emission of vibration at source, such as redistribution or addition of mass and changes of process parameters [for example, frequency and/or amplitude of movements (for hand-held and hand-guided machinery, see CR 1030-1)],	Pass
	3) the emission of hazardous substances, including the use of less hazardous substances or dust-reducing processes (granules instead of powders, milling instead of grinding), and	Pass
	4) radiation emissions, including, for example, avoiding the use of hazardous radiation sources, limiting the power of radiation to the lowest level sufficient for the proper functioning of the machine, designing the source so that the beam is concentrated on the target, increasing the distance between the source and the operator or providing for remote operation of the machinery [measures for reducing emission of non-ionizing radiation are given in 6.3.4.5 (see also EN 12198-1 and EN 12198-3)].	Pass
6.2.3	Taking into account general technical knowledge of machine design	---
	a) mechanical stresses;	Pass
	b) materials and their properties;	Pass
	c) emission values	Pass
	When the reliability of particular components or assemblies is critical for safety, stress values shall be multiplied by appropriate working coefficients	Pass
6.2.4	Choice of an appropriate technology	Pass
	Choice of the technology used to eliminate hazards and reduce risks, e.g.:	---
	a) on machines intended for use in explosive atmospheres: - pneumatic or hydraulic control system and machine actuators; - “intrinsically safe” electrical equipment	Not application
	b) for particular products to be processed such as a solvent: equipment assuring that the temperature will remain far below the flash point	Not application
	c) alternative equipment to avoid high noise level, e.g.: - electrical instead of pneumatic equipment; - in certain conditions, water cutting instead of mechanical equipment	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
6.2.5	Applying principle of positive mechanical action	Pass
	A moving mechanical component inevitably moves another component along with it, either by direct contact or via rigid elements, these components are connected in the positive mode.	Pass
6.2.6	Provisions for stability	Pass
	Machines shall be designed to have sufficient stability	Pass
	Factors to be taken into account include: - geometry of the base; - weight distribution, including loading; - dynamic forces due to movements - vibration; - oscillations of the centre of gravity; - characteristics of the supporting surface - external forces	Pass These factors have been taken into account
	Stability considered in all phases of the life of the machine	Pass
	Other protective measures for stability relevant to safeguarding are given in 6.3.2.6	Pass
6.2.7	Provisions for maintainability	Pass
	- accessibility	Pass
	- ease of handling	Pass
	- limitation of the number of special tools and equipment	Pass
6.2.8	Observing ergonomic principles	Pass
	Ergonomic principles shall be taken into account in designing machinery to reduce mental or physical stress and strain of the operator.	Pass
	Account shall be taken of body sizes likely to be found in the intended user population, strengths and postures, movement amplitudes, frequency of cyclic actions	Pass
	All elements of the “operator-machine” interface shall be designed to be easily understood	Pass
	a) Avoid the necessity for stressful postures and movements during the use of the machine (for example, providing facilities to adjust the machine to suit the various operators).	Pass
	b) Design machines, especially hand-held and mobile machines, so as to enable them to be operated easily, taking into account human effort, actuation of controls and hand, arm and leg anatomy.	Pass
	c) Limit as far as possible noise, vibration and thermal effects such as extreme temperatures.	Pass
	d) Avoid linking the operator's working rhythm to an automatic succession of cycles.	Pass
	e) Providing local lighting on or in the machine for the illumination of the working area and of adjusting setting-up, and frequent maintenance zones when the design features of the machine and/or its guards render the ambient lighting inadequate. Flicker, dazzling, shadows and stroboscopic	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	effects shall be avoided if they can cause a risk. If the position of the lighting source has to be adjusted, its location shall be such that it does not cause any risk to persons making the adjustment	
	f) Selecting, locating and identifying manual controls (actuators) so that:	---
	- they are clearly visible and identifiable and appropriately marked where necessary	Pass
	- they can be safely operated without hesitation or loss of time and without ambiguity	Pass
	- their location (for push-buttons) and their movement (for levers and handwheels) are consistent with their effect	Pass
	- their operation cannot cause additional risk	Pass
	Where a control is designed and constructed to perform several different actions, namely where there is no one-to-one correspondence (e.g. keyboards), the action to be performed shall be clearly displayed and subject to confirmation where necessary	Not application
	Controls shall be so arranged that their layout, travel and resistance to operation are compatible with the action to be performed, taking account of ergonomic principles. Constraints due to the necessary or foreseeable use of personal protective equipment (such as footwear, gloves) shall be taken into account	Pass
	g) Selecting, designing and locating indicators, dials and visual display units so that:	---
	- they fit within the parameters and characteristics of human perception;	Pass
	- information displayed can be detected, identified and interpreted conveniently;	Pass
	- the operator is able to perceive them from the control position	Pass
6.2.9	Electrical hazard	Pass
	For the design of the electrical equipment of machines IEC 60204-1 gives general provisions, especially in clause 6 for protection against electric shock. For requirements related to specific machines, see corresponding IEC standards	Pass
6.2.10	Pneumatic and hydraulic equipment	Not application
	Pneumatic and hydraulic equipment of machinery shall be designed so that:	---
	- the maximum rated pressure cannot be exceeded in the circuits;	Not application
	- no hazard results from pressure surges or rises, pressure losses or drops or losses of vacuum;	Not application
	- no hazardous fluid jet or sudden hazardous movement of the hose results from leakage or component failures;	Not application
	- air receivers, air reservoirs or similar vessels comply with the	Not application

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	design rules for these elements;	
	- all elements of the equipment, and especially pipes and hoses, be protected against harmful external effects;	Not application
	- reservoirs and similar vessels shall, if possible, be automatically depressurized when switching off the power	Not application
	- all elements which remain under pressure after isolation of the machine from its power supply be provided with clearly identified exhaust devices, and a warning label	Not application
6.2.11	Applying inherently safe design measures to control system	Pass
6.2.11.1	General	Pass
	Safety-related performance provides a sufficient amount of risk reduction	Pass
	Avoid unforeseen and potentially hazardous machine behaviour	Pass
	Comply with the principles and methods presented in this subclause (6.2.11) and in 6.2.12.	Pass
	Enable the operator to interact with the machine safely and easily	Pass
	This requires one or several of the following solutions:	---
	- systematic analysis of start and stop conditions;	Pass
	- provision for specific operating modes;	Pass
	- clear display of the faults	Pass
	- measures to prevent accidental generation of unexpected start commands likely to cause dangerous machine behaviour;	Pass
	- maintained stop commands to prevent restarting that could result in dangerous machine behaviour	Pass
	An assembly of machines may be divided into several zones for emergency stopping, for stopping as a result of protective devices and/or for isolation and energy dissipation. The different zones shall be clearly defined and it shall be obvious which parts of the machine belong to which zone. Likewise it shall be obvious which control devices and/or protective devices belong to which zone. The interfaces between zones shall be designed such that no function in one zone creates hazards in another zone which has been stopped for an intervention	Pass
	Control systems shall be designed to limit the movements of parts of the machinery, the machine itself, or workpieces and/or loads held by the machinery, to the safe design parameters. Allowance shall be made for dynamic effects.	Pass
	When machinery is designed to use synchronously different elements which can also be used independently, the control system shall be designed to prevent risks due to lack of synchronization	Pass
6.2.11.2	Starting of an internal power source/switching on an external power supply	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	Starting of an internal power source or switching on an external power supply shall not result in a hazardous situation.	Pass
6.2.11.3	Starting/stopping of a mechanism	Pass
	The primary action for starting or accelerating the movement of a mechanism should be performed by application or increase of voltage or fluid pressure, or, if binary logic elements are considered, pa passage from state 0 to state1	Pass
	The primary action for stopping or slowing down should be performed by removal or reduction of voltage or fluid pressure, or, if binary logic elements are considered, by passage from state 1 to state 0	Pass
	When, in order for the operator to maintain permanent control of deceleration, this principle is not observed, the machine shall be equipped with a means of slowing the stopping in case of failure of the main braking system	Not application
6.2.11.4	Restart after power interruption	Pass
	If it may generate a hazard, the spontaneous restart of a machine when it is re-energized after power interruption shall be prevented	Pass
6.2.11.5	Interruption of power supply	Pass
	Machinery shall be designed to prevent hazardous situations resulting from interruption or excessive fluctuation of the power supply.	Pass
6.2.11.6	Use of automatic monitoring	Not application
	Automatic monitoring is intended to ensure that a safety function(s) implemented by a protective measure do(es) not fail to be performed if the ability of a component or an element to perform its function is diminished, or if the process conditions are changed in such a way that hazards are generated	Not application
	Automatic monitoring either detects a fault immediately or carries out periodic checks so that a fault is detected before the next demand upon the safety function. In either case, the protective measure can be initiated immediately or delayed until a specific event occurs	Not application
6.2.11.7	Safety function implemented by programmable electronic control systems	Not application
6.2.11.7.1	General	Not application
	A control system including programmable electronic equipment can be used to implement safety functions at machinery. Where a programmable electronic control system is used it is necessary to consider its performance requirements in relation to the requirements for the safety functions	Not application
	The design of the programmable electronic control system shall be such that the probability of random hardware failures and the likelihood of systematic failures that can adversely	Not application

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	affect the performance of the safety-related control function(s) are sufficiently low. Where a programmable electronic control system performs a monitoring function, the system behaviour on detection of a fault shall be considered	
	The programmable electronic control system should be installed and validated to ensure that the specified performance for each safety function has been achieved. Validation comprises testing and analysis to show that all parts interact correctly to perform the safety function and that unintended functions do not occur	Not application
6.2.11.7.2	Hardware aspects	Not application
	The hardware shall be selected and installed to meet both the functional and performance requirements of the safety function(s) to be performed, in particular, by means of:	Not application
	- architectural constraints	Not application
	- selecting equipment and devices with an appropriate probability of dangerous random hardware failure;	Not application
	- incorporating measures and techniques within the hardware to avoid systematic failures and control systematic faults	Not application
6.2.11.7.3	Software aspects	Not application
	The software shall be designed so as to satisfy the performance specification for the safety functions	Not application
	Application software should not be re-programmable by the user.	Not application
	When the application requires reprogramming by the user, the access to the soft ware dealing with safety functions should be restricted	Not application
6.2.11.8	Principles relating to manual control	Pass
	a) Designed and located according to the relevant ergonomic principles given in 6.2.8, item f)	Pass
	b) A stop control device shall be placed near each start control device. Where the start/stop function is performed by means of a hold-to-run control, a separate stop control device shall be provided when a risk can result from the hold-to-run control device failing to deliver a stop command when released	Pass
	c) Manual controls shall be located out of reach of the danger zones	Pass
	d) Whenever possible, control devices and control positions shall be located so that the operator is able to observe the working area or hazard zone	---
	1) The driver of a ride-on mobile machine shall be able to actuate all control devices required to operate the machine from the driving position, except for functions which can be controlled more safely from other positions	Not application
	2) On machinery intended for lifting persons, controls for lifting and lowering and, if appropriate, for moving the carrier, shall generally be located in the carrier shall be provided with the	Not application

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	means of preventing hazardous movements	
	e) If it is possible to start the same hazardous element by means of several controls, the control circuit shall be so arranged that only one control is effective at a given time. This applies especially to machines which can be manually controlled by means among others of a portable control unit, with which the operator may enter danger zones	Pass
	f) Control actuators shall be designed or guarded so that their effect, where a risk is involved, cannot occur without intentional operation	Pass
	g) For machine functions whose safe operation depends on permanent, direct control by the operator, measures shall be taken to ensure the presence of the operator at the control position, e.g. by the design and location of control devices	Pass
	h) For cableless control an automatic stop shall be performed when correct control signals are not received, including loss of communication	Not application
6.2.11.9	Control mode for setting, teaching, process changeover, fault-finding, cleaning or maintenance	Pass
	Where, for setting, teaching, process changeover, fault-finding, cleaning or maintenance of machinery, a guard has to be displaced or removed and/or a protective device has to be disabled, and where it is necessary for the purpose of these operations for the machinery or part of the machinery to be put in operation, safety of the operator shall be achieved using a specific control mode which simultaneously:	---
	a) disables all other control modes;	Pass
	b) permits operation of the hazardous elements only by continuous actuation of an enabling device, a hold-to-run control device or a two-hand control device;	Pass
	c) permits operation of the hazardous elements only in reduced risk conditions	Pass
	d) prevents any operation of hazardous functions by voluntary or involuntary action on the machine's sensors.	Pass
	This control mode shall be associated with one or more of following measures:	---
	- restriction of access to the danger zone as far as possible;	Pass
	- emergency stop control within immediate reach of the operator;	Pass
	- portable control unit and/or local controls allowing sight of the controlled elements	Pass
6.2.11.10	Selection of control and operating modes	Pass
	If machinery has been designed and built to allow for its use in several control or operating modes requiring different protective measures and/or work procedures, it shall be fitted with a mode selector which can be locked in each position. Each position of the selector shall be clearly identifiable and	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	shall exclusively allow one control or operating mode	
	The selector may be replaced by another selection means which restricts the use of certain functions of the machinery to certain categories of operators	Pass
6.2.11.11	Applying measures to achieve electromagnetic compatibility(EMC)	Not application
	For guidance on electromagnetic compatibility, see IEC 60204-1 and IEC 61000-6.	Not application
6.2.11.12	Provision of diagnostic systems to aid fault-finding	Not application
	Diagnostic systems to aid fault finding should be included in the control system so that there is no need to disable any protective measure	Not application
6.2.12	Minimizing probability of failure of safety functions	Pass
6.2.12.1	General	Pass
	Safety of machinery is not only dependent on the reliability of the control systems but also on the reliability of all parts of the machine.	Pass
	The continued operation of the safety functions is essential for the safe use of the machine. This can be achieved by the measures given in 6.2.12.2 to 6.2.12.4.	Pass
6.2.12.2	Use of reliable components	Pass
6.2.12.3	Use of “oriented failure mode” components	Not application
6.2.12.4	Duplication (or redundancy) of components or subsystems	Pass
6.2.13	Limiting exposure to hazards through reliability of equipment	Pass
	Increased reliability of all component parts of machinery reduces the frequency of incidents requiring rectification, thereby reducing exposure to hazards	Pass
	This applies to power systems as well as to control systems, to safety functions as well as to other functions of machinery	Pass
	Safety-critical components with a known reliability shall be used	Pass
	The elements of guards and of protective devices shall be particularly reliable, as their failure can expose persons to hazards, and also as poor reliability would encourage attempts to defeat them	Pass
6.2.14	Limiting exposure to hazards through mechanization or automation of loading(feeding) /unloading (removal) operations	Not application
	Mechanization and automation of machine loading/unloading operations and more generally of handling operations limit the risk generated by these operations by reducing the exposure of persons to hazards at the operating points	Not application
	Automation can be achieved e.g. by robots, handling devices, transfer mechanisms, air blast equipment. Mechanization can be achieved, e.g. by feeding slides, push rods, hand-operated indexing tables	Not application
	While automatic feeding and removal devices have much to	Not application

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	offer in preventing accidents to machine operators, they can create danger when any faults are being rectified. Care shall be taken to ensure that the use of these devices does not introduce further hazards between the devices and parts of the machine or workpieces/materials being processed. Suitable safeguards shall be provided if this cannot be ensured	
	Automatic feeding and removal devices with their own control systems and the control system of the associated machine shall be interconnected after thoroughly studying how all safety functions are performed in all control and operation modes of the whole equipment	Not application
6.2.15	Limiting exposure to hazards through location of the setting and maintenance points outside of danger zones	Not application
	The need for access to danger zones shall be minimized by locating maintenance, lubrication and setting points outside these zones	Not application
6.3	Safeguarding and complementary protective measures	Pass
6.3.1	General	Pass
	Guards and protective devices shall be used to protect persons whenever inherently safe design does not reasonably make it possible either to remove hazards or to sufficiently reduce risks. Complementary protective measures involving additional equipment may have to be taken	Pass
	Certain safeguards may be used to avoid exposure to more than one hazard	Pass
6.3.2	Selection and implementation of guards and protective devices	Pass
6.3.2.1	General	Pass
	This subclause gives guidelines for the selection and the implementation of guards and protective devices the primary purpose of which is to protect persons against hazards generated by moving parts, according to the nature of those parts and to the need for access to the danger zone(s)	---
	a) hazards from falling or ejected objects, using, for example, protection in the form of a falling object protection structure (FOPS),	Pass
	b) emission hazards (protection against noise, vibration, radiation, substances hazardous to health, etc.),	Pass
	c) hazards due to the environment (protection against heat, cold, foul weather, etc.),	Pass
	d) hazards due to tipping over or rolling over of machinery, using, for example, protection in the form of roll-over or tip-over protection structures (ROPS and TOPS).	Pass
6.3.2.2	Where access to the hazard zone is not required during normal operation	Pass
	a) fixed guards (see also ISO 14120);	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	b) interlocking guards with or without guard locking (see also 6.3.3.2.3, ISO 14119 and ISO 14120);	Not application
	c) self-closing guards (see ISO 14120:2002, 3.3.2);	Not application
	d) sensitive protective equipment, such as electrosensitive protective equipment (see IEC 61496) or pressure-sensitive protective devices (see ISO 13856).	Not application
6.3.2.3	Where access to the hazard zone is required during normal operation	Not application
	a) interlocking guards with or without guard locking (see also ISO 14119, ISO 14120 and 6.3.3.2.3 of this document);	Not application
	b) sensitive protective equipment, such as electrosensitive protective equipment (see IEC 61496);	Not application
	c) adjustable guards;	Not application
	d) self-closing guards (see ISO 14120:2002, 3.3.2);	Not application
	e) two-hand control devices (see ISO 13851);	Not application
	f) interlocking guards with a start function (control guard) (see 6.3.3.2.5).	Not application
6.3.2.4	Where access to the hazard zone is required for machine setting, teaching, process changeover, fault-finding, cleaning or maintenance	Pass
6.3.2.5	Selection and implementation of sensitive protective equipment	Pass
6.3.2.5.1	Selection	Pass
6.3.2.5.2	Implementation	Pass
	a) the size, characteristics and positioning of the detection zone (see ISO 13855, which deals with the positioning of some types of sensitive protective equipment)	Pass
	b) the reaction of the device to fault conditions (see IEC 61496 for electrosensitive protective equipment),	Pass
	c) the possibility of circumvention, and	Pass
	d) detection capability and its variation over the course of time (as a result, for example, of its susceptibility to different environmental conditions such as the presence of reflecting surfaces, other artificial light sources and sunlight or impurities in the air).	Pass
6.3.2.5.3	Additional requirements for sensitive protective equipment when used for cycle initiation	Not application
	a) only active optoelectronic protective devices (AOPDs) complying with IEC 61496 series shall be used;	Not application
	b) the requirements for an AOPD used as a tripping and presence-sensing device (see IEC 61496) are satisfied — in particular, location, minimum distance (see ISO 13855), detection capability, reliability and monitoring of control and braking systems;	Not application
	c) the cycle time of the machine is short and the facility to re-initiate the machine upon clearing of the sensing field is limited to a period commensurate with a single normal cycle;	Not application

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	d) entering the sensing field of the AOPD(s) or opening interlocking guards is the only way to enter the hazard zone;	Not application
	e) if there is more than one AOPD safeguarding the machine, only one of the AOPDs is capable of cycle re-initiation;	Not application
	f) with regard to the higher risk resulting from automatic cycle initiation, the AOPD and the associated control system comply with a higher safety-related performance than under normal conditions.	Not application
6.3.2.6	Protective measures for stability	Pass
6.3.2.7	Other protective devices	Not application
	a) devices for limiting parameters of movement (distance, angle, velocity, acceleration),	Not application
	b) overloading and moment limiting devices,	Not application
	c) devices to prevent collisions or interference with other machines,	Not application
	d) devices for preventing hazards to pedestrian operators of mobile machinery or other pedestrians,	Not application
	e) torque limiting devices, and breakage points to prevent excessive stress of components and assemblies,	Not application
	f) devices for limiting pressure or temperature,	Not application
	g) devices for monitoring emissions,	Not application
	h) devices to prevent operation in the absence of the operator at the control position,	Not application
	i) devices to prevent lifting operations unless stabilizers are in place,	Not application
	j) devices to limit inclination of the machine on a slope, and	Not application
	k) devices to ensure that components are in a safe position before travelling.	Not application
6.3.3	Requirements for the design of guards and protective devices	Pass
6.3.3.1	General requirements	Pass
	Suitable for the intended use	Pass
	Compatible with the working environment	Pass
	Cannot be easily defeated	Pass
	Provide the minimum possible interference with activities	---
	a) be of robust construction;	Pass
	b) not give rise to any additional hazard;	Pass
	c) not be easy to by-pass or render non-operational;	Pass
	d) be located at an adequate distance from the danger zone	Pass
	e) cause minimum obstruction to the view of the production process;	Pass
	f) enable essential work to be carried out	Pass
6.3.3.2	Requirements of guards	Pass
6.3.3.2.1	Function of guards	Pass
	Prevention of access to the space enclosed by the guard	Pass
	Containment/capture of materials, workpieces, chips, liquids and reduction of emissions	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	Have particular properties	Pass
6.3.3.2.2	Requirements for fixed guards	Pass
	Fixed guards shall be securely held in place	Pass Securely held in place
6.3.3.2.3	Requirements for movable guards	Not application
	Movable guards which provide protection against hazards generated by moving transmission parts	Not application
	Movable guards against hazards generated by non-transmission moving parts shall be designed and associated with the machine control system	Not application
6.3.3.2.4	Requirements for adjustable guards	Not application
6.3.3.2.5	Requirements for interlocking guards with a start function (control guards)	Not application
	a) all requirements for interlocking guards are satisfied (see ISO 14119),	Not application
	b) the cycle time of the machine is short,	Not application
	c) the maximum opening time of the guard is preset to a low value	Not application
	d) the dimensions or shape of the machine do not allow a person, or part of a person, to stay in the hazard zone or between the hazard zone and the guard while the guard is closed (see ISO 14120),	Not application
	e) all other guards, whether fixed (removable type) or movable, are interlocking guards,	Not application
	f) the interlocking device associated with the interlocking guard with a start function is designed such that — for example, by duplication of position detectors and use of automatic monitoring (see 6.2.11.6) — its failure cannot lead to an unintended/unexpected start-up, and	Not application
	g) the guard is securely held open (for example, by a spring or counterweight) such that it cannot initiate a start while falling by its own weight.	Not application
6.3.3.2.6	Hazards from guards	Pass
	Care shall be taken to prevent hazards which might be generated by guards	Pass
6.3.3.3	Technical characteristics of protective devices	Pass
	Correct implementation of their safety function(s)	Pass
	Either selected as meeting the appropriate product standard or designed according to principles formulated in ISO 13849-1 or IEC 62061.	Pass
	Cannot be easily defeated	Pass
6.3.3.4	Provisions for alternative types of safeguards	Pass
	Provisions should be made to facilitate the fitting of alternative types of safeguards on machinery where it is known that this fitting will be necessary because the work to be done on it will vary	Pass
6.3.4	Safeguarding for reduce emissions	Not application

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
6.3.4.1	General	Not application
	If the measures for the reduction of emissions at source mentioned in 6.2.2.2 are not adequate, the machine shall be provided with additional protective measures	Not application
6.3.4.2	Additional protective measures against noise	Not application
6.3.4.3	Additional protective measures against vibration	Not application
6.3.4.4	Additional protective measures against hazardous substances	Not application
6.3.4.5	Additional protective measures against radiation	Not application
6.3.5	Complementary protective measures	Not application
6.3.5.1	General	Not application
	Protective measures which are neither inherently safe design measures, nor safeguarding, nor information for use may have to be implemented as required by the intended use and the reasonably foreseeable misuse of the machine. Such measures include. But are not limited to, the ones dealt with in 6.3.5.2 to 6.3.5.6	Not application
6.3.5.2	Components and elements to achieve the emergency stop function	Not application
6.3.5.3	Measures for the escape and rescue of trapped persons	Not application
6.3.5.4	Measures for isolation and energy dissipation	Pass
	a) isolating (disconnecting, separating) the machine (or defined parts of the machine) from all power supplies;	Pass
	b) locking (or otherwise securing) all the isolating units in the isolating position;	Pass
	c) dissipating or, if this is not possible or practicable, restraining (containing) any stored energy which can give rise to a hazard;	Pass
	d) verifying, by means of safe working procedures, that the actions taken according to a), b) and c) above have produced the desired effect.	Pass
6.3.5.5	Provisions for easy and safe handling of machines and their heavy component parts	Pass
6.3.5.6	Measures for safe access to machinery	Pass
6.4	Information for use	Pass
6.4.1	General requirements	Pass
6.4.1.1	Drafting information for use is an integral part of the design of a machine. Information for use consists of communication links, such as texts, words, signs, signals, symbols or diagrams, used separately or in combination to convey information to the user. It is directed to professional and/or non-professional users	Pass
6.4.1.2	Information shall be provided to the user about the intended use of the machine taking into account, notably, all its operating modes	Pass
6.4.1.3	Information for use shall cover, separately or in combination, transport, assembly and installation, commissioning, use of the machine, and, if necessary, dismantling, disabling and	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	scrapping.	
6.4.2	Location and nature of the information for use	Pass
6.4.3	Signals and warning devices	Pass
	Visual signals and audible signals may be used to warn of an impending hazardous event	Pass
	Such signals may also be used to warn the operator before the triggering of automatic protective measures	Pass
	It is essential that these signals:	Pass
	a) be emitted before the occurrence of the hazardous event;	Pass
	b) unambiguous;	Pass
	c) be clearly perceived and differentiated from all other signals used;	Pass
	d) can be clearly recognized by the operator and other persons	Pass
	The warning devices shall be designed and located such that checking is easy. The information for use shall prescribe regular checking of warning devices	Pass
	The attention of designers is drawn to the risks from “sensorial saturation” which results from too many visual and/or acoustic signals, which may also lead to defeating the warning devices	Pass
6.4.4	Markings, signs (pictograms), written warnings	Pass
	Machinery shall bear all markings which are necessary:	---
	a) for its unambiguous identification	Pass
	b) in order to indicate its compliance with mandatory requirements	Pass
	c) for its safe use	Pass
	Information printed directly on the machine should be permanent and remain legible throughout the expected life of the machine	Pass Permanent and remain legible
	Signs or written warnings only saying “danger” shall not be used	Pass
	Readily understandable and unambiguous	Pass
	Signs and pictograms should only be used if they are understood in the culture in which the machinery is to be used	Pass
	Written warnings shall be drawn up in the language(s) of the country in which the machine will be used for the first time and, on request, in the language(s) understood by operators	Pass In English
	Markings comply with recognized standards	Pass
6.4.5	Accompanying documents (in particular — instruction handbook)	Pass
6.4.5.1	Contents	Pass
	The instruction handbook or other written instructions shall contain among others:	---
	a) information relating to transport, handling and storage of the machine	Pass
	b) information relating to installation and commissioning of the machine	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	c) information relating to the machine itself	Pass
	d) information relating to the use of the machine	Pass
	e) information for maintenance	Pass
	f) information relating to dismantling, disabling and scrapping;	Pass
	g) information for emergency situations	Pass
	h) maintenance instructions provided for skilled persons and maintenance instructions provided for unskilled persons, that should appear clearly separated from each other	Pass
6.4.5.2	Production of the instruction handbook	Pass
	a) The type font and size of print shall ensure the best possible legibility.	Pass
	b) The information for use shall be given in the language(s) of the country in which the machine will be used for the first time and in the original version.	Pass
	c) Whenever helpful to the understanding, text should be supported by illustrations.	Pass
	d) Consideration should be given to presenting information in tabular form where this will aid understanding.	Pass
	e) The use of colours should be considered, particularly in relation to components requiring quick identification.	Pass
	f) When information for use is lengthy, a table of contents and/or an index should be provided.	Pass
	g) Safety-relevant instructions which involve immediate action should be provided in a form readily available to the operator.	Pass
6.4.5.3	Drafting and editing information for use	Not application
	a) Relationship to model: the information shall clearly relate to the specific model of machine and, if necessary, other appropriate identification (for example, by serial number).	Not application
	b) Communication principles: when information for use is being prepared, the communication process “see – think – use” should be followed in order to achieve the maximum effect and should follow sequential operations. The questions, “How?” and “Why?” should be anticipated and the answers provided.	Not application
	c) Information for use shall be as simple and as brief as possible, and should be expressed in consistent terms and units with a clear explanation of unusual technical terms.	Not application
	d) When it is foreseen that a machine will be put to on-professional use, the instructions should be written in a form that is readily understood by the non-professional user.	Not application
	e) Durability and availability of the documents: documents giving instructions for use should be produced in durable form (i.e. they should be able to survive frequent handling by the user). It can be useful to mark	Not application
7	Documentation of risk assessment and risk reduction	Pass
	a) the machinery for which the risk assessment has been	Pass

EN ISO12100: 2010		
Clause	Requirement – Test	Result - Remark
	made (for example, specifications, limits, intended use);	
	b) any relevant assumptions that have been made (loads, strengths, safety factors, etc.);	Pass
	c) the hazards and hazardous situations identified and the hazardous events considered in the risk assessment;	Pass
	d) the information on which risk assessment was based (see 5.2):	---
	1) the data used and the sources (accident histories, experience gained from risk reduction applied to similar machinery, etc.);	Pass
	2) the uncertainty associated with the data used and its impact on the risk assessment;	Pass
	e) the risk reduction objectives to be achieved by protective measures;	Pass
	f) the protective measures implemented to eliminate identified hazards or to reduce risk;	Pass
	g) residual risks associated with the machinery;	Pass
	h) the result of the risk assessment (see Figure 1);	Pass
	i) any forms completed during the risk assessment.	Pass
Annex A	Schematic representation of a machine	Pass
Annex B	Examples of hazards, hazardous situations and hazardous events	Pass
B.1	General	Pass
B.2	Examples of hazards	Pass
B.3	Examples of hazardous situations	Pass
B.4	Examples of hazardous events	Pass

TABLE: Components					P
Object / part No.	Manufacturer/ trademark	Type / model	Technical data	Standard	Mark(s) of conformity
Battery pack	SHENZHEN JETECH ENERGY TECHNOLOGY CO LTD	JT-BC200-10	48Vdc,20Ah, 960Wh	IEC62133	CB
Motors	Changzhou Hanghong Electrical Co., Ltd	HH	48Vdc	EN60335	Tested with appliance
PCB	Shenzhen Euler Intellectual Tech Co.,Ltd	OLZZ	V-0 or better,130°C Minimum.	UL 94	UL E330731
Lead wires (signal)	Interchangeable	Interchangeable	Min. 80°C, Min. 300V, Min. 24AWG	--	Tested with appliance
Lead wires (power)	Interchangeable	Interchangeable	Min. 150°C, Min. 300V, Min. 16AWG	--	Tested with appliance
Lead wires (motor)	Interchangeable	Interchangeable	Min. 80°C, Min. 300V, Min. 16AWG	--	UR

Model:Q20-X

FIGURE 1



FIGURE 2



FIGURE 3**FIGURE 4**

FIGURE 5



FIGURE 6



FIGURE 7



FIGURE 8



FIGURE 9**FIGURE 10**

FIGURE 11



FIGURE 12



FIGURE 13



FIGURE 14



---End of report---